PROCEEDINGS

SOUTHERN WEED SCIENCE SOCIETY

Y2K: The Challenge of Change

53nd Annual Meeting

Serving Agriculture In:

ALABAMA	MISSOURI
ARKANSAS	NORTH CAROLINA
FLORIDA	OKLAHOMA
GEORGIA	SOUTH CAROLINA
KENTUCKY	TENNESSEE
LOUISIANA	TEXAS
MISSISSIPPI	VIRGINIA

PUERTO RICO

January 24, 25, and 26, 2000
Adams Mark
Tulsa, Oklahoma

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PREFACE

These PROCEEDINGS of the 53nd Annual Meeting of the Southern Weed Science Society contain papers and abstract of presentations made at the annual meeting. These papers and abstracts are indexed according to subject matter and authors. A list is also included giving the common and trade or code names, chemical names and manufacturers of all herbicides mentioned in the publication. Other information in these PROCEEDINGS includes: biographical data of recipients of the SWSS Distinguished Service, Weed Scientist of the Year, Outstanding Young Weed Scientist, Outstanding Educator, and Outstanding Graduate Student awards; the RESEARCH REPORT; lists of officers and committee members; minutes of all business meetings; and lists of registrants attending the annual meeting, sustaining members, charter members and contributors to the SWSS Endowment Foundation.

Only papers presented at the meeting and submitted to the Editor in the prescribed format for printing are included in the PROCEEDINGS. Papers may be up to five pages in length and abstracts are limited to one page. Papers and abstracts exceeding these limits will be published but the authors will be charged $15 per page for each page the contribution exceeds these limits. Invitational papers are not subject to these page charges.

Authors are required to submit an original, two copies and a diskette copy of the file prepared according to the prescribed format. If a contribution is not submitted in a suitable form for publication, it may be retyped by the Editor at a charge of $25.00 or it may not be printed in the PROCEEDINGS. Some papers may be returned to the author for retyping if time permits.

The use of commercial names in the PROCEEDINGS does not constitute an endorsement, nor does the non-use of similar products constitute a criticism, by the Southern Weed Science Society.

Additional copies of the 2000 PROCEEDINGS and of some prior year editions of the PROCEEDINGS AND RESEARCH REPORTS are available. Also, copies of the SWSS RESEARCH METHODS IN WEED SCIENCE (3rd edition, 1986), and the SWSS WEED IDENTIFICATION GUIDES are available. This document is also available in PDF format at the SWSS web site (www.weedscience.msstate.edu/swss). For information concerning the availability and cost of these publications, contact Mr. R. A. Schmidt, Business Manager, Southern Weed Science Society, 1508 West University Avenue, Champaign, IL 61821-3133.

Daniel B. Reynolds, Editor
Southern Weed Science Society
www.weedscience.msstate.edu/swss

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REGULATIONS AND INSTRUCTIONS FOR PAPERS AND ABSTRACTS TO BE PUBLISHED IN THE PROCEEDINGS OF THE SOUTHERN WEED SCIENCE SOCIETY

Regulations

1. Only papers presented at the conference will be published in the Proceedings. An abstract or paper must be submitted for each presentation at the time the presentation is made.

2. Persons wishing to present a paper(s) at the conference must submit a title submission form(s) to the program chairman before the established deadline as announced in the call for papers.

3. Facilities will be provided for using 2 x 2-in. slides in presentations at the conference.

4. Terminology in presentations and publications shall generally comply with standards accepted by the Weed Science Society of America. English or metric units of measurement may be used. The approved common names of herbicides as per the latest issue of *Weed Science* should be used. It is not necessary to give the chemical name since this will be given in the Herbicide Appendix. If no common name has been assigned, the code name or trade name may be used and the chemical name should be shown in parenthesis if available. Common names of weeds and crops as approved by the Weed Science Society of America should be used.

   Where visual ratings of crop injury or weed control efficacy are reported, it is suggested that they be reported as a percentage of the untreated check where 0 equals no weed control or crop injury and 100 equals complete weed control of complete crop kill. Where a rating scale is used, a 0-10 scale is suggested using the above guidelines.

5. Abstracts shall not be longer than one page, and papers shall not be longer than five pages unless the author agrees to pay $15 for each additional page. Invitational papers are exempt from page charges.

6. A person may not serve as senior author for more than two articles in a given year.

7. Papers and abstracts are to be prepared in accordance with the instructions and format attached before they will be accepted for publications. Papers not prepared in accordance with these instructions will be returned to the author for retyping, or may not be published.

8. Papers and abstracts are due at the time the presentation is made!

Instructions to Authors

Prepare an original typed copy and two photocopies of the completed paper or abstract and a diskette copy of the file as it is to appear in the PROCEEDINGS. It is the responsibility of each author to submit their disk/abstract in **READY FOR PUBLICATION** condition.

Submit the original (**unfolded**) and two copies to the section chairman at the time the paper is presented along with a diskette copy of the file. The authors should submit a list of key words or phrases on the form provided. Publication will be made using desktop publishing software. SWSS will not retype or make typographical corrections on papers/abstracts submitted for the Proceedings. If a paper is more than one page long, lightly pencil page numbers in the upper right hand corner of each page. On the back of the first page of a paper or abstract, lightly pencil the paper number also. Do not type in page numbers or staple pages together. At the end of each session, the section chairman is to immediately carry the original, copies, and diskette file of all papers presented in that section to the Editor in the Press Room. One of the photocopies is needed by the Editor and the other is for the Press.

Typing Instructions - Format

1. (a) Margins, spacing, etc.: Use 8-1/2 x 11" white bond paper. **Leave 1" margins on all sides**. Use 10 point type with a ragged right margin; do not justify and **do not use hard carriage returns** in the body of text. Single space with double space between paragraphs and major divisions. **Do not indent paragraphs**. See example below.

   2. Computer disk: Use an IBM Compatible System (MS/DOS). Submit on 3-1/2" diskettes and submit only one abstract per diskette. Store file in one of the following software packages or formats: 1) Word Perfect, 2) Microsoft Word, or 3) ASCII. If abstract or paper contains graphs or figures, they must be in Word Perfect Graphics (WPG) and be black and white. Label diskette giving 1) title of abstract, 2) abstract number, 3) author, 4) section, 5) daytime phone, and 6) file format. If you do not have access to compatible software, secretarial assistance is available at $25.00 per abstract. Contact Daniel B. Reynolds at (662) 325-0519 or at DReynolds@WeedScience.MSState.EDU.

2. Content:

Abstracts - Title, Author(s), Organizations(s), Location, the heading ABSTRACT, text of the Abstract, and Acknowledgments. Use double spacing before and after the heading, ABSTRACT.

Papers - Title, Author(s), Organizations(s), Location, Abstract, Introduction, Methods and Materials (Procedures), Results and Discussion, Literature Citations, Tables and/or Figures, Acknowledgments.

Each section of an abstract or paper should be clearly defined. The heading of each section should be typed in the center of the page in capital letters with double spacing before and after.

Pertinent comments regarding some of these sections are listed below:

Title - All in capital letters. Start at the upper left hand corner leaving a one-inch margin from the top and all sides.

Author(s), Organizations(s), Location - Start immediately after title. Use the lower case except for initials, first letters of words, etc. Do not include titles, positions, etc. of authors.

Example:

WEED CONTROL SYSTEMS IN SPRINKLER-IRRIGATED RICE. K. H. Akkari, R. F. Talbot, J. A. Ferguson and J. T. Gilmour; Department of Agronomy, University of Arkansas, Fayetteville, AR 72701.

ABSTRACT

First line of abstract begins at left margin. **Do not indent paragraphs.**

Acknowledgments - Show as a footnote at the end of the abstract (not end of page) or the bottom of the first page of papers.

Literature Citations - Number citations and list separately at the end of the text.

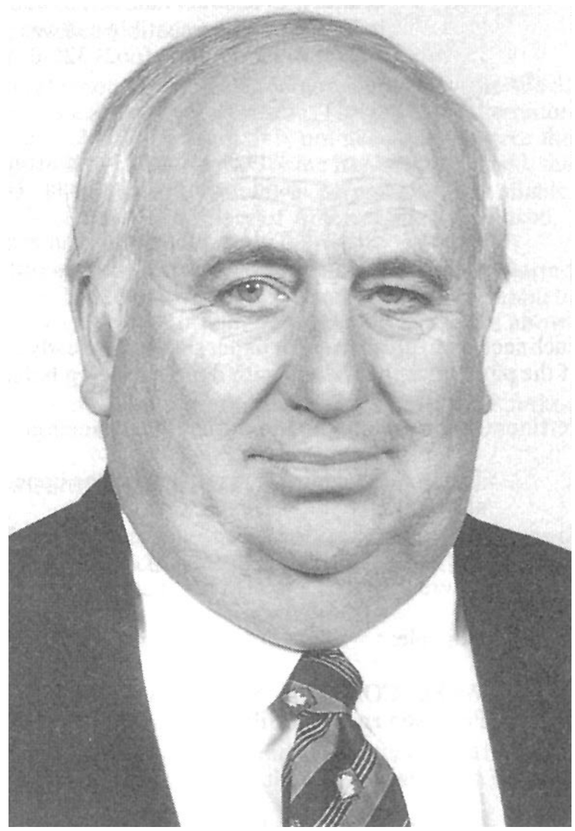
Tables and Figures - Place these after literature citations. Single space all tables. Tables should be positioned vertically on the page. Figures must be black and white photographs or pen and ink drawings on white bond paper. Store charts, graphs, figures, etc., as WPG files on diskette with abstract and enclose a printed copy. Charts and figures must be black and white. Check your exported WPG files for accuracy.

2000 AWARDS

2000 DISTINGUISHED SERVICE AWARD - ACADEMIA

William W. Witt

Dr. William W. Witt is Professor, Department of Agronomy, University of Kentucky. He joined the faculty in 1974 and has developed strong programs in research and teaching of graduate and undergraduate students. Dr. Witt has served as the major advisor 15 M.S. and 16 Ph.D. students and has served on the advisory committee of 25 others. Two of his students have won the Weed Science Society of America Outstanding Graduate Student Award.



His research is focused on weed and herbicide management in agronomic crops with particular emphasis on no-tillage cropping systems. This research has resulted in 24 journal articles, 15 papers published in proceedings, and 160 abstracts which he authored or coauthored. In addition, he has authored or co-authored 5 book chapters and has 108 experiment station, extension and other publications. He has served on numerous review panels and has given 24 invited presentations to national or regional groups and has been invited to Brazil and Argentina to make presentations on weed management in no-tillage corn or soybeans.

Dr. Witt has served the SWSS in many capacities. He was the first Editor of the Newsletter from 1978-1981. In addition, he served as Secretary-Treasurer in 1984-1986, and Proceedings Editor in 1990-1992. He currently serves on the Board of Directors for Academia. He has served on the following committees: Student Contest, Research Report, Newsletter Editorial, Student Interest, Publications, Resolutions and Necrology, Nominating, Finance, Endowment Fund, Program, Outstanding Young Weed Scientist Award, and External Funding.

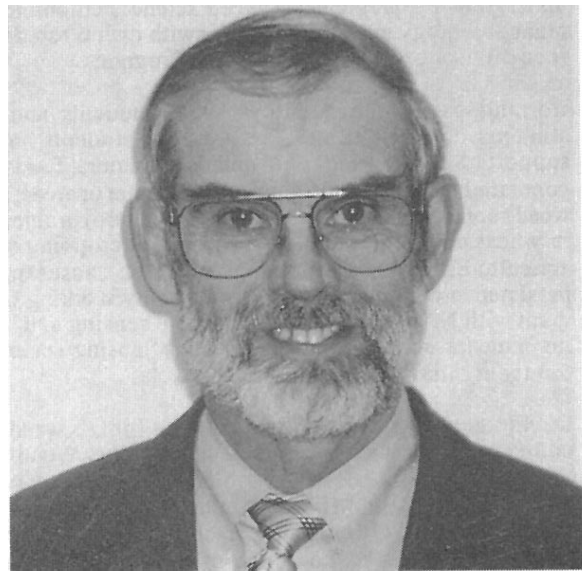
Dr. Witt has been honored with: Weed Science Society of America Fellow Award, Weed Science Society of America Outstanding Teaching Award, Distinguished Achievement Award in Education by the North Central Weed Science Society, Honorary Member of the North Central Weed Science Society, Outstanding Young Weed Scientist Award by Southern Weed Science Society. He currently serves as an Associate Editor of *Weed Science* and is the WSSA Liaison to CAST.

He grew up near Fletcher, OK and attended Oklahoma State University, received a B.S. in 1969 and M.S. in 1971. He received the Ph.D. from N.C. State University in 1974. He and his wife, Mary, have two children, Emma and John.

2000 DISTINGUISHED SERVICE AWARD - INDUSTRY

Tom N. Hunt

TomHunt is currently a Master Technical Representative at American Cyanamid, a position he has held in NC, SC, and VA for the past 19 years. He was instrumental in the field development and technology transfer phases of the imidazolinone herbicides (1984-1997). He was one of the first field representatives to conduct training on this new class of herbicides in the U.S. and Latin America during the mid 1980s.



He has been a member of the Southern Weed Science Society for 19 years. He has participated in many capacities including session moderator, student poster judge, graduate student paper contest judge and weed and grower/judge in both the Northeast and Southern Weed Contests of 1997 and 1998. His commitment to students in our industry is exemplary. Tom also had the honor of being the Southern awards banquet Master of Ceremonies in 1998, and an invited symposium speaker in 1999. On the state level he was the president of the WSSNC 1997-1998, and the president of the Crop Protection Association of NC in 1996.

Some would say Tomhas the ability to spin a yarn about his experiences growing up in western N.C. He is sought after as a motivational, and after dinner speaker by numerous farm and church groups. The most notable of these are N.C. Soybean Producers Association in 1989, the N.C./Va. Peanut Growers Awards Banquet in 1992, and the Va. Farm Bureau in 1998. In addition, he has served as the Master of Ceremonies for the N.C. Soybean, Wheat and Corn Growers annual meeting for the past three years.

Tom has been very active in the production of ten training modules through Cyanamid's Technical Training Program. He has taught more than20 modules and served as chairman or production committee member for Cadre herbicide, Basic Entomology, Counter/Thimet for Corn and Cotton Production.

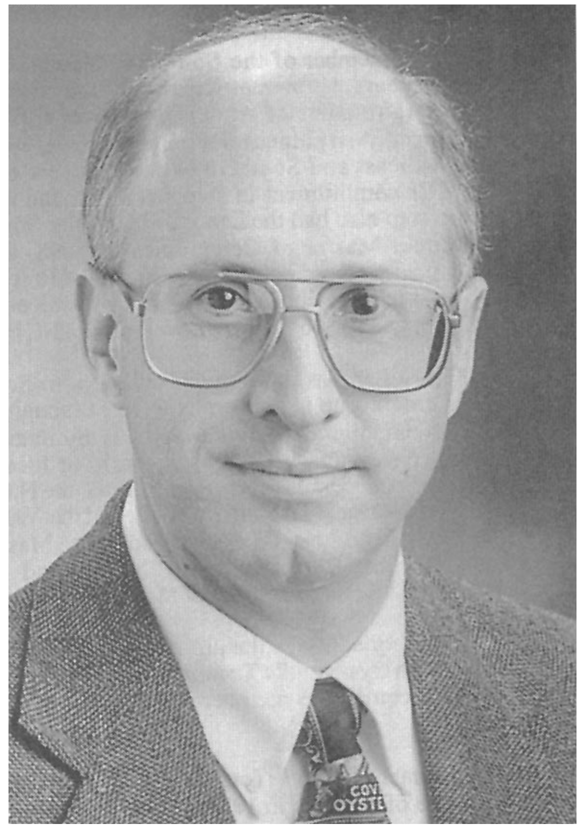
Some awards that have come Tom's way include Cyanamid's Presidents Club in 1982, 1983 and 1986; Technical Service Representative of the Year in 1987, 1994 and 1996; NC Corn Growers Association Outstanding Contributions in 1993; and the Spirit Award from the Crop Protection Association of N.C. in 1998

He holds a B.S. in Forestry and an M.S. in Entomology from N.C. State University. Prior to joining American Cyanamid in 1980 he was an Extension Entomologist at N.C.S.U. for 10 years.

2000 WEED SCIENTIST OF THE YEAR

David R. Shaw

In the 14 years of David's career as a weed scientist at MSU, his contributions to education in weed science of undergraduate students, graduate students, and clientele have been exemplary. David has helped transform MSU's Weed Science program into one of the truly successful programs in the United States.



With faculty in Entomology and Plant Pathology, David has played a leading role in bringing almost non-existent undergraduate programs in weed science, entomology, and plant pathology into an APM major with over 60 students. He is co-advisor of the APM Internship Program.

Currently, he is advisor to 4 Ph.D. students and 6 M.S. students. These and the 35+ previous students have been supported by the nearly $31 million extramural funds he has generated. His research focuses on a number of areas: soybean weed control, particularly, sicklepod; control of problem weeds in wheat production and development of cropping systems; agricultural chemicals in runoff water; assessment of persistence of herbicides. He is currently working on a new grant with NASA in the area of remote sensing and has been instrumental in establishing the Remote Sensing Technologies Center at Mississippi State University.

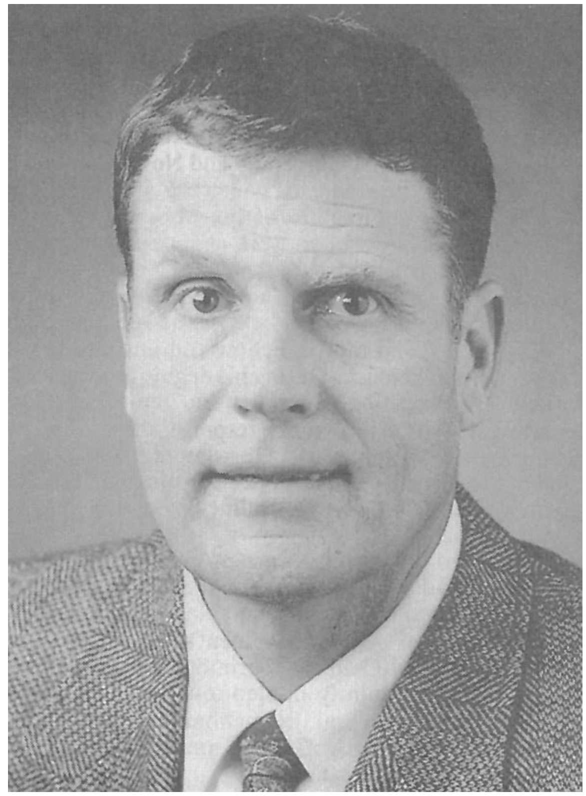
David has been a team player in building MSU's weed science course offerings to seven courses (Introductory Weed Science, Weed Biology and Ecology, Herbicide Technology, Turfgrass Weed Management, Mode of Action, Fate of Herbicides, and Current Topics). He currently teaches three of these courses. David also serves as co-coach of the MSU Weed Contest Team, spending numerous hours outside the class room working with students who have finished in the top three the last seven years.

To date, Dr. Shaw's publication list includes over 90 refereed articles, over 25 experiment station bulletins, over 250 abstracts from presentations , and 40 graduate theses and dissertations.

David was born in Water Valley, MS and grew up on a farm in Oklahoma. He received a B.S. in Agriculture from Cameron University in 1981, and M.S. in Agronomy-Weed Science from Oklahoma State University in 1983, and a Ph.D. in Crop Science-Weed Science from Oklahoma State University in 1985. He is beginning his fourteenth year on faculty at Mississippi State University and has recently been named Director of the Remote Sensing Technologies Center at Mississippi State University, in addition to his duties in teaching and research in weed science.

2000 OUTSTANDING EDUCATOR AWARD

Lawrence R. Oliver



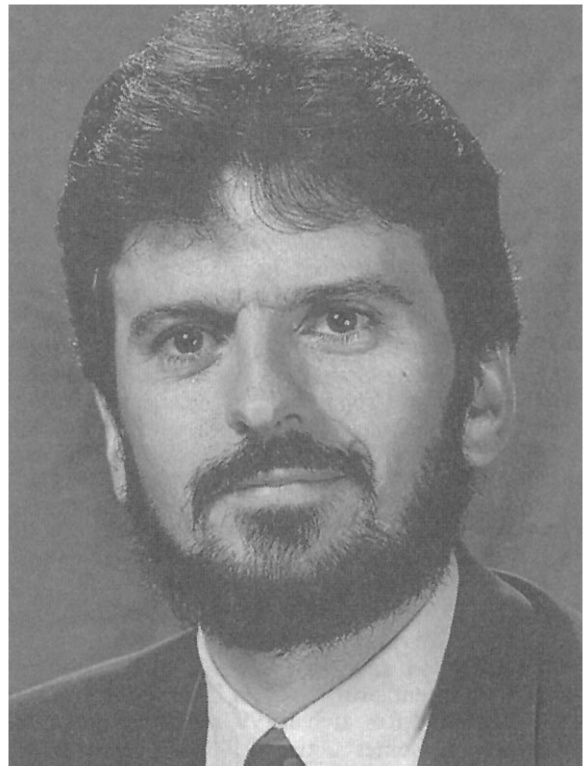
Lawrence R. "Dick" Oliver, born at Stuttgart, Arkansas, in 1942, is a University Professor and Elms Farming Chair for Weed Science in the Department of Crops, Soil, and Environmental Sciences at the University of Arkansas, Fayetteville. He has been in Arkansas since 1972. Agriculture was the backdrop of his youth which profoundly affected his career choice. He is actively involved in weed science research and teaching. His research on weed biology, weed interference, reduced herbicide rate programs and control of specific problem weeds in soybean, corn, and wheat has earned him recognition throughout the United States and especially in the southern region. He teaches several courses including Weed Identification, Morphology and Ecology, in which he uses innovative and effective techniques such as his weed nursery and self-constructed slide set. The other courses are Weed Practicum, Introductory Weed Science, and Pest Management. The last two are team taught.

Dr. Oliver is a member of the Weed Science Society of America (WSSA), Southern Weed Science Society (SWSS), Arkansas Crop Protection Association (ACPA), Council for Agriculture, Science, and Technology (CAST), Alpha Zeta, Gamma Sigma Delta, and Sigma Xi. He has been Secretary-Treasurer and President of SWSS, President of ACPA, and currently President-Elect of WSSA. Awards and honors have included SWSS Outstanding Young Weed Scientist in 1982; WSSA Outstanding Teacher Award in 1986; John W. White Outstanding Teacher Award in 1989 and Outstanding Research Award in 1997 in the Bumpers College of Agriculture, Food, and Life Sciences; WSSA Fellow in 1993; SWSS Distinguished Service Award Academia in 1994; SWSS Weed Scientist of the Year in 1995; and Arkansas Alumni Association Faculty Distinguished Achievement Award for Teaching and Research in 1997. Dr. Oliver has coached the Arkansas Weed Team to 14 wins in 17 years at the Southern Weed Contest between 1983 and 1999. Dr. Oliver has advised 17 Ph.D. and 34 M.S. students.

2000 OUTSTANDING YOUNG WEED SCIENTIST AWARD

Fred Yelverton

Fred Yelverton is Associate Professor and Extension Specialist in the Crop Science Department at North Caroling State University. He has extension and research responsibilities for weed management in turfgrasses and forage crops and plant growth regulators in turfgrasses. He also co-teaches a course at NCSU entitled "Weed Mangement Turfgrasses and Ornamentals."



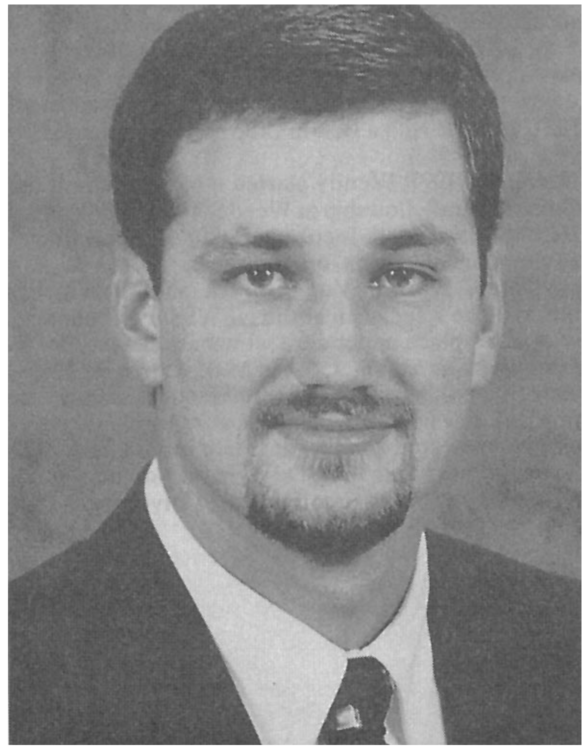
Fred grew up on a farm in eastern North Carolina. He attended East Carolina University and North Carolina State University where he graduated with a B.S. degree in wildlife biology. Upon completion of his M.S. degree in weed science at NCSU, he began work as an extension agent in Wilson County where he had educational responsibilities for various field crops, urban horticulture, and pesticide education. After three years as extension agent, he returned to NCSU as a Philip Morris Fellow and pursued the Ph.D. degree in Weed Science. During his degree program, he also worked as Extension Specialist in the Crop Science Department with state-wide responsibilities for weed management and plant growth regulators in tobacco. As a result of Fred's research and education program, residues of maleic hydrazide on tobacco declined over 30%.

In 1995, Fred began his current position at NCSU. Currently, he advises 2 Ph.D. and 3 M.S. students in the area of turfgrass weed mangement and plant growth regulators. He co-teaches two weed management seminars with Dr. Bert McCarty for the Golf Course Superintendents Association of America. He is regularly invited to speak throughout the United States and several international turfgrass meetings. Fred is active in WSSA, SWSS, and the Weed Science Society of North Carolina.

2000 OUTSTANDING GRADUATE STUDENT AWARD (PH.D.)

Jason K. Norsworthy

Jason Norsworthy, a native of Arkansas, obtained a B.S. degree in Agronomy from Louisiana Tech University in Ruston, Louisiana. While at Louisiana Tech, Jason was awarded the Outstanding Agronomy Student and 1995 Outstanding Plant Science Senior in 1995. Jason, under the guidance of Dr. Ronald Talbert, began research at the University of Arkansas developing a laboratory screening procedure for detection of propanil-resistant barnyardgrass by monitoring chlorophyll florescence. For his accomplishments at the M.S. level, he was awarded the 1997 Outstanding M.S. Agronomy Student.

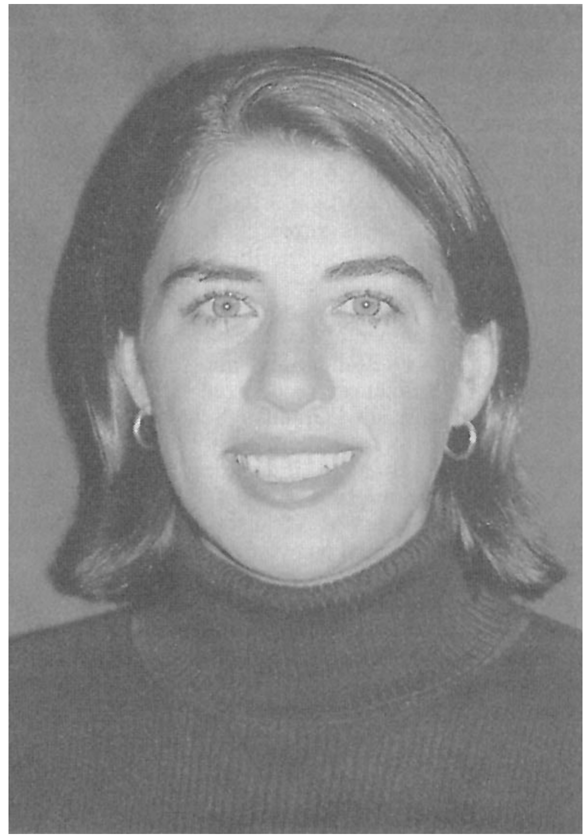


Following completion of an M.S. degree in Agronomy (Weed Science), he began work on a Ph.D. under the leadership of Dr. Dick Oliver. His research involves a quantitative description of weed competition in drilled soybean as affected by cultural practices and glyphosate timing. For this work and other accomplishments, the Department of Crop, Soil, and Environmental Sciences awarded Jason the 1999 Outstanding Ph.D. Student and the College of Agricultural, Food and Life Sciences recognized him as the 1999 Dale Bumpers Distinguished Graduate Scholar.

Jason has been very active in teaching, where he has assisted and lectured in numerous classes. Other accomplishments while at the University of Arkansas include: first-, third-, and eighth-place individual on two first- and a third-place team at the Southern Weed Contest in 1998, 1997 and 1996, respectively; assistant coach of the 1999 first-place University of Arkansas weed team; a first-place poster in the Southern Weed Science Poster Competition; two third-place oral presentations at the Arkansas Crop Protection Association Research Conference; and published five referred journal articles.

2000 OUTSTANDING GRADUATE STUDENT AWARD (M.S.)

Wendy A. Pline



Wendy Pline grew up on her family farm in St. Johns, Michigan. After graduating from St. Johns High School in 1993, Wendy won a Distinguished Agriculture and Natural Resources scholarship to attend Michigan State University. While at MSU, Wendy was very active in FFA, agronomy club as well as working in Siberia, Russia for a Samantha Smith Agricultural Intern Program in 1996. Wendy also worked as an undergraduate research assistant in Weed Physiology under Dr. Donald Penner for four years. She received a WSSA undergraduate research grant and a Sigma Xi undergraduate research grant in 1996 to develop tissue culture techniques in turf grass species for development of herbicide resistance. She graduated from MSU in 1997 with a B.S. in Crop and Soil Sciences.

In August 1997, Wendy started a M.S. program under a Cunningham Fellowship in Weed Science at Virginia Tech. Her M.S. research focused on weed physiology and environmental effects on transgenic herbicide resistant soybeans. While at Virginia Tech, she was a member of the 3rd place weed team at the NEWSS weed contest, and was a 2nd place paper contest winner at the 1999 SWSS meeting. She completed her M.S. degree in May 1999 under the guidance of Dr. Kriton Hatzios. Wendy recently finished an internship with Dow AgroSciences LLC midwest research and development in Minnesota. She is currently pursuing a Ph.D. in weed science and crop physiology at North Carolina State University.

SOUTHERN WEED SCIENCE SOCIETY
OFFICERS AND EXECUTIVE BOARD

100. SOUTHERN WEED SCIENCE SOCIETY OFFICERS AND EXECUTIVE BOARD

100a. OFFICERS

President - D.S. Murray - 2001
President Elect - L.L. Whatley - 2002
Vice President - J.E. Street - 2003
Secretary-Treasurer - D.W. Monks - 2002
Editor - D.B. Reynolds - 2002
Immediate Past President - R.L. Ratliff - 2000

100b. ADDITIONAL EXECUTIVE BOARD MEMBERS

Member-at-Large - W.L. Barrentine - 2000
Member-at-Large - D.L. Jordan - 2000
Member-at-Large - W.W. Witt - 2001
Member-at-Large - C.D. Youmans - 2001
Representative to WSSA - B.J. Brecke - 2002
Representative to CAST - A.C. York - 2002

100c. EX-OFFICIO BOARD MEMBERS

Constitution and Operating Proc. - G.D. Wills - 2000
Business Manager - R.A. Schmidt
Forestry Representative - S.M. Zedaker - 2001
Student Representative - C. Tingle - 2000

101. SWSS ENDOWMENT FOUNDATION

101a. BOARD OF TRUSTEES - ELECTED

A.D. Worsham - President - 2001
J.E. Street - Vice-President - 2001
D. Prochaska - Secretary - 2002
H.R. Smith - 2003
T.J. Monaco - 2004
T.F. Peeper - Past President - 2000

101b. BOARD OF TRUSTEES - EX-OFFICIO

T. Whitwell
J.E. Street
R.A. Schmidt
G.D. Wills

102. AWARDS COMMITTEE, PARENT (STANDING)

R.L. Ratliff*	2000	H.D. Coble	2000	L.B. McCarty	2000	G.E. Coats	2000

102a. Distinguished Service Award Subcommittee

H.D. Coble*	2000	P.A. Banks	2001	B.J. Brecke	2002
C.W. Derting	2000	M.C. Boyles	2001	E.C. Murdock	2002
A. McMahon	2000	J.B. Weber	2001	S.K. Rick	2002

102b. Outstanding Young Weed Scientist Award Subcommittee

L.B. McCarty*	2000	T.R. Dill	2001	J.W. Boyd	2002
C.S. Williams	2000	D.R. Shaw	2001	E.F. Eastin	2002
J.L. Yeiser	2000	J.F. Stritzke	2001	J.R. Martin	2002

102c. Weed Scientist of the Year Award Subcommittee

A.W. Ezell	2000	G.E. Coats*	2001	B.W. Bean	2002
K.K. Hatzios	2000	R. Hoagland	2001	G.N. Rhodes	2002
C.D. Youmans	2000	K.L. Smith	2001	W.W. Witt	2002

102d. Outstanding Educator Award Subcommittee

G.E. Coats	2000	J.W. Keeling	2001	R.C. Scott	2002
J.B. Weber*	2000	E.C. Murdock	2001	S. Senseman	2002
A. Wiese	2000	D.R. Shaw	2001	R.E. Talbert	2002

102e. Outstanding Graduate Student Award Subcommittee

J.D. Burton	2000	T.A. Baughman	2001	J.A. Dusky	2002
D. Gealy*	2000	E.P. Webster	2001	J.D. Green	2002
M. Locke	2000	J.W. Wilcut	2001	E.P. Prostko	2002

103. CONSTITUTION AND OPERATING PROCEDURES COMMITTEE (STANDING)

G.D. Wills 2000

104. DISPLAY COMMITTEE (STANDING)

P.A. Dotray*	2000	K.L. Ferreira	2001	B.W. Bean	2002
D.S. Jenkins	2000	J.A. Mills	2001	J. Braun	2002
J.J. Mullahey	2000	D. Porterfield	2001	N.W. Buehring	2002

105. FINANCE COMMITTEE (STANDING)

L.B. Gillham	2000	B.D. Sims	2000	R.M. Hayes	2001
C.E. Snipes	2000	J.E. Street*	2000	D.B. Reynolds (Ex-Off)	2001

106. HISTORICAL COMMITTEE (STANDING)

T.R. Dill*	2000	M.C. Boyles	2001
A. McMahon	2000	J.A. Baysinger	2001
M.L. Wood	2000	E.W. Palmer	2001

107. LEGISLATIVE AND REGULATORY COMMITTEE (STANDING)

L.P. Gianessi	2000	J.D. Byrd	2001	E.F. Eastin	2002
W.C. Johnson	2000	M.M. Kenty	2001	K. Melton	2002
T.F. Peeper*	2000	K.L. Smith	2001	W. Odle	2002
B. Rhodes	2000	G. Stapleton	2001	D.G. Shilling	2002

108. LOCAL ARRANGEMENTS COMMITTEE - 2000 (STANDING)

L.R. Oliver	- Chairperson
R. Williams	- Audio Visual
J.C. Banks	- Registration
J.& T. Driver	- Meal Functions
M.C. Boyles	- Room Setup
A. McMahon	- Information Booth and Message Center
A.&R. Talbert	- Spouses Program
J.W. Boyd	- Signs and Exhibits
N.R. Burgos	- Graduate Students
J.R. Sholar	- Public Relations Liaison
M. McClelland	- Placement Liaison
L.M. Cargill	- Equipment Storage and Security

109. LONG RANGE PLANNING COMMITTEE (STANDING)

R.M. Hayes*	2000	P.A. Banks	2001
T.C. Mueller	2000	R.B. Cooper	2001
D.R. Shaw	2000	J.L. Griffin	2001
J.B. Weber	2000	R.L. Ratliff	2001

110. MEETING SITE SELECTION COMMITTEE (STANDING)

D.B. Reynolds	2000	R.E. Eplee	2002	T.C. Mueller	2003	R.A. Schmidt
W.L. Currey*	2001	A.D. Klosterboer	2002	H.R. Smith	2003	(Ex-Off)

111. NOMINATING COMMITTEE (STANDING)

J.D. Byrd	2000	C.T. Bryson	2001	S.O. Duke	2002
G.R. Glover	2000	D. Smith	2001	J.D. Green	2002
R.L. Ratliff*	2000	J.W. Wilcut	2001	C.D. Youmans	2002
J. Yanes 2000					

112. PLACEMENT COMMITTEE (STANDING)

C. Grymes	2000	K.N. Reddy	2001	T.A. Baughman 2002	
D.L. Jordan*	2000	M. Thornton	2001	T. Heap	2002
D. Porterfield	2000	J.W. Wells	2001	E.R. Johnson	2002

113. PROGRAM COMMITTEE - 2000 (STANDING)

	Chairperson	L.L. Whatley
1.	Agronomic Crops	F.B. Walls
2.	Turf, Pasture & Rangeland	J. Higgins
3.	Horticultural Crops	W. Mitchem
4.	Forest Vegetation Management	J. Groninger
5.	Utility, Railroad & Highway Rights-of-Way, Industrial Sites	J.M. Taylor
6.	Biological, Aquatic & New Weed Problems	K.A. Langeland
7.	Ecological & Physiological Aspects	D. Gealy
8.	Educational & Regulatory	J.W. Wilcut
9.	Developments from Industry	K.R. Muzyk
10.	Application of Herbicides	J.E. Hanks
11.	Soil & Environmental Aspects	S. Senseman
12.	Research Posters	P.A. Banks

114. PROGRAM COMMITTEE - 2001 (STANDING)

	Chairperson	J.E. Street
1.	Agronomic Crops	C.D. Youmans
2.	Turf, Pasture & Rangeland	T.R. Murphy
3.	Horticultural Crops	D.K. Robinson
4.	Forest Vegetation Management	W.D. Mixson
5.	Utility, Railroad & Highway Rights-of-Way, Industrial Sites	B. Watkins
6.	Biological, Aquatic & New Weed Problems	C.T. Bryson
7.	Ecological & Physiological Aspects	P.A. Dotray
8.	Educational & Regulatory	J.A. Kendig
9.	Developments from Industry	S.K. Rick
10.	Application of Herbicides	C.D.Elmore
11.	Soil & Environmental Aspects	D.L. Jordan
12.	Research Posters	G.D. Wills

115. PUBLIC RELATIONS COMMITTEE (STANDING)

R.F. Montgomery	2000	D.P. Montgomery	2001	B. Besler	2002
M.G. Patterson	2000	L. Newsom	2001	C.T. Kroger	2002
S.M. Zedaker	2000	J.W. Wilcut*	2001	B. Zutter	2002

116. RESEARCH COMMITTEE (STANDING)

J.E. Street*			2000
E.P. Webster	Economic Losses Due to Weeds	2000	
J.D. Byrd	State Extension Weed Control Publications	2000	
T.M. Webster	Weed Survey - Southern States	2000	
V.L. Ford	Chemical & Physical Properties of New Herbicides		2000

117. RESOLUTIONS AND NECROLOGY COMMITTEE (STANDING)

W.W. Bachman	2000	C. Moseley	2001	M.C. Boyles	2002
J. Creighton	2000	K.N. Reddy	2001	M. Nespeca	2002
D.W. Monks	2000	H.R. Smith	2001	S.M. Zedaker*	2002

118. SALES COORDINATION COMMITTEE (STANDING)

M. DeFelice*	2000	C.T. Bryson	2001	W.C. Johnson	2002
J.A. Kendig	2000	J.H. Miller	2001	C. Mosely	2002

119. SOUTHERN WEED CONTEST COMMITTEE (STANDING)

C.T. Bryson	R.M. Hayes	T.C. Mueller	J.R. Stritzke
C.B. Corkern	J.A. Kendig	L.R. Oliver	J.A. Tredaway (student rep)
P.A. Dotray	M.L. Ketchersid	M.G. Patterson	W.K. Vencill
J.A. Dusky	R.T. Kincade	D.B. Reynolds	E.P. Webster*
J.W. Everest	V.B. Langston	S. Senseman	T. Whitwell
J.L. Griffin	W. Mitchem	D.R. Shaw	W.W. Witt
E.S. Hagood	D.W. Monks	D.G. Shilling	

120. STUDENT PROGRAM COMMITTEE (STANDING)

P.A. Dotray	2000	L. Newsom	2001	J.V. Altom	2002
G.P. Ferguson	2000	R.C. Scott	2001	M.E. Kurtz	2002
J.A. Kendig	2000	S. Senseman	2001	S.K. Rick	2002
T.C. Mueller*	2000	E.P. Webster	2001	C.D. Youmans	2002
G.R. Wehtje	2000				

121. SUSTAINING MEMBERSHIP COMMITTEE (STANDING)

D.L. Colvin	2000	T. Holt*	2001	J.V. Altom	2002
G.E. MacDonald	2000	C. Moseley	2001	T.R. Clason	2002
G.C. Weed	2000	G. Stapleton	2001	C.H. Slack	2002

122. TERMINOLOGY COMMITTEE (STANDING)

T.R. Clason	2000	T.D. Klingaman	2001	J.A. Baysinger	2002
J.L. Griffin*	2000	D.R. Shaw	2001	J.W. Boyd	2002
E.P. Richard	2000	J.W. Wells	2001	C.E. Walls	2002

123. WEED IDENTIFICATION COMMITTEE (STANDING)

J.D. Green	2000	M. DeFelice	2001	J.W. Boyd	2002
R. Muir	2000	C. Moseley	2001	C.T. Bryson*	2002
R. Smeda	2000	W.K. Vencill	2001	T.M. Webster	2002

123a. Forest Weeds Subcommittee

G. Bobo	A.W. Ezell	J.D. Gnegy	K.V. Miller
T.R. Clason	F. Fallis	D.K.Lauer	B. Watkins
C.A. Cobb	W.S. Garbett	J.H. Miller*	J.L. Yeiser

123b. Herbicide Resistant Weeds Subcommittee

W.L. Barrentine	M.L. Fischer	J.A. Kendig*	R. Smeda
M. Barrett	J.L. Griffin	C.C. Kupatt	J.D. Smith
T.A. Bewick	K.K. Hatzios	J.J. LeClair	R.E. Talbert
J.D. Burton	R.M. Hayes	E.C. Murdock	W.K. Vencill
J.M. Chandler	D. Johnson	R.L. Nichols	G.R. Wehtje
S.O. Duke	D.L. Jordan	T.F. Peeper	

124. NEWSLETTER INFORMATION COMMITTEE (SPECIAL)

T.E. Adcock	E.S. Hagood	D.W. Monks	R. Smeda
P.A. Banks	M.J. Hainds	T.C. Mueller	C.E. Snipes
M. Barrett	K.K. Hatzios	E.C. Murdock	J.E. Street
T.A. Baughman	R.M. Hayes	D.S. Murray	R.E. Talbert
T.A. Bewick	D.L. Jordan	L.R. Oliver	W.K. Vencill
J.R. Bone	J.A. Kendig	T.F. Peeper	P.R. Vidrine
C.T. Bryson	A.D. Klosterboer	R.L. Ratliff	R.H. Walker
M. DeFelice	W.M. Lewis	R.A. Schmidt	G.R. Wehtje
P.A. Dotray	L.B. McCarty*	S. Senseman	L.L. Whatley
S.O. Duke	K. Menchey	D.R. Shaw	G.D. Wills
C.L. Foy J.H. Miller	D.G. Shilling	A.C. York	
L.B. Gillham	T.J. Monaco	B.D. Sims	S.M. Zedaker
J.L. Griffin			

125. CONTINUING EDUCATION UNITS COMMITTEE (SPECIAL)

D. Dippel	R. Rivera*	J. Snodgrass	A.C. York

126. MEMBERSHIP COMMITTEE (SPECIAL)

J.D. Byrd	W.N. Kline	T.R. Murphy	G. Stapleton
R.B. Cooper	M. Locke	T.F. Peeper	F.B. Walls*
S.O. Duke	J.H. Miller	B.D. Sims	J.W. Wilcut

127. EXTERNAL FUNDING COMMITTEE (SPECIAL)

J.R. Bone	J.H. Miller	T.F Peeper	W.W. Witt
J.L. Griffin	L.R. Oliver	D.G. Schilling	A.D. Worsham*

128. COMPUTER APPLICATIONS COMMITTEE (SPECIAL)

S. Askew	T.C. Mueller	S. Senseman	T. Whitwell
A.C. Bennett	D.B. Reynolds*	W.K. Vencill	

*Chairperson

SWSS Minutes - Summer Board Meeting
June 12 and 13, 1999
Tulsa, Oklahoma

President Don Murray called the summer SWSS Board of Directors meeting to order at 2:00 p.m. In attendance during the board meeting were Don Murray (President), Bill Barrentine (Member-at-Large), Barry Brecke (Member-at-Large), David Jordan (Member-at-Large), David Monks (Secretary/Treasurer), Randy Ratliff (Past President), Dan Reynolds (Editor), Joe Street (WSSA Representative), Laura Whatley (President-Elect), Gene Wills (Constitution and Operating Procedures Chair), William Witt (Member-at-Large), Alan York (CAST Representative), Cletus Youmans (Member-at-Large), and Eric Palmer (graduate student from OK State University substituting for Chris Tingle).

A motion to accept the President Murray's Agenda was made by Barry Brecke and seconded by Dan Reynolds. The motion was approved.

President Murray, substituting for Secretary Monks (delayed by travel) read the minutes fromthe January 28, 1999 BOD meeting. A motion to accept the Minutes was made by Ratliff with a second by Joe Street. A short discussion on whether the Minutes should say 1999 or 2000 for the Paper Submission since the call for titles will be in 1999 and the meeting will be 2000.

Local Arrangements Chairman Dick Oliver made a short presentation to the BOD pertaining to the 2000 meeting. He indicated that 450 rooms of the Adams Mark were reserved for the Society meeting. After a short discussion of meal options for the banquet, Ratliff moved, second by Wills, that the banquet meal should be the Duo (beef and chicken) and the price including gratuities and taxes should not exceed $40.00. Motion Passed. The BOD toured the meeting room and banquet room facilities of the hotel.

Graduate student representative Eric Palmer presented the activities of the graduate students for the 2000 meeting. Potential activities include a lunch on Monday with one or two speakers to describe various position responsibilities in industry and academia. They are also considering having a poster describing graduate programs at each member university. The BOD complimented the graduate students on their activities and encouraged them to proceed.

President Elect and Program Chair Laura Whatley reported that the theme for the 2000 meeting will be Y2K, The Challenge of Change. Paul Santleman will welcome attendees at the General Session. The General Session will also have President Murray's comments and guest speaker, Dr. Sally Baliunis of Harvard University and she will discuss issues associated with global warming. Brecke moved, second by Reynolds, to approve a $1,000.00 honorarium, plus expenses, for Dr Baliunis. Motion approved.

President Elect Whatley requested financial assistance for secretarial help in compiling the program. Street moved, second by Brecke, to provide up to $1,000.00 for this endeavor. Motion approved.

Dan Reynolds provide an update on the Site Selection for 2001. Sites under considerations are Adams Mark in Jacksonville, Atlanta Hyatt, and Holiday Inn Four Seasons in Greensboro. More information will be provided to the Board before a site is selected.

Dan Reynolds discussed the SWSS Website and requested funds to support personnel preparing and updating the site. Brecke moved, second by Jordan, to provide up to $1,000.00 per year for maintenance for the SWSS WebPage. Motion carried.

Further, Dan Reynolds described a List Server for potential use by the SWSS. Street moved, second by Whatley, to authorize a SWSS List Server. Motion carried. Reynolds moved, second by Ratliff, that the List Serve Manager will be the SWSS Editor and the Editor/Manager shall determine what can be sent to the membership via the List Server. The President, President Elect, and Vice-President will make a determination on the suitability of material to be sent on the List Server, when requested by the Editor/Manager. Motion approved.

A discussion of the Good Laboratory Practices (GLP) training to be held before the SWSS meeting was held. Novartis will provide trainers for the sessions. General GLP training will occur on Saturday afternoon and Sunday. Advanced training will be given on Monday morning. The cost will be $250.00 per person for basic training, $150 for advanced, and $350 if attending both.

The SWSS must pay travel expenses for the AESOP representative to attend SWSS meetings. This point was made to clarify the SWSS responsibilities in supporting this position.

A discussion about the need for SWSS participation on the Washington Liaison committee was held. The MOP clearly states that the Chair of the Legislative and Regulatory committee is to serve as the SWSS representative. Members appointed to this Chair must be willing to attend and participate in WSSA activities.

A discussion on the need of an Education committee in SWSS and how the SWSS could interact with the WSSA Education committee resulted in WSSA representative Brecke saying he would inquire on the status of theWSSA committee at the summer WSSA BOD meeting and report to the SWSS Board at thw next meeting.

The BOD discussed the subject of using computer projection equipment for presentations at the 2000 meeting. The Board believes at this time that the technology for large screen projection is not adequate. It was suggested that a Newsletter article be written explaining the Board's decision and that the Board will continue to evaluate this item in the future.

The need for a "History of SWSS" was discussed. The BOD agrees that such information would be useful and of interest to many in SWSS. However, the problem continues to be with finding someone to undertake this endeavor. Witt agreed to develop a form that could be used by several members in conducting oral interviews with individuals involved with important development of the SWSS.

Business Managers Report - Bob Schmidt went over the report. CDRom sales were highlighted. The Greensboro, NC meeting in January, 1999 made money because of increased registration fees and extra money fromBirmingham meeting in January, 1998 being deposited. Schmidt indicated there was enough money available to print Weed ID set 7. Registration on site is presently $150 walk-in. Motion was made to accept report and the report was approved.

Check writing - Schmidt was asked about the procedure for writing check for SWSS and the double signature requirement. He reported that the procedure was to pre-sign checks by Secretary/Treasurer and then he (Schmidt) would sign them as needed. Ratliff asked if this procedure as in the spirit of what the bonding company wanted. Schmidt responded that paying bills would not be timely if both signatures were signed as needed due to time it would require to accomplish this. Murray responded to leave procedure as it is as long as bonding company has not raised concerns.

Newsletter - Murray asked about the possibility of printing 300 more newsletters to mail to potential attendees who are in the SWSS membership and WSSA directories fromthe region near this year's meeting (Kansas, Texas, Arkansas and Oklahoma). The SWSS Board was supportive of this activity. Bob Schmidt was asked to send these extra Newsletters to the addresses provided by Murray.

SWSS Ribbons or Pins - SWSS Endowment wants to sell (approved at January meeting) buttons, stickers or pins to veterans of any of the student contests. Motion to authorize Bob to buy stickers, buttons or pins was requested by the SWSS Endowment committee for the endowment fund raiser. The motion passed unanimously.

Training at SWSS Annual Meeting - Board discussed training at the SWSS annual meeting once the current GLP training is completed at the upcoming Tulsa, OK meeting. It was noted that if GLP training is successful (good participation) then other areas of training may be a possibility. Among the areas mentioned were soils, weed identification, herbicide diagnosis, calibration (use of weed contest plots), etc. Potential participants include Departments of Agriculture, chemical companies, agricultural suppliers.

SWSS Annual Meeting Promotion - Promotion of SWSS annual meeting was discussed and it was agreed on that Local Arrangements Committee, SWSS Endowment, Committee Chairs have to get involved to increase promotion leading to increased attendance. No action was taken.

Weed Lit - The Weed Lit program developed by Murray's program at OSU is available for SWSS board. No action taken.

Weed ID Guides/CD Roms Forestry Guide - SWSS Has already approved printing of the 7th set of the SWSS ID notebook, however, there are bids from two printing companies for $45,000 and $30,000. The $45,000 bid was very detailed; the $30,000 was not. Motion was made by Ratliff to authorize the President to make decision on selecting the printing company based on his findings. It was seconded by Whatley and passed unanimously.

Forestry Guide - Previously increasing the printing cost to improve quality of the guide was approved by the SWSS Board. It was discussed whether to increase cost of the guide and then agreed on by the Board to keep the price of the guide at $36.00 as previously approved. No discounts have been approved at this time. The board wishes to revisit promotion through Noble or Amazon next year. No action taken.

SWSS Society Brochure - Whatley, Reynolds, and Zedaker have agreed to work on a SWSS Society brochure for education purposes.

SWSS Weed ID Set - Budget was discussed for digitizing slides for Weed ID VIII. Charles Bryson wishes to increase from$3,600 previously approved to $4,000 for paying students to write weed keys. There was no need for Board action since monies were approved the previous year and is in the 1999 budget.

Budget - Discussion of Endowment contribution from SWSS Board was deferred to January Board meeting.

OLD BUSINESS

Nomination Committee - This committee has already asked candidates to consider running for election to ensure meeting upcoming deadlines. The Board instructed Secretary to follow cut-off dates for the election of offices.

NEW BUSINESS

Conversation-on-Change -Conversation-on-Change, a program supported by CAST, to encourage society dialogue, was discussed. The Focus Group (Whatley is a member) has asked public opinion about agriculture. The Outreach Group of Conversation-on-Change is developing a video publication to encourage public dialogue on agriculture. A motion was made by Street for: SWSS, in principle, to support Conversation-on-Change pilot video presentation for encouraging public dialogue on agriculture. It was seconded by Youmans and passed unanimously.

NEW BUSINESS

Washington Liason Committee - It was discussed to encourage WSSA to send information to our WSSA representative when they do not attend WSA Board meeting.

Necrology - Charlie Rieck recently died.

Budget - A motion was made to approve the budget by Reynolds, seconded by Whatley and passed unanimously.

The meeting ended at 11:00 a.m.

Minutes for SWSS Board Meeting
January 23 and 24, 2000
Adam's Mark Hotel, Tulsa OK

President Don Murray called the meeting to order at 1:00 pm on January 23, 2000. Attendance included Past President Randy Ratliff, President Elect Laura Whatley, Vice President Joe Street, Editor Dan Reynolds, Secretary Treasurer David Monks, CAST representative Alan York, Forestry representative Shep Zedaker, Board Members-at-Large David Jordan, William Barrentine, Barry Brecke, Bill Witt, Cletus Youmans, Business Manager Bob Schmidt, and Constitution and Operating Procedures Chair Gene Wills.

A motion to accept President Murray's agenda was made by Laura Whatley and seconded by Bill Witt. The motion was approved.

President Murray, substituting for Secretary Monks (delayed by travel) read the minutes from the June 11, 1999 summer board meeting. A motion to accept the Minutes was made by Gene Wills with a second by Cletus Youmans. The motion was approved.

Editors Report
Dan Reynolds indicated can access last years papers/abstracts on the web site. His goals for this year are to have an electronic version of the proceedings by March 1 and a hard copy by April 1, 2000. Reynolds asked whether items such as weed survey information and extension publications, and crop losses should be included in the proceeding. This would eliminate approximately 75 pages. Murray and Witt indicated because libraries use them that it would be best to continue with all the information. There was no board action on this item. Brecke mentioned the first step would be to mention in the hard copy that the proceedings are available on the website. Witt motioned that the Editors report be accepted, seconded by Brecke and then the motion was approved. Wills indicated that the MOP may need to be updated to reflect the fact that proceedings are available electronically?

Computer Applications Committee
Dan Reynolds discussed what SWSS could do with publications with regard to the web site. He indicated that currently members can print ordering information but can not order by the web. There were a few questions about how to more efficiency use the web page. Whatley mentioned that in long term SWSS may want to modify the web page to make it more exciting. Reynolds pointed out that the goal originally of the web page was a way to service membership instead of attracting new members. A motion was made to accept the report and it passed unanimously.

Local Arrangement Committee
Dick Oliver indicated that local arrangement activities were meshing well. The GLP training was going especially well. He also indicated that the Graduate student luncheon was would have about 150 attending. Thus, there was difficulty in arranging a room for the luncheon. Oliver also mentioned that the breaks would be in the Tulsa Ballrooms in an effort to promote greater exposure of the displays. He also indicated that audio visual costs would be approximately $5800. Oliver saved SWSS by purchasing some laser pointers than renting them from the Hotel. He also indicated that they borrowed easels from the North Central Weed Science Society. The motion was tabled until Thursday.

A Kids Journey to Understand Weeds
Susan Sherman gave a report on A Kids Journey to Understand Weeds. She discussed the project and thanked the society for their support. Murray indicated that SWSS was fortunate to be on the list of supporters for the project. Susan Sherman discussed the status of the project and indicated that she would be speaking in the symposium. There was no action taken.

Graduate Student Association
Chris Tingle indicated that the display representing the region is completed. The display is designed to provide students in the region with a general idea of graduate programs offered at the universities in the region. He discussed the graduate student luncheon for Monday and indicated that E.P. Prostko and ___ Scott would speak about challenges that have faced in their transition from graduate school to university and industry. Funds have been collected to cover costs associated with the meal ($2,339.30) with exception of $289. He indicated that the money for this expense has been promised and asked if the board would cover the addition costs at the this time. Dan Reynolds made a motion to accept the report, to cover additional for the luncheon and to allow the graduate student association to maintain an account within the society. Brecke seconded the motion and the motion passed.

Business Managers report
Bob Schmidt gave the report. Reynolds moved to accept the report and Alan York seconded the report. The motion passed unanimously. Questions concerning how the Forest ID guide was being advertized was asked because a high number of books were sold in November and December as a result of a press release that had some incorrect information. Computer needs for the business manager was discussed. Following some discussion Whatley made a motion that the BOD approve a maximum of $5,000 for computer system, software and technical support for the business manager. Brecke seconded the motion and motion passed. Because the business manager is associated with the North Central Weed Science Society, and the Southern Weed Science Society compatibility issues need to be addressed.

Endowment Committee report
Doug Worsham indicated that the committee was very busy. He also indicated that Ray Smith estimated that they would be getting approximately $11,000 from the GLP training. He also indicated that no profit was made from the veteran buttons. Also, he said that there was interest in doing the GLP training in 2001. Worsham and Witt felt that the preregistration cutoff of Oct 1 was too early. Witt asked if the full cost of GLP could be paid up front. Several members of the board indicated that they have to pay the full amount up front when attending other seminar events. Laura Whatley felt like the information available for the GLP training needed more detail. Witt made a motion to the accept the report, Whatley seconded it and it passed unanimously.

External Funding report
Doug Worsham reported a list on ways to enhance external funding. Brecke made a motion to accept the report, Reynolds seconded the motion and it passed unanimously.

Helms Briscoe
Kathy Tatom discussed with the BOD how they handle hotel negotiations. Murray indicated that with Helms Briscoe being involved allowed for more consistency in negotiations. Currently there little consistency involved since the president changes yearly. This company works with Site Selection committee. It does not cost our society, it is paid out of commissions from the hotel. The BOD asked several questions. She asks specifics with regard to needs of the society before she starts her work. She also indicated that once given information as to the area the society wishes to meet she could give advice and information that would lead to society making a discussion as to where to meet. There was no board action.

Awards Committee
Randy Ratliff reported that the election was a success with successful and unsuccessful candidates for each office being notified in a timely manner. Ratliff made a motion that the slate of recipients be approved and the motion carried unanimously. A motion was also made to accept the Awards committee report and it passed unanimously.

Student Program Committee
Tom Mueller reported that the committee would be discussing the feasibility of dropping the lowest score of the five judges in the graduate student contest. They will bring it to the BOD at a later date. He also mentioned that the committee will be discussing ways to encourage the paper contest to be more focused on the content of the poster and less focus on the visual display. This will also be brought to the BOD at a later date. A motion was made to accept the report and it passed unanimously.

Constitution and Operating Procedures
Gene Wills indicated there are no changes to be considered for the MOP this year. A motion was made to accept the report and it passed unanimously.

President Murray mentioned that we may need to add that the Site Selection Committee will use advice of a conference resource firm such as Helms Briscoe to help with site selection and negotiation to the MOP.

CAST
Alan York reported that CAST met as usual in spring and fall this year. He also mentioned the publications that CAST published this year. He also asked the BOD if he should send out information over email that he receives from CAST. Alan will send what he feels is appropriate to members. The BOD was appreciative of receiving e-mails updating them on CAST.

Program Committee 2000
Laura Whatley presented reported that there are a record high number of papers this year with 345 to be presented this year and two symposiums. All student papers are on Tuesday afternoon this year. A motion was made to accept the report and it passed unanimously.

WSSA Rep
Barry Brecke indicated that WSSA is clarifying the relationship of the member societies with WSSA in regard to supporting the Director of Science Policy position. A document has been prepared for consideration that outlines the relationships, roles and responsibilities of participants as related to the Director of Science Policy position. Brecke indicated that he would check on WSSA publications that SWSS is storing to see if they would release them to SWSS to sell. It was discussed that if released by WSSA, then go with a fire sale price until the summer board meeting. A motion was made to accept the report and it passed unanimously.

Forest Weeds subcommittee
James Miller asked the BOD for their feeling about quality of the new publication “Forest Plants of the Southeast and their Wildlife Uses”. He received favorable comments from several board members on its quality. He reported that 6300 copies were printed at a cost of $95,584 or $15.17 per copy. It is selling at $36 a copy. Over 500 copies have been sold at this time. A CD version of the book has been produced for $1475; this is $305 more than was allocated initially for this activity. This $305 was used from the $2400 saved from past BOD approval and savings in the photography account. He recommended additional $3000 be allocated for advertising the book and CD in addition to the $2095 saved

from past BOD approval and saving in the photography account. Miller also recommended that the Southern Research Station, USDA Forest Service, be permitted to buy 100 copies of the Book at $25 per copy. He also recommended that the authors (James and Karl Miller) be able to buy 48 copies each at $15 per copy. A motion was made to accept the report and it passed unanimously. (Note: the recommendations were not considered at this time)

Weed Identification Committee
Charles Bryson gave an update on the committee activity indicating that Weed ID Set 7 is still in the galley proof stage. They are trying to get them in file format to go to printer. Descriptions are being written for Weed ID Set 8. Set 8 will likely be the last one. A motion was made to accept the report and it passed unanimously.

Meeting adjourned at 5:30 pm

Minutes for SWSS Board Meeting
January 24, 2000
Adam's Mark Hotel, Tulsa OK

Finance Committee
Joe Street presented this report. A motion was made for report to be accepted and it passed unanimously. The Finance Committee made five recommendations. A motion was made and passed for BOD to consider each motion separately. The recommendations are: 1) recommended that $10,000 be transferred from the general budget to the Endowment Foundation. A motion was made to support this recommendation and it passed unanimously. 2) recommended to allocate $3,000 for CD production and replication with up to 30% overrun for developing and implementing locks to prevent duplication. A motion was made to support this recommendation and it passed unanimously. 3) recommended to approve $3000 plus $2095 saved frompast BOD approval and saving in the photography account for advertizement with stipulation that Business Manager, President and Forestry rep on BOD review and approve all ads regarding advertizement.
A motion was made to support this recommendation and it passed unanimously. 4) recommends that SRS be able to buy 100 copies of the book at $25 per copy. A motion was made to support this recommendation and it passed unanimously. 5) recommends that each author (Miller and Miller) be able to purchase 48 copies each at $15 per copy. A motion was made to support this recommendation and it passed unanimously.

Research Committee
Joe Street reported that this years information (weed survey, extension publications, etc) will be collected for the grass crops. A motion was made to accept this report and it passed unanimously.

Program Committee 2000
Laura Whatley made a motion to change the due date of title submissions to September 1 which coincides with the North Central Weed Science Society. She also indicated that the committee felt that sections for the program need changing. She gave an example of changing Soil and Environmental Aspects of Weed Science to Soil and Water Quality and Environmental Aspects of Weed Science. Also, possibly splitting Weed Control in Agronomic Crops someway such as monocots and dicots.

Program Committee 2001
Joe Street reported that the theme for next years meeting will be "New Century New Opportunities". He reported that the instructions for abstracts on the web site differed from the ones sent to authors, and the committee would work to rectify this difference. Motion was made and passed unanimously to accept the report.

Display Committee
Peter Dotray reported that there were 38 letters sent out to sustaining members resulting in 5 booths. He expressed concern for the low number of booths and asked the BOD for direction on how to improve this. The BOD suggested that the chairman of this committee to work with the Sustaining Membership committee to increase this. The BOD suggested that other companies involving safety equipment, spray tips, forestry supplies, etc should be contacted and the benefits regarding membership be expressed to them. A motion was made and passed unanimously to accept the report.

Discretionary funds
Don Murray indicated that often there is a need for some discretionary funds to pay for items that arise and need immediate attention. A motion was made and passed approving up to $2500 per year discretionary fund for the Presidents use as needs arise.

Resolutions and Necrology Committee
Shep Zedaker reported that the committee developed a resolution commending, on behalf of the society, the Local Arrangements Committee, and Chairwoman Laura Whatley and the members of the Program committee for the outstanding efforts with the annual meeting. The committee also developed a resolution recognizing Charley Rieck for his distinctive service to various universities, significant contributions to agronomy and weed science; and indicating that SWSS makes special note of his death and extends sympathy and appreciation for his contributions. A motion was made to accept the report and it passed unanimously.

Long Range Planning Committee
Bob Hayes reported that the committee is concerned with the loss of membership. They recommend to have a renewed effort in increasing sustaining members by soliciting in agriculturalrelated categories such as distributors, suppliers, etc. The committee also suggested sending an invoice with a letter when soliciting for sustaining membership. The committee discussed individual dues but felt that they are now more in line with other societies so does not recommend any actions. They also recommend that committee structure in relation to their job responsibility be addressed since committee members of some committees often do not know what their job is. They recommend that the Past President serve as a liaison for committee chairs to communicate to them the expected activities of the committee. The Long Range Planning Committee also would like the society to continue to pursue becoming self supporting by advertizing SWSS products such as the Weed ID book and Forest ID book. Suggested that SWSS consider a Herbicide Action Short Course like a short version of the Purdue University. They would also like the SWSS web site to be more user friendly.

It was suggested that for next report period that this committee review committee structure and standing committees and make suggestions for streamlining them. A motion was made to accept the Long Range Planning Committee and it passed unanimously.

Historical Committee

Randy Ratliff reported for this committee and indicated that Bob Dill would like to continue as chairman. This committee would like to develop the history of Weed Science. In an attempt to develop the history, Bill Whitt will develop a questionnaire for members to complete that would help capture information for this history. A motion was made to accept this committee report and it passed unanimously.

Meeting was adjourned at 11:55 am.

Minutes for SWSS Board Meeting
January 26, 2000
Adam's Mark Hotel, Tulsa OK

President Laura Whatley called the meeting to order at 9:35 pm on January 26, 2000. (The meeting was held at this time because inclement weather threatened making it a possibility of Board Members not being able to leave Tulsa the next day) Attendance included Past President Don Murray, President Laura Whatley, President Elect Joe Street, Editor Dan Reynolds, Secretary Treasurer David Monks, CAST representative Alan York, Board Members-at-Large Jerry Wells, Jackie Driver, Charles Bryson, Barry Brecke, Bill Witt, Cletus Youmans, Graduate Student Representative Eric Palmer, Business Manager Bob Schmidt, and Constitution and Operating Procedures Chair Gene Wills.

Chair of Constitution and Operating Procedures
A motion was made by Charles Bryson for Gene Wills to continue as the chair of the Consitution and Operating Procedures. A second was made by Cletus Youmans and the motion passed unanimously.

Graduate Student Contest Committee
This committee recommended that the worksheet for judges in the paper contest be changed from using numbers to a system using categories (fair, poor, good, excellent). Don Murray made a motion to send the report back to the committee for more work and then present it at the summer board of directors meeting. It carried unanimously.

Computer application
Dan Reynolds reported that the web site is a service based site and has a goal of making the service up to a higher level within the year then maybe transition to a more outreach role. Dan is checking into the specifications for Bob Schmidt a new computer and software. Software will be installed by someone at a university or by the factory. Discussed the use of computer projection units at our meeting and also whether to provide a computer connected to the web on site for use by attendees. Dan will discuss with the committee about the possibility of having a computer available at the meeting. However, it was felt at this time that use of computer projector units are not dependable enough and are too disruptive to be used at the meeting.

Local Arrangements Committee
Dick Oliver reporting for the committee expressed concern over the use by some members of the society using computer projectors. He indicated that set up and use of this method of presentation was disruptive to sessions and is very expensive to the society. He recommended that we continue to use North Central Weed Science Society's easels to save money. He also suggested that the breakfast for section chairs be mandatory.

Graduate Report
Eric Palmer reported. The graduate students passed a motion for the chair of the graduate students to be in charge of a graduate student account, university poster and inform possible applicants of the outstanding graduate student award. They elected Jeff Ellis of LSU as the graduate student representative on the Weed Contest committee. They elected Shawn Askew from N.C. State University as the graduate student representative on the Outstanding Graduate Student sub-committee. Next year graduate representatives from each school will contact their local industry representatives to support their luncheon. They are considering asking each graduate student for $5.00 to go to the graduate student account. A motion was made to accept report by Don Murray, and then seconded and the it passed unanimously.

Site Selection
Discussed the site of the 2003 meeting which will be in the western region of the Southern Weed Science Society member states. The committee will seek advice from Helms Briscoe on final selection of the location. Dan Reynolds made a motion to accept the report, second by Cletus Youmans and it passed unanimously.

Program committee (2000)
The 2000 SWSS program was discussed and Laura Whatley encouraged people to send Vice-president Joe Street comments that would improve future meeting.

Helms-Briscoe
Dan Reynolds described Helms-Briscoe and the services they provide. They assist with site selection, contract development, etc. They maintain a data base on sites across the U.S. They make suggestions on questions to ask properties. They make on site visits to insure that these sites will work. A motion was made by Don Murray, seconded by Joe Street that the Site Selection Committee be allowed to use Helms-Briscoe in their site selection. The motion passed unanimously.

Kid's Journey to Understanding Weeds
The finance committee recommended $1,000 to support Kid's Journey to Understanding Weeds. Murray seconded the motion and it passed unanimously.

Membership committee report
This committee suggested that members that have not attended meeting be asked if they would like to continue their membership. Bob Schmidt already has a form and does this. It was suggested that the MOP be standardized to say that membership is $25. A motion was made to accept the report and it was accepted unanimously.

GLP training at the annual meeting
The GLP training required Bob Schmidt to come in early and work beyond his current responsibilities. Joe Street made the motion to give Bob Schmidt $500 to cover this work and Don Murray seconded it and the motion passed unanimously. It was discussed that next time the board of directors could stipulate to the Endowment to put all funds above expenses of this activity in the Endowment Fund. Discussion was also held concerning whose (committee) responsibility it was to secure rooms for activities such as GLP workshops and other activities outside the usual annual meeting. Possibilities included the Long Range Planning committee, an ad hoc committee, etc. No action was taken

Breakfast for committees
Discussion was held on SWSS providing breakfast for committees meetings. A motion by Cletus Youmans was made to provide breakfast for the Local Arrangements committee, section chairs, judges for graduate students and board of directors (last day of annual meeting). The motion was seconded by Barry Brecke and it passed unanimously.

Director of Science Policy
This position was discussed. Comments on the descriptions of this position should be sent to Barry Brecke. No action taken

Resolution and Necrology Committee
Discussion of dissolving this committee was moved to the summer board meeting.

Funds from making copies of abstracts at the annual meeting
Discussion was held on where funds go from making copies of the abstracts for attendees at the annual meeting. It currently goes to pay for the service. A motion was made by Joe Street and a second by Don Murray to move collections ($541) from copying abstracts at the 2000 annual meeting to the Endowment Fund. It passed unanimously.

Graduate Student Reimbursement for lodging
The board of directors discussed whether to reimburse graduate students who left early (did not attend the banquet as required by the MOP) due to inclement whether this year for their lodging.
It was decided that they would not be reimbursed because there are always reasons to come that would prevent attending the banquet. This could possibly lead to reduced attendance at the banquet.

Summer Board meeting.
The meeting is scheduled on June 24 and 25, 2000.

Meeting adjourned at 12:35 January 28,2000.

Southern Weed Science Society

Business Manager's Report

Membership as of December 31

	1999	1998	1997	1996	1993	1988
Members and Sustaining Members	559	662	661	637	756	824
Students	136	136	120	139	103	102
Totals	695	798	781	776	879	1,015

Research Methods to date

Expense $37,107 Income $40,328

Weed Identification Guide to date

Expense $396,491 Income $727,603

Weed ID sales for the first 6 months is $5,197 as compared to $7,935 for the same period a year ago. Budget for year was projected with sales of $15,000

Weed CD-ROM version 1, final report
Expenses $21,936 Income $57,691

Weeds of the United States and Canada CD-ROM
Expenses $6,044 Income $68,378

Forest Plants of the Southeast and Their Wildlife Uses
Have shipped over 500 copies as of this date. Suggest that future news releases include the SWSS mailing address. Current book reviews state only the phone number and Email address. There are some people who do not or will not give out their credit card numbers in email. They phone and ask for a mailing address which all takes time.

Good Laboratory Practice for the Field

Registration	
Basic	15
Advance	14
Basic and advance	15

With this symposium beginning Saturday at noon, I was required to travel one extra day in order to collect monies due for the registration.

Endowment Foundation

Only eight people order the "Veteran" buttons when they registered for the SWSS meeting.

Office computer

The computer, Compaq Prolinea 4/25s, was purchased in 1993. CD-Rom were not in use at that time and all SWSS records were on floppy disks. With the limited space on the hard drive, I have not been able to upgrade the software. With the influx of email attachments, I do not have the programs to convert them to the software I am using. I am reporting this to let the Board know the limitations on receiving attachments.

Preregistration

	2000	1999	1998	1997	1996	1995	1994
Members	249	261	285	292	282	331	319
Students	115	116	74	74	63	67	63
Total	364	377	359	365	345	398	382
Percentage of final	75%	75%	67%	62%	60%	56%	61%
Total Attendance	485 est	501	601	584	566	703	622

Investments

$55,000	CD 5.75 due 1/00
$50,000	CD 5,25% due 10/99
$24,355	CD 4.35% due 10/00
$30,000	CD 5.85% due 2/99
$14,124	CD 5.95% due 5/01
$16,000	CD 6.5% due 1/02
$70,249	IMMA

SWSS Net Worth, May 31

1999	$324,919
1998	$279,925
1997	$289,104
1996	$293,453
1995	$302,303
1994	$272,351
1993	$271,436
1992	$253,927
1991	$212,096
1990	$155,328
1989	$144,333
1988	$134,670
1987	$100,395
1986	$105,280
1985	$103,878
1984	$ 88,587
1983	$ 67,892
1982	$ 65,681
1981	$ 69,404

Annual Meeting

Year	Location	Attendance	Income	Expense
1999	Greensboro	501	$48,266	$45,713
1998	Birmingham	601	$48,542	$54,599
1997	Houston	584	$40,888	$56,732
1996	Charlotte	566	39,777	38,148
1995	Memphis	703	45,145	42,551
1994	Dallas	622	33,500	37,777
1993	Charlotte	669	36,695	35,161
1992	Little Rock	719	37,608	32,343
1991	San Antonio	731	42,072	43,105
1990	Atlanta	820	24,722	31,084
1989	Nashville	893	41,865	49,903
1988	Tulsa	725	30,145	35,277
1987	Orlando	884	38,639	49,849
1986	Nashville	1,042	42,826	51,111

CAST REPRESENTATIVE REPORT - Presented by A.C. York

CAST had an excellent and productive year during 1999. The spring board meeting was held in Washington, DC, and the fall board meeting was held in Phoenix, AZ. The Board approved two new projects at its spring meeting: *Estrogenicity and Endocrine Disruption: Regulation, Risk and Reality* (report); and *Soil Sampling Test Methods and Results: Impact on Soil Loading from Applications of Fertilizer, Municipal Biosolids and Residuals, Animal Wastes, and Industrial Byproducts* (issue paper). The following three new projects were approved at the fall meeting: *Urban Agriculture* (report); *Intervention Strategies for Safety of Foods of Animal Origin* (issue paper); and *Genetically Modified Organisms.* The later will be an internet document. Previously approved reports and issue papers in various stages of preparation include: *Global Climate Change*; *Integrated Pest Management*; *Johne's Disease*; *Movement and Impacts of Detrimental Non-Native Organisms Affecting Agricultural Production and Natural Resource Environments (Pests)*; *Movement and Impacts of Detrimental Non-Native Organisms Affecting Agricultural Production and Natural Resource Environments (Plants)*; *Mycotoxins: Risks and Impacts in Plant and Animal Systems*; *Transmissible Spongiform Encephalopathy*; and *Vertical Integration of Agriculture and its Impact on Rural America* .

CAST published five reports and issue papers in 1999. The publications included the following: *Agricultural Impact of the Sudden Elimination of Key Pesticides under the Food Quality Protection Act*; *Benefits of Biodiversity*; *Animal Agriculture and Global Food Supply*; *Gulf of Mexico Hypoxia: Land and Sea Interactions*; and *Application of Biotechnology to Crops: Benefits and Risks.* The later publication, an issue paper, was prepared specifically for the Third Ministerial Conference of the World Trade Organization held in Seattle in December, 1999. The issue paper was aimed at a general audience. CAST plans to produce a series of subsequent papers that will address some of the issues surrounding biotechnology in more detail and in the context of genetic modification beyond crops.

During 1999, CAST submitted comments to the FDA on "Biotechnology in the Year 2000 and Beyond" and on "Subtherapeutic Use of Antibotics in Animal Agriculture", comments to the National Science Board Task Force on the Environment on "Environmental Science and Engineering for the 21st Century: The Role of the National Science Foundation", comments on changing the name of the proposed "Plant-Pesticide" term in the EPA ruling (of May 21, 1999), and comments on the EPA/USDA "Unified National Strategy for Animal Feeding Operations". CAST hosted briefings in Washington on two of its reports, *Benefits of Biodiversity* and *Animal Agriculture and Global Food Supply*. It also co-hosted a series of meetings with staff from the House Agriculture Committee, the Senate Agriculture, Forestry, and Nutrition Committee, and the Congressional Research Service. CAST sponsored a series of biotechnology briefings in Washington in February, 1999 and co-sponsored (with the International Society of Regulatory Toxicology and Pharmacology) a workshop in March 1999 on "The FQPA: A Challenge for Science Policy and Pesticide Regulation". CAST continues to play an active role in Conversations on Change.

The American Association of Avian Pathologists joined CAST as a member society during 1999. CAST now has 38 member societies and four associate member societies.
The spring and fall board meetings for 2000 will be March 22-25 in Arlington, VA and Sept 29-Oct.1 in New Orleans, respectively. Harold Coble will assume presidency of CAST in the fall of 2000.

Respectfully submitted:

Alan York - SWSS Representative to CAST

EDITORS REPORT - Presented by Daniel B. Reynolds

The 1999 Proceedings contained 488 pages. This was an increase of 65 pages over the Proceedings from 1998. The Proceedings contained all Executive Board minutes, committee reports, Business Managers' report, General Session presentations, Presidential Address, Award winners, Research report, abstracts, and full papers. The abstracts and full papers are available via the web from the SWSS home page. Following is the distribution of number of presentations and number of pages.

Section	Number Presented	Number of Pages	Number of Papers
Minute of Executive Board, Committee Reports, etc.		76	
General Session	3	7	2
Weed Management in Agronomic Crops	103	67	0
Weed Management in Turf, Pasture, and Rangeland	14	9	0
Weed Management in Horticultural Crops	14	8	0
Forest Vegetation Management	36	64	10
Vegetation Management in Utility, Railroads & Highway Right-of-Ways, and on Industrial Sites	11	10.5	1
Ecological & Physiological Aspects of Weed Management	28	20.5	0
Educational & Regulatory Aspects of Weed Management	6	5	0
Developments from Industry	11	8	0
Soil & Environmental Aspects of Weed Science	10	14	2
Posters	70	54	2
State Extension Publications, Weed Survey, Economic Losses, Index		75	
Indexes, Registrants, etc		70	
Total Abstracts & Papers	306	267	17
Total - Other		221	
Grand Total	**306**	**488**	**17**

Respectfully Submitted: Daniel B. Reynolds, Editor

SWSS STUDENT ORGANIZATION REPORT - Presented by C.H. Tingle

Summary of Progress:

A motion was made to designate the Graduate Student Chairman as manager of the Graduate Student account containing all funds remaining from the 2000 SWSS meeting (approximately $650) for future graduate student events. The motion was seconded and approved by the committee.

An additional motion was made appointing the Graduate Student Chairman as supervisor of the graduate school display each year. The Chairman will not only be in charge of the display set up, but also responsible for any changes based on each school's needs. The motion was seconded and approved by the committee.

Elected Chairman for the 2000/2001 term, Jimmy Summerlin (Univ. of Tenn.) announced his resignation for personal reasons. Chairman Chris Tingle recommended that a special election be held within the committee to elect a replacement. Eric Palmer (Okla. State Univ.) was nominated and unanimously approved by the committee to serve as Graduate Student Chairman for 2000/2001 term.

Graduate students were informed of changes to the SWSS Weed Contest per the Weed Contest Committee meeting.

Graduate students were also informed of the number of applicants submitted for the 2000 Outstanding Graduate Student award contest and were encouraged to make sure that each professor continues to nominate deserving candidates.

Weed Contest (Jeff Ellis, LSU) and Outstanding Graduate Student (Shawn Askew, NCSU) committee representatives were elected.

Objectives for Next Year:

Continue with Graduate Student Luncheon and consider suggestions for other activities.
Maintain University display and make necessary changes prior to next years meeting.

Recommendation or Request for Board Action:

The graduate student organization requests permission to have representation on the paper/poster committees in order to make suggestions concerning paper/poster matters.

Respectfully Submitted:

Chris Tingle

COMMITTEE REPORTS

Committee Number: 101 **Committee Name:** SWSS Endowment Foundation

Summary of Progress: The 14th Annual Meeting of the SWSS Endowment Foundation Board of Trustees was held on Monday, January 24, 1999 at the Holiday Inn Four Seasons, Greensboro, NC. The Board heard a report from Doug Worsham, chair, External Funding Committee. Several ideas for projects to generate income for the Society and the Endowment Foundation were discussed.

Tom Peeper reported that the SWSS Endowment Foundation balance sheet as of September 30,1998 showed:

1998 year-to-date	
Earnings from Contributions:	28,810.00
Expenses:	
Banking	(90.00)
Accounting	(300.00)
Awards	(1,900.00)
Net operating income:	26,519.00
Plus investment income for the year:	9,444.00
Net earning for the year:	**$35,963.00**
1997 balance:	$141,038.00
Year to date 1998 earnings:	35,963.00
Net Asset:	**$177,000.13**

The Board voted to cosponsor a GLP training project with the Novartis Crop Protection Assurance Unit to generate income. Novartis is donating their services and expertise. The training will be conducted prior to the start of the 2000 SWSS meeting in Tulsa. The SWSS Board of Directors accepted this proposal.

The fee for the Basic GLP and QA training session was $250.00 each and the fee for the Advanced GLP session was $150.00. A brochure was prepared by a sub-committee and sent to all SWSS members and a list of consultants in August 1999. An article describing and promoting the workshops was prepared for the August SWSS Newsletter.
As of November 16,1999, 30 persons have registered for the Basic session and 31 have registered for the Advanced GLP session.

The GLP training was very successful at the 2000 meeting. The Basic course had 15 participants; the Advanced course had 14, and there were 15 participants in the Basic and Advanced Courses. The Endowment Foundation Board of Trustees greatly appreciates the cooperation of Novartis Crop Protection in conducting this program. Thanks also to Ray Smith, Jim Bone, and Mike Chandler for arranging the program and to Griffin Corp. for printing the brochures.

The SWSS also accepted a proposal from the External Funding Committee to sell "Contest Veteran" buttons for the 2000 meeting for $10.00 each. The proceeds from the project will go to the Endowment Foundation. At the beginning of the 2000 meeting, only 8 buttons had been purchased through the pre-registration form.

President Doug Worsham prepared an article for the December 1999 newsletter urging SWSS members to donate to the Endowment Foundation.

The Endowment Foundation Board of Trustees again supported the long-term goal of the Foundation to provide total support for SWSS Student Programs. Currently, banquet and lodging at the annual meeting are approximately $155 per student. At present, the Foundation is only supporting awards associated with the SWSS Graduate Student Contest at annual meetings. The short-term goal is to have a total of $200,000 in 2000. The long-term goal is to have $300,000 for support of student programs.

1999 Financial Report as of September 30,1999

Beginning Net Asset:	**$177,002.00**
Income	
Donations:	$ 5,665.00
Investment income	6,661.53
Total Income	$ 12,326.53
Expenses	
Insurance	100.00
Bank charge	104.49
Accounting	340.00
Awards	1,050.00
Miscellaneous	144.80
Total Expenses	2,639.29
Ending Net Asset:	**$186,689.37**

Expected income from the pre-conference GLP and Basic course and the Advanced GLP training is $12,100.00. This added to the net asset balance of $186,689.37 should equal a total of $198,789.37. Hopefully, year-end donations will make it possible to reach the goal of $200,000.00 in 2000!

Objectives for next year: To cooperate with the SWSS Board of Directors in any projects accepted from the ideas submitted by the External Funding Committee. To sponsor another GLP training workshop. To continue to search for projects to increase income for the Endowment Foundation. To increase publicity for the "Veteran Contest" buttons.

Recommendations or Requests for SWSS Board Action: To study the ideas presented by the External Funding Committee and act on one or more of the ideas.

Finance Requested: Although we may reach our goal of $200,000 in 2000, this will still be a long way from our final goal of $300,000 in the Endowment Fund. Therefore, we respectfully request that the SWSS Board of Directors continue to transfer funds they deem appropriate to the Endowment Foundation.

At the January 24 meeting of the SWSS Board of Directors, a $10,000 transfer was approved from the SWSS General Budget to the Endowment Foundation. This, plus the income from the GLP training and donations from 13 individuals during 1999, PUT US OVER OUR SHORT-TERM GOAL OF $200,000 by 2,000!

Respectfully submitted:

Joe Street, Ex-Officio
David Monks, Ex-Officio
Bob Schmidt, Ex-Officio
Gene Wills, Ex-Officio

Ray Smith, Secretary
David Prohaska, Pres. Elect
Tom Peeper, Past Pres.
Tom Monaco, Trustee
Doug Worsham, President

Committee #: 102	**Committee Name:** Awards Committee (Standing)

Summary of Progress: Award nominations were solicited in summer and fall newsletters. Excellent candidates were received for each award and the respective subcommittees ranked the candidates for each award. The aggregate high ranking candidate was selected as the winner within each category and they are listed below. Photographs and biographies of each winner were forwarded to Bob Schmidt for inclusion in the banquet program. Awards will be presented at the SWSS Award Banquet on Wednesday evening.

Distinguished Service Award:	Industry:	Tom Hunt
	Academia:	Bill Witt
Outstanding Young Weed Scientist:		Fred Yelverton
Weed Scientist of the Year:		David Shaw
Outstanding Educator:		Dick Oliver
Outstanding Graduate Student:	Ph.D.:	Jason Norsworthy
	MS:	Wendy Pline

Objective(s) for Next Year: Grant full slate of SWSS awards to most deserving candidates in a timely and organized manner.

Recommendation or Request for Board Action: Approve slate of recipients.

Finances (if any) Requested: None

Respectfully Submitted:

R.L. Ratliff, Chairperson

H.D. Coble, Distinguished Service Award Subcommittee Chairperson

C.W. Derting	P.A. Banks	B.J. Brecke	M.C. Boyles
E.C. Murdock	A. McMahon	J.B. Weber	S.K. Rick

L.B. McCarty, Outstanding Young Weed Scientist Award Subcommittee Chairperson

T.R. Dill	J.W. Boyd	C.S. Williams	D.R. Shaw
E.F. Eastin	Y.L. Yeiser	J.F. Stritzke	J.R. Martin

G.E. Coats, Weed Scientist of the Year Award Subcommittee Chairperson

A.W. Ezell	B.W. Bean	K.K. Hatzios	R. Hoagland
G.N. Rhodes	C.D. Youmans	K.L. Smith	W.W. Witt

J.B. Weber, Outstanding Educator Award Subcommittee Chairperson

G.E. Coats	J.W. Keeling	R.C. Scott	E.C. Murcdock
S. Senseman	A. Wiese	D.R. Shaw	R.E. Talbert

D. Gealy, Outstanding Graduate Student Award Subcommittee Chairperson

J.D. Burton	T.A. Baughman	J.A. Dusky	E.P. Webster
J.D. Green	M. Locke	J.W. Wilcut	E.P. Prostko

Committee #: 103	**Committee Name:** Constitution and Operating Procedure (Standing)

Summary of Progress: At the annual meeting of the SWSS Executive Board in January and at the Summer meeting in June 1999, suggestions for changes in the SWSS Operating Procedures were presented to the Executive Board. Following the June 1999 Summer Board Meeting, all approved revisions and all directives for changes as derived by the Executive Board were made in the SWSS Manual of Operating Procedures (MOP). During September 1999, the revised edition of the MOP was submitted for distribution on the SWSS Web Site, www.weedscience.msstate.edu/swss/.

Objective(s) for Next Year: To continue with a timely revision of the SWSS Manual of Operating Procedures following the annual Summer Meeting of the SWSS Executive Board.

Recommendation or Request for Board Action: None

Finances (if any) Requested: None

Respectfully Submitted:
Gene D. Wills, Chairperson

Committe #: 104	**Committee Name:** Display Committee (Standing)

Summary of Progress: A letter was mailed to each SWSS Sustaining Member inviting them to display information in Tulsa. We mailed out 38 invitation letters and 4 responded.

Objective(s) For Next Year:

Recommendations or Request For Board Action: The display committee feels a better system is needed to contact our sustaining members to explain the benefits of displaying information at our meeting and our desire to have them at our meeting. The committee felt we might need to solicit other companies that should be SWSS sustaining members and try to get others involved in displaying at our meeting. The Display Committee and Sustaining Members Committee should work together before our next meeting to improve our efforts

Finances (if any) Requested: None

Respectively Submitted:
B.W. Bean, J. Braun, N.W. Buehring, K.L. Ferreira, D.S. Jenkins, J.A. Mills, J.J. Mullahey, D. Porterfield,
P.A. Dotray, Chairman

Committee #: 105	**Committee Name:** Finance Committee (Standing)

Summary of Progress: The Finance committee reviewed the financial condition of the Society and found it to be sound.

Objective(s) For Next Year:

Recommendation or Request For Board Action:

1. Recommend funding the CD production and replication of the Forest Plants of the Southeast for $3000.00 with up to 30 percent overrun for installation of firewalls for duplication.
2. Recommend allocation of $5400.00 including $2400.00 already allocated for advertising with the stipulation that the President, Bob Schmidt and the Forestry Representative review and approve ads prior to publication.
3. Recommend that the authors of the Forest Plants of the Southeast be provided 48 copies of the book.
4. Recommend approval of the request from the Southern Research Station and the National Forest Service to purchase 100 copies of the Forest Plants of the Southeast for $25.00 per copy.
5. Recommend transferring $10,000.00 from the general fund to the Endowment Fund.

Finances (if any) Requested: None

Respectfully submitted:

L.B. Gillham, R.M. Hayes, B.D. Sims, C.E. Snipes, D.B. Reynolds, and J.E. Street, Chairperson

Committee #: 106 **Committee Name:** Historical Committee (Standing)

Summary of Progress: Progress to date has been limited due to delayed efforts by the current chairman and the fragmented information available from previous efforts of the Historical Committee. We are still trying to pull together the information for the committee to work fromand provide specific goals. More information should be available during the upcoming Southern Weed Science Society meetings.

Objective(s) for Next Year: Gather all the information available needed for the Historical Committee to make significant progress on established goals.

Recommendation or Request for Board Actions: Allow T.R. Dill to serve as chair a second year to accomplish the objectives stated above.

Finances (if any) Requested: None

Respectfully Submitted:
J.A. Baysinger, M.C. Boyles, E.W. Palmer, A. McMahon, M.L. Wood, T.R. Dill, Chairperson

Committee #: 108 **Committee Name:** Local Arrangements (Standing)

Summary of Progress: Meeting room assignments, banquet menu, newsletter information and spouse program are complete. Meeting should run smoothly. A local arrangements booklet was prepared similar to the one used by Euel Coats and Bill Lewis in previous years. The booklet coordinated each committee members assigned duties and time line for completion. The booklet greatly assisted each committee member accomplish their individual objective and the committee objective to facilitate an excellent meeting. The Arkansas and Oklahoma committee mix worked well.

Summary of rooms blocked and reserved by SWSS members in 2000 at Adams Mark Hotel in Tulsa

	Rooms	
Day	**Blocked**	**Picked Up**
Friday	0	11
Saturday	50	53
Sunday	250	204
Monday	450	342
Tuesday	450	338
Wednesday	250	152
Total	1,450	1,100

The meeting went smooth except for the snow storm on Wednesday night that caused an approximate 35% reduction in Wednesday nights banquet attendance (guaranteed 350).

The hotel facilities and audio/visual equipment were excellent. However, if more than 4 to 5 concurrent sessions were occurring, the hotel would have been inadequate.

All expenses incurred were reviewed by appropriate members of committee and chairman before forwarding to Bob Schmidt for payment. All important committee information has been forwarded to Mark Kurtz, next years Local Arrangements Chairperson.

Objective(s) For Next Year: Get information to next year's committee and work with them at Tulsa meeting.

Recommendation or Request For Board Action: Make sure hotel has adequate meeting space and distance between meeting room sites is reasonable. Pick hotel with a stable sales and convention management personnel.

Finances (if any) Requested: None

Respectfully Submitted:
J.C. Banks, J.W. Boyd, M.C. Boyles, N.R. Burgos, L.M. Cargill, J. Driver, T. Driver, M. McClleland, A. McMahon
J.R. Sholar, A. & R. Talbert, R. Williams, L.R. Oliver, Chairperson

Committee #: 109	**Committee Name:** Long Range Planning (Standing)

Summary of Progress: Our committee met during the annual meeting with Ratliff, Shaw, Griffin, and Hayes present. An agenda was presented consistent with the charge in the MOP. Specific items addressed were membership, Dues, Volunteer Service, Long Term Sustainability, and Biotechnology debate.

Objective for Next Year: For the committee to develop a plan for the Long Term Sustainability of SWSS.

Recommendations or Requests for Board Action:

1. Membership: Redouble efforts to secure sustaining memberships from among distributors, dealers, seed companies, and suppliers. Include invoice with initial letter. Follow up on regular members not attending annual meeting for renewal of membership.

2. Dues: Board should monitor dues structure to insure that dues cover the cost of the annual meeting. Modest annual increases are advised over large increases.

3. Volunteer Service: Considerable discussion occurred with regard to the Academia-Industry rotation and the difficulty of securing nominees for offices. LRPC recommends that the rotation be maintained and that volunteer service be stressed to membership. Furthermore we recommend that committee structure be reviewed in relation to its function. Expectations should be clearly communicated to committee chairpersons by the President. Chairpersons and committee members should be made aware of the access to the MOP on the Web. Recommend that the committee directory be distributed ASAP and the Past-President serve as a liaison between the committee chairs and the Board.

4. Sustainability: SWSS should aggressively advertize our product sales (Weed ID Guide and CD ROM and Forest Plants of the Southeast and their Wildlife Uses and soon to be released corresponding CD ROM versions). Consider securing the services of a public relations firm and/or enhancing press coverage (*Delta, Southwest, Southeast Farm Press, Mid-America Farmer Grower, Progressive Farmer, Farm Journal*, etc.) of meeting and products.

We should continue workshops (GLP, Turf, Herbicide Action, etc.) with fee charge structure as appropriate.

Stress membership and student contest alumni giving to SWSS endowment. Consider establishing an endowment for long term funding of the Society once the endowment for the student program is fully funded.

Pursue getting companies to buy Weed ID Guides and CD ROM's for drawings and/or giveaways at Beltwide, Gin Show, etc. This would provide sales and publicity for both SWSS and our products.

Finances (if any) Requested: None

Respectively Submitted:
P.A. Banks, R.B. Cooper, J.L. Griffin, T.C. Mueller, R.L. Ratliff, D.R. Shaw, J.B. Weber, R.M. Hayes, Chairperson

Committee #: 110	**Committee Name:** Meeting Site Selection Committee (Standing)

Summary of Progress: The site selection committee considered locations in the eastern portion of the SWSS states. Cities considered were: Greensboro, NC; Winston-Salem, NC; Atlanta, GA, Savannah, GA;Destin, FL; and Orlando, FL.

With the assistance of Kathy Tatom of Helms-Briscoe Performance Group the sites were reduced to three. Contract proposals were received from Holiday-Inn-Four Seasons in Greensboro, NC, Adams-Mark in Jacksonville, FL, and Hyatt Regency in Atlanta,GA.

At this time the Holiday-Inn in Greensboro, NC cannot accommodate us for the exact dates we desire and has been dropped from consideration. The contract proposal from Adams-mark in Jacksonville, FL is not competitive with Hyatt-Regency in Atlanta, GA.

Objective(s) for Next Year:

Recommendation or Request for Board Action: Atlanta, GA is centrally located for easy air and auto travel and SWSS hasn't met there for sometime. Therefore, the site selection committee recommends the Hyatt-Regency in Atlanta, GA as the site for the SWSS meeting, January 26-31, 2002.

Finances (if any) Requested: None

Respectfully submitted:
W.L. Currey, Chairperson

Committee #: 111	**Committee Name:** Nominating Committee (Standing)

Summary of Progress: Committee members solicited nominations from the membership for the office of Vice President and two Board members. Names and limited bios were forwarded to the Chair and then disseminated to the committee via email. The nominees were ranked and the two highest ranking members were selected and placed on the ballot as candidates as indicated below. Ballots were returned to the Secretary/Treasurer and tallied. The results were verified and forwarded to the President who informed the three winners (indicated by an asterisk below).

Vice President:	Jerry Wells* Michael Defelice
Board member for Academia:	Charles Bryson* David Bridges
Board member for Industry:	Jackie Driver* Don Grant

Objective(s) for Next Year: Facilitate the nomination of candidates for the election of officers to the SWSS Board.

Recommendation or Request for Board Action: Approve slate of recipients.

Finances (if any) Requested: None

Respectfully Submitted:
C.T. Bryson, J.D. Byrd, S.O. Duke, G.R. Glover, J.D. Green, D. Smith, J.W. Wilcut, C.D. Youmans, J. Yanes
R.L. Ratliff, Chairperson

Committee #: 112	**Committee Name:** Placement Committee (Standing)

Summary of Progress: Position desired and position available forms will be included in the issue of the newsletter directly preceding the 2000 annual meeting in Tulsa. Seven position available and 14 position desired forms were filled out and were on display at the 1999 annual meeting in Greensboro. Copies of these forms were forwarded to the WSSA Placement Committee Chair.

Objective(s) for Next Year: Coordination between the Placement Committee Chair and the local arrangements committee for the 2000 annual meeting is in progress. A new chair will be selected.

Recommendation or Request for Board Actions: None

Finances (if any) Requested: None

Respectfully Submitted:
T.A. Baughman, C.L. Grymes, T. Heap, E.R. Johnson, D Porterfield, K.N. Reddy, M. Thorton, J.W. Wells
D.L. Jordan, Chairperson

Committee #: 113 **Committee Name:** Program Committee: 2000 (Standing)

Summary of Progress: The Tulsa Program, "Y2K: The Challenge of Change," consists of 345 presentations (a record high), including two symposia. The general session will be highlighted by a welcome from Dr. Paul Santleman (former SWSS president), Dr. Don Murray's presidential address, and Dr. Sallie Baliunas of the Harvard - Smithsonian Center for Astrophysics, speaking on global warming.

A break-down of the papers in each section, plus comments, follows.

Agronomic 87
Horticultural 12
Turf 21
Forestry 41
Veg Mgt./Utilities 12
Dev. from Industry 23
Soil 12
Ecology/Physiol 27
App. Technology 10
Educational/Regulatory 11
Posters 79
Symposium: Weed Science Outside the Loop: Just What Do They Think: (5 presentations)
Symposium: Precision Agriculture (5 presentations)

Efforts were made to balance the sections as much as possible with respect to paper numbers, either by moving papers to a "second choice" section or by requesting that authors change to different sections. Since only three papers were submitted for the Biological and Aquatic Weed Control section, they were scheduled in an Ecology and Physiology session.

For the first time, all student contest papers were scheduled for Tuesday afternoon. This change resulted in scheduling split multi-session sections, i.e. the Turf and Developments from Industry sessions were scheduled on Monday and Wednesday rather than on consecutive days.

Objective(s) for Next Year: None. Committee will disband after annual meeting. However, we do recommend that Program Committee 2001, along with the Student Program Committee, review the success of compressing the contest papers into Tuesday afternoon.

Recommendation or Request for Board Actions: Accept recommendations for re-naming Annual Meeting sections, to be proposed after January 24 Committee Meeting.

Finances (if any) Requested: None

Respectfully Submitted:
Tim Adcock, Phil Banks, Dave Gealy, John Groninger, James Hanks, Jeff Higgins, Ken Langeland,
Wayne Mitchem, Scott Senseman, Jim Taylor, Bobby Walls, John Wilcut, Laura L. Whatley, Chairperson

Committee #: 114 **Committee Name:** Program Committee Report 2001(Standing)

Summary of Progress: The program committee met to discuss the 2001 program. Several themes were suggested and the most likely theme will be "New Century – New Opportunities."

The committee will evaluate the current section breakout to determine if some sections should be combined or eliminated.

Anyone interested in developing a symposium should provide a request for funds to the finance committee by the summer Board Meeting.

One symposium has been proposed for the Vegetation Management section entitled "Wildlife Enhancement with Technology".

Objective(s) for Next Year:

Recommendation or Request for Board Actions: None

Respectfully Submitted:
C.T. Bryson, P.A. Dotray, C.D. Elmore, D.L. Jordan, J.A. Kendig, W.D. Mixson, T.R. Murphy
D.H. Poston, S.K. Rick, D.K. Robinson, C.D. Youmans, J.E. Street, Chairperson

Committee #: 116	**Committee Name:** Research Committee Report (Standing)

Summary of Progress: This is the first year of the expanded format of the Economic Losses and Weed Survey section with four subsections on a four-year rotation. This year, the report will include the Grass crops, turf, range, and pastures.

Ted Webster replaced Clyde Dowler as chairman of the Weed Survey – Southern States subsection

Objective(s) for Next Year:

Recommendation or Request for Board Action: None

Respectfully Submitted:
J.D.Byrd, Vic Ford, E.P. Webster, Ted Webster, J.E. Street, Chair

Committee #: 117	**Committee Name:** Resolutions and Necrology Committee (Standing)

Summary of Progress: One necrology report (Dr. C.E. Rieck) submitted to the newsletter editor for publication in the August newsletter. No resolutions submitted to the committee for consideration. Three resolutions developed by the committee for approval by the Board and membership.

Objective(s) for next year: Continue necrology reports and consider/draft resolutions as requested by the membership or the Executive Board.

Recommendation or Request for Board Action: The committee recommends disbanding the Resolution and Necrology Committee. Most resolutions come from the Executive Board members and must be approved by them. The R&N Committee adds another layer of unnecessary bureaucracy.

The committee asks the Executive Board of SWSS to approve the following resolutions pending the successful completion of the 53rd SWSS Meeting

Resolution:
WHEREAS the arrangements and programs of the 53rd Annual Meeting of the Southern Weed Science Society has been of excellent quality, and
WHEREAS a well-planned and well-organized meeting is important for the continued development of the society and is appreciated by its officers and members,
THEREFORE BE IT RESOLVED that the officers and the membership of the Southern Weed Science Society commend Chairwoman Laura Whatley and the members of the program committee and Chairman Dick Oliver and his local arrangements committee for their outstanding efforts on behalf of the society.

Resolution:
WHEREAS the population of the globe is expected to increase beyond the capability of the land base and the existing technology to supply food, fiber, fuel, and building materials, and
WHEREAS biotechnology and the use of genetically enhanced organisms can, with the proper safeguards for preventing undesirable ecological, social and economic consequences, greatly improve our ability to supply the quantity and quality of food, fiber, fuel, and building materials at affordable prices to society,
THEREFORE BE IT RESOLVED that the officers and membership of the Southern Weed Science Society support continued research and development of genetically enhanced organisms that will benefit humankind

Resolution:
WHEREAS: In response to the triazine special review, the Environmental Protection Agency (EPA) received more than 80,000 public comments from growers, university weed scientists and commodity organizations supporting and providing information on the continued use of atrazine. Four decades of safe on-farm use has provided a reliable indication of the value of atrazine in the production of corn, grain sorghum, sugarcane, and other crops.

Atrazine is used on two thirds of the corn and sorghum acreage and on up to 90 percent of the sugarcane acreage in the U.S. allowing farmers to practice conservation tillage which reduces soil erosion, improves water quality, reduces fuel consumption and helps build organic content in topsoil. Atrazine very effectively controls weeds, and in 1999 was used on more than 80 percent of the no-till corn acres and 70 percent of the conservation tillage acres in the U.S., yet the average application rate has decreased by one-half since 1985.

Since atrazine sets precedence for the 62 herbicides on EPA's Tier 1 list for safety assessment under the FQPA, we urge the EPA to establish a transparent and science based process for reassessing the safety of these weed control tools.

In April of 1996 the EPA published a draft of new cancer guidelines designed to replace those EPA had been using since 1986. The finalized version of the new cancer guidelines still does not exist. The lack of final guidelines and accompanying policy only contributes to obscuring what should (and must) be a transparent process.

For this reason the members of the Southern Weed Science Society encourage the EPA, in the spirit of the Food Quality Protection Act (FQPA) Tolerance Reassessment Advisory Committee's (TRAC's) direction, to develop an interim Cancer Guideline Science Policy and submit it for public review and comment.

In addition, the EPA should strive to harmonize their final cancer classification framework with other science-based global regulatory bodies such as The World Health Organization's International Agency for Research on Cancer.

THEREFORE, BE IT RESOLVED that the members of the Southern Weed Science Society charge the EPA with the responsibility to conduct the cancer assessment and further safety assessments of atrazine, and other weed control products transparently and based on completely unbiased, sound and reliable science.

Necroloogy Resolution:
WHEREAS Dr. Charley Edward Rieck served with distinction at Clemson University, the University of Kentucky, and Cameron University, and as an agricultural consultant, and
WHEREAS Dr. Rieck served the Southern Weed Science Society, providing significant contributions to weed science and agronomy through his work with, and dedication to, his graduate and undergraduate students,
THEREFORE BE IT RESOLVED that the officers and membership of the Southern Weed Science Society hereby take special note of the loss of our coworker Charley Edward Rieck on June 11, 1999, and by copy of this resolution, we express to his family our sincere sympathy and appreciation for his contributions.

Finances (if any) Requested: None

Respectfully Submitted:
W.W. Bachman, C. Moseley, M.C. Boyles, J. Creighton, K.N. Reddy, M. Nespeca D.W. Monks, H.R. Smith,
S.M. Zedaker, Chairperson

Committee #: 118	**Committee Name:** Sales Coordination Committee (Standing)

Summary of Progress: Sent half-page ad to SWSS newsletter editor to print in future editions of the SWSS newsletter. However, this has not printed in the newsletters due to lack of space.

Discussed placing the half-page ad in Weed Technology as a substitute for our current allotted space with Bob Schmidt.

Objective(s) for Next Year: We have about exhausted our potential candidates for free press releases on the CD-ROM. It is time to start thinking about paid advertising avenues. I have not had time to follow up on this with any publications at this time. I will try to get some information by the January meeting.

Work with Forestry Weeds committee to help them promote the new book.

Recommendation or Request for Board Action: None

Finances (if any) Requested: None at this time. However, we should be making a request for an advertising budget at the closing meeting in January.

Respectfully Submitted:
C.T. Bryson, W.C. Johnson, J.A. Kendig, J.H. Miller, C. Moseley, M. DeFelice, Chairperson

Committee #: 119	**Committee Name:** Southern Weed Contest Committee (Standing)

Summary of Progress: The 20th annual Southern Weed Contest was held August 10, 1999, at the Novartis Crop Protection Research Farm near Greenville, MS. Dr. James Holloway and the entire staff of the Novartis Crop Protection Research Farm did an excellent job providing the students with a challenging day. The weed identification, herbicide symptomology, sprayer calibration, and the field problem solving were well prepared and challenging to all of the contestants. The mystery event involved diagnosing problems with a crop duster that was actually landed on the contest site at the end of the day. This was an excellent contest for students to demonstrate their knowledge and talent.

A total of 67 contestants from 10 universities competed this year. Universities represented by graduate student teams were Auburn University, University of Arkansas, University of Florida, Louisiana State University, Mississippi State University, North Carolina State University, University of Tennessee, Texas A&M University, and Texas Tech University. Undergraduate teams represented Murray State University and North Carolina State University. The university participation was excellent this year.

Winning teams and individuals were as follows:

Team Awards:
1st - University of Arkansas ($500)
2nd - Louisiana State University ($300)
3rd - Mississippi State University ($200)

Individual Awards:

1st	Mike Lovelace, University of Arkansas ($400)	6th	Scott Payne, University of Arkansas
2nd	Cade Smith, Mississippi State University ($250)	7th	Jeff Ellis, Louisiana State University
3rd	Jeff Barnes, University of Arkansas ($100)	8th	Jason Bond, Louisiana State University
4th	Shawn Askew, North Carolina State University ($75)	9th	Joe Pankey, Louisiana State University
5th	Oscar Sparks, University of Arkansas ($50)	10th	Robert Etheridge, University of Tennessee

The traveling "Broken Hoe" trophy was presented to the University of Arkansas at the awards banquet. Plaques and cash awards were presented to winning teams and individuals, and contestants with the highest scores within each event were also recognized.

Objective(s) for Next Year: The 2000 Southern Weed Contest will be hosted by Drs. Andy Kendig and Anthony Ohmes at the University of Missouri's Delta Center near Portageville, MO. I am sure that Andy and Anthony will have an excellent contest. This was the largest number of contestants to ever participate in the contest and we hope the numbers continue to grow.

Recommendation or Request for Board Action: None

Finances (if any) Requested: (None) Sustaining members for 1999 ($2,000+) - American Cyanamid, BASF, Bayer, DowAgro, FMC, Monsanto, Rhone-Poulenc, and Zeneca; (1,000-1,999) - AgrEvo, Griffin, Novartis, and R&D Sprayers; Annuals ($1-999) - Helena and PBI Gordon. The Southern Weed Science Society Contest Committee will again ask each company in 2000 to become, or continue to be, sustaining members of the Southern Weed Contest.

Respectfully submitted,

J. L. Griffin	T. C. Mueller	T. Whitwell	C. T. Bryson	R. T. Kincade	L. R. Oliver
W. W. Witt	S. Senseman	E. S. Hagood, Jr.	M. G. Patterson	A. Kendig	R. M. Hayes
D.B.Reynolds	D.R. Shaw	P. Dotray	V. B. Langston	D. S. Murray	T. A. Baughman A.
Rankins	W. K. Vencill	J. W. Everest	D. W. Monks	J. Tredaway	G. E. MacDonald
C. Tingle	D. Ferguson	J. Barrentine	T. Webster	J. Wilcut	A. Ohmes

E. P. Webster, Chairperson

Committee #: 120 **Committee Name:** Student Program Committee (Standing)

Summary of Progress: Contestants have been divided into respective sections as appropriate. Bob Scott is serving as Vice-Chairman and has worked to recruit appropriate judges.

The composite section this year was very diverse and will largely be designated to be in the Soil and Environmental section (for logistic reasons).

Objective(s) for next Year: No new objectives.

Recommendation or Request for Board Action: The committee will probably discuss the following 3 points in our meeting.

1. Clarification of eligibility from non-SWSS member institutions (this year 4 contest talks were not from the southern region).
2. Dropping the lowest score of the 5 judges. Instances have been documented that appear to have “compromised fairness” by some judges.
3. Encouraging poster contest to be more on content rather than purely visual display. It is common knowledge that some contestants are not preparing their own poster, but they (actually not them, but their university) are paying their respective graphic arts department to do their posters for them. This may not be in the spirit or intent of the poster contest.

Finances (if any) Requested: None

Respectfully Submitted:
B. Scott and T. Mueller, Chairperson

Committee #: 122 **Committee Name:** Terminology Committee (Standing)

Summary of Progress: This committee supports the effort by Dr. Dan Reynolds to develop a SWSS web site that will post the program and proceedings of the annual meetings. We foresee an additional use of this site to provide information in respect to up-to-date weed science terminology. Standardization of approved common names of herbicides, weed scientific names, and modes of action is needed for use of correct terminology in preparation of abstracts for proceedings, papers presented at professional meetings and published in professional journals, and weed contest activities. This committee would support adding such pertinent information to our SWSS web site with encouragement of the membership to access the site when terminology questions arise. Some of this information can be found in the SWSS proceedings, but should be included separately and under specific categories for easy access. There could also be information concerning weed resistance problems specific to the southern region. In no way are we proposing that individuals bypass the WSSA web site, but rather that terminology information relative to the southern region be readily accessible to SWSS membership and interested parties.

Objectives for the Next Year:

1. Work closely with Dr. Reynolds to add terminology items to the web site to include listings of approved common and chemical names of herbicides, standardized classifications of herbicide mode of action and adjuvant terminology, and herbicide resistant weed updates.

2. Maintain close liaison with WSSA Terminology Committee to provide membership with updates and changes.

Recommendation or Request for Board Action: This committee would like the Board to discuss the possibility of adding terminology information to the SWSS web site. We recommend that if approved, the membership be encouraged through newsletter and other sources to integrate accepted terminology into papers presented at SWSS meetings, abstracts published in the proceedings, papers published in the Society journals, and in Society sponsored events such as the Weed Contest. This committee will be willing to provide information and to work in cooperation with the Board and Dr. Reynolds to accomplish these goals.

Finances Requested: No funding support is requested.

Respectively submitted:
J.A. Baysinger, J.W. Boyd, T.R. Clason, T.D. Klingaman, E.P. Richard, D.R. Shaw, C.E. Walls, J.W. Wells
J.L. Griffin, Chairperson

Committee #: 123	**Committee Name:** Weed Identification Committee (Standing)

Summary of Progress: Photos have been selected, maps generated, and write-ups are completed and being edited for publication of another hard copy set of 50 weeds (set number 7). Hopefully this will be completed by January 1, 2000.

Data-based descriptions have been developed by two graduate students at Mississippi State University for about 40% of the weeds currently in the SWSS Weeds of the United States and Canada CD ROM. These descriptions will be used to develop an interactive key for mature and immature weeds in the next version of the SWSS Weeds of the United States and Canada CD ROM.

Objectives for Next Year: Completion of the data-base descriptions for the SWSS Weeds of the United States and Canada CD ROM.

Completion of work for the next hard copy set of 50 weed (set number 8). All photos were completed in 1999 and to date, descriptions of 28 species and maps on 22 species are completed.

Recommendation or Request for Board Action: None

Finances (if any) Requested: Re-approve funding to continue data-based descriptions for the SWSS Weeds of the United States and Canada CD ROM if all descriptions have not been completed by the SWSS annual meeting in January, 2000. The original request was for $4000.00 and to date $1305.00 has been spent for the development of the data-based descriptions.

Re-approve funding for set number 7 of the SWSS Weed Identification Guide if completion does not occur prior to the SWSS annual meeting in January, 2000.

Respectfully Submitted:
J.W. Boyd, M. DeFelice, J.D. Green, C. Moseley, R. Muir, R. Smeda, W.K. Vencill, T.M. Webster
C.T. Bryson, Chairperson

Committee #: 123a	**Committee Name:** Forest Weeds Subcommittee

Summary of Progress: The book, *Forest Plants of the Southeast and Their Wildlife Uses*, has been produced. The 6,300 copies were printed at a total cost of $95,584 or $15.17 per copy. It has been available since November 8 at a price of $36 per copy (includes shipping and handling at about $2.63 per copy) with a potential income of about $18.20 per copy. This makes the break-even sales at around 2,864 copies. At present, copies can only be ordered from Bob Schmidt. Press releases with his address and phone number have been widely distributed. After initial free announcements, advertising will commence next year.

A beta CD version of the book has been produced (the latest is a beta version 6). It uses Adobe Acrobat Reader 4.0 as the platform. The cost of production to the Society has been $1,475. The costs for programing this near-finished product is only $305 more than the $1,170 initially budgeted for a mere CD copy of the Book. A very talented computer specialist has contributed much time to this as his special project. This unique CD plant identification tool contains the high-resolution plant images (besides the text), which permits the user to gain magnified close-ups of plant traits not visible in the book and to print these. After user testing and any needed modifications, this will be ready for replication, packaging, and sales.

Objectives for Next Year:
1. Complete Book CD version, replicate and package it, and initiate sales.
2. Assist in distribution and advertising of the Book and the Book CD version.
3. Continue to facilitate reviews of both products in popular journals and magazines, providing free copies to reviewers for national and regional journals and magazines.

Recommendations for Board Action:
1. Produce 1,000 copies of the CD version with cases and labels. Production cost should be about $3.00 per copy. It is recommended that the Society sell the CD version for $24 each (includes shipping and handling). This low price will promote the use of the CD as another plant identification tool and stymie the need for wide-spread home replication.
2. Recommend that an additional $3,000 be allocated for advertising the Book and CD. There is about $2,400 already available for advertising, from past Board approval and savings in the photography account. After initial free announcements, advertisements will be placed in selected regional journals and magazines for forestry, farming, wildlife, conservation, and wildflower organizations. Selected outlets will be sent to Schmidt for his handling of the transactions. A quarter-page ad with the book cover has been furnished free by the publicity specialist with the University of Georgia's School of Forest Resources.
3. Recommend that the Board discuss options for sales of the book through retailers and the necessary terms of sale, focusing on discount rate. One rate must be used for all, and the going discount rate appears to vary from 55 percent for Books-A-Million to no discount for some university bookstores. A medium rate that would allow access to catalog and bookstore outlets would appear to be around 40 percent.
4. Recommend that the Board initiate steps to ask key Society members at each agricultural university in the region to request that their university bookstore and library acquire the Book.
5. Recommend that the Headquarters of the Southern Research Station, USDA Forest Service, be permitted to purchase 100 copies of the Book at $25 per copy to permit by law the giving of these copies to congressional delegations and key individuals for promotion of the Society and the Book (there is a $25 legal-maximum per gift).
6. Request that the authors, Jim and Karl Miller, be permitted to purchase up to 48 copies each (2 cases) at production costs of $15 per copy.

Finances Requested:
1. Production and replication of CD version..........................$3,000
2. Advertising of the Book and CD version............................ 3,000
3. Loss of revenues from complimentary copies,
   SRS purchases, and authors discount................................3,225

This subcommittee started this project in 1993 and worked together reviewing and improving lists of plants to include, formats, and distribution networks. We are pleased to have accomplished this task for bettering our profession, our research, and our Society.

Respectively submitted:

T.R. Clason, C.A. Cobb, A.W. Ezell, F. Fallis, W.S. Garbett, J.D. Gnegy, D.K. Lauer, K.V. Miller
B. Watkins, J.L. Yeiser, J.H. Miller, Chairperson

Committee #: 123b	**Committee Name:** Herbicide Resistant Weed Subcommittee

Summary of Progress: The status of herbicide weed resistance in the southern region was discussed in an effort to continue developing an accurate database for the region. Electronic copy of this list will be maintained by the committee chair. The status of the North American Herbicide Resistance Working Group was discussed. Greg MacDonald agreed to represent the Southern Weed Science Society on this committee at future meetings.

Objective(s) for Next Year: Continue updating the list of confirmations of herbicide weed resistance in the southern region and address issues related to herbicide weed resistance. Maintain contact with the North American Herbicide Resistance Working Group.

Recommendation or Request for Board Actions: None

Finances (if any) Requested: None

Respectfully Submitted:
W.L. Barrentine, M. Barrett, T.A. Beswick, J.D. Burton, J.M. Chandler, S.O. Duke, M.L. Fisher, J.L. Griffin
K.K. Hatzios, R.M. Hayes, D.H. Johnson, J.A. Kendig, C.C. Kupatt, J.J. LeClair, E.C. Murdock, R.L. Nichols
T.F. Pepper, R. Smeda, J.D. Smith, R.E. Talbert, W.K. Vencill, G.R. Wehtje, D.L. Jordan, Chairperson

Committee #: 124	**Committee Name:** Newsletter Committee (Special)

Summary of Progress: 1999 has seen the SWSS Newsletter transition from the former newsletter editor, Dr. Tom Mueller to the current one. Three issues were printed. The May issue covered the 1999 SWSS Annual Conference, the August issue issued a call for papers for the 2000 conference while the December issue concentrated on conference logistics.

All members are encouraged to submit pertinent societal news to the newsletter editor. This includes people on the go, new (recent) graduates and their whereabouts, necrology, upcoming events, award winners, new publications, job announcements, etc. Pictures are used if space is available. For the 2000 issues, the following are deadlines:

2000 Issue	**Deadline**
May Issue	March 15, 2000
August Issue	June 15, 2000
December Issue	October 15, 2000

Please have your articles typed and either e-mail as an attached file or submitted on diskette by the specified dates. WordPerfect format is preferred followed by MS Word. Use MS Photo Editor attached files for pictures.

Submit to:
Bert McCarty
Department of Horticulture
E-142 Poole Ag. Center
Box 340375
50 Cherry Road
Clemson University
Clemson, SC 29634-0375
Tel. (864) 656-0120
FAX (864) 656-4960
e-mail: bmccarty@clemson.edu

Objective(s) for Next Year:

Recommendation or Request for Board Action: None

Finances Requested: None

Respectfully Submitted:
Bert McCarty

Committee: 125	**Committee Name:** Continuing Education Units Special Committee (Special)

Summary of Progress: The Texas Department of Agriculture (TDA) approved the 1999 SWSS conference for continuing education units (CEUs) for licensed pesticide applicators. The department then contacted the other states in the region for approval of recertification credit for applicators attending from their state. Fourteen states approved all or portions of the conference for CEUs.

TDA prepared the proper forms for the applicators and had personnel attend the meeting to distribute the forms and answer questions. The forms were collected at the end of the session.

Fifty-four licensed pesticide applicators requested continuing education units (CEUs) from 12 state agencies during the 1999 SWSS conference. A copy was sent to the state(s) where they were licensed. The original certificate was mailed to the individual.

Objectives (S) for Next Year: During the week of December 6, 1999, letters will be sent to states agencies requesting their approval for the 2000 SWSS conference.

The department has requested that a representative from the Oklahoma Department of Agriculture set out the CEU materials at the beginning of the conference. At the end they will collect the completed forms and mail them to TDA for processing.

The program for the 2000 SWSS Conference should again state that to obtain CEU credits, licensed pesticide applicators are to pick up a recertification form near the registration table. As last year, the forms are to be returned to the table at the end of the conference.

Recommendation or Request for Board Action: None

Finances (in any) Requested: None

Respectfully Submitted:
D. Dippel, J. Snodgrass, A.C. York, R. Rivera, Chairperson

Committee #: 127	**Committee Name:** External Funding Committee (Special)

Summary of Progress: The committee met by correspondence in the spring of 1999 and, at President Murray's request, prioritized the list of ideas for producing income that had been presented to the SWSS Board in January. The Committee will meet again before the 2000 SWSS Board meeting to update this report.

The priority listing presented to the SWSS Board before the Annual Summer meeting is listed below.
Continue the transfer of funds from SWSS to the Endowment Foundation as desired appropriate by the SWSS Board.

Plan and conduct a GLP Training Session(s) with the cooperation of Novartis. (This endeavor was approved by the SWSS Board and will take place on Saturday, Sunday, and Monday morning prior to the annual SWSS meeting. We expect income from the GLP training to be around $12,000 for the Endowment Foundation.)
Sale of "Graduate Student Contest Veteran" buttons. This has been approved by the Board and was listed on the 2000 registration forms.

A contest among university students to contact appropriate persons for donations to the Endowment Foundation.
To offer training sessions at annual meetings for practitioners in various areas.
A very aggressive sales promotion of the Forestry Weed ID Guide.
An on-line diagnostic web site by subscription.

At the committee meeting on January 24, 2000, additional ideas for increasing income were discussed. One possibility that could be explored is to try to standardize GLP or Efficacy Electronic Notebooks. EPA, NAIC, ACPA and industry should be interested.
We might be able to get a grant from EPA. Jim Bone and Ray Smith agreed to make some contacts. There were several suggestions for training sessions in various areas. These were: (1) for the media, (2) turf managers, (3) rights-of-way managers, (4) children and FQP, (5) water protection issues, (6) training for Green Certification in forestry, (7) stream-side management, and (8) invasive species. Tom Peeper suggested that SWSS scientists might play a role in EPS's push for dust reduction which includes agriculture. Such training sessions might be conducted similar to the GLP training or at separate times or in conjunction with other organizations.

Objective(s) for next year: To continue to search for ideas for projects that will generate income to SWSS and ultimately to the Endowment Foundation.

Recommendation or Request for Board action: To study the suggestions already presented and identify those to be implemented and who will be responsible for implementation.

Finances (if any) Requested: None for the committee but it is requested that the Board transfer any funds available to the Endowment Foundation.

Respectfully submitted:
J.R. Bone, J.L. Griffin, J.H. Miller, L.R. Oliver, T.F. Peeper, D.G. Shilling, W.W. Witt,
A.D. Worsham, Chairperson

Committee: 128	**Committee Name:** Computer Application Committee (Special)

Summary of Progress: The committee's primary focus at this point is the website. The group decided that on the front end this should be a service to the membership rather than an educational site. Emphasis has been placed on completing the title and abstract submission procedures for the web. The group has already developed two list-servers. One is for the general membership and the other is only for use by the Executive Board. These list-servers allow anyone to send a message to all members subscribed to the list. Transparent to the user, all messages are held in a send que until reviewed and approved by the web-site administrator.

Objectives (S) for Next Year: The group would like to have on-line submission of titles and abstracts available for the 2001 annual meeting. This would greatly increase the efficiency with which the editor would collect electronic copies of the reports. Additionally, we would like to have the ability to submit committee reports electronically over the web. The group will also investigate the possibility of purchasing a simpler easy to use domain name for the SWSS site.

Recommendation or Request for Board Action: That a new computer be purchased for the Business Manager and that a small amount of funding be made available for miscellaneous programming associated with the Web-Page.

Finances (in any) Requested: $500.00

Respectfully Submitted:
S. Askew, A.C. Bennett, T.C. Mueller, S. Senseman, W.K. Vencill, T. Whitwell, and D.B. Reynolds, Chairperson

SOUTHERN WEED SCIENCE SOCIETY PROCEEDINGS OF ABSTRACTS AND PAPERS

THEME: Y2K THE CHALLENGE OF CHANGE

SWSS GENERAL SESSION

SECTION I: WEED MANAGEMENT IN AGRONOMIC CROPS

SECTION II: WEED MANAGEMENT IN TURF, PASTURE AND RANGELAND

SECTION III: WEED MANAGEMENT IN HORTICULTURAL CROPS

SECTION IV: FOREST VEGETATION MANAGEMENT

SECTION V: VEGETATION MANAGEMENT IN UTILITY, RAILROAD, AND HIGHWAY RIGHTS OF WAY AND ON INDUSTRIAL SITES

SECTION VII: ECOLOGICAL AND PHYSIOLOGICAL ASPECTS OF WEED MANAGEMENT

SECTION VIII: EDUCATIONAL AND REGULATORY ASPECTS OF WEED SCIENCE

Section IX Developments from industry

SECTION X: APPLICATION TECHNOLOGY

SECTION XI: SOIL AND ENVIRONMENTAL ASPECTS OF WEED SCIENCE

SECTION XII: RESEARCH POSTERS

SYMPOSIUM: WEED SCIENCE OUTSIDE THE LOOP: JUST WHAT DO THEY THINK?

SYMPOSIUM: PRECISION AGRICULTURE

SWSS GENERAL SESSION
Y2K: The Challenge of Change

INCREASING CARBON DIOXIDE AND GLOBAL CLIMATE CHANGE.[1] S. Baliunas and W. Soon, Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138.

ABSTRACT

No evidence can be found for catastrophic global warming from the recent rise in the air's carbon dioxide content as a result of human activities. The elevated carbon dioxide concentration in the air has, however, had a positive impact on plant growth.

INTRODUCTION

The earth is warmer than it would be in the absence of the greenhouse gases in the atmosphere. Most of the greenhouse effect is natural and caused predominantly by water vapor and water droplets in clouds, then followed by, in diminishing order of importance, carbon dioxide, methane and other minor gases in the air. Since the Industrial Revolution, carbon dioxide concentration has been increasing in the air owing to human actions like coal combustion and deforestation,[1] with a rapid rise in the last several decades. The increase in the air's carbon dioxide would suggest a rising global temperature, all other things being equal. However, it is difficult to calculate the *response* of the climate system to the small amount of energy added by the presence of extra carbon dioxide in the air. The reason is that climate is a complex, dynamical and non-linear system, with positive and negative feedbacks, and knowledge of the causes and responses of climate change is presently insufficient to give an accurate response.

METHODS

Will the recent or expected future rise in the air's concentration of carbon dioxide produce significant and catastrophic global warming? This question is often studied by way of computer simulations of the climate (e.g., General Circulation Models; GCMs). The simulations yield specific outcomes that are testable by comparing the results to measurements of the climate. We will discuss simulation outcomes and measurements of global temperatures, Arctic temperatures and the Antarctic paleoclimate extending back 420,000 years inferred from ice cores.

According to computer simulations, increases in greenhouse gases over the last 100 years should have caused a rise of roughly 1 C in the global average temperature and 2 C in the Arctic temperature.[2] These forecasts are important tests of the computer scenarios.

Temperature records at the surface – Thermometer records collected in the last 150 years near the surface over land and sea from different parts of the world show an average temperature rising roughly 0.5 C starting about 100 years ago (Figure 1)[3]. At first glance it seems that the observed warming occurred owing to increased carbon dioxide concentration in the air in the last 100 years and is thus good evidence for global warming from human activities.

But there are three problems with that conclusion. First, it ignores the most important feature of the temperature record: the 20th-century warming was not steady. A significant warming took place before 1940, while most (~80%) of the carbon dioxide from human activities entered the air after 1940. That means that *much of the temperature rise of the last 100 years occurred before the greenhouse gases from human activities existed in the atmosphere*. The warming of the early 20th-century must be mostly natural. Of the 0.5 C rise observed, at most only a few tenths of a degree can be attributed to the increases in greenhouse gases. The few tenths degree C rise in surface temperature since 1940 is far below the warming predicted by the computer scenarios with increased carbon dioxide concentration in the air.

The second problem is uncertainty in the surface records. There is the urban-heat-island effect: thermometers in growing cities record extra warmth owing to the machinery and pavement of modern cities. Although a correction has been attempted for this effect in Figure 1, the correction process is uncertain and introduces systematic error to the record.[4]

Another uncertainty in the surface record is its uneven and scanty surface coverage. Good records with near-continual coverage for the last 100 years cover only 18% of the surface of the earth, leaving vast areas of the southern and tropical oceans inadequately sampled.[5]

A third problem with the surface record arises because 100 years is insufficient for gauging the size of natural fluctuations in the climate. The natural warming of the 20th century should be placed in the perspective of a longer view of climate change. There are no worldwide instrumental records going back further, but temperature records or

[1] This work was supported by the Massachusetts Space Grant Consortium (MIT grant 16717049) and the National Aeronautics and Space Administration (grant NAG5-7635).

reconstructions do extend back in several regions. For example, the natural variability of temperature in the mid-latitude Atlantic Ocean (32/N) over the last 3000 years has been reconstructed from ocean-bottom sediments (Figure 2).[6] The longer view, hidden by the bias of the shortness of the instrumental records, shows substantially more variability in temperature. Evident are periods like the Little Ice Age, a period including the 17th and 18th centuries, a global cooling roughly equivalent to 1 C compared to the present, and the Medieval Climate Optimum of the 10th - 11th centuries, a warming of slightly above the present temperature in some regions. This record does not stretch as far back as the Holocene Optimum, 6500 years ago – the warmest interval of the last 10,000 years after the end of the last major ice age of the Pleistocene. The record of natural variability shows the 20th century warming is not unusual, either in its amplitude or rate.

Temperature measurements from satellites -- In the last 20 years precise readings of the temperature of the lower troposphere over nearly the entire earth have become available from satellites (Figure 3).[7] One deficiency of the satellite record, like the surface record, is its short period of coverage. However, according to the computer scenarios, atmospheric carbon dioxide has increased enough that the global temperature in this low layer of air should have increased by approximately 0.5 C. The satellite record shows no such increased warming trend, in contradiction to the computer scenarios.

The satellite records are often dismissed on two grounds. First, they are claimed to be imprecise. This is incorrect because they have been verified by measurements made *in situ* by balloon-borne instruments. The second claim is that the satellite records are immaterial because people do not live at an altitude of a few kilometers, the layer of air sensed by the satellites. This criticism is irrelevant because computer scenarios claim that the lower troposphere warms at least as much as the surface.[8]

Arctic temperature records – According to the computer forecasts, climate over polar latitudes is very sensitive to global warming. The forecasts say that the polar regions should have warmed by roughly 2 C in the last 50 years, enough to begin melting polar ice. Melting the polar ice produces a positive feedback that amplifies any warming. The reason is that ice reflects much of the sunlight and helps keep the polar regions cold. But as the temperature rises and the ice melts, the bare ground or sea underneath absorbs more of the Sun's energy and magnifies the warming. One long-term view of the lower Arctic (Figure 4) comes from proxy records like tree-ring growth.[9] There is a rapid warming in the record, but it began in the mid-19th century, and must be natural because it predates most of the rise in the air's carbon dioxide concentration. This record suggests that the Arctic has cooled since 1950. Instrumental measurements (Figure 5) also contradict the intense warming trend projected by the computer scenarios. On the average over the last 40 years, the temperature does not show the large, increasing warming trends projected by the computer simulations.[10] That observed lack of warming may seem contradictory to recent newspaper reports of a thinning or diminishing extent of Arctic sea-ice.[11] However, sea ice will change in response to several factors, including not also temperature, but also ocean currents and salinity, wind, terrain, etc. The recent observed sea-ice changes cannot have been caused by human-made global warming because Arctic temperatures are not showing the expected increasing warming trend. No increasing warming trend of the kind expected from human-made global warming has occurred in recent decades, when most of the increase in the air's carbon dioxide concentration took place. In the test of the Arctic temperature record, the computer scenarios exaggerate the observed warming by more than ten-fold.

Paleoclimate and ice core measurements – For the past several million years the earth has been in a continual state of major ice ages. The warm, equable inter-glacial periods like the current Holocene of the last ca. 10, 000 - 12,000 years are rare. The ice ages last around 100,000 years, and the inter-glacial periods around 10,000 years. One important trigger for the shift between glacial and inter-glacial states is changing insolation as a result of changes in the geometric properties of the earth's orbit, e.g., obliquity, precession and eccentricity. Following the trigger must be an amplification of climate change through feedbacks like sea-ice or vegetation changes, or both. Records of the local temperature (from measurements of the deuterium content of the melted, individual ice core layers) and the air's carbon dioxide content through the past cycle of four major glaciations and de-glaciations have been constructed from measurements in the ever-accumulating layers of snow and ice in ice cores drilled in Antarctica (Figure 6)[12].

Such a correlation is often cited as the best empirical evidence that atmospheric carbon dioxide changes drive temperature changes.

The ice core record itself undermines the hypothesis. The changes in temperature in the ice core record precede the changes in carbon dioxide by several hundred to one thousand years. According to the ice core results, shifts in carbon dioxide do not provoke the temperature changes; the changes in atmospheric carbon dioxide concentration occur in response to changes in temperature.

The temperature information yields three conclusions: (1) the computer scenarios exaggerate the warming that should have already occurred; (2) most of the warming this century must have been natural because the warming predates the large increase in minor greenhouse gases; and (3) the ice core records of the paleoclimate do not support the idea that carbon dioxide changes caused the major temperature shifts into and out of the ice ages.

Natural factors of climate change: The Sun – one reason for the exaggerated forecasts of the computer scenarios may rest in incomplete knowledge of natural climate variations. One such natural factor may be changes in the brightness of the Sun over decades to centuries. The magnetism on the Sun's surface is marked by the coverage of sunspots – cool areas of intense magnetic fields. The number of sunspots varies with an 11-years period (Figure 7). This magnetic cycle is linked to a brightening and fading in the Sun's total energy output.[13] Solar brightness changes of a few tenths percent sustained over decades could drive global temperatures to change.

The climate record indicates a solar influence of this kind. An example (Figure 8) is the record of the Sun's magnetism (a proxy for solar brightness change, whose direct measurements extend back only to 1979) and reconstructed land temperatures of the Northern Hemisphere over 240 years. The two curves are highly correlated over several centuries.[14] Those changes in the Sun's magnetism indicate changes in the Sun's brightness.

Assuming that the Sun's magnetic change is a proxy for the Sun's changing brightness,[15] computer simulations[16] of the climate suggest that a change of 0.4% in the Sun's brightness[17] would produce observed global average temperature changes of about 0.5 C over the last 100 years.

Additional evidence points to the Sun's signature in the climate record over many millennia. Every few centuries the Sun's magnetism weakens to low levels sustained for several decades. An example is the magnetic low from ca. 1640 - 1720, when sunspots were rare. That period was coincident with the climate cooling of the Little Ice Age. Quantitative records of the Sun's magnetism over millennia come from measurements of the isotopes radiocarbon (^{14}C, from tree rings) and ^{10}Be (from ice cores).[18] These cosmogenic isotopes are products of atmospheric neutrons created when the upper air is bombarded by highly energetic galactic cosmic rays.

The isotope records indicate that the Sun's magnetism of the 17th century was low then and for every few centuries before that, with occasional, sustained magnetic maxima (ca. 11th century). During the periods of weak magnetism, the Sun should dim compared to the average or magnetically high intervals, when the sun should brighten. Tree ring records from Scandinavia covering 10,000 years show that 17 out of 19 coolings line up with lows in the Sun's magnetism.[19]

The idea that the total energy output of the Sun changes is one of the simplest mechanism for the Sun's possible effect on climate change. However, the Sun's output comes in many wavelengths; it also emits energetic particles, and both are variable in time, space and frequency. The various components of the earth's atmosphere and surface respond to different aspects of the Sun's diverse energy outflows, in ways that are yet unknown. Understanding of the possible effects of the changing Sun on climate change is still evolving.[20]

RESULTS AND DISCUSSION

What's wrong with the computer forecasts? At the heart of the climate scenarios is the calculation of the response of the climate system to energy input from increases in minor greenhouse gases. The most sophisticated computer program would have to track 5 million climate parameters and their interactions, a feat ideally requiring 10^{19} degrees of freedom.[21] The computer to carry out such a calculation does not yet exist. More importantly, the physics of many climate interactions and measured values of many parameters are poor. Furthermore, it is certain that not all the causes of natural climate change, e.g., El Niño-Southern Oscillation, or changes of the sun, are understood.

The poor simulation outcomes, as judged by the comparison with climate observations, highlight the fact that major physical processes are incorrectly modeled or completely neglected. The simulations calculate the effects of a 2% perturbation in the energy budget of the climate system (+4 Watts per square meter for a doubling of the carbon dioxide concentration in the atmosphere), in the face of uncertainties of 10% in the energy budget (compared to a total energy of ~242 Watts per square meter of incident sunlight at the top of the troposphere).[22] It does not seem possible to compute accurately the response of the climate to an added warming expected from doubling carbon dioxide when the unknowns in the climate physics are more than an order of magnitude larger. Moreover, the simulations have positive feedbacks that are perhaps unjustified (e.g., upper tropospheric water vapor) and so yield an artificial warming.

The warming 100 years from now in the absence of any other effects except that of doubling the carbon dioxide content in the air can be estimated by scaling the observed temperature response to the presence of increased atmospheric carbon dioxide concentration in the last several decades. The warming from doubling the air's carbon dioxide content should be less than 0.5 C, an amount within the bounds of observed, natural climate change. A small, gradual warming should be not only tolerable but also beneficial, if the record of human history, climate change and the environment is any guide.[23]

It has become common to see impact studies giving catastrophic consequences of global warming based on the flawed computer scenarios. For example, it is incorrectly believed that diseases like malaria will spread to the populated countries of the high Northern latitudes as a result of warmer temperatures there. But malaria is endemic to those regions, and was common, especially during the colder temperatures of the Little Ice Age.[24] More importantly, the spread of diseases like malaria in economically advanced nations is increasingly controlled by modern medicine and technology.

Is carbon dioxide a pollutant? No, it is essential to life on earth. Based on extensive evidence from agricultural research on enhanced carbon dioxide environments both in the field and in labs, carbon dioxide increases should cause many plants to grow more vigorously and quickly.[25] The reason is that most plants evolved under and so are better adapted to higher-than-present atmospheric carbon dioxide concentrations. In experiments doubling the air's carbon dioxide content, the productivity of most herbaceous plants rises 30-50%, while the growth of woody plants rises more so. The impacts of enhanced plant growth and related soil changes may even provide a strong quenching effect of warming from carbon dioxide. The vegetation feedbacks as a result of carbon dioxide fertilization have yet to be correctly incorporated in the climate simulations.[26]

Partly as a result of elevated carbon dioxide in the air and more efficient agricultural practices, the U.S. has experienced in recent decades enhanced growth in vegetation. The acceleration of plant growth is of a magnitude that the U.S., despite its energy use and resultant prosperity, may not be a net emitter of carbon.[27]

There is no doubt about the improvement of the human condition through the unfettered access to energy. Energy use may also produce local unwanted pollutants as a byproduct. Those sources of true environmental pollution may be tolerated or mitigated, based on rational considerations of the risks of pollutants and benefits of energy use. But in the case of recent fears of anthropogenic carbon dioxide, science indicates at most a little warming and certainly better plant growth owing to the projected future increase of carbon dioxide content in the air. An optimal warming and enhanced plant growth should be of great benefit to mankind and the environment.

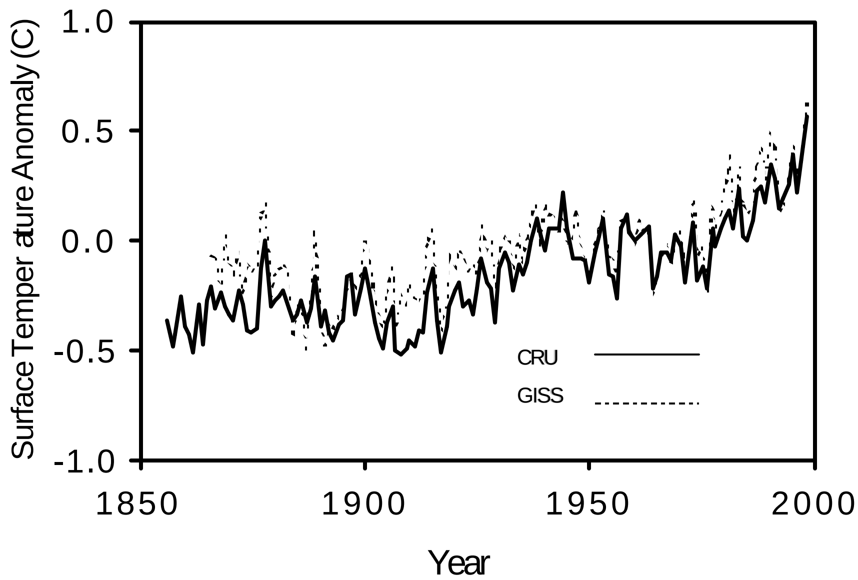


Figure 1 – Changes in annually-averaged surface temperatures sampled worldwide, compiled and analyzed over land and sea (University of East Anglia Climate Research Unit), and land only (NASA-Gadded Institute for Space Studies). The reason for the good agreement between the land plus sea and land alone records remains unknown.

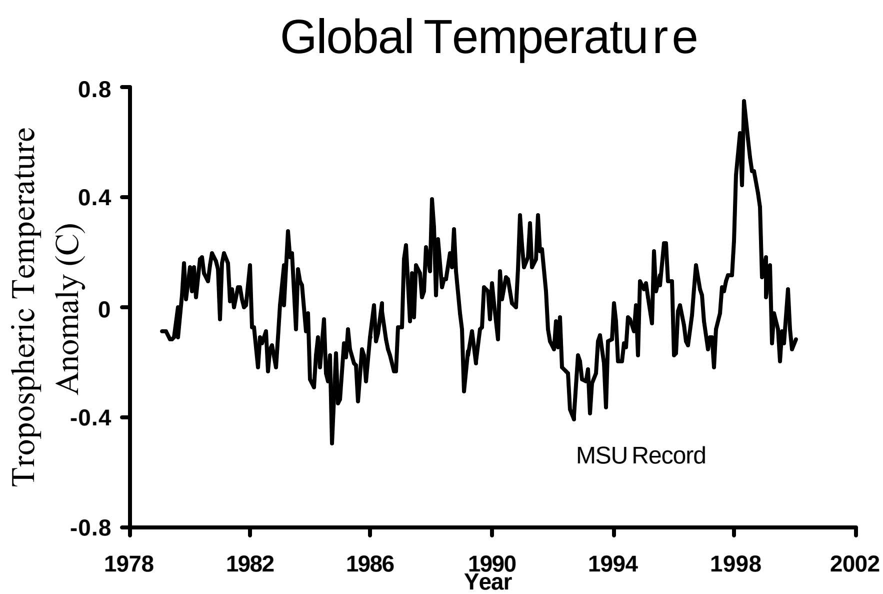


Figure 2 – Changes in monthly-averaged temperatures of the lower troposphere measured by satellites and between latitudes 82ºN and 82ºS.

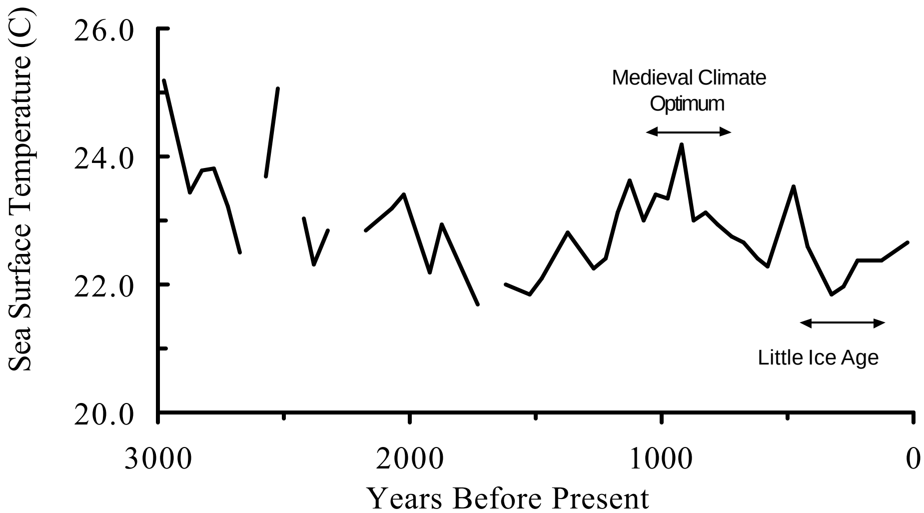


Figure 3 – Reconstructed temperatures of the Sargasso Sea (Keigwin 1996).

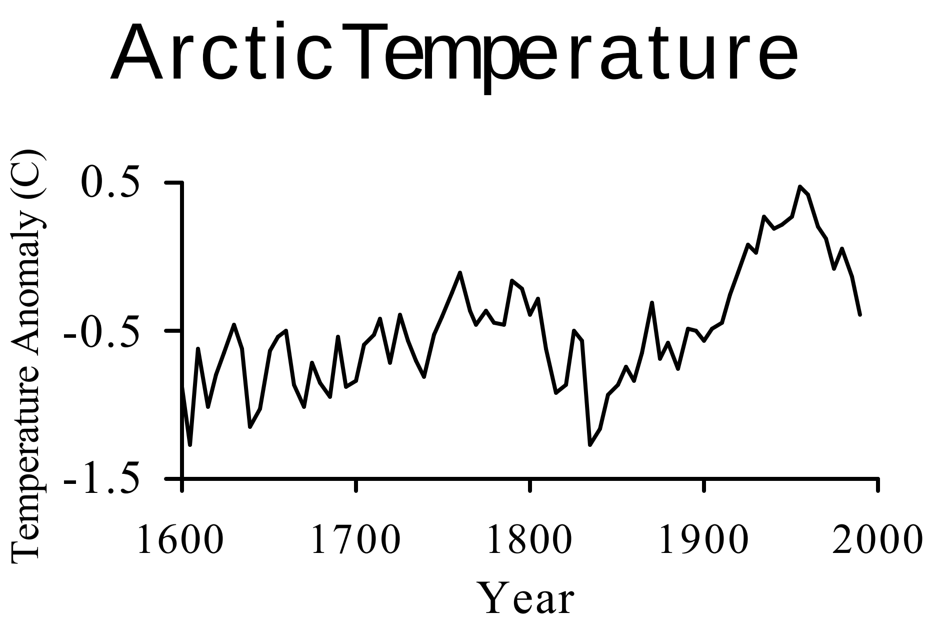


Figure 4 – Reconstructed temperature (highly weighted by summer temperature because the record is predominantly based on tree ring growth) of the near Arctic region (Overpeck et al. 1997) for the last 400 years.

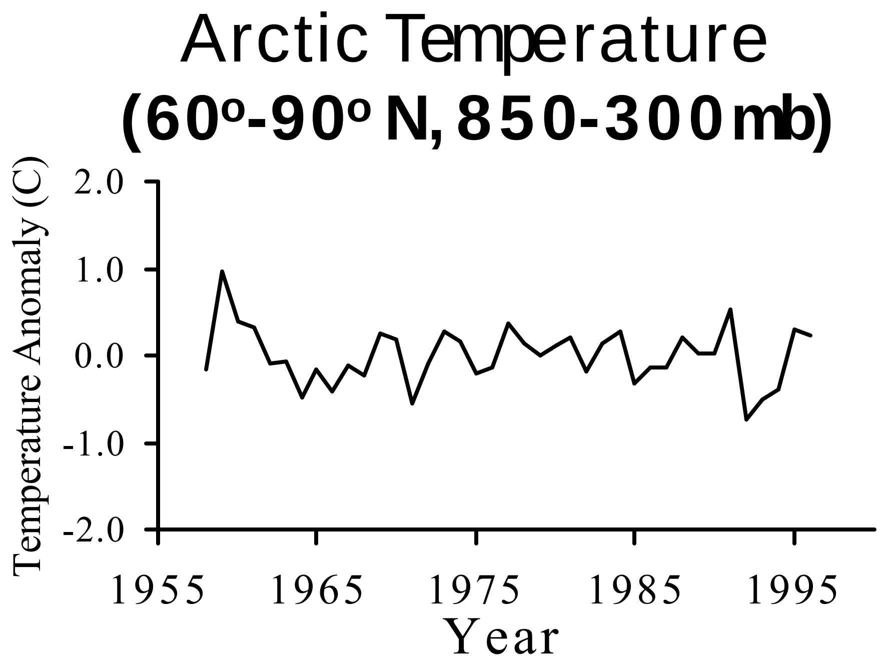


Figure 5 – Radiosonde record of lower-tropospheric temperatures in the Arctic (Angell 1999).

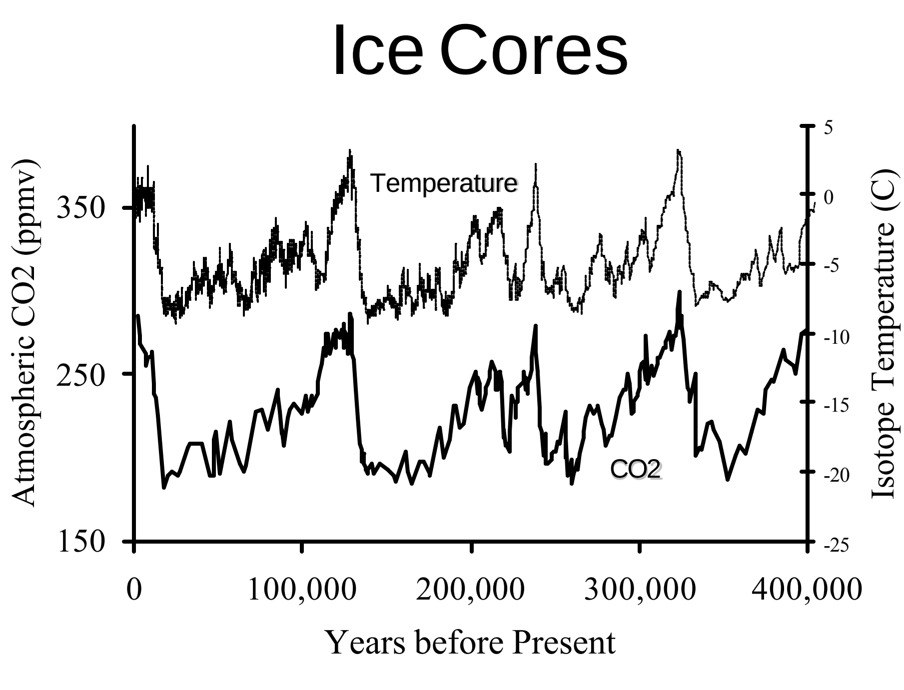


Figure 6 – Reconstructions of air temperature and carbon dioxide concentration from ice cores drilled in Antarctica (Petit et al. 1999; data kindly provided by J. R. Petit and colleagues).

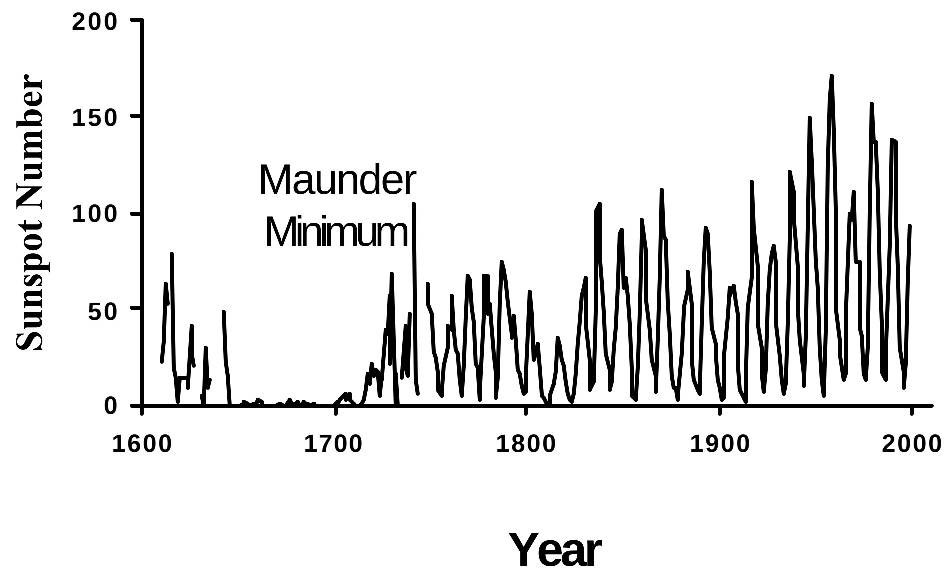


Figure 7 – Annually-averaged Sunspot Number. Note the approximate 11-year cycle in the sun's surface magnetism as well as the magnetically-low period ca. 1640 - 1720 ("Maunder Minimum")

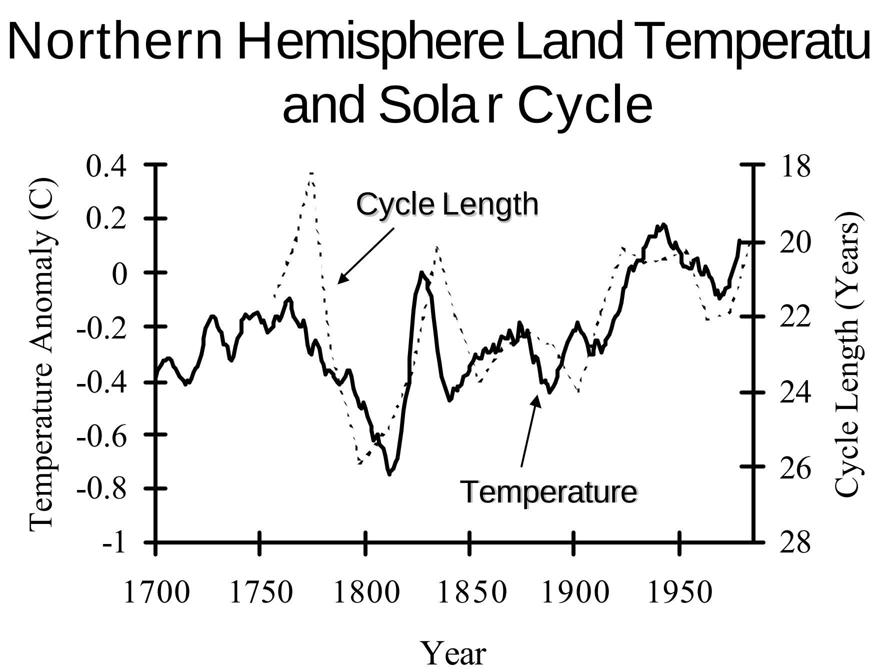


Figure 8 – Changes in the Sun's magnetism (the length of the 22-year, or polarity cycle, *dotted line*) and changes in Northern Hemisphere land temperatures (*solid line*). Shorter magnetic cycles are more intense, which suggests a brighter Sun (Baliunas and Soon 1995).

LITERATURE CITATIONS

1. The carbon dioxide increase from human activities provides approximately half the added radiative energy to the climate system from greenhouse gases; the other half is from the sum of other greenhouse gases from human activities like methane and chlorofluorocarbons. All the greenhouse gas increases may be summed and considered equivalently as an increase in carbon dioxide alone. In terms of the equivalent increase in carbon dioxide alone, the rise in greenhouse gases to date is roughly equal to a 50% rise in carbon dioxide alone. A discussion of atmospheric greenhouse gas increases can be found in *Climate Change 1995: The Science of Climate Change*, 1996, eds. J. T. Houghton et al. (Cambridge: Cambridge University Press), 572pp.
2. J. T. Houghton et al., 1996, *Climate Change 1995: The Science of Climate Change*.
3. D. E. Parker, 1994, *Journal of Geophysical Research*, 99, 14373, D. E. Parker et al., 1995, *Climatic Change*, 31, 559, and P. D. Jones, 1994, *Journal of Climate*, 7, 1794, and updates from the East Anglia Climate Research Unit website; J. Hansen and S. Lebedeff, 1987, *Journal of Geophysical Research*, 92, 13345 and updates from the NASA-Goddard Institute for Space Studies website.
4. See R. C. Balling, Jr., 1992, *The Heated Debate*, (San Francisco: Pacific Research Institute) 195pp.
5. P. J. Michaels et al., 1998, *Climate Research*, 10, 15.
6. L. D. Keigwin, 1996, *Science*, 274, 1504. (See also large temperature variability ca. 60,000 to 30,000 years ago in J. P. Sachs and S. J. Lehman, 1999, *Science*, 286, 756).
7. J. R. Christy, 1995, *Climatic Change*, 31, 455; J. R. Christy, R. W. Spencer and E. S. Lobl, 1998, *Journal of Climate*, 11, 2016; J. R. Christy, R. Spencer and W. D. Braswell, 2000, *Journal of Atmospheric and Oceanic Technology*, in press. Data are from ftp://wind.atmos.uah.edu/ms/t2lt.
8. See *Reconciling Observations of Global Climate Change*, 2000, National Research Council (Washington, DC: National Academy Press), 104pp. The report highlights the failure of the computer simulations to explain the observed lack of warming in the lower troposphere and leaves unresolved the important disagreement between the recent trends observed in the satellite and surface data.
9. J. Overpeck et al., 1997, *Science*, 278, 1251.
10. J. K. Angell, 1999, *Geophysical Research Letters*, 26, 2761; Arctic data kindly provided privately.
11. Based on climate scenarios, K. Y. Vinnikov et al. (1999, *Science,* 286, 1934) state, "This strongly suggests that the observed decrease in northern hemisphere sea ice is related to [human-caused] global warming." But, for analysis and interpretation of actual measurements, see C. H. Davis, C. A. Kluever and B. J. Haines, 1998, *Science*, 279, 2086 and W. Krabill et al., 1999, *Science*, 283, 1522; D. A. Rothrock, Y. Yu and G. A. Maykut 1999, *Geophysical Research Letters,* 26, 3469. For example, Krabill et al. note that Greenland's coastal ice is thinning while its inland ice is thickening. Rothrock et al. conclude that the observed Arctic changes in sea ice could be explained by an increase in ocean heat flux, or equator-to-pole atmospheric heat transport or incoming short-wavelength radiation, none necessarily caused by global warming.
12. J. R. Petit et al. 1999, *Nature,* 399, 429; H. Fisher et al. 1999, *Science*, 283, 1712; A. Indermühle et al., 1999, *Nature*, 398, 121.
13. Over the cycle, the full range of brightness change is at most 0.14%. Such changes seem insufficient in amplitude and time scale to cause a temperature response of the climate system that is larger than 0.1 C over the period of observations.
14. Northern Hemisphere land temperatures (from B. S. Groveman and H. E. Landsberg 1979, *Geophysical Research Letters*, 6, 767; P. D. Jones et al. 1986, *Journal of Climate and Applied Meteorology*, 25, 161) are shown because the global surface records do not reach back so far (S. Baliunas and W. H. Soon, 1995, *Astrophysical Journal*, 450, 896); first reported in a shorter temperature record by E. Friis-Christensen and K. Lassen 1991, *Science*, 254, 698; K. Lassen and E. Friis-Christensen, 1995, *Journal of Atmospheric and Terrestrial Physics*, 57, 835).
15. It assumes that one knows the mechanismof solar change (i.e., total brightness), and the response of the climate to such change. Neither is known! Some wavelengths of sunlight may be more important than others in affecting the climate. For example, the solar ultraviolet irradiance may make changes in the chemistry in the stratosphere and troposphere (J. D. Haigh, 1996, *Science*, 272, 981); visible-wavelength irradiance changes may affect the lower atmosphere and sea surface (W. B. White, J. Lean, D. R. Cayan and M. D. Dettinger, 1997, *Journal of Geophysical Research*, 102, 3255). Both portions of the solar irradiance spectrum may combine to influence the dynamics of planetary-scale waves and Hadley circulation. In addition, brightness changes have been considered here independent of wavelength. Then, too, the Sun's surface magnetism and wind modulate the galactic cosmic rays impinging on the geomagnetic field, and so the electrical (B. A. Tinsley, 1997, *Eos*, 78, No. 33, 341) and chemical (J. W. Chamberlain, 1977, *Journal of Atmospheric Science*, 34, 737) properties of the upper atmosphere. In turn, cloud microphysics and cloud coverage may change (H. Svensmark & E. Friis-Christensen 1997, *Journal of Atmospheric & Terrestrial Physics*, 59, 1225). See also W. Soon et al., 2000, *New Astronomy*, in press.
16. Further details can be found in E. Posmentier (1994, *Nonlinear Processes in Geophysics*, 1, 26) and W. H. Soon et al. (1996, *Astrophysical Journal*, 472, 891); the latter contains a diagnostic comparison of the model results to the observations.
17. How believable is an irradiance change of 0.5% over 100 years? A recent analysis (R. Willson, 1997, *Science*, 277, 1963) finds a baseline change in irradiance between the solar minima in 1986 and 1996. Over a century, that base change would be about 0.4%. Additional, results from observations of surface magnetismand brightness changes in sunlike stars yield consistent results: changes of the Sun's brightness over decades may be as large as several tenths per cent (S. L. Baliunas and W. H. Soon, 1995, *Astrophysical Journal*, 450, 896).
18. Why do the isotope records contain information on magnetic changes of the Sun? Cosmic rays, energetic particles from deep space, form ^{14}C and ^{10}Be at the top of the earth's atmosphere. The amount of cosmic rays hitting the

earth's atmosphere, hence the amount of ^{14}C and ^{10}Be formed, is modulated by changes in the Sun's magnetism. ^{14}C may be subsequently bound in a carbon dioxide molecule and incorporated in a tree ring through photosynthesis; ^{10}Be precipitates into an ice layer accumulating in the ice sheets at high latitudes.
19. W. Karlén and J. Kuylenstierna, 1996, *Holocene*, 6, 359; W. Karlén 1998, *Ambio*, 27, 270.
20. W. Soon et al. 2000, *New Astronomy*, in press.
21. J. L. Lions et al., 1997, *Journal of The Atmospheric Science*, 43, 1137.
22. An effective doubling of the atmospheric concentration of carbon dioxide corresponds to the effect of adding 4 Watts per square meter of energy to the climate energy budget. But the *uncertainty* in calculating, e.g., the effect of humidity is about 20 Watts per square meter. An additional uncertainty of roughly 25 Watts per square meter stems from estimating the heat flow fromthe equator to the polar regions Such errors give rise to area-by-area "flux adjustments" of up 100 Watts per square meter in some regions of the coupled ocean-atmosphere simulations. ("...[W]ithout knowing the dynamical heat fluxes, it is clear...that one cannot even calculate the mean temperature of the earth." R. S. Lindzen 1997, *Proceedings of the National Academy of Science, USA*, 94, 8335). The uncertainty in cloud calculations is estimated to be about 25 Watts per square meter (e.g., K. Ya. Kondratyev 1997, *Bulletin of the American Meteorological Society* 78, 689).
23. H. H. Lamb, 1985, *Climate, History and the Modern World*, (London: Methuen), 387pp.
24. P. Reiter, 2000, *Emerging Infectious Diseases*, 6, 1.
25. K. E. Idso and S. B. Idso, 1994, Agriculture For Meteorology, 69, 153; S. B. Idso, 1989, Carbon Dioxide and Global Change: Earth in Transition (Tempe, AZ: IBR Press), 292 pp; S. B. Idso, 1991, *Bulletin of the American Meteorological Society*, 72, 962.
26. W. Soon et al., 1999, *Climate Research*, 13, 149.
27. S. Fan et al. 1998, *Science*, 282, 442; for South and Central America, see O. L. Phillips et al., 1998, *Science*, 282, 439.

SWSS GENERAL SESSION
Y2K: The Challenge of Change

BEFORE Y2K AND BEYOND. D.S. Murray, President SWSS, Regents Professor and P.E. Harrill Distinguished Professor of Crop Science, Department of Plant and Soil Sciences, Oklahoma State University, Stillwater, OK 74078

Fellow weed scientists - I too want to welcome you to my home state of Oklahoma and the first meeting of this Society this century. It is especially nice to be in Tulsa and close to Stillwater, making it possible for Paul Santelmann, my former major advisor, Department Head, and Past SWSS President to welcome the Society to Tulsa. It has really been an honor and a pleasure to have served as the President of this fine Society this past year. No, it has been a blast! Your Board of Directors and a multitude of committees and committee Chairpersons are dedicated to the improvement of this Society and they have been a hard working, fun group to work with. I owe a lot of thanks to Randy Ratliff and Laura Whatley for all of their support and help this past year. I know that Laura has an excellent program for this years meeting and I am looking forward to it. Dick Oliver and his local arrangements committee have truly done an outstanding job on all of the necessary details to accomplish a good meeting.

When I selected the title for this address "Before Y2K and Beyond" I was trying to leave myself as much leeway as I could for the content. I am not particularly good at predicting the future and at the pace of the changes occurring today, predictions are especially difficult. With the almost daily buy-outs and mergers I have no deep visions into the future. Let me illustrate a few quotes from others who thought they had a vision, but history has proven otherwise.

- "This 'telephone' has too many shortcomings to be seriously considered as a means of communication. The device is inherently of no value to us." Western Union, internal memo, 1876.
- "Computers in the future may weigh no more than 1.5 tons." Popular Mechanics, forecasting the march of Science, 1949.
- "I think there is a world market for maybe five computers." Thomas Watson, Chairman of IBM, 1943.
- "640 K ought to be enough for anybody." Bill Gates, 1981.

Being from an oil producing state I found this quote to be interesting.

- "Drill for oil? You mean drill into the ground to try and find oil? You're crazy." Drillers who Edwin L. Drake tried to enlist to his project to drill for oil in 1859.

While reading all of the Presidential addresses and many of the guest speakers from 1948 to present I ran across some quotes by Dr. Glenn Burton in his speech in 1976 which were on-track.

- "Herbicides capable of controlling a broader spectrum of weeds will be applied without risk of injury to varieties bred for adequate tolerance."
- "By 2176 more football will be played on natural turf than today."

We now have many herbicide tolerant crops and "astroturf" is rapidly being replaced by "real turf". Dr. Burton had a vision and history has already proven many of these statements correct. I do not propose to have this vision.

About a year ago I commented to Joe Street that I had no idea in the world what I could say in my address to this Society that would be both informative and interesting. Joe suggested that I start the new century by highlighting some of the many accomplishments of SWSS. Many of our members and most of our student members are probably not aware of these or they never took the time to reflect on what this Society has accomplished.

Glenn Klingman in his 1956 SWSS presidential address said "Weed workers, like others, should occasionally pause to consider how far they have come, just where they are, and where they are going." The more I thought about Joe's idea the better I liked it. I set about to read all of the minutes, business reports, former presidential addresses, many of the invited general session speakers messages, and then many of the committee reports. It was a very enlighting although time consuming process. Bob Frans did this when he gave a 50-year history of this Society. I highlighted many of the important events that have occurred with this Society and I hope that I have stolen enough ideas, accomplishments, and quotes from 52 years of proceedings to provide you with an informative message. Today, my presentation will pause to reflect on the past and provide a "State of the Society" message.

I heard that the Graduate Student luncheon yesterday was a success and I hope they have attended the General Session today. I hope in part, the students will take on an even greater appreciation of this Society and I hope the former students of this Society will take on the challenge that will be offered or presented later in this presentation. During Joe's suggestion that I give this "State of the Society" message he and I agreed that many of our younger members and most of the students do not know about many of the accomplishments of this Society. These accomplishments are varied and many, and the entire Society should be made aware of them and be proud of them. Last year in President Ratliff's address he talked about membership trends.

I will not repeat those, but will only show you the state of our membership. Full (1100 to 523 now) and Sustaining (118 to 36 now) membership are declining dramatically; however, the student (now about 136) membership is at an all-time high (approximately one-fourth of our membership is students). As Randy commented last year - are we going to be dinosaurs? Well if we are, the student numbers indicate a lot of young dinosaurs - is this Jurassic Park in Weed Science?

The following slides illustrate some of the more noteworthy accomplishments and projects that this Society has been involved with. I have organized these into: Publications, Services, Partnerships, and Sponsorships.

SWSS ACCOMPLISHMENTS

PUBLICATIONS
Proceedings
Newsletter
Research Report-discontinued
Sandoz/Herbicide symptomology video
Cumulative Index (2)
Forest Research Methods
Methods Manuals (3)
Weed ID Guide (6)
Weed ID Slide Sets
Weed ID Guide CD-ROM
Forestry Weed ID Guide

SERVICES
Annual Meeting
Placement Service
Business Office

PARTNERSHIPS
CAST
Congressional Science Fellow-discontinued
AESOP
Endowment Foundation
IAF
AI

SPONSORSHIPS
Awards
Student Program

Publications/Educational Materials. This society has a proud heritage of many fine publications. There are over 50 years of Proceedings and a Newsletter that is now published three times a year. The Research Report has been discontinued, but several of the components (weed surveys, extension publications, etc.) have been incorporated into the current Proceedings. Sandoz donated a Herbicide symptomology video which the Society has sold. A Research Methods Manual was first printed in 1972 and then revised in 1977 and 1986. Two Cumulative Indexes have been printed. The Foresters prepared and published a Forest Research Methods booklet. The popular Weed ID Guide has been printed into 6 sets and the 7th set is at the printer now. Slide sets for the first 6 printed sets were made. The Weed ID Guide has now been put on a CD/ROM and soon there will be an interactive key for the CD/ROM. Most recently, a Forestry Weed ID Guide has been printed and a CD-ROM version is under development. A few copies of the book are at the registration desk for sale at this meeting. All of these publications are of the highest quality and have been distributed world wide.

To give you an idea of what some of these publications have meant to the Society in addition to the educational value, the Society has spent nearly $400,000 printing the Weed ID guides. They have sold these for $722,000, profiting $325,000.

The Weed ID CD-ROM was developed at a cost to the Society of $28,000, sold for $113,000, and the Society profited by $85,000.

You might be thinking that the Society is a non-profit Scientific Society, so why are we making all of this profit. The Society MOP requires that we maintain a two-year budget in reserve for operation. It costs approximately $100,000 per year for this Society to operate. The annual meetings, with our reasonable registration fee, have at best, broken even each year, so there are no financial profits in our annual meetings. I won't even attempt to put a dollar figure on the educational value of these annual meetings. Until the Weed ID Guides were printed and sold, the Society had not reached its goal of a two-year operational reserve and money was not available to fund nor support other very worthwhile projects. Due almost entirely to the success of the Weed ID Guides and Weed ID CD-ROM sales, the Society is very sound financially. I hate to use the term "profits", but none the less I guess they are "profits" with which the Society has been able to support many very worthwhile projects. The balance of this address will show the membership how these "profits" have been put to use.

For example, the recent Forestry Weed ID Guide cost over $90,000 to print 6000 copies. Presently, these very high quality books are being sold faster than originally expected. Please look at a copy of one of these books at the registration desk. The members of SWSS will certainly be proud of it's fine quality in both content and printing. It should be noted that the talents and time of individual members was "given" to the Society.

Services. The most obvious services the Society provides its membership include the organization and development of the Annual Meeting, Placement Service, and Business Office. Some of the Society "profits" are spent on these services. I commented earlier about the annual meeting normally not breaking even, well these "profits" are used to cover those additional expenses. The Placement Service is operated on a volunteer basis like most of the Society, so no expense is associated with its operation. The Society does have a full-time Business Office which is manned by Bob Schmidt and his services are shared with the North Central Weed Science Society. I won't even begin to cover what Bob's duties are, I will only say they are varied and many with a capital M on the many.

Partnerships. Unless we pause to think about the outside involvements of SWSS, we would probably overlook many of these. SWSS is a member Society of CAST and at one point when CAST had a back-log of publications because they could not afford to print them, SWSS appropriated $2000 to "help" with printing costs. We do have a SWSS member on the CAST Board of Directors–Alan York. In partnership with the American Society of Agronomy, North Central Weed Science Society, and the Weed Science Society of America, SWSS supported a Congressional Science Fellowship. This activity has been replaced by going into a partnership with WSSA and all of the regional weed science Societies and supporting a Washington Liaison through AESOP. SWSS has been a major contributor to the SWSS Endowment Foundation Fund–more on this later.

Within the last two or three years, SWSS has contributed to two video productions. One, A Kid's Journey to Understanding Weeds, is developed by the Intermountain Agriculture Foundation and is targeted for third grade teachers and students. The video is accompanied by a work book and printed material. The project for Region 2 (Mountain Area) and Region 6 (southeast U.S.) are complete and Region 1 (West Coast) is well underway. The second video that SWSS is supporting is one on Alien Invaders and is being produced by Vermeer Production and the National Fish and Wildlife Foundation. SWSS is acknowledged as a supporter and endorser of each of these projects and we should be proud to be a part of them. I have a copy of the Kid's Journey to Understanding Weeds (Region 2) and it has excellent quality and exceptional educational value. These partnerships have all been at a cost to the Society or I should say a cost supported by the "profits" from publication sales.

The Society paid $68,000 in support of the Congressional Science Fellow and $33,000 in support of AESOP.

As I indicated earlier, SWSS has been a major contributor to the SWSS Endowment Foundation. SWSS has been able to budget $10,000 to $20,000 annually to the Endowment Fund entirely because of publication sales. Presently, $124,000 has been contributed to the Endowment Fund.

Sponsorships. SWSS is sponsoring the following awards: Distinguished Service, Weed Scientist of the Year, Outstanding Young Weed Scientist, Outstanding Educator, and Outstanding M.S. and Ph.D. Graduate Student. Some of these awards are also financially supported by our industry partners and that support is certainly appreciated. This Wednesday night we will honor the recipients of these awards during our annual banquet.

SWSS Summer Weed Contest. I believe that everyone in the SWSS is proud ofthis contest which has run each year since 1981; however, SWSS has only provided moral support and support of its Business office to this contest. The contest is self supporting through industry donations solicited by the Summer Weed Contest Committee. This contest costs approximately $12,000 to $15,000 annually; however, it is cost-free to the Society. I attended the contest for the first time this past summer and it indeed is an excellent educational experience. The camaraderie of the students and their coaches is phenomenal. I only wish I had attended the weed meet in earlier years. Three individuals should be recognized for their efforts in managing this contest for the past 20 years-David Teem, Dick Oliver, and now Eric Webster.

Graduate Student Program. I think that the Graduate Student Program is one that everyone associated with SWSS can be proud of. This interest in students is not new.

In President Richard Behrens address in 1959 he stated "I believe the proposed plan of the committee on the Promotion of Student Interest should be the major Southern Weed Conference effort in this direction."

In 1972, Don Davis in presenting the History of the SWSS stated "the attractiveness of the student interest program to the student and their professors has done much to maintain the quality of the research papers presented."

I think that is only fitting and proper to include the Endowment Foundation with the SWSS and the Graduate Student program. The goal of the Endowment Foundation is to fully support the Student Program. Presently, the Society/Endowment Foundation spends approximately $12,000 annually on the student program. This includes the speech and poster contests, banquet tickets, and lodging support. These funds come from the sale of SWSS publications. Interest from the money in the Endowment Fund supports the speech and poster contests, but the long range goal of the Endowment Foundation is to fully and completely support the student program through earned interest.

The students themselves should be very proud of their recent accomplishments. They have organized themselves along with the help of Phil Banks, they held a luncheon on Monday which they organized and solicited funds for, and they have asked and been given representation on the Board of Directors.

Earlier in this presentation, I commented on the decline in the full and sustaining membership while the student membership is increasing. The student membership has grown to such a point that entry in the speech contest was limited to once per degree so that the contest could be managed. Similar to the speech contest, a poster contest was started and entry in it, too, had to be restricted to once per degree. If a student attends the annual meeting they can register at a reduced fee, and if they present either a paper or poster, the Society will provide a banquet ticket, and a lodging allowance if they attend the banquet.

Endowment Foundation. Let me make a few brief comments about the Endowment Foundation. Bob Frans, Dick Oliver, Doug Worsham, Jerry Weber, and Phil Banks were instrumental in the formation of the Endowment Foundation. Bob Frans undertook this project or concept with tremendous energy and effort, and I would like to personally recognize Bob for his and the committee's foresight.

In 1986, the Endowment Foundation was officially formed and what better way than through money raised from gambling - the Mobay Casino Night, in addition to several individuals donating money. The near-term financial goal of the Endowment Foundation is $200,000 in 2000. I believe that the fund is at approximately $186,000. They have sponsored and just completed a Good Laboratory Practices workshop in partnership with Norvartis Quality Assurance personnel, which raised about $11,000, and they have offered for sale the little green veteran button that many of you are wearing.

The long-term financial goal is $300,000; however, if the student numbers continue to increase, this goal must be increased. The Endowment Foundation wants to support the entire Student Program.

There is always a risk of failing to recognize all people deserving recognition, but I really feel compelled to recognize several people who "volunteered" their time and talents to the Society.

First, had it not been for the confidence of Don Davis and Handly Funderburk in 1966 that the Southern Weed Conference was a viable organization, they would not have taken out a personal loan to print programs. Arlyn Evans is the person behind the camera who has photographed all of the weeds in the Weed ID Guide and CD-ROM.

I would be remiss if I didn't thank DuPont for their supporting Arlyn's efforts. Dennis Elmore worked closely with Arlyn to complete sets 1 through 6. Charles Bryson is working with Arlyn on sets 7 and 8. Michael and Karen DeFelice donated their time, equipment, and expertise to put the Weed ID Guide on CD-ROM and will be working with Charles on the interactive key. James and Karl Miller authored the newest publication–the Forestry Weed ID Guide. Bob Frans and Doug Worsham are with us today, they will probably go down in SWSS history as the "Fathers of the Endowment Foundation." The Society owes all of these individuals a great debt of gratitude.

I know that I am running out of time, but I should at least provide a challenge for the future. Again, I will use a quote from my mentor Paul Santelmann. "It is only by each individual contributing his time, efforts, and knowledge that will enable our organization to meet the challenge of the future." I think we have evidenced that today with the noteworthy contributions made by this Society's members.

Another lofty goal for this Society and its members is to devise a mechanism to harness the "transient" graduate student "interest and energy" for the betterment of the Society. They should immediately begin serving on committees and moderating sessions.

I did a few calculations and came up with 2340 student years. The Society has provided students with support that ranged between $100 per year for us old geezers to nearly $150 per year to the younger set. Give back to the Society what it gave to you. Make yourself a pledge to give a little each year until you returned what you received - a donation to the Endowment Foundation is tax deductible and this will be a "lasting" donation. If those 2340 gave just $100 each, $234,000 could be raised; however, if those same 2340 students gave $150 each, $351,000 could be raised!

As a closing challenge, I have adapted a quote of President J.F. Kennedy during his January 1961 inaugural speech. "And so my fellow Weed Scientists: ask not what your Society can do for you - ask what you can do for your Society."

Southern Weed Science Society members, you have a Society to be proud of. Reflect on these accomplishments and improve on them in this new century. I thank you for electing me your President, and it has truly been a pleasure serving a Society that has meant so much to me and my career.

ZA1296: A NEW MODE OF ACTION FOR WEED CONTROL IN CORN. **T.C. Mueller, Department of Plant and Soil Sciences, The University of Tennessee, Knoxville.**

ABSTRACT

ZA1296 is a new low use rate herbicide candidate under development by Zeneca Ag products Co. The proposed common name is mesotrione, and it is a member of the triketone chemical family. ZA1296 has low volatility, moderate water solubility, medium soil adsorption, a short residual in soil due to microbial degradation, and a good toxicological profile. It is a new mode of action for corn weed control. The target enzyme is HPPD, which is p-hydroxy-phenyl-pyruvate-dioxygenase. This enzyme is in the pathway that converts tyrosine to plastiquinone. Plastiquinone is a required cofactor for phytoene desaturase (a key to carotenoid biosynthesis). Blockage of this pathway results in "bleaching symptoms" of sensitive species. Corn is tolerant due to its ability to metabolize the herbicide.

Field studies were conduct over several years at Knoxville. Herbicide treatments usually included acetochlor PRE for grass weed control. Corn injury from PRE ZA1296 was minimal. ZA1296 applied POST provides good control of difficult control broadleaf weeds, such as common cocklebur, morningglories, and the compound also has some grass activity. The addition of a low rate (0.25 lb/acre) of atrazine to postemergent treatments increases activity. ZA1296 + atrazine was an effective control for POST weed control in corn.

RESIDUAL WEED CONTROL BENEFITS FROM IMAZAQUIN OR IMAZETHAPYR WITH GLYPHOSATE IN ROUNDUP READY SOYBEAN. G.S. Stapleton and R.C. Scott. American Cyanamid Company, Dyersburg, TN and Jonesboro, AR.

ABSTRACT

Growers are beginning to see the benefits of selecting a herbicide partner for glyphosate in their Roundup Ready soybean program. Reasons for this include; to improve efficacy on difficult to control weeds, reduce the number of in-season applications, and delay resistance or weed species shifts.

Nine studies were conducted throughout the Southern corn belt and Delta. The objectives of these studies were 1) to evaluate the efficacy of tank-mixtures of the imidazolinone herbicides, imazaquin or imazethapyr plus glyphosate and 2) to determine the residual benefits these combinations exhibit over glyphosate alone. Across locations, Roundup Ready soybean were planted from 28 May to 6 July, 1999 with eight locations under no-tillage or stale seedbed and one location conventionally tilled. Treatments included imazaquin @ .125 lb ai/A or imazethapyr @ .063 lb ai/A, plus glyphosate @ .625 lb ai/A or .75 lb ai/A, respectively, as well as a single application of glyphosate @ 1.0 lb ai/A, and a glyphosate sequential of 1.0 lb ai/A followed by .75 lb ai/A. Application timings ranged from 24 days preplant to the day of planting for the burndown application, early postemergence (EPOST) 12 to 22 days after planting (DAP), and late postemergence (LPOST) varied from 18 to 31 DAP. Standard herbicide application procedures were followed with all trials. Weeds observed were IPOLA, IPOHE, CASOB, ACCOS, CUMMD, AMAPA, AMATA, AMARE, AMASP, XANST, POLPY, AMBEL, AMPAL, SEBEX, ERICA, SETFA, SORHA, PANRA, ELEIN, BRAPP, and ECHCG. Two of the nine locations were harvested.

Combinations of imidazolinones plus glyphosate generally provided better control than a single application of glyphosate. Additionally, these tank-mixes controlled IPOLA, IPOHE, AMARE, AMBEL, AMASP, CUMMD, SETFA better than the glyphosate sequential program and provided equal control of the other species evaluated. Yields of the tank-mixtures were 19% and 10% higher compared to the glyphosate single and sequential applications, respectivley.

These combinations have become the basis of two new pre-package herbicides recently labeled for use in Roundup Ready soybean. These herbicides are Extreme with an equivalent use rate of imazethapyr @ .063 lb ai/A + glyphosate @ .75 lb ai/A and Backdraft with its equivalent as imazaquin @ .125 lb ai/A + glyphosate .625 lb ai/A.

COMPARISON OF MANAGEMENT SYSTEMS IN CONVENTIONAL AND HERBICIDE-RESISTANT CORN HYBRIDS. H.L. Crooks, A.C. York, and R.B. Batts, Crop Science Department, North Carolina State University, Raleigh, NC 27695-7620.

ABSTRACT

Field experiments were conducted at three locations in North Carolina in 1999 to compare weed management systems in Clearfield (imidazolinone-resistant), Liberty Link (glufosinate-resistant), and Roundup Ready (glyphosate-resistant) corn hybrids with conventional herbicide systems in a conventional hybrid. Experiments were conducted in fields heavily infested with weeds. Species present at one or more locations included fall panicum (*Panicum dichotomiflorum*), broadleaf signalgrass (*Brachiaria platyphylla*), giant foxtail (*Setaria faberi*), mixtures of morningglory species (*Ipomoea spp.*), smooth pigweed (*Amaranthus hybridus*), sicklepod (*Senna obtusifolia*), and common lambsquarters (*Chenopodium album*). Treatments included Roundup Ultra (glyphosate) at 2 pt/acre, Liberty (glufosinate) at 20 fl oz/acre, and Lightning (imazethapyr + imazapyr) at 1.28 oz/acre applied POST alone to the appropriate hybrid or mixed with atrazine

at 1.5 pt/acre followed by layby options of nothing, Evik (ametryn) at 2 lb/acre, or 2,4-D amine at 1 pt/acre. Also included was Dual II Magnum (metolachlor) at 1.5 pt/acre applied PRE followed by Roundup plus atrazine, Liberty plus atrazine, or Lightning plus atrazine POST and followed by a layby of nothing or Evik. Treatments in the conventional hybrid included Bicep II Magnum(metolachlor+ atrazine) at 1.6 qt/acre applied PRE in combination with nothing, Evik, or 2,4-D at layby.

Liberty and Roundup alone controlled weeds well initially, but late-season control was poor due to lack of residual activity. Late in the season, Lightning alone was more effective than Liberty or Roundup alone on all weeds. Lightning alone controlled common lambsquarters and ALS-susceptible smooth pigweed completely and annual grasses 86% late in the season. Late-season control of morningglory species, sicklepod, and ALS-resistant smooth pigweed (74% or less) was inadequate with Lightning alone. Mixing atrazine with Liberty or Roundup increased annual grass and broadleaf weed control while an increase in control of ALS-resistant smooth pigweed was observed with Lightning plus atrazine. There were no differences in broadleaf weed control when comparing Evik and 2,4-D applied at layby; Evik was more effective on annual grasses. Greater control of annual grasses, morningglory species, and sicklepod was obtained with the POST herbicides alone followed by Evik as compared with the POST herbicides plus atrazine without Evik at layby. Common lambsquarters was controlled 100% by POST herbicides plus atrazine and by POST herbicides followed by Evik. Atrazine was of little or no value in systems where Evik was applied at layby. Excellent control was obtained in Clearfield, Liberty Link, and Roundup Ready systems when Evik was applied at layby. Dual PRE improved annual grass control in systems with POST herbicides plus atrazine and no layby but not in systems where Evik was used. Weed control in Clearfield, Liberty Link, and Roundup Ready systems was equal to or greater than in the conventional hybrid treated with Bicep PRE or Bicep PRE followed by Evik layby. Yields were not determined as plots were destroyed by two hurricanes and flooding.

INFLUENCE OF APPLICATION TIMING AND RESIDUAL HERBICIDES ON PERFORMANCE OF ROUNDUP READY CORN WEED CONTROL SYSTEMS. G.N. Rhodes, Jr., G.K. Breeden, J.R. Summerlin, Jr., J.A. Kendig, and G.A. Ohmes, University of Tennessee, Knoxville, and University of Missouri Delta Center, Portageville.

ABSTRACT

A typical no-till corn weed control program for Midsouth producers involves application of a burndown herbicide tank-mixed with a premix of atrazine and a grass herbicide such as Bicep II Magnum, FulTime or Harness Xtra. Key early escape weeds include annual ryegrass, broadleaf signalgrass, rhizome johnsongrass, common cocklebur, sicklepod, velvetleaf and perennial vines. Due to the complexity of our weed spectrum, many fields receive a follow-up POST application at 3 to 5 weeks after planting (WAP) of Exceed + Accent, Accent + Clarity, or Basis Gold for escape weeds. Over the past few years some producers have gained experience with herbicide tolerant (HT) corn weed control programs. These include the Clearfield, Poast Protected, Liberty Link, and Roundup Ready systems. Research in the Midsouth has shown the Roundup Ready system to offer the greatest potential.

Field research was conducted during 1999 at Greenback and Murfreesboro, TN and Portageville, MO to determine the influence of Roundup Ultra application timing on weed control and corn yield, and to determine the contribution of preemergence herbicides in a Roundup Ready corn weed control system. 'DeKalb DK 626 RR' corn was planted in 30 inch rows in small plot experiments with four replications. Herbicides were applied with a CO2 pressurized tractor or backpack sprayer. In Tennessee the residual herbicide chosen for comparison was Bicep II Magnum + atrazine (2.1 + 0.4 qt/A) while atrazine (2 qt/A) was used in Missouri. Roundup Ultra rate was 1.5 pt/A in Tennessee and 2 qt/A in Missouri. Efficacy of treatments was measured using weed control ratings and corn grain yield.

Residual herbicides did not consistently increase mid-season weed control or corn yield in a Roundup Ready corn weed control system. The benefits of a residual herbicide were related to the relative competitive ability of weeds and timing of Roundup Ultra overtop. A greater benefit was observed for giant ragweed, Palmer pigweed and velvetleaf than for sicklepod, smooth pigweed or common lambsquarters. Residual herbicides tended to improve weed control and corn yield where Roundup Ultra was applied either too early or too late for optimum weed control. As shown in our previous research, the optimum timing of Roundup Ultra for rhizome johnsongrass control was 4 to 5 WAP, and this was not influenced by use of a residual herbicide. In sequential Roundup Ultra overtop programs without a residual herbicide applied PRE, the optimum timing appears to be 2 followed by 4 WAP. Corn yield decreased as sequential applications were delayed.

WEED CONTROL AND CORN INJURY WITH ISOXAFLUTOLE IN THE TEXAS HIGH PLAINS. B.W. Bean and M.W. Rowland, Texas Agricultural Extension Service, Amarillo, TX 79106.

ABSTRACT

Studies in corn were conducted in 1997, 1998, and 1999 in the Texas High Plains with isoxaflutole at rates ranging from 0.75 to 1.88 oz ai/A. A premix (EPIC) of isoxaflutole plus flufenacet was also examined. Studies were located on both clay loam and sandy clay loam soils.

Pigweed (*Palmer amaranth)* and velvetleaf (*Abutilon theophrasti)* control was excellent in all studies in the clay loam soil at rates equal to or greater than 1.0 oz ai/A. Barnyardgrass (*Echinochloa crusgalli L.*) control was variable in the clay loam soil with isoxaflutole alone. When used in combination with flufenacet, control was improved. Sandbur (*Cenchrus incertus*) control in sandy loam soil in 1998 was 31, 21, 54, and 60% with isoxaflutole rates of 0.5, 0.75, 0.9, and 1.12 oz ai/A, respectively. In 1999, excellent control was achieved with isoxaflutole at 0.5 oz ai/A. Conditions in 1998 were extremely dry, while conditions in 1999 were very wet early in the season.

In the clay loam soil, crop injury in 1997 consisted of slightly chlorotic leaves two weeks after emergence. No injury was observed in 1998. In 1999, two out offour tests showed some chlorotic and stunted plants soon after emergence, however, crop yield was not reduced. In the sandy clay loam soil, crop injury was not observed in 1998. In 1999, 40 days after treatment application, crop injury was 40 and 50%, respectively, at isoxaflutole rates of 0.75 and 1.12 oz ai/A. Crop yield was significantly reduced with these treatments.

PROFITABLE WEED-CONTROL SYSTEMS IN A THREE-YEAR GRAIN SORGHUM PROGRAM. M.L. Wood and D.S. Murray, Department of Plant and Soil Sciences, Oklahoma State University, Stillwater, OK 74078.

ABSTRACT

A three-year dryland grain sorghum field experiment was initiated to evaluate several herbicides for weed control using a “target cost” of $15/A. There were 42 treatments in these experiments which included PRE only, POST only, and PRE followed by POST herbicide treatments. To evaluate cost, some herbicide treatments were applied in a band and these were cultivated twice in 1997, and once in 1998 and 1999.

A randomized complete block design was used with four replications. Plot size was four rows, 30 inches wide by 45 feet long. The center two rows were harvested and the grain adjusted to 12% moisture to obtain yield data. The top five treatments, a cultivated check, and untreated non-cultivated check, ranked by net value, from a total of the 42 treatments will be discussed. Net value is obtained after the cost of herbicides, cultivation if herbicide treatments were banded, and application costs of herbicides were made.

Of the top five treatments, metolachlor banded PRE was a component four out of five times in 1997 and three out of five in 1998 and 1999. The top five treatments, cultivated check, and non-cultivated check ranked by net value in each year are as follows: (1997) 1] metolachlor banded plus propazine banded PRE, $103/A; 2] metolachlor banded PRE followed by atrazine banded post, $93/A; 3] metolachlor banded PRE followed by atrazine broadcast POST, $89/A; 4] atrazine banded POST, $89/A; 5] metolachlor banded PRE followed by prosulfuron banded POST, $78/A; 19] cultivated check, $48/A; 38] non-cultivated check, $12/A; (1998) 1] metolachlor banded PRE followed by 2,4-D broadcast POST, $54/A; 2] metolachlor banded PRE followed by dicamba broadcast POST, $47/A; 3] dimethenamid broadcast PRE, $47/A; 4] metolachlor banded PRE followed by dicamba banded POST, $46/A; 5] 2,4-D banded POST, $42/A; 11] cultivated check, $36/A; 15] untreated check, $33/A; (1999) 1] propazine banded PRE, $75/A; 2] metolachlor banded PRE followed by dicamba plus atrazine broadcast POST, $73/A; 3] dimethenamid banded PRE, $71/A; 4] metolachlor banded PRE followed by dicamba plus atrazine banded POST, $70/A; 5] metolachlor banded PRE followed by dicamba broadcast POST, $70/A; 9] cultivated check, $66/A; 28] untreated check, $53/A. A weed control program, using herbicides, with a “target cost” of $15/A was achieved with only one of the top five treatments in 1997, four out of the top five in 1998, and three out of the top five in 1999. In all years the cultivated check and non-cultivated check ranked higher than some herbicide treatments.

WEED CONTROL IN GRAIN SORGHUM USING PARAMOUNT AND PARAMOUNT TANK MIXES. M.W. Rowland and B.W. Bean; Texas Agricultural Extension Service, Amarillo, TX 79106.

ABSTRACT

Field experiments were conducted to evaluate field bindweed (*Convolvulus arvensis* L.) control and grain sorghum injury using Paramount and Paramount tank mixes. Two experiments were conducted, one near Dumas, TX and the other near Canyon, TX. The experiments were a randomized complete block design with four replications. Plot size was 4 rows wide and 25 ft long. Treatments included Paramount alone @ 0.25 and 0.38 lb ai/ac, Paramount at the previous rates combined with 2,4-D amine @ 0.25 lb ai/ac or Clarity @ 0.125 lb ai/ac, 2,4-D amine alone @ 0.5 lb ai/ac, and Clarity alone @ 0.25 lb ai/ac. Applications were made at Dumas to 12 inch grain sorghum and 16 inch field bindweed and at Canyon to 4 inch grain sorghum and 10 inch field bindweed. Ratings were taken at approximately 2, 4, and WAT. Ratings consisted of crop injury and weed control on a 0 - 100% scale with 0 = no injury or control and 100 = complete kill or control.

In Dumas at 2 WAT, Paramount alone at 0.25 lb ai achieved only 30% control while the 0.38 lb ai rate had close to 80% control. All other tank mixes had above 70% control. At 4 and 8 WAT control improved for both Paramount alone treatments with ratings above 80%. Tank mixes had control of 90% or better. Clarity and 2,4-D amine alone maintained close to 90% control through all ratings. In Canyon at 2 WAT Paramount alone at 0.25 lb ai achieved only 60% control while 0.38 lb ai had over 80% control. Paramount tank mixes at both rates had 80% or better control. Clarity and 2,4-D

alone were above 80%. At 4 WAT Paramount alone at 0.25 lb ai improved to over 75% control while the 0.38 lb ai rate stayed closely the same. Tank mixes improved to 90% or better. At 8 WAT ratings were basically unchanged as compared to the 4 WAT ratings. Overall, Paramount alone was slower acting compared to the Paramount tank mixes but control improved toward the later rating. Paramount at 0.25 lb ai provided good to excellent control when applied with either Clarity or 2,4-D as a tank mix partner.

MANAGEMENT OF ROUNDUP READY CROPS IN ROTATION CROPS. R.M. Hayes, University of Tennessee, West Tennessee Experiment Station, Jackson, TN 38301.

ABSTRACT

There has been speculation about glyphosate resistant crops becoming weeds, even some going so far as to suggest 'SUPERWEEDS'. The focus has centered on Roundup Ready (RR) corn becoming a weed problem in corn and soybeans in the Midwest and Roundup Ready rapeseed escaping to wild *Brassicas.* In early studies with RR soybeans, researchers were required to destroy the crop before seed production. More recently, trials were taken through harvest. We first noticed RR soybean escapes in situations where Roundup was used as an early burndown
In other situations, some volunteer RR soybeans emerged in no-till RR cotton. The problem was worse in drought areas where soybean seeds were small and shattering occurred the previous fall. RR soybeans in cotton can compete for resources and may contribute to trash and extraneous matter in lint. The objective of our studies were to evaluate options for controlling RR soybeans in RR cotton.

Glufosinate (Liberty) at 28 oz/ac controlled RR soybeans 100% in early burndown situations. Glyphosate, as expected had no effect on volunteer RR soybeans. DSMA at 1.8 lb ai/acre, pyrithiobac (Staple) at .0.063 lb ai/acre,and CGA 362622 at 0.004 lb ai/acre POST controlled RR soybeans 28, 40, and 55% at 21 DAT and 15, 20, and 30% at 42 days. Post-directed prometryn (Caparol/Cotton Pro) + MSMA controlled RR soybean 98% in RR cotton with an occasional escape in the drill accounting for the lack of complete control.

This is not a widespread, serious problem unless it occurs on your farm or if you are rotating from RR soybean to RR cotton. The problem was magnified where shattering or harvesting losses were high from drought conditions. It is less likely to occur in a tilled situation. While some options exist for managing RR soybeans in RR cotton, solutions for managing RR soybeans in a rotational crop of soybeans remains a challenge.

EFFECT OF COVER CROP MANAGEMENT ON YIELD AND QUALITY OF NO-TILL TRANSPLANTED DARK-FIRED AND BURLEY TOBACCO. R.L. Ellis, T.C. Mueller and B.D. Sims. University of Tennessee, Knoxville, TN 37901-1071.

ABSTRACT

Tobacco is an important crop in the southeastern United States and is normally grown in cultivated fields. Cultivation is primarily used to control weeds and improve soil tilth. Cultivation sometimes leads to increased soil erosion, which reduces long-term productivity of the land. Producers are also challenged with meeting conservation compliance regulations established by the government in order to remain eligible for the loan program. No-till systems would allow production on sloping fields while decreasing soil erosion and could reduce production costs.

Two studies were conducted in burley and dark-fired tobacco using a split plot design with a randomized complete block treatment arrangement on the Highland Rim Experiment Station in 1999 to evaluate the management of a wheat cover crop and different herbicide combinations in a no-till system. Main treatments consisted of a non-selective herbicide treatment applied at 30 days (early) and 15 days (late) prior to transplant and conventional handling of the wheat cover crop. Sub-plot treatments were Spartan (6.7 oz/A) + Prowl (2.0 pt/A), Spartan (6.7oz/A) + Command (1.5 pt/A), each applied preemergence, hand weeded check, and a weedy check.

Weed control for smooth pigweed, broadleaf signalgrass, and entireleaf morningglory was greater than 90% at 28 days after transplant for both herbicide treatments. Yields in the no-till plots in both types of tobacco were significantly lower than in the conventional plots. Tobacco quality in the early burn-down treatment was significantly higher in the burley study than the late burn-down and conventional treatments. There was no significant difference in quality among the treatments in the dark-fired study.

RYE MULCH INCREASES HERBICIDE EFFICACY IN NO-TILL BURLEY TOBACCO. A.D. Worsham and D.S. Whitley, Upper Mt. and Mt. Research Stations, Dept. of Crop Science, N.C. State University, Raleigh, NC 27695.

ABSTRACT

Soil erosion is a serious problem in N.C. The Water Quality Division of the N.C. department of Natural and Human Resources has identified sediment as the major cause of lowered quality of rivers and streams.

Tobacco is the most erosive of N.C. crops because of the intensive cultivation. Erosion in the Piedmont and Mountain regions of the state is especially serious because of the slopes of fields. Sometimes entire crops or parts of a crop are washed away in heavy spring or summer rains. We are promoting, and some growers are trying, no-till tobacco as a solution to this problem and to meet soil conservation requirements.

In our research over the years, we have noticed better weed control in no-till burley tobacco with a heavy rye mulch as compared to conventional tobacco with the same herbicides. In 1999 we set up direct comparisons at the Upper Mountain and Mountain Research Stations. At each location, a split-plot design was used. In the fall of 1998, Wrens Abruzzi rye was planted in the no-till blocks at 3 bu./acre. Conventional-till blocks were disked and left bare. Whole blocks for both no-till and conventional were 15 rows by 33 feet. Sub-plots (herbicide treatments) were 3 rows each. Herbicide treatments chosen were Spartan 75DF, Command 3ME, and Devrinol 50DF, and Spartan pre-plant followed by Command post-planting. Labeled rates were used. The rye was killed about 2 weeks prior to transplanting with Gramoxone Extra plus non-ionic surfactant. Weeds rated were yellow nutsedge, redroot pigweed, common purslane, hairy galinsoga, and Pa. smartweed.

Whole-plot treatments were not different, although there was a strong trend for no-till to have better weed control. Whole-plot treatments were not different because there were interactions among herbicides, weed species, and tillage. Herbicides which were weak on weeds present gave better control in no-till plots. Examples were Spartan, Command, and Devrinol on hairy galinsoga; Command on yellow nutsedge and redroot pigweed; and Devrinol on yellow nutsedge and common purslane. Weeds easily controlled by a given herbicide were controlled well in either no-till or conventional plots. Thus in a no-till burley tobacco program using heavy Abruzzi rye cover, and particularly with use of Spartan plus Command, major problem annual weeds can be satisfactorily managed.

ACKNOWLEDGEMENTS

We appreciate partial financial support of this work from the North Carolina Tobacco Research Commission and the Burley Stabilization Corporation.

COTTON WEED MANAGEMENT SYSTEMS FOR CENTRAL TEXAS. B.V. Ottis, C.H. Tingle, and J.M. Chandler, Texas Agricultural Experiment Station, College Station, TX 77843.

ABSTRACT

Field studies were conducted at the Texas Agricultural Experiment Station field laboratory in Burleson County, TX comparing the efficacy and economics of various cotton weed management systems. The herbicide systems compared were a conventional, BXN, and Roundup Ready. The cotton varieties used were DPL 50, BXN 47, and DPL 5690RR. The weed species evaluated were johnsongrass (SORHA), velvetleaf (ABUTH), and entireleaf morningglory (IPOHE). All weeds were seeded prior to initiation of the experiment. Included in the study was a weed-free treatment used as a control. Costs reflect a per acre expense using a 110-hp tractor, 15-ft. tandem disk, planter, rolling cultivator, sprayer, herbicide and seed.

The most economical treatment in all three years of the experiment was fluometuron (1.5 lb/A) PRE followed by glyphosate (0.75 lb/A) POST-1 *fb* glyphosate (1.0 lb/A) PDIR. The most expensive treatment in the study was fluometuron (1.5 lb/A) PRE *fb* pyrithiobac (1.0 oz/A) POST-1 *fb* cyanazine (0.8 lb/A) + MSMA (2.0 lb/A) LAYBY. There was a decrease in overall cost of all treatments over the three years of the study. This decline was mostly due to the slight decrease in herbicide costs.

There was a decrease in SORHA control in the BXN and conventional treatments over the course of the study. Control declined from80% to 53% and 87% to 78.5%, respectively. This decrease in control was due to the fact that the SORHA was not adequately controlled in the first year of the experiment resulting in lower control in the subsequent years of the study. SORHA control was 95% with the glyphosate treatment. Control of ABUTH increased with the BXN and conventional treatments during the study. Control increased from 80% to 94% and 87% to 94%, respectively. Control was consistent over the three years of the study considering weed populations were diminished considerably after the first year. The weeds were not re-seeded prior to each year of the study. IPOHE control ranged from 86% to 94% in the conventional treatment with the pyrithiobac treatment having slightly better control each year. The BXN treatment controlled IPOHE 89% to 94% while the glyphosate treatment ranged from 91% to 95% control over the three years of the study. Size of IPOHE plants at application was important for adequate control.

In 1997, no differences were observed in yield from DP-50 (weed-free) and it's corresponding herbicide programs. This was also observed with the BXN-47 variety. Yields from glyphosate programs were lower than weed-free yields. Differences were observed in 1998 with DP-50 (weed-free) and BXN control programs and were 2960 and 2306 lb/A, respectively. In 1999, yield data ranged from 2987 to 2252 lb/A.

TOLERANCE OF ROUNDUP READY COTTON TO POST-DIRECTED APPLICATIONS OF GLYPHOSATE.
S.L. File[1], D.B Reynolds[1], C.E. Snipes[2], and R.H. Blackley[1]. Mississippi State University, Mississippi State, MS[1], and Stoneville, MS[2].

ABSTRACT

Topical applications of glyphosate on Roundup Ready cotton after the 4-leaf stage may affect reproductive development, therefore, applications applied after the 4-leaf stage are required by current label restrictions to be post-directed. Field experiments were conducted in 1997 and 1998 at the Black Belt Branch Experiment Station near Brooksville, MS, the Delta Branch Research Station near Stoneville, MS, and at the Plant Science Center near Starkville, MS, to evaluate Roundup Ready cotton tolerance to post-directed applications of glyphosate. Post-directed treatments were arranged in a randomized complete block design with four replications. A total delivery volume of 15 GPA was used to apply the treatments. Treatments consisted of topical applications of 1.12 kg/ha of glyphosate at the 6, 10, and 14 node growth stage. The 6 and 10 leaf growth stages consisted of post-directed applications made at the base of the plant and 25% of the total plant height, with the 14 th leaf treatment having an additional treatment of 33% of the plant height. No significant differences between glyphosate post-directed treatments were seen in the in-season parameters such as height or plant mapping data. No differences in yield were detected in either year or at any location. The box mapping also concluded that there was no difference in fruiting patterns between treatments. Post-directed applications of glyphosate made to heights of up to 33% showed no yield losses or changes in fruiting pattern.

COTTON (*Gossypium hirsutum*) AND WEED RESPONSE TO FLUMIOXAZIN. S.D. Askew, J.W. Wilcut, J.D. Hinton, and J. Cranmer; North Carolina State University, Raleigh, NC; and Valent USA Company, Cary, NC.

ABSTRACT

Studies were conducted at Clayton, Goldsboro, Lewiston, and Rocky Mount, NC between 1996 and 1999 to evaluate flumioxazin for use as a preplant herbicide in stale seedbed cotton. In a study on cotton tolerance, flumioxazin was applied at 0.063 lb ai/A at 10, 8, 6, 5, 4, 3, 2, 1, and 0 weeks prior to planting to evaluate cotton response to preplant applications. The test area was maintained weed free for the duration of the growing season and yield was collected. Cotton response to herbicidal treatment was measured by visual estimates of stunting, discoloration, stand reduction, and overall injury at various times throughout the season. In a separate study, weed control and cotton tolerance from preplant applications of flumioxazin at two rates and with various tank-mix options were evaluated. A factorial treatment arrangement contained three flumioxazin rates (none, 0.063, and 0.094 lb ai/A) and four tank-mix options (nothing, 1.0 lb ai/A glyphosate, 1.0 lb ai/A sulfosate, and 0.94 lb ai/A paraquat). When cotton reached the four-leaf stage, glyphosate applications and hand weeding were used to keep the test weed free until harvest.

In the cotton response study, early- and mid-season injury ratings averaged over years exhibited a marginal contribution to the quadratic polynomial ($R^2 = 0.57$ and 0.52, respectively). Essentially, slight injury (up to 12%) was observed when flumioxazin was applied at cotton planting with no more than 3% injury observed at one week or more prior to planting. Trends in late-season cotton fresh weight (as % of nontreated) were similar ($R^2 = 0.70$ and 0.77 in 1996 and 1997, respectively). Maximum fresh weight reduction was 4% and occurred when flumioxazin was applied at cotton planting. No differences were noted in late-season injury ratings or cotton lint yield within years. Yield potential averaged 850 lb lint/A in 1996 and 1200 lb lint/A in 1997 regardless of flumioxazin application time. These trends indicate that flumioxazin is a safe residual burndown herbicide when applied at least one week prior to cotton planting.

In the weed control study, flumioxazin alone provided excellent (> 90%) control of common chickweed (*Stellaria media*), Palmer amaranth (*Amaranthus palmeri*), smooth pigweed (*Amaranthus hybridus*), slender amaranth (*Amaranthus gracilis*), common ragweed (*Ambrosia artemisiifolia*), and common lambsquarters (*Chenopodium album*). When mixed with either glyphosate, sulfosate, or paraquat, flumioxazin systems controlled spring whitlowgrass (*Draba verna*), henbit (*Lamium amplexicaule*), annual bluegrass (*Poa annua*), sibara (*Sibara virginica*), and purple cudweed (*Gnaphalium purpureum*). No injury was noted within one week of cotton emergence, however, weeds that emerged prior glyphosate application to four-leaf cotton slowed growth of young cotton seedlings at Rocky Mount. At mid-season, cotton stunting was evident in previously weedy plots. This stunting was reflected in a significant main effect of flumioxazin rate averaged over tank-mix options. When compared to cotton grown weed free, cotton was stunted 48% when flumioxazin was not included in burndown applications. When 0.063 lb ai/A or 0.094 lb ai/A flumioxazin was included with burndown applications, cotton stunting was 14 and 9%, respectively. These differences indicate that residual control of weeds provided by flumioxazin is important when glyphosate applications are delayed until the four-leaf stage of cotton.

WEED AND COTTON RESPONSE TO VARIOUS HERBICIDES. R.J. Richardson, H.P. Wilson, and D.H. Poston. Eastern Shore Agricultural Research and Extension Center, Virginia Polytechnic Institute and State University, Painter, VA 23420.

ABSTRACT

Current cotton herbicides do not control all broadleaf weeds. Pyrithiobac, an acetolactate synthase (ALS) inhibitor, is currently the only broad spectrum over-the-top (OTT) cotton herbicide not requiring genetically modified varieties. However, pyrithiobac does not control all broadleaf weed species and must be utilized in a complete weed management program. Field studies were conducted at Painter, VA, in 1999 to evaluate the experimental ALS-inhibitor herbicide CGA-362622 for weed and cotton response. CGA-362622 was applied alone to determine the effects of postemergence (POST) timing, with crop oil concentrate (COC) and nonionic surfactant (NIS) to determine adjuvant effects, and in combination with pyrithiobac. Treatments were arranged in randomized complete block designs with 3 replications. Cotton variety 'Suregrow 125' was planted for all three studies.

CGA-362622 was applied POST at 0.0034 and 0.0067 lb ai/A with 0.125 and 0.25% (v/v) NIS and 1.00% (v/v) COC to compare adjuvants; a hand-weeded check was included . Cotton height at 56 days after treatment (DAT) and seed cotton yields were not affected by adjuvant treatment. Control of common ragweed (*Ambrosia artemisiifolia L.*) and yellow nutsedge (*Cyperus esculentus L.)* was not different among adjuvant treatment.

To investigate influence of application timing on cotton response, CGA-362622 was applied POST at 0.0034 and 0.0067 lb/A with 0.25% NIS. Applications were made OTT to 1- to 2-lf, 3-lf and 5-lf cotton as well as post directed (PD) to 8- and 12-in cotton; a hand-weeded check was included. At 56 DAT, none of the OTT treatments affected cotton height and seed cotton yield did not differ from the hand-weeded check. However, cotton treated PD to 12-in cotton with 0.0034 lb/A CGA-362622 produced yields below those of the hand-weeded check; this difference may be attributed to weed competition prior to application.

CGA-362622 and pyrithiobac were applied POST in a 4 by 3 factorial design with 0.25 % NIS. CGA-362622 rates were 0.0022, 0.0034, 0.0045, and 0.0067 lb/A. Pyrithobac was applied at 0, 0.015, and 0.031 lb/A. Pyrithiobac at 0.063 lb/A and an untreated check were included for comparison. CGA-362622 controlled common lambsquarters (*Chenopodium album L.*) 95 to 99 %, common ragweed 90-99%, annual morningglory species (*Ipomoea spp.)* 81 to 88 %, ivy-leaf morningglory [*Ipomoea hederacea (L.*) Jacq.] 86 to 92 %, common cocklebur (*Xanthium strumarium L.*) 90 to 99%, and spurred anoda [*Anoda cristata (L.*) Schlecht.] 30 to 33 % at the four rates. Pyrithiobac at 0.063 lb/A controlled common lambsquarters 67 %, common ragweed 63 %, annual morningglory species 50 %, ivy-leaf morningglory 94 %, common cocklebur 40 %, and spurred anoda 98 %. Combinations of CGA-362622 at 0.0034 lb/A or greater with pyrithiobac at 0.015 lb/A or 0.031 lb/A provided excellent control of all weed species (87 to 99%).

EVALUATION OF TANK MIXTURES IN CONJUNCTION WITH A ROUNDUP READY SYSTEM FOR ENHANCED WEED CONTROL. S.B. Blanche, D.R. Shaw and C.S. Bray, Department of Plant and Soil Sciences, Mississippi State University, MS 39762.

ABSTRACT

Herbicide-tolerant crops are becoming an integral component in many crop production systems. Non-selective herbicides such as glyphosate applied in Roundup Ready soybean offer a broad spectrum of weed control and better crop rotational flexibility. Recent studies have shown that tank-mixed herbicides can provide better control of problematic weeds and reduce the number of spray applications. Diphenylether herbicides and ALS-inhibiting (ALS) herbicides are good candidates for tank mixtures with glyphosate due to their excellent control of morningglory species (*Ipomoea* spp.) and hemp sesbania [*Sesbania exaltata* (Raf.) Rydb.ex. A. W. Hill], which are at times not consistently controlled with glyphosate. The objective of this research was to evaluate diphenylether and ALS herbicides, alone and tank-mixed with different rates of glyphosate, for their ability to control pitted morningglory (*Ipomoea lacunosa* L.), entireleaf morningglory (*Ipomoea hederacea* var. *integriuscula* Gray), sicklepod [*Senna obtusifolia* (L.) Irwin & Barneby], and hemp sesbania.

Studies were conducted at the Plant Science Research Center, Starkville, MS. The experiments were designed as randomized complete blocks with a factorial arrangement of treatments. Factors were diphenylether or ALS herbicide, diphenylether or ALS rate, and glyphosate rate. Diphenylether herbicides evaluated were fomesafen, acifluorfen, and lactofen. ALS herbicides evaluated were imazaquin, imazamox, and chlorimuron-ethyl. The diphenylether and ALS herbicides were applied at full and 1/2X rates. Glyphosate rates were 0, 0.42 (low), and 0.84 (high) kg ai/ha. Comparison treatments of a single application of glyphosate at 0.42 and 0.84 kg/ha and sequential applications of glyphosate at 0.84 kg/ha followed by 0.56 kg/ha were also included. All treatments received a postemergence application 3 weeks after planting (WAP), and sequential applications of glyphosate received a second application at 5 WAP. Evaluations included weed control and injury at 5 and 9 WAP, and yield. Weeds evaluated were pitted morningglory, entireleaf morningglory, sicklepod and hemp sesbania.

Throughout the entire growing season, tank mixtures containing diphenylether or ALS herbicides did not improve sicklepod control compared to single or sequential applications of glyphosate. At 5 WAP, tank mixtures containing diphenylether herbicides at 1/2X rates and glyphosate at either rate controlled entireleaf morningglory more than 84%, whereas applications of glyphosate at low and high rates controlled entireleaf morningglory 64 and 65%, respectively. At 5 WAP, hemp sesbania control was more than 93% with any treatment containing a diphenylether herbicide. Glyphosate, applied at a high rate, controlled hemp sesbania 64% at 5 WAP. Injury symptoms at 5 WAP were noted for all diphenylether herbicides, but were most dramatic when lactofen was applied alone. Hemp sesbania control, evaluated at 9 WAP, was more than 91% for any treatment containing diphenylether herbicides alone and 80% for sequential applications of glyphosate. Soybean yields increased as glyphosate rate increased, regardless of diphenylether herbicide, and all treatments receiving tank mixtures of diphenylether herbicides + 0.84 kg/ha glyphosate resulted in higher yield than sequential applications of glyphosate.

At 5 WAP, chlorimuron-ethyl alone or tank-mixed with glyphosate, controlled *Ipomoea* spp. as well as single applications of glyphosate. Hemp sesbania control was better when chlorimuron-ethyl was applied at a 1X rate, with or without glyphosate, when compared to single applications of glyphosate. No significant injury symptoms were noted as a result of ALS herbicides. At 9 WAP, sequential applications of glyphosate controlled pitted morninggglory 42% and imazaquin, regardless of rate, tank-mixed with low and high rates of glyphosate controlled pitted morningglory more than 63%. Hemp sesbania control, evaluated at 9 WAP, was equivalent for tank mixtures containing chlorimuron-ethyl at 1X rates and sequential applications of glyphosate.

POTENTIAL ATRAZINE RESISTANCE IN RED MORNINGGLORY (*Ipomoea coccinea* L.) AND HERBICIDE ALTERNATIVES IN LOUISIANA SUGARCANE. B.J. Viator, J.L. Griffin, E.P. Webster, J.M. Ellis, Louisiana State University Agricultural Center, Baton Rouge, LA 70803; and E.P. Richard, Jr., USDA-ARS SRRC Sugarcane Research Unit, Houma, LA 70361.

ABSTRACT

Atrazine, an inhibitor of electron transport at photosystem II, has been the primary herbicide used to control red morningglory (*Ipomoea coccinea* L.) in Louisiana sugarcane. Control with atrazine has declined over the past few years and because of its extensive use, control failures might be attributed to resistance. Resistance to atrazine in other weeds was determined to result from a single nucleotide substitution on the *psbA* gene encoding for the Q_b binding site on the D1 thylakoid protein. This mutation prevents binding of atrazine to the Q_b site and as a result, electron transport is no longer inhibited. However, due to conformational changes in the D1 protein, atrazine resistant plants are less photosynthetically efficient than the susceptible biotypes. Previous research has shown that chlorophyll fluorescence of leaf material from triazine susceptible plants increases upon exposure to atrazine, while no change in fluorescence occurs in resistant plants. In addition, fluorescence prior to atrazine treatment has been shown to be higher in resistant biotypes than in susceptible ones, indicating differences in photosynthetic efficiency.

A laboratory study was conducted to determine if atrazine-resistant red morningglories are present in Louisiana. The experimental design was a randomized complete block with 5 replications and the experiment was repeated. Seeds were collected from 20 commercial sugarcane fields in eight parishes where red morningglory control failures were reported. In addition, seeds were collected from four locations not in agronomic production and with no prior history of atrazine use. Plants from each location were grown in the greenhouse with an average temperature of 93F and a 14 hr photoperiod. When plants reached the 5- to 7-leaf stage, the third youngest, fully expanded leaf was removed and brought to the laboratory. Leaf sections (10 mm diameter) were floated in deionized water for 30 min in the dark and 30 min under a light source with an intensity of 2.46 mmol/m^2/s. Leaf material were then removed and placed under the fluorometer probe adaxial side down. Fluorescence was measured for 10 seconds, with the final reading being terminal fluorescence (F_T). Following the initial readings, one leaf section from each plant was placed in a 10^{-3} M atrazine + 0.01% nonionic surfactant solution while the remaining section was treated with surfactant only. Measurements were taken at 30 min intervals until F_T peaked. Change in relative fluorescence (CRF) was then calculated by subtracting F_T for the control from the maximum F_T for the treated leaf section. T-tests were used to determine if CRF for each morningglory population was different from zero. In addition, data was subjected to ANOVA to compare CRF and initial fluorescence parameters among populations. All morningglory populations showed a significant increase in fluorescence when treated with atrazine, with CRF values ranging from 47 to 62 fluorescence units. Analysis of variance indicated small differences in CRF values, but no differences in initial fluorescence were detected among populations. These data indicate that red morningglory populations were not resistant to atrazine.

A greenhouse study was conducted to evaluate atrazine sensitivity of the morningglory populations evaluated in the laboratory study. The experimental design was a randomized complete block replicated 5 times and the experiment was repeated. Plants at the 2- to 3-leaf stage were treated with 1.1 kg/ha atrazine + 0.25% nonionic surfactant or surfactant only. All plants treated with atrazine were controlled 10 days after treatment at least 99%, supporting the findings of the fluorescence assay.

Field studies were conducted over two years to evaluate preemergence control of red morningglory in sugarcane with atrazine (1.7 kg/ha), diuron (3.4 kg/ha), metribuzin (1.1 kg/ha), terbacil (0.84 kg/ha), sulfentrazone (0.14, 0.28, and 0.42 kg/ha), and azafeniden (0.42, 0.56, 0.71, and 0.84 kg/ha). Red morningglory was controlled 21 days after treatment 90 to 100% with all treatments except terbacil (84% in 1998). Control 45 days after treatment in 1997 with atrazine and

terbacil was 84%, while the remaining treatments gave 89 to 100% control. At the same rating date in 1998, maximum control was observed with all rates of sulfentrazone (84 to 90%) and azafeniden at 0.84 kg/ha (87%). The remaining treatments controlled red morningglory 36 to 78%. Data from field studies demonstrate that red morningglory control with atrazine may decline by 45 days after treatment and that alternative herbicides may increase residual control.

ALTERNATIVE HERBICIDE PROGRAMS FOR DICLOFOP-RESISTANT RYEGRASS IN WHEAT. L.T. Barber, L.R. Oliver and F.L. Baldwin. Department of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville and Arkansas Cooperative Extension Service, Little Rock, AR 72704.

ABSTRACT

Ryegrass (*Lolium sp.*) is a major problem weed in Arkansas wheat production. With the increasing spread of diclofop (Hoelon)- resistant ryegrass across the state, alternative herbicide programs are needed to provide adequate control of the ryegrass. Studies were initiated at Fayetteville and Willow Beach, AR, in 1998 to determine alternative herbicides for control of perennial ryegrass (*Lolium perenne*). A natural infestation of diclofop-resistant perennial ryegrass, which was resistant to 7.5 lb ai/A of diclofop, was present at the Willow Beach location, and seed stock from this location was planted at Fayetteville to establish a resistant ryegrass population.

Studies were conducted at Fayetteville on a silt loam and at Willow Beach on a clay loam. Pioneer cultivar 2684 was drilled in 7-in. rows at both locations at a rate of 90 lb/A. The study at both locations was a randomized complete block with four replications and a plot size of 10 by 24 feet. Treatments were sprayed with a backpack sprayer at 20 GPA. Visual ratings were taken 3, 6, and 12 WAE (weeks after emergence) and at 30 WAE or harvest. Data were subjected to ANOVA, and means were separated by least significant difference at the 0.05 level of significance ($LSD_{0.05}$). Ryegrass control and yield were averaged across locations.

Preemergence (PRE) treatments of chlorsulfuron (Glean), chlorsulfuron + metsulfuron (Finesse) and flufenacet + metribuzin (Axiom) provided excellent control, 95, 93, and 97% at 6 WAE. However, control declined at harvest to 74 and 71% for chlorsulfuron and chlorsulfuron + metsulfuron, respectively, while flufenacet + metribuzin gave only 54% control. At 2- to 3-leaf wheat, MKH 6562 and tralkoxydim (Achieve) + Supercharge (wetting agent) provided 85 and 82% control, respectively, at harvest, which was higher control than from any other herbicide applied alone at this timing. Tank-mixes of chlorsulfuron + pendimethalin (Prowl) PRE and chlorsulfuron + (chlorsulfuron + metsulfuron) at 2- to 3- leaf wheat provided only 74% perennial ryegrass control at harvest. This was lower than metribuzin (Sencor) + tralkoxydim at the 2- to 3- leaf stage, which provided 82% control. Sequential treatments of chlorsulfuron PRE fb (followed by) metribuzin or chlorsulfuron PRE fb chlorsulfuron + metsulfuron at 2- to 3- leaf wheat gave 86% control at harvest. The highest control of the resistant ryegrass (92%) was obtained with pendimethalin + chlorsulfuron PRE fb tralkoxydim at the 2- to 3- leaf wheat stage or (flufenacet + metribuzin) PRE fb MKH 6562 at the 2-to 3-leaf wheat stage.

All herbicide treatments improved wheat yields over the untreated check, which suffered a 35% yield loss due to diclofop-resistant ryegrass. The PRE and early POST applications of a single herbicide provided around 75% control, but yield was not different from sequential herbicide treatments that provided 92% control. However, with less control, a large amount of resistant-ryegrass seed escaped, allowing this weed to be a problem in the future. Treatments containing sequential herbicide applications provided no significant increase in wheat yield but allowed the least amount of diclofop-resistant ryegrass seed to be added to the soil seedbank.

PERFORMANCE OF ACHIEVE AND PROWL ON ANNUAL RYEGRASS IN WINTER WHEAT. G.K. Breeden, G.N. Rhodes, Jr., R.M. Hayes and T.C. Mueller; University of Tennessee, Knoxville 37996.

ABSTRACT

Tennessee producers planted 570,000 acres of wheat (*Triticum aestivum*) in 1998. Much of this acreage was infested with annual ryegrass (*Lolium multiflorum*). Ryegrass continues to be a costly problem in wheat as well as in other crops. This cool season grass competes with wheat for nitrogen and, thereby, reduces yields dramatically. Current management inputs for annual ryegrass include crop rotation, use of nonselective herbicides or tillage in fallow fields, and in-crop applications of Hoelon (diclofop-methyl).

Field studies were conducted at Jackson and Spring Hill, TN during 1998-99 to address this problem and evaluate new herbicides for ryegrass control and crop tolerance. All experiments were replicated 3 or 4 times in a randomized complete block design. New herbicides included in the research were Achieve (tralkoxydim) and Prowl (pendimethalin). Hoelon was included as a standard treatment. Achieve was applied at 7.52 or 9.6 oz./A early postemergence (EPOST) or late postemergence (LPOST). Hoelon was applied at 1.33 or 2 pts./A. preemergence (PRE), delayed preemergence (DPRE), EPOST or LPOST. Prowl was applied at 2.4 or 3.6 pts./A PRE or DPRE. Herbicides were applied with a CO_2 pressurized backpack or tractor sprayer at 15 to 18 gpa, depending upon location. Plots were visually rated using a 0-99% scale.

Achieve applied EPOST provided excellent control (98-99%) when evaluated at 163 days after planting (DAP), which was equal to that of Hoelon when applied EPOST. However, control (85-88%) was significantly lower than that provided by Hoelon when applied LPOST. Achieve, therefore, must be applied timely to provide adequate control. Prowl gave 90-95% control when plots were evaluated at 43 DAP and 83-92% at 218 DAP, when applied PRE or DPRE. Prowl also controlled henbit (*Lamium amplexicaule*) and chickweed (*Stellaria media*) (95% or greater control at 163 DAP). Neither Achieve nor Hoelon controlled these broadleaf weeds. Slight injury (2-13%) was observed with Prowl treatments, with more injury at the higher rates. Yields did not differ among herbicide treatments; however, all treatments increased yield by 15 to 20 bu./A compared to the untreated check.

Our research indicates that both Achieve and Prowl are promising for annual ryegrass control in wheat. This research is being repeated in 1999-00. More information is needed to determine the optimum rates and timings of Prowl, and the influence of environmental conditions on potential wheat injury from Prowl applications.

ALS INHIBITING HERBICIDE INTERACTION WITH ULV MALATHION APPLICATIONS. W.F. Bloodworth, D.B. Reynolds, R.H. Blackley, Jr. and K.M. Bloodworth. Mississippi State University, Miss. State, MS.

ABSTRACT

Herbicide - insecticide interactions can be beneficial in cotton production. An example is the interaction of disulfoton to safen cotton against clomazone injury. However, research has shown there to be a detrimental interaction between applications of malathion and pyrithiobac when applied to cotton. Previous research has shown significant visual injury, but this injury has had little effect on fruiting or yield. In these studies, malathion was applied in high volume applications and also as a tank mix with pyrithiobac. Further laboratory research has shown increased injury when pyrithiobac and malathion are applied in cool conditions. CGA-362622 is a broad spectrum ALS inhibiting herbicide with the proposed common name of trifloxysulfuron sodium. Previous research with CGA-362622 has shown similar effects as pyrithiobac in postemergence applications. These experiments were conducted to determine the interaction of applications of pyrithiobac and CGA-362622 made at various time intervals before and after ultra low volume (ULV) malathion applications under field conditions.

Research was conducted at the Plant Science Research Center near Starkville, MS, and the Black Belt Branch Experiment Station near Brooksville, MS, to evaluate ULV applications of malathion with pyrithiobac and CGA-362622. Aerial malathion applications were made by the Southeastern Boll Weevil Eradication Foundation at 1 pint per acre. Pyrithiobac and CGA-362622 applications were made with a CO_2 backpack sprayer delivering 15 gallons per acre. Data included visual injury (0-100 scale), nodes above white flower (NAWF), nodes above cracked boll (NACB), and yield in the pyrithiobac experiment. In the CGA-362622 experiment, data included visual injury (0-100 scale) and yield.

No visual injury was observed at 7, 14, or 28 DAT rating intervals. NAWF, NACB, and yield exhibited no significant difference between treatments. The results of these preliminary studies indicate that there is no detrimental effect of ULV malathion applications made to cotton when pyrithiobac and CGA-362622 have been applied. The reason these results differ from previous research may be due to using an ultra low application volume rather than standard (e.g. 15 GPA) application volumes of malathion, and no tank mixture. Also, lower injury may be the result of applications being made under warmer field conditions.

ROTATIONAL CROPPING SYSTEMS TO IMPROVE HARD RED WINTER WHEAT GRAIN QUALITY. J.C. Stone, T.F. Peeper, J.T. Sholar, R. Gribble, and A.E. Stone, Oklahoma State University, OK 74078.

ABSTRACT

Producers of hard red winter wheat in Oklahoma are seeking alternative methods of controlling grassy weeds while improving economic returns. Experiments were established in North Central Oklahoma at three locations to agronomically and economically compare three crop rotations for their impact on cheat density. Each rotation was implemented under no tillage and conventional tillage, with eight herbicide programs in each system. The cropping systems included wheat followed by double-crop grain sorghum, wheat followed by double-cropped soybeans, and continuous wheat. These experiments were initiated following wheat harvest in June 1999. Fall cheat densities were significantly less in double-cropped grain sorghum and double-cropped soybean residue in conventional tillage than in no till. Fall panicum and large crabgrass were major weeds at one site. Control of both species was more effective with several treatments in conventional tillage than in no till plots. In no till double-cropped soybeans, sequential applications of Roundup Ultra was the only treatment that controlled both species 100%. Success of the double-crop soybeans and double-cropped grain sorghum appeared highly related to planting date. In conventionally tilled double-crop soybeans and double-crop grain sorghum, no herbicide treatment increased yield over that of the untreated check. In no till double-crop soybeans and double-cropped grain sorghum, no treatment with residual herbicides increased yields over that obtained by applying Roundup Ultra preemergence.

COTTON RESPONSE TO STAPLE AND THRIPS INJURY. R.W. Costello, J.L. Griffin, B.R. Leonard, D.K. Miller, and E.M. Holman Louisiana State University Agricultural Center Baton Rouge, LA.

ABSTRACT

Experiments were conducted in 1998 and 1999 at the Northeast Research Station, near St. Joseph, LA, and at Macon Ridge Research Station, near Winnsboro, LA, to evaluate the relationship of Staple (pyrithiobac) rate and thrips injury on cotton growth and development. Cotton was planted May 29 and May 6 in 1998 and 1999, respectively at St. Joseph and May 13 both years at Winnsboro. Stoneville 474 was the used each year. A split-plot experimental design with four replications was used. Main plots were Temik 15G (aldicarb, 0.5 lb ai/A) applied in-furrow or no Temik. Sub plots were Staple 85WP applied at 0, 0.5, 1, 2, 4, 8, and 16 oz ai/A to 2-3 leaf cotton. Two center rows of each plot were hand-thinned to 2-3 plants per row foot prior to Staple applications. Leaf area per plant was obtained from 0.5m section of row 7, 14, and 28 days after treatment (DAT). Height of 10 plants, total nodes, and nodes to first square were determined at the same time that leaf area was measured. After flowering, node above white flower (NAWF) were determined from 10 plants weekly until NAWF totaled no more than 5. Seedcotton yield was determined by harvesting the center two rows from each plot. Normal cultivation and fertility practices were followed. Plots were kept weed free by hand weeding

The Staple by Temik interaction at each location was not significant for any parameter measured, therefore, data were averaged across Temik treatments. Averaged across years and locations, leaf area/plant 7 DAT was reduced 23 to 36% by 4, 8, and 16 oz/A Staple. At St. Joseph, Staple rates of 2, 4, 8, and 16 oz/A reduced leaf area/plant 14 DAT from 31 to 43% when compared with the nontreated control. No differences in leaf area/plant were observed in 1998 28 DAT or in 1999 at either 14 or 28 DAT. Staple applied at 4, 8, and 16 oz/A reduced cotton height at least 11% at 7 and 14 DAT in 1998 when compared with the nontreated control. At 28 DAT, height of cotton treated with 16 oz/A was 7% less than the nontreated control. Cotton height was not reduced by Staple in 1999. No significant differences were observed among Staple rates for total nodes per plant, nodes to the first square, NAWF, or seedcotton yield.

At Winnsboro, leaf area/plant of cotton treated with 4, 8, or 16 oz/A was 26 to 55% and 41 to 63% less than the nontreated control 14 DAT in 1998 and 1999, respectively. Leaf area/plant 28 DAT in 1998 was reduced 33% by 16 oz/A when compared with the nontreated control. In 1999, all rates of Staple with the exception of 0.5 oz/A reduced leaf area/plant 10 to 51% 28 DAT when compared with the nontreated control. Cotton height 7 DAT was not reduced by Staple applications in 1998, however 14 DAT, height was reduced 13 and 25% with Staple at 8 and 16 oz/A, respectively. In 1999, cotton height was reduced 14 to 25% with Staple at 4, 8, and 16 oz/A 7 DAT and 19 to 29% with 8 and 16 oz/A 14 DAT when compared with the nontreated control. Staple at 4, 8, and 16 oz/A 28 DAT reduced cotton height 12 to 37%. Averaged across years, nodes to the first square were increased by 0.5 and 1.2 nodes with 8 and 16 oz/A. Averaged across years, NAWF were increased by one node with Staple at 16 oz/A. Seedcotton yield was reduced by 16 oz/A only in 1999 when compared with the nontreated control.

COTTON HADSS: A NEW DECISION MAKING TOOL FOR WEED MANAGEMENT IN COTTON (*Gossypium hirsutum*). G.H. Scott, J.W. Wilcut, G.G. Wilkerson, and S.B. Clewis, Crop Science Department, North Carolina State University, Raleigh, NC 27695-7620.

ABSTRACT

The Herbicide Application Decision Support System (HADSS) is a computer program that aids weed management in corn, cotton, peanuts, and soybeans. Inputs required by HADSS include weed counts by species, heights of weeds and cotton, soil moisture status, anticipated yield potential of cotton in the particular field, selling price of cotton, and the cotton variety. HADSS then calculates the expected yield loss based on weed competition and interference research data and provides the user a list of herbicide treatment choices based on the best combination of cost and weed control performances. The objectives of this research were to evaluate weed control, cotton yield, and net returns to land and management systems with traditional management systems.

This research was conducted at Goldsboro, NC in 1998 and 1999, Lewiston, NC in 1998, and Rocky Mount, NC in 1999 on sandy loam soils. The cotton varieties included Stoneville 474 or DeltaPine 51, Stoneville BXN 474, and DeltaPine 5415RR. The tests were scouted four separate times and the results were entered into the HADSS program. The number one recommendation provided by HADSS was then applied on the same day as the scouting. Treatments included a nontreated and weed free check for each variety (nontransgenic, BXN, and Roundup Ready). Herbicide management systems for each variety included 1) Treflan PPI at 1.0 pint/ac followed by (fb) Cotoran PRE at 2 pints/ac fb HADSS recommendation(s), HADSS recommendations without soil-applied herbicides (postemergence treatments only); Treflan PPI fb Cotoran PRE fb Staple early postemergence (EPOST) at 1.2 oz/ac fb Caparol at 2.4 pints/ac + Bueno 6 at 2.7 pints/ac late postemergence-directed (LAYBY) for nontransgenic varieties; Treflan PPI fb Cotoran PRE fb Buctril EPOST at 1 pint/ac fb Caparol + Bueno 6 LAYBY for the BXN variety; and Treflan PPI fb Cotoran PRE fb Roundup Ultra at 1.5 pints/ac EPOST fb Caparol + Bueno 6 LAYBY.

Roundup Ready systems provided control equivalent to or to or better than control provided by Buctril or Staple systems for smooth pigweed (*Amaranthus hybridus*), Palmer amaranth (*Amaranthus palmeri*), large crabgrass (*Digitaria*

sanguinalis), goosegrass (*Eleusine indica*), ivyleaf morningglory (*Ipomoea hederacea*), and fall panicum (*Panicum dichomiflorum*). Jimsonweed (*Datura stramonium*) was controlled >90% with all systems. Soil applied herbicides fb HADSS recommendations provided equivalent or higher levels of weed control than soil applied herbicides fb Staple, Buctril, or Roundup fb Caparol + Bueno 6. Lint yields of cotton and net returns in the Roundup Ready systems were always equal to or higher than non-transgenic or BXN systems. In 11 of 12 comparisons, the soil-applied herbicides fb HADSS recommendations provided net returns equivalent to the standard system for each respective variety. Net returns were higher for soil applied herbicides fb HADSS recommendations in 8 of 12 comparisions with HADSS POST-only systems. Early-season weed interference reduced cotton lint yields and net returns in the HADSS POST-only systems.

Total seed, herbicide application, and herbicide costs for systems containing HADSS were always greater than the standard POST systems for each variety with few exceptions. Soil-applied herbicides fb HADSS recommendation system application, seed, and herbicide costs were higher in 8 of 12 comparisons. The average cost of the standard POST and soil-applied plus HADSS were $40.49/ac and $54.66/ac, respectively. However , the net returns for the the standard POST and soil-applied plus HADSS were $218/ac and $231/ac, respectively.

CHEAT (*Bromus secalinus*) CONTROL WITH MON 37500 AND MKH 6561 IN WINTER WHEAT. J.P. Kelley and T.F. Peeper, Senior Agriculturist and Professor, Department of Plant and Soil Sciences, Oklahoma State University, Stillwater, OK 74078.

ABSTRACT

Field trials were conducted in at three locations in central Oklahoma during the 1998-1999 crop year to evaluate the effect application timing of MON 37500 and MKH 6561 on wheat injury, cheat control and wheat yield. Treatments were applied on an approximate ten day interval, beginning with a preemerge treatment in early October and continuing with postemergence treatments until mid March. MON 37500 was applied at 0.031 lb ai/a and MKH 6561 was applied at 0.04 lb ai/a. All treatments were applied at 20 GPA using a CO_2 pressurized backpack sprayer. All postemergence treatments were applied with 0.25% v/v AG-98 surfactant. Wheat chlorosis was most apparent from fall applications and was similar for both herbicides. Cheat control from the preemerge treatments was 86 % for MON 37500 and 96% for MKH 6561 averaged over three sites. Postemergence cheat control, averaged over three sites, ranged from 63% to 98% with MON 37500, depending on time of application and 84% to 99% with MKH 6561 depending on time of application. Fall applications gave more consistent cheat control for both herbicides. Wheat yields were greater from fall applications than from spring applications, but all applications increased wheat yields compared to untreated check.

A field trial was conducted in north central Oklahoma in the 1998-1999 growing season to evaluate cheat control in post-grazing wheat with MON 37500 and MKH 6561. Treatments evaluated included; MON 37500 at 0.023 and 0.031 lb ai/a and MKH 6561 at 0.027, 0.04, and 0.027 + Sencor at 0.188 lb ai/a. Tonkawa, hard red winter wheat was seeded in late September in 7 by 25-ft plots. Cattle began grazing cheat-infested wheat in mid November and continued through late February. Cattle were removed and two days later, treatments were applied. All treatments were applied at 20 GPA using a CO_2 backpack sprayer. Cheat control at heading ranged from 54% to 56% for MON 37500 treatments and 99% to 100% for MKH 6561 treatments. Wheat in the untreated check yielded 18.4 bu/a while MON 37500 treatments yielded 27.3 and 30.9 bu/a. Wheat yield from MKH 6561 treatments ranged from 29.1 to 35.1 bu/a.

THE INFLUENCE OF GLYPHOSATE APPLICATION TIMING ON PURPLE NUTSEDGE CONTROL AND BOLL DEVELOPMENT IN GLYPHOSATE-TOLERANT COTTON. M.W. Edenfield, B.J. Brecke, D.L. Colvin, J.A. Dusky, and D.G. Shilling, University of Florida, Gainesville, FL 32601.

ABSTRACT

Experiments were conducted at the West Florida Research and Education Center near Jay, FL in 1997, 1998, and 1999. Cotton >DP 5415 RR= was planted the first week of May in each year and the entire site was treated with pendimethalin at 0.84 kg/ha PPI and fluometuron at 1.7 kg/ha PRE. In the first study glyphosate and MSMA herbicide programs and cultivation were evaluated over three years for purple nutsedge control and impact on tuber populations. Treatments were applied to the same plots each year. A split-plot design was utilized with cultivation (+/- two early-season cultivations) as main plots and herbicide treatments as subplots. Herbicide treatments included glyphosate at 1.12 kg/ha postemergence (POT) to 4 leaf cotton followed by (fb) glyphosate at 1.12 kg/ha directed postemergence (DP); norflurazon at 1.7 kg/ha preemergence (PRE) fb MSMA at 1.12 kg/ha POT at 4 leaf cotton fb MSMA at 2.24 kg/ha plus cyanazine at 0.85 kg/ha DP; and an untreated check.

Glyphosate, regardless of cultivation, was the most effective treatment for purple nutsedge control and reducing nutsedge tubers in 1997. MSMA POT fb MSMA plus cyanazine DP resulted in 65% mid-season control, which increased to 75% with cultivation in 1997. There was no difference in control between glyphosate or MSMA POT fb MSMA plus cyanazine DP provided cultivation was included with the MSMA treatment. All treatments reduced purple nutsedge tubers from year to year except for the untreated check without cultivation. Tuber density for the untreated uncultivated check increased from 325 tubers per 0.25 m^2 in 1997 to 425 tubers in 1999. Glyphosate treatments resulted in 58, 14,

and 7 tubers per 0.25 m^2 in 1997, 1998, and 1999. The sequential MSMA treatment without cultivation resulted in 203, 12, and 9 tubers per 0.25 m^2 in 1997, 1998, and 1999. The sequential MSMA treatment with cultivation resulted in 41, 3, and 3 tubers per 0.25 m^2 in 1997, 1998, and 1999.

In the second study, the effect of glyphosate on cotton fruit development and yield was investigated in 1999. Glyphosate at 0.85 kg/ha was applied POT to 4, 6, 8, 10, and 12 leaf cotton. Sequential applications of glyphosate POT and DP were applied at 4 leaf fb 6 leaf, 4 leaf fb 8 leaf, 4 leaf fb 10 leaf, and 4 leaf fb 12 leaf cotton. Plots were maintained weed-free. At season=s end following defoliation, 10 cotton plants per plot were randomly chosen for plant mapping and boll analysis following defoliation and prior to harvest.

Most growth parameters of cotton were not affected by glyphosate. Single POT applications of glyphosate at 12 leaf cotton reduced position 1 boll retention. Position 1 boll retention was not affected when applied at 4, 6, 8, or 10 leaf POT. Position 1 boll retention was also reduced when glyphosate was applied 4 leaf POT fb 10 or 12 leaf POT. No glyphosate treatment reduced position 2 boll retention, or position 1 and 2 boll retention on the 5 lowest sympodial branches. Even though glyphosate reduced position 1 boll retention at 10 and 12 leaf POT, there was no yield difference between any glyphosate treatments and the untreated check.

WEED MANAGEMENT AND CROP TOLERANCE IN GLUFOSINATE-TOLERANT COTTON. L.K. Blair, P.A. Dotray, J.W. Keeling, J.R. Gannaway, L.L. Lyon, M.J. Oliver, and J.E. Quisenberry. Texas Tech University, Texas Agricultural Experiment Station, USDA-ARS, Lubbock, TX and USDA-ARS, Hilo, Hawaii.

ABSTRACT

Glufosinate tolerance in cotton has recently been achieved by the insertion and expression of the BAR gene into Coker 312 from *Streptomyces hygroscopicus.* In 1997 and 1998, field experiments conducted at the Texas Agricultural Experiment Station near Lubbock showed that regardless of cotton growth stage at application, number of applications or glufosinate application rate, no visual injury nor adverse effects on cotton development, yield or fiber quality were observed in either year. Sequential applications of glufosinate were applied again to glufosinate-tolerant cotton in 1999. Glufosinate at 0.54 lb ai/A was applied to cotton in the 0-1, 3-4, 9-10, and 14-15 leaf stage in all possible combinations. Plots, 4 rows by 40 feet, were maintained weed-free throughout the growing season. Visual injury was evaluated 7, 14, and 21 days after treatment. Plant heights were evaluated 21 and 56 days after treatment. At harvest, plants were mapped and lint yield and fiber quality determined.

No visual injury was observed as a result of sequential glufosinate applications. Yield, micronaire, length, and strength were not adversely effected by the herbicide applications. No differences in plant height, nodes per plant, or number of first position bolls following glufosinate applications. These results were similar to those obtained in 1997 and 1998.

In 1998 and 1999, annual weed control in glufosinate-tolerant cotton was evaluated. Trifluralin was applied alone at 0.75 lb/A preplant incorporated or followed by (fb) prometryn at 1.0 lb/A applied preemergence. Glufosinate at 0.36 lb/A was applied postemergence topical alone or in combination with the soil applied treatments. All herbicide treatments were used with and without cultivation. Cotton, Palmer amaranth (*Amaranthus palmeri*), and devil's-claw (*Proboscidea louisianica*) height and Palmer amaranth and devil's-claw densities in nontreated control plots were taken at the time of glufosinate applications. After each herbicide application, Palmer amaranth and devil's-claw control was evaluated.

In 1998, late-season (10 weeks after planting) Palmer amaranth was controlled 95% by trifluralin fb glufosinate and 91-96% by trifluralin fb prometryn fb glufosinate. Prometryn alone, glufosinate alone, or prometryn fb glufosinate did not provide acceptable Palmer amaranth control (4-55%), even when cultivation was used. The use of cultivation with trifluralin fb glufosinate or trifluralin fb prometryn fb glufosinate controlled devil's-claw 91-98% late-season. In 1999, late season palmer amaranth was controlled (94-99) by trifluralin fb prometryn fb glufosinate applied alone and with cultivation. Prometryn fb glufosinate controlled Palmer amaranth 85-97%. Trifluralin fb glufosinate provided similar late-season control (87-95%). Although glufosinate alone plus cultivation did not provide late-season control in 1998, glufosinate plus cultivation controlled Palmer amaranth 84% in 1999. Throughout the growing season in 1999, the use of cultivation with glufosinate alone or glufosinate used in conjunction with trifluralin, prometryn, or a combination of trifluralin and prometryn controlled devil's-claw 93-100%.

In 1998, plots following the use of trifluralin fb glufosinate or trifluralin fb prometryn fb glufosinate yielded similar regardless if cultivation was used (305 and 313 lb/A); however, when cultivation was employed, plots treated with trifluralin fb prometryn fb glufosinate yielded approximately 89 lb/A more than trifluralin fb glufosinate. Trifluralin fb prometryn fb glufosinate and trifluralin fb glufosinate treated plots provided the greatest cotton yields in 1999. Also, glufosinate applied alone or in combination with prometryn improved yields as compared to the nontreated control.

Results from 1997-1999 field experiments showed that glufosinate-tolerant cotton is tolerant to glufosinate throughout the growing season. Effective palmer amaranth and devil's-claw were achieved using glufosinate as part of the overall weed management program.

EVALUATION OF CGA 362622 IN LOUISIANA SUGARCANE. E.P. Richard, Jr. Sugarcane Research Unit, USDA-ARS, SRRC, Houma, LA 70361.

ABSTRACT

Louisiana's sugarcane industry is dependent on triazine and dinitroaniline herbicides for the control of problem weeds within the crop. Often the spectrum of targeted weeds and the length of the growing season necessitates the use of multiple applications and/or mixtures containing both classes of herbicide. The increased selection pressure from frequent applications increases the likelihood of weeds developing tolerance to these herbicides. The continued use of both classes of herbicide is also in jeopardy because of environmental concerns being raised, especially with the triazines and atrazine in particular. Research conducted since the 1997 growing season evaluated the use of CGA 362622, a member of the sulfonylurea class of herbicides, at rates of 0.21 to 0.86 oz ai/A for the preemergence (PRE) and postemergence (POST) control of weeds within the sugarcane crop.

Seedling johnsongrass control with CGA 362622 at 0.21 to 0.43 oz ai/A applied PRE and POST was similar, averaging 58 and 68%, respectively, 28 days after treatment (DAT). Johnsongrass control with CGA 362622 PRE was equivalent to the levels of control obtained with standard applications of atrazine, but lower than the levels of control obtained with diuron, metribuzin, and pendimethalin. When applied POST, control with CGA 362622 was equivalent to the control obtained with diuron and better than the control obtained with atrazine, metribuzin, and pendimethalin. Morningglory (red and entireleaf) control 28 DAT with CGA 362622 was equivalent to the control obtained with the standards, especially when applied POST at 0.43 oz/A. Purple and yellow nutsedge control with CGA 362622 PRE was equivalent to the control obtained with metribuzin and superior to the control obtained with diuron, atrazine, and pendimethalin. As a POST spray, nutsedge control was significantly higher where CGA 362622 was applied than any of the standards. Itchgrass control was observed in one study and appeared to be greatest (57 to 90%) when CGA 362622 was applied PRE.

Some sugarcane injury in the form of a chlorotic band on leaves that were still part of the whorl at the time of treatment was observed by 14 DAT. The degree of chlorosis depended on rate, environmental conditions at the time of treatment, and cultivar. Injury ranged from 0 to 28% by 28 DAT and was greater for the cultivar 'CP 70-321' than for the cultivars 'LCP 85-384' and 'HoCP 85-845'. Crop injury from CGA 362622 applications of less than 0.86 oz/A did not result in significant reductions in sugarcane stalk numbers or heights for all years and cultivars evaluated and in sugar yield in one mechanically-harvested study in 1999 planted to 'LCP 85-384' sugarcane.

The labeling of CGA 362622 for sugarcane would provide the Louisiana sugarcane grower with a new class of chemistry that provides POST control of seedling johnsongrass, morningglory, and nutsedge at rates which would pose a minimal threat to the environment. Additional information is needed regarding itchgrass control and the influence of weed size and application timing on CGA 362622's efficacy.

LONG-TERM CONTROL OF REDVINE (*Brunnichia ovata*) IN ROUNDUP READY SOYBEAN. D.S. Akin, D.R. Shaw, and S.G. Flint, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

In the past, chemical control of tough perennial weeds such as redvine entailed the use of few herbicides and could not be used during the soybean growing season. These applications were to be made when the rate of photosynthate translocation is at its highest, particularly in the fall prior to harvest. Since the development and introduction of glyphosate-tolerant soybean, producers can now implement weed control strategies to control weeds with in-season applications of glyphosate. Therefore, perennial and annual weed control strategies can be integrated in order to eliminate unnecessary applications of glyphosate or other herbicides for more complete control of both redvine and annual weeds in a systems approach.

Experiments were conducted at two locations in the North Delta of Mississippi to evaluate long-term control of redvine with in-season applications of glyphosate. Glyphosate rates include 0.56, 0.84, 1.1, 1.7, and 2.2 kg ai/ha, applied at various in-season timings: PO-3WAP (weeks after planting), PO-4WAP, PO-5WAP, PO-7WAP, and preharvest. Preplant herbicides 0.84 kg ai/ha glyphosate or 0.63 kg ai/ha paraquat were included for comparison. Dicamba preharvest at 2.2 kg/ha was also used in this study for comparison. Treatments were applied during the growing season of 1998, and redvine density was determined during the growing season of 1999. Yield was also measured in 1999 to determine the effects of redvine density on soybean yield.

During June, redvine population was 24.2 stems/m^2 for the untreated check (paraquat preplant alone). Treatments containing in-season applications of 1.1 followed by 2.2 kg ai/ha glyphosate (glyphosate or paraquat preplant) controlled redvine better than the untreated check, with 13.1 and 7.4 stems/m^2 for glyphosate preplant and paraquat preplant, respectively. Three sequential applications of glyphosate (including 2.2 kg/ha at preharvest) controlled redvine equally well, with 10.5 stems/m^2. Control from these treatments was comparable to dicamba preharvest (6.6 stems/m^2).

In August, both treatments containing glyphosate 1.1 followed by 2.2 kg ai/ha controlled redvine better than the untreated check (31.1 stems/m^2). Stem counts for these treatments were 18.3 and 11.7 stems/m^2 for glyphosate preplant and paraquat preplant, respectively. Again, these treatments controlled comparable to dicamba, with a stem count of 8.5 stems/m^2.

In October, only paraquat preplant followed by 1.1 followed by 2.2 kg ai/ha glyphosate controlled redvine better than the untreated check. Redvine population in the untreated check was 30.6 stems/m^2, while in the herbicide treatment it was 16.8 stems/m^2. Most treatments receiving two sequential applications of glyphosate in-season were comparable to dicamba preharvest. All treatments containing preharvest applications of glyphosate also controlled redvine as well as dicamba.

Soybean yield for both treatments containing 1.1 followed by 2.2 kg ai/ha glyphosate was 1250 and 1317 kg/ha for glyphosate preplant and paraquat preplant, respectively. Yield following 1.1 followed by 1.1 kg/ha glyphosate in-season followed by a preharvest application of 1.1 kg ai/ha glyphosate was 1317 kg/ha. Yield for both untreated checks were 927 and 733 kg/ha for glyphosate preplant and paraquat preplant, respectively.

COMPARISON OF WEED CONTROL SYSTEMS WITH VARIOUS ROW SPACING IN TRANSGENIC SOYBEAN CULTIVARS. J.L. Norris, D.R. Shaw, C.E. Snipes, and T.H. Koger, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762; and Delta Research and Extension Center, Stoneville, MS 38776.

ABSTRACT

Field studies were conducted at the Delta Research and Extension Center, Stoneville, MS and Plant Science Research Center, Starkville, MS, to evaluate the effects of row spacing in Roundup Ready and Liberty Link weed management systems. Asgrow 5901RR, a Roundup Ready cultivar of the maturity group (MG) V, and Asgrow 5547LL, a MG V with the Liberty Link gene, were used in this study. Treatments for the Roundup Ready system were: untreated, 1120 g ai/ha glyphosate, 560 g/ha glyphosate followed by 280 g/ha glyphosate, 840 g/ha glyphosate followed by 560 g/ha glyphosate, 840 g ai/ha pendimethalin plus 140 g ai/ha imazaquin PRE, 840 g/ha pendimethalin plus 140 g/ha imazaquin PRE followed by 840 g/ha glyphosate, 420 g/ha pendimethalin plus 70 g/ha imazaquin PRE followed by 487 g/ha glyphosate, 840 g/ha pendimethalin plus 140 g/ha imazaquin PRE followed by 279 g ai/ha bentazon plus 560 g ai/ha acifluorfen. Treatments for the Liberty Link system were: untreated, 560 g/ha glufosinate, 280 g/ha glufosinate followed by 280 g/ha glufosinate, 420 g/ha glufosinate followed by 420 g/ha glufosinate, 840 g/ha pendimethalin plus 140 g/ha imazaquin PRE, 840 pendimethalin plus 140 g/ha imazaquin PRE followed by 420 g/ha glufosinate, 420 g/ha pendimethalin plus 70 g/ha imazaquin PRE followed by 280 g/ha glufosinate, 840 g/ha pendimethalin plus 140 g/ha imazaquin PRE followed by 279 g/ha bentazon plus 560 g/ha acifluoren . Row spacings of 38 and 76 cm were used with both cultivars.

Sicklepod [*Senna obtusifolia* (L.) Irwin and Barnaby], pitted morningglory (*Ipomoea lacunosa* L.), large crabgrass [*Digitatia sanguinalis* (L.) Scop.], barnyardgrass [*Echinochola crus-galli* (L.) Beauv.], and hemp sesbania [*Sesbania exltata* (Raf.) Rydb. ex. A.W. Hill] were the predominant species. Pendimethalin plus imazaquin followed by glyphosate controlled pitted morningglory more than glyphosate alone in both 38 and 76 cm rows 7 weeks after planting (WAP). Pendimethalin plus imazaquin followed by glyphosate did not increase pitted morningglory control compared to two applications of glyphosate in either row spacing. Pendimethalin plus imazaquin followed by glyphosate controlled sicklepod more than glyphosate alone. Pendimethalin plus imazaquin plus glyphosate increased hemp sesbania control in 76 cm rows compared to two applications of glyphosate. Glyphosate at 840 g/ha followed by 560 g/ha controlled hemp sesbania more than treatments of pendimethalin plus imazaquin alone. Large crabgrass control was equal within the treatments exccept for one application of glyphosate. Pendimethalin plus imazaquin followed by glyphosate did not improved large crabgrass control compared to two applications of glyphosate in either row spacing. Glufosinate at 420 g/ha followed by 420 g/ha glufosinate controlled hemp sesbania more than the conventional herbicide treatment at 5 WAP. Pendimethalin plus imazaquin followed by glufosinate controlled sicklepod in 38 cm rows more than two application of glufosinate. Pendimethalin plus imazaquin followed by bentazon plus acifluorfen controlled pitted morningglory more in 76 cm rows than in 38 cm rows. Pendimethalin plus imazaquin followed by glufosinate controlled large crabgrass more than one application of glufosinate, regardless of row spacing. Treatments containing glufosinate controlled barnyardgrass more than the conventional herbicide treatments. There was no difference in yield among the herbicide treatments in 38 cm rows. In 76 cm rows, yield was lower than in 38 cm rows following pendimethalin plus imazaquin alone.

COMPARISON OF NEW GRAMINICIDES IN RICE. N.W. Buehring, F.L. Baldwin and R.E. Talbert; University of Arkansas Cooperative Extension Service, Little Rock, AR and Department of Crop, Soil and Environmental Science, University of Arkansas, Fayetteville, AR.

ABSTRACT

Due to an increase in barnyardgrass (*Echinochloa crus-galli*) resistance to propanil and quiniclorac, new herbicides are needed to provide control alternatives. Three ACCase herbicides: fenoxaprop+safener (AgrEvo), cyhalofop-butyl (Dow Agrosciences), and clefoxydim (BASF) were evaluated in 1999. To identify the strengths and weaknesses of each of these, trials were established at Lonoke and Stuttgart, AR. Data was collected for rice injury, broadleaf signalgrass (*Bracharia platyphylla*), barnyardgrass, propanil-resistant barnyardgrass and Amazon sprangletop (*Leptochola panicoides*) control and yield. Treatments in each experiment were arranged in factorial design with four replications. Normal rice growing practices were used and all treatments were applied with backpack equipment in a spray volume of 10 GPA.

Rice injury was rated nine days after a two to three leaf application. Of the three compounds, clefoxydim at 0.089 lbs ai/a had the highest injury rating at 31% injury. Fenoxaprop+safener at 0.08 lbs ai/a resulted in 16% injury and cyhalofop-butyl at 0.25 lbs ai/a resulted in 5% injury.

Cyhalofop-butyl at 0.125 lbs ai/a, clefoxydim at 0.067 lbs ai/a and fenoxaprop+safener at 0.04 lbs ai/a provided 98% control of broadleaf signalgrass when applied at 2-3 leaf timing. Cyhalofop-butyl at 0.25 lbs ai/a and fenoxaprop+safener at 0.08 lbs ai/a provided 98% control of broadleaf signalgrass when applied at pre-flood timing. However, clefoxydim at 0.089 lbs ai/a provided only 75% control of broadleaf signalgrass at a pre-flood timing.

None of the compounds showed any significant difference in control between propanil-resistant and -susceptible barnyardgrass. Cyhalofop-butyl at 0.25 lbs ai/a provided 97% control of barnyardgrass, clefoxydim at 0.089 lbs ai/a provided 90% control of barnyardgrass and fenoxaprop+safener at 0.06 lbs ai/a provided 93% control of barnyardgrass when they were applied at 2-3 leaf timing. However, the results were quite different when they were applied pre-flood. Cyhalofop-butyl at 0.25 lbs ai/a, clefoxydim at 0.089 lbs ai/a and fenoxaprop+safener at 0.08 lbs ai/a provided only 52 to 59% control when they were applied at pre-flood timing.

Amazon sprangletop control was 98% with cyhalofop-butyl at 0.188 lbs ai/a, clefoxydim at 0.089 lbs ai/a and fenoxaprop+safener at 0.04 lbs ai/a when they were applied at 2-3 leaf timing. At a pre-flood timing, cyhalofop-butyl at 0.25 lbs ai/a provided 70% control, clefoxydim at 0.089 lbs ai/a provided 91% control and fenoxaprop+safener at 0.04 lbs ai/a provided 98% control.

A separate trial was established in Lonoke, AR to evaluate these compounds in post-flood conditions. Cyhalofop-butyl at 0.25 lbs ai/a provided excellent control of broadleaf signalgrass and barnyardgrass (98% and 96%). Fenoxaprop+safener at 0.08 lbs ai/a provided only 80% control of broadleaf signalgrass and 38% control of barnyardgrass. Clefoxydim at 0.089 lbs ai/a provided poor control of broadleaf signalgrass and barnyardgrass when applied post-flood (23% and 28%).

EVALUATION OF GRASS ACTIVITY OF SULFONAMIDE HERBICIDES. W.B. Henry, D.R. Shaw, and C.T. Leon, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

This experiment was designed to determine the efficacy of sulfonamide herbicides applied PRE on several grass species. The two components of this study were a greenhouse portion and a field portion. Field studies were conducted at the Plant Science Research Center, Starkville, MS, (Marietta fine sandy loam), and the Brown Loam Branch Experiment Station, Raymond, MS, (Riedtown silt loam). The greenhouse component was conducted in Starkville with a Marietta silty loam soil. All herbicides were applied PRE on the following grass species: barnyardgrass [*Echinochloa crus-galli* (L.) Beauv.], broadleaf signalgrass (*Brachiaria platyphylla* Griseb.) Nash, browntop millet [*Brachiaria ramosa* (L.) Stapf.], large crabgrass [*Digitaria sanguinalis* (L.) Scop.], goosegrass [*Eleusine indica* (L). Gaertn.], johnsongrass [*Sorgum halepense* (L). Pers.], and red rice (*Oryza sativa* L.). The full rate sulfonamide treatments included 70 g ai/ha flumetsulam, 26 g ai/ha diclosulam, 44 g ai/ha cloransulam-methyl, 36g ai/ha cloransulam-methyl+ flumetsulam, and 140 g ai/ha imazaquin as a comparison treatment.

The sulfonamide treatments generally exhibited grass control equal to, and at times greater than, imazaquin. Barnyardgrass was controlled equally well with flumetsulam and imazaquin. At 5 WAP, full rates of flumetsulam and imazaquin controlled 40 and 46%, respectively, in the greenhouse and 53 and 78%, respectively, in the field. Cloransulam-methyl+ flumetsulam controlled barnyardgrass better than either flumetsulam or imazaquin, at 66% in the greenhouse and 96% in the field. Among all of the half-rate treatments, imazaquin offered the least effective control of broadleaf signalgrass. In the greenhouse, full rates of sulfonamide treatments performed equally well on broadleaf signalgrass. In the field, the flumetsulam controlled broadleaf signalgrass best, ranging up to 65% at 4 WAP and 60% at 6 WAP. Browntop millet control followed a trend similar to that observed in barnyardgrass. Flumetsulam and

imazaquin controlled 54 and 64%, respectively, whereas diclosulam and cloransulam-methyl+ flumetsulam controlled browntop millet 90 and 93%, respectively. Large crabgrass was controlled 45 to 70% by all treatments except flumetsulam, which controlled 34 to 39%. Control of goosegrass, johnsongrass, and red rice was generally equal among all treatments.

Sulfonamide herbicides applied PRE offered limited grass activity in addition to broadleaf activity. This may be particularly important during the early growing season when it may be too wet to get into the field and apply postemergence herbicides. The data suggest that a PRE application of a sulfonamide may expand the application window for early season control of grasses. This is of particular importance because some studies suggest early season grass competition may be correlated to yield reduction.

WEED CONTROL PROGRAMS IN LIBERTY LINK RICE. H.C. Smith, J.E. Street, D.B. Reynolds, M.E. Kurtz, and R.M. Cobill. Department of Plant and Soil Sciences, Mississippi State, Mississippi, and Delta Branch Experiment Station, Stoneville, Mississippi.

ABSTRACT

In 1998 and 1999, field studies were conducted at the Plant Science Research Center in Starkville, Mississippi to evaluate the efficacy of Liberty (glufosinate) alone and in sequential applications for red rice (*Oryza sativa* L.) control. Field studies were also conducted in 1998 and 1999 at the Plant Science Research Center in Starkville, Mississippi and the Delta Branch Experiment Station in Stoneville, Mississippi to evaluate Liberty at various rates above and in combinations with Facet (quinclorac) for pitted morningglory (*Ipomoea lacunosa* L.) and barnyardgrass [*Echinochloa crus-galli* (L.)] spore control.

In both experiments treatments were arranged in a randomized complete block design with three replications in one experiment and four replications in the other. All treatments were applied at 15 GPA to experimental units that were 5.5 ft by 15 ft in size. Treatments in the red rice experiment included Liberty at 0.5 lb ai/A early postemergence over-the-top (EPOT), Liberty at 0.75 lb ai/A EPOT, Liberty at 0.375 lb ai/A EPOT followed by (fb) Liberty at 0.375 lb ai/A late postemergence over-the-top (LPOT), and Liberty at 0.5 lb ai/A fb Liberty at 0.5 lb ai/A LPOT. Treatments in the weed control experiment included Liberty at 0.375 lb ai/A EPOT, Liberty at 0.5 lb ai/A EPOT fb Liberty at 0.5 lb ai/A LPOT, Liberty at 0.38 lb ai/A tankmixed with Facet at 0.4 lb ai/A EPOT, Facet at 0.4 lb ai/A delayed preemergence (DPRE), and Facet at 0.4 lb ai/A DPRE fb Liberty at 0.38 ai/A mid-season postemergence over-the-top (MPOT). Ratings were taken on both trials at 7 day intervals after the first postemergence treatment until 35 DAT.

Red rice control ranged from 78 to 100% across all evaluation intervals in both 1998 and 1999. In the weed control test in 1998 at Starkville, by 21 DAT, all treatments controlled pitted morningglory and barnyardgrass at least 87%, with no differences among treatments. By 35 DAT, Liberty at 0.375 lb ai/A EPOT provided less control than all other treatments. Plots receiving Facet at 0.4 lb ai/A DPRE yielded significantly less than all other treatments (83-122 Bu/A) at the Starkville location in 1998. In Starkville in 1999, at 14 DAT, there were no significant differences among treatments for pitted morningglory and barnyardgrass control with the exception of Facet at 0.4 lb ai/A which was significantly less than other treatments. At 35 DAT, Liberty at 0.5 lb ai/A EPOT fb Liberty at 0.5 lb ai/A LPOT and Facet 0.4 lb ai/A DPRE fb Liberty at 0.38 lb ai/A MPOT exhibited significantly higher control of barnyardgrass than all other treatments.

In the weed control test at Stoneville in 1998, there were no significant differences among treatments for control of pitted morningglory or barnyardgrass at 35 DAT with the exception of Facet at 0.4 lb ai/A DPRE. In 1999 at Stoneville, Liberty at 0.375 EPOT exhibited significantly less pitted morningglory and barnyardgrass control than all other treatments at 21 and 35 DAT. Yield was significantly higher following Liberty at 0.5 lb ai/A EPOT fb Liberty at 0.5 lb ai/A LPOT and following Facet 0.4 lb ai/A DPRE fb Liberty at 0.38 lb ai/A MPOT than all other treatments.

WEED CONTROL AND IMIDAZOLINONE-TOLERANT RICE RESPONSE TO IMAZETHAPYR APPLICATION TIMINGS. J.A. Masson, E.P. Webster, and S.N. Morris. Louisiana State University Agricultural Center, Baton Rouge, LA, 70803.

ABSTRACT

A study was established to evaluate weed control and crop response with imidazolinone-tolerant (IT) rice in water-seeded culture in 1998 and 1999 at the Rice Research Station near Crowley, LA. The research area was naturally infested with barnyardgrass (*Echinochloa crus-galli* L.) and Indian jointvetch (*Aeschynomene indica* L.) both years of this study, and red rice (*Oryza sativa* L.) was present in 1998. The experimental design was an augmented 3 factor-factorial with a nontreated control added in a randomized complete block. Factor A consisted of imazethapyr at 70, 105, and 140 g ai/ha. Factor B consisted of four soil application timings: 1) PPI, 2) surface prior to seeding (SURFACE), 3) surface following seeding (SEED), and 4) at pegging (PEG). Factor C consisted of 70 g/ha imazethapyr postemergence (POST) on 2 to 3-leaf rice, or no POST. A non-ionic surfactant at 0.25% v/v, was added to all POST applications. Pre-germinated '93 AS-3510' imidazolinone-tolerant rice was water-seeded on May 22, 1998 and July 8, 1999, on a Crowley silt loam with

5.5 pH and 1.4% organic matter. Plot size was 1.5 by 6 meters. Applications were made with a CO_2 pressurized backpack sprayer set to deliver 140 L/ha. Weed control and rice injury was evaluated 28 and 42 days after POST treatment (DAT). All data were subjected to analysis of variance, testing all possible interactions of herbicide rate, application timing, POST application, and years. Treatment differences were compared by Fisher's protected LSD test at the 5% level of significance.

A year interaction occurred for barnyardgrass control at 28 and 42 DAT; therefore, data were averaged over herbicide rate, soil application timing, and POST treatment. In 1998, barnyardgrass control was 96% at 28 DAT, compared with 93% in 1999. At 42 DAT, barnyardgrass control decreased to 88% in 1998, compared with 94% control in 1999. Previous barnyardgrass control evaluations with imazethapyr reported similar results.

An interaction occurred for imazethapyr rate by soil application timing by POST application for Indian jointvetch control at 28 and 42 DAT; therefore, data were averaged over years. At 28 DAT, control was 70 and 74% with 105 and 140 g/ha imazethapyr PEG followed by POST, respectively, all other treatments controlled Indian jointvetch less than 70%. At 42 DAT, control was 80% with 140 g/ha imazethapyr SURFACE and 79% with 70 g/ha imazethapyr SEED followed by POST, control with all other treatments was below 75%.

Red rice control was only evaluated in 1998. Control was at least 95% for all treatments at 28 DAT, and 85 to 98% at 42 DAT with no differences observed. Averaged over all factors, red rice control was 96 and 95% at 28 and 42 DAT, respectively. These data indicate that red rice is controlled with imazethapyr; however, two applications will be needed to prevent escapes and limit the potential for outcrossing.

A year by soil application timing interaction for rice injury occurred at 28 DAT; therefore, data were averaged over imazethapyr rate and POST application. Rice injury increased as application timing was delayed from PPI to PEG in 1998 at both rating dates. In 1998, rice injury was 16% with a PEG application, all other application timings injured rice 4 to 7% at 28 DAT. In 1999, no injury was observed at 28 DAT. All application timings had greater injury in 1998 compared with 1999. At 42 DAT, rice injury was less than 5% for all application timings and years with no differences observed. Rice injury has been observed previously with PEG applications of imazethapyr; however, previous research indicates by applying imazethapyr prior to emergence of green tissue can reduce injury.

In conclusion, barnyardgrass and red rice were controlled with imazethapyr at all rates and timings evaluated in this study. Indian jointvetch control was consistent over years, but not application timing or rate. Imazethapyr is less effective on weeds in the Fabaceae family, this may explain why Indian jointvetch is tolerant. Other problem rice weeds such as hemp sesbania (*Sesbania exaltata* Rydb. ex A.W. Hill) and Texasweed (*Caperonia palustris* (L.) St. Hil.) belong to the family Fabaceae, and similar control problems with imazethapyr have been reported. Indian jointvetch may be suppressed by imazethapyr, but other herbicides will be needed to achieve acceptable control. Rice injury was 16% with all PEG applications in 1998 at 28 DAT. However, in 1999, due to late study establishment, rice injury was less severe, indicating that crop response to imazethapyr may be affected by temperature. Imidazolinone tolerant rice technology can be beneficial in a rice weed control program; however, other herbicides will be needed to control problem broadleaf weeds.

EVALUATION OF CULTURAL PRACTICES AND IMAZETHAPYR APPLICATION TIMINGS IN CLEARFIELD RICE. R.J. Levy, Jr., E.P. Webster, S.D. Linscombe, and W. Zhang, Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

A study was established in 1999 at the Rice Research Station near Crowley, Louisiana to evaluate weed control, crop response, and yield of Clearfield[a] Rice (*Oryza sativa* L.) '93 AS 3510' to imazethapyr applications under different cultural practices. The experimental design was a split-split plot design with seeding method as the whole plot, and sub plots were tillage and herbicide treatments. Rice was drill-seeded and water-seeded into conventional and minimum tillage areas. Imazethapyr was applied at 0.063 lb ai/A or 0.094 lb/A preplant surface (SURFACE) followed by a postemergence (POST) application of 0.063 lb/A on 4 to 5 leaf rice (POST). Weeds evaluated included barnyardgrass [*Echinochloa crus-galli* (L.) Beauv], Amazon sprangletop [*Leptochola panicoides* (Presl) Hitchc.], alligatorweed [*Alternanthera philoxeroides* (Mart.) Griseb.], and ducksalad [*Heteranthera limosa* (Sw.) Willd.], yellow nutsedge (*Cyperus esculentus* L.). Rice injury and weed control were visually evaluated at 14 and 35 days after the POST treatment (DAT). Seedling vigor, days to 50% heading, and plant height at harvest were also evaluated.

Barnyardgrass control was 97 to 99% for all treatments at 14 and 35 DAT. Similar results have been reported for control of barnyardgrass with imazethapyr. Amazon sprangletop control was 86 to 90% at 14 DAT for all treatments; however, control in a drill- or water-seeded minimum-tillage system was 90 to 98% for all herbicide treatments evaluated at 35 DAT. Amazon sprangletop control in a conventional tillage system was 81 to 91% at 35 DAT. This is probably due to less Amazon sprangletop emergence in a minimum-tillage system compared with conventional-tillage. These two grasses are problem weeds across the rice belt, and imazethapyr has activity on barnyardgrass and Amazon sprangletop. However, Amazon sprangletop may become a late season problem due continuous germination throughout the growing season.

Alligatorweed control was 91% in a drill-seeded minimum-tillage system with 0.094 lb/A imazethapyr SURFACE followed by 0.063 lb/A POST at 14 DAT, and all other treatments resulted in 80 to 89% control. At 35 DAT, all imazethapyr applications in a water-seeded minimum-tillage system controlled alligatorweed 85 to 88%; however, alligatorweed control was 91 to 97% with all rates of imazethapyr in drill- and water-seeded conventional-tillage systems and a drill-seeded minimum-tillage system. Control of ducksalad was 94 to 99% for all treatments with drill-seeded rice at 14 and 35 DAT. Ducksalad control was 84 to 91% for all treatments with water-seed rice. Control of yellow nutsedge was 94 to 99% for all treatments at both rating dates. Crop injury was 10% or less for all treatments at 14 DAT and no injury was observed at 35 DAT.

Days to 50% heading were 53 to 59 days for all treatments. Water-seeded minimum-tillage treatments reached 50% heading 2 to 6 days later than all other treatments. Plant height at harvest was 100 to 106 cm for all treatments. Water-seeded minimum tillage treatments resulted in shorter plants compared with all drill-seeded treatments. Yield was 3540 to 4440 lb/A for drill-seeded and 2770 to 3370 lb/A for water-seeded. All treatments had increased yields compared with the nontreated within each tillage system. All treatments with water-seeded rice had lower yields than the drill-seeded minimum-tillage treatments.

In conclusion, imazethapyr has excellent potential for controlling a broad spectrum of weeds under different tillage systems. Imazethapyr can be surface applied and it will allow producers to drill- or water-seed with little to no crop response. In other studies imazethapyr has effectively controlled red rice. The ability to control red rice and a broad spectrum of weeds in minimum tillage drill-seeded rice can reduce water usage and soil and nutrient losses related to water-seeded culture commonly practiced in southwest Louisiana.

RED RICE (*Oryza sativa* L.) CONTROL WITH VARYING RATES AND APPLICATION TIMINGS OF IMAZETHAPYR. G.L. Steele, J.M. Chandler, G.N. McCauley, and C.H. Tingle, Texas Agricultural Experiment Station, College Station, TX 77843 and Eagle Lake, TX 77534.

ABSTRACT

Field research was conducted in 1998 and 1999 at the Texas Agricultural Experiment Station Research and Extension Center, near Beaumont, TX. One study consisted of imazethapyr applications at various rates and timings to evaluate red rice (ORYSA) control and crop injury. An additional study evaluated reduced rates and sequential applications. In both years, the soils were League silty clay with organic matter content ranging from 1.2 to 1.7%, and pH of 5.8. The experimental design of each study was a randomized complete block with 4 replications. Plot size was 3.75 by 16 ft. with six crop rows spaced 7.5 in. apart. ORYSA was overseeded to ensure an adequate infestation. In the first study, imazethapyr applications were made preplant incorporated (PPI), preemergence (PRE), and postemergence (POST) at rates of 0.063, 0.094, and 0.125 lb a.i./A of imazethapyr. The sequential application study consisted of PPI and PRE applications of imazethapyr at 0.063 and 0.094 lb/A, POST treatments of 0.032, 0.047, and 0.063 lb/A, and combinations of soil-applied and POST treatments at all rates. Weed control and crop injury was evaluated by visual ratings on a scale of 0 to 100%, with 0 being no control or injury and 100 being complete control or crop death.

At 28 days after treatment (DAT), POST applications of imazethapyr at rates of 0.063 to 0.125 lb/A controlled ORYSA at least 96%. ORYSA control did not differ among POST applications, or PPI applications at rates above 0.063 lb/A. Significantly lower ORYSA control was observed with PRE treatments, regardless of rate. In this study, a rate response for crop injury was observed with all POST applications of imazethapyr. At 12 DAT, crop injury was 15, 24 and 39% with imazethapyr treatments of 0.063, 0.094, and 0.125 lb/A, respectively. By 28 DAT, crop injury ranged from 6 to 15%.

With reduced rates, POST applications of imazethapyr controlled ORYSA 89 to 95%, at 28 DAT. As before, no differences in ORYSA control was observed between POST or PPI treatments, regardless of rate. Imazethapyr at 0.063 and 0.094 lb/A, applied PRE, controlled ORYSA 78% or less. ORYSA control increased with the addition of a POST application to single PPI and PRE treatments. Prior to harvest, ORYSA control was better with all sequential applications than with single POST applications at 0.032 and 0.047 lb/A. Sequential imazethapyr applications controlled ORYSA at least 94%. Crop injury at 20 DAT was less than 7% with any imazethapyr treatment, regardless of rate or timing. No significant injury was detected with treatments that did not include a POST application of imazethapyr at 0.063 lb/A.

In conclusion, at least 96% ORYSA control was observed with single POST applications of imazethapyr at 0.063 lb/A and higher. However, these treatments resulted in crop injury up to 39% by 12 DAT. ORYSA control with sequential applications was better than any single application, regardless of rate or timing. With imazethapyr rates of 0.032, 0.047 and 0.063 lb/A, less than 7% crop injury was observed with any treatment at 20 DAT.

TOLERANCE OF VARIOUS RICE CULTIVARS TO CLOMAZONE. E.F. Scherder, R.E. Talbert, L.A. Schmidt, and M.L. Lovelace, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR 72704.

ABSTRACT

Clomazone was approved for use in the mid-south in 1999 under a crisis exemption permit for rice production. Through a cooperative effort of many universities, an extensive database has been collected over various soil types, weather conditions, and weed flora. These studies address the issue of rice cultivar tolerance to clomazone using conventional rice production practices. Field studies in 1999 were conducted at two locations in Arkansas to evaluate the tolerance of 18 rice cultivars to clomazone. Experimental sites were located at the Rice Research and Extension Center at Stuttgart, Arkansas, on a DeWitt silt loam and at the Pine Tree Branch Station at Pine Tree, Arkansas, on a Calloway silt loam. The experimental design at each location was a split-plot with cultivars being the main factor and rate of clomazone as the subplot factor. Main plots were 1.8 by 4.5 meters with subplots of 1.8 by 1.8 meters. Clomazone was applied at 0.34 and 0.67 kg ai/ha preemergence (PRE), with the 0.34 kg/ha rate as a reduced application rate recommended by the University of Arkansas for these soil types. Visual ratings were taken 7, 14, 21, 28, 42, and 56 days after emergence (DAE) for chlorosis, biomass reduction, and overall rice injury. Visual observations were also taken for the date of 50% rice heading and % lodging at harvest. Yields were taken on each subplot from the four center rows and adjusted to 12% moisture.

Chlorosis and overall rice injury ratings of clomazone at 0.34 kg/ha were minimal for all cultivars for both locations (<15%) at 7 DAE. At the 14 DAE rating, 95% of the cultivars had chlorosis and rice injury ratings below 8%, with no significant differences being observed in subsequent ratings. All cultivars were tolerant to the reduced rate of 0.34 kg/ha of clomazone, but significant differences were seen at the 0.67 kg/ha rate. Differences in cultivar chlorosis and injury ratings were evident up to the 28 DAE with clomazone at 0.67 kg/ha, but no differences were observed in subsequent ratings. Evaluation of 50% heading showed a total of 11 days difference among the 18 cultivars. Clomazone at 0.34 and 0.67 kg/ha did not affect heading, compared to the untreated check within a cultivar, for 12 of the cultivars, with the largest detectable difference of 1 day observed. Yield was not significantly affected by clomazone at 0.34 or 0.67 kg/ha compared to the untreated check within all varieties. Yield difference did occur among varieties at both locations as expected.

Overall, cultivars displayed different levels of tolerance to clomazone, with the least tolerant cultivars still demonstrating acceptable levels of injury. Based on early injury ratings, cultivars can be separated into two tolerance categories: Tolerant (0 to 15% injury) = Mars, Lemont, Experimental Cultivar 2, LaGrue, Kaybonnet Priscilla, Experimental Cultivar 4, Experimental Cultivar 3, Cypress, Experimental Cultivar 5, Jefferson, and Koshihikari; Moderately Tolerant (16 to 30% injury) = Bengal, Cocodrie, Drew , Madison, Wells, and Experimental Cultivar 1.

CONVENTIONAL AND NO-TILL WHEAT-SOYBEAN CROPPING SYSTEMS FOR ITALIAN RYEGRASS (*LOLIUM MULTIFLORUM* LAM.) SUPPRESSION. C.S. Trusler and T.F. Peeper. Oklahoma State University, Stillwater, OK.

ABSTRACT

In Oklahoma, producers of winter wheat are seeking alternative methods of controlling Italian Ryegrass and improving economic returns. Experiments were established at three locations in Central Oklahoma to agronomically and economically compare two crop rotations, each under no tillage and conventional tillage with various herbicide treatments in each system. The cropping systems include wheat, double-crop soybean and continuous wheat. The experiments were established following wheat harvest in June 1999. At the three sites I. Ryegrass density in no-till continuous wheat exceeded 12,000 plants per meter^2 compared to 500 or less plants per meter^2 in the conventional till. The major weed in no-till continuous wheat at two sites was seedling elm. Prairie cupgrass, a species that requires higher rates of glyphosate to control, was present at two of three sites. Averaged over herbicide treatments, yields of double-crop soybeans were higher in conventional tillage than in no tillage at two of three sites, with higher yields in no tillage at the third site. Turbo and Dual II Magnum applied preemergence to double-crop soybeans decreased ryegrass density in November at two of the three sites. Net returns from no-till double-crop soybeans were negative for all herbicide treatments at all sites. Net returns from conventional till double-crop soybeans were positive for two herbicide treatments at one of the three sites. Negative net returns were associated with low yields. July and August rainfalls were below the long-term average at the three sites.

WEED CONTROL AND CORN INJURY WITH GLYPHOSATE AND SULFOSATE IN ROUNDUP READY™ CORN. D.R. Scott, B.W. Bean, M.W. Rowland, G. Shuster, J. Mehlhorn. Texas Agricultural Extension Service, Amarillo, TX, and West Texas A&M University, Canyon, TX.

ABSTRACT

Corn hybrids with the Roundup Ready™ gene are available, but have not been widely used by Texas Panhandle producers. This study evaluated weed control efficacy and crop tolerance with Touchdown® (sulfosate) and Roundup® (glyphosate) in Roundup Ready™ corn. Touchdown® has a similar mode of action as Roundup®, therefore the Roundup gene may protect the corn from Touchdown® injury. This study was conducted at the Texas Agricultural Experiment Station near Bushland and a producer's field near Wilderado. Plots were 13 ft. wide by 25 ft. in length and replicated four times in a randomized complete block design. Each treatment was applied with a backpack sprayer at 10 gallons per acre at 22 PSI. Roundup® and Touchdown® were applied at different rates and times of application. Weed control evaluations were made on pigweed (*Amaranthus palmeri* S. Wats), velvetleaf (*Abutilon theophrasti* Medicus), shattercane (*Sorghum bicolor* (L.) Moench) and barnyardgrass (*Echinochloa crus-galli* (L.) Beauv). Injury to the corn was only observed at the Wilderado site. Touchdown® caused more injury than Roundup®. Corn stage at the time of herbicide application was a factor in how much injury occurred. Both products gave good weed control of all weeds evaluated.

WEED CONTROL AND CROP TOLERANCE IN ROUNDUP READY AND LIBERTY LINK CORN. D.A. Peters, J.L. Griffin, J.A. Bond, J.M. Ellis, J.H. Pankey, and J.L. Godley, Louisiana State University Agricultural Center, Baton Rouge, 70803 and R & D Research Farm, Inc, Washington, LA 70589.

ABSTRACT

Studies were conducted in 1998 near Washington, LA and in 1999 near Baton Rouge, LA to evaluate weed control programs and corn injury with Roundup Ultra and Liberty using Roundup Ready® and Liberty Link® technologies. For the weed control studies, treatments included Bicep II at 1.8 qt/A, Prowl at 2.4 pt/A, or atrazine at 1.5 pt/A preemergence (PRE) followed by (fb) early postemergence (EPOST) application of Roundup Ultra at 1.5 pt/A or Liberty at 20 oz/A; atrazine at 1.5 pt/A + Roundup Ultra at 1.5 pt/A or Liberty at 20 oz/A EPOST; Roundup Ultra or Liberty at the same rates EPOST; Roundup Ultra at 2 pt/A or Liberty at 28 oz/A late postemergence (LPOST); and Roundup Ultra at 1.5 pt/A or Liberty at 20 oz/A EPOST and LPOST. Bicep II at 2.4 qt/A PRE and Accent at 0.67 oz/A + Buctril at 16 oz/A EPOST were included for comparison. 'Dekalb 580 RR' and 'Cargill 7750 LL' corn hybrids were planted March 24, 1998 and March 29, 1999, and harvested August 3, 1998 and August 18, 1999. Experimental design was a randomized complete block with four replications. Early POST applications were made May 4, 1998 and April 27, 1999 when weeds were 0.5 to 5 inches tall. Late POST applications were made to 1 to 14 inch weeds May 21, 1998 and May 19, 1999. Weed control was rated visually 28 days after treatment (DAT).

Broadleaf signalgrass [*Brachiaria platyphylla* (Griesb.) Nash] control 28 DAT both years was at least 81% when any PRE treatment was followed by Roundup Ultra or Liberty. Control ranged from 74 to 93% for Bicep II alone. When only Roundup Ultra or Liberty was applied EPOST, control ranged from 73 to 100%, and from 91 to 100% with LPOST application. Accent plus Buctril controlled broadleaf signalgrass 95% in 1998, but no more than 70% in 1999. Pitted morningglory (*Ipomoea lacunosa* L.) control was at least 91% when atrazine was applied prior to or in combination with Roundup Ultra or Liberty. Control was at least 89% with only a LPOST Roundup Ultra or Liberty application. Pitted morningglory control with Accent plus Buctril was 100% in 1998, but no more than 78% in 1999. Prickly sida (*Sida spinosa* L.) control both years was at least 83% for any treatment consisting of Roundup Ultra or Liberty. Accent plus Buctril controlled prickly sida no more than 76% in 1999. Differences in weed control were not reflected in corn yield either year.

Rainfall during the growing season totaled 7 inches in 1998 and 18 inches in 1999. The lower weed control the second year can be attributed to weed germination and emergence after POST herbicides were applied. This was not the case the first year. Greater rainfall in 1999 also contributed to maximizing the yield potential of the hybrids. That year, Dekalb 580 RR or Cargill 7750 LL yielded as much as 115 bu/A. In many cases, Bicep II alone controlled broadleaf signalgrass, pitted morningglory, and prickly sida as well as PRE/POST programs. Roundup Ultra and Liberty were as effective as PRE only or PRE/POST programs, but application timing was critical in regard to weed reinfestation.

For the corn tolerance study, Roundup Ultra at 1, 2, and 3 qt/A and Liberty at 28, 56, and 84 oz/A (1, 2, and 3x rates) were applied to 4-, 6-, and 8-collar Dekalb 580 RR and Cargill 7750 LL corn hybrids, respectively. Corn was planted March 26, 1998 and March 19, 1999 and harvested August 4 both years. The experimental design was a randomized complete block with 3 replications in 1998 and 4 replications in 1999. A nontreated weed free control was included for comparison. Corn yield for each hybrid following Roundup Ultra or Liberty applied at the various rates and application timings was equivalent to the respective nontreated weed-free control both years. In 1998, only 7 inches of rainfall was received, but plots were irrigated as needed in 1999. As a result, yields in 1999 were as high as 240 Bu/A and averaged 1.3 times greater than in 1998. The consistency in response of the hybrids to Roundup Ultra and Liberty over the two diverse years indicated a high level of tolerance.

CORN AND RICE RESPONSE TO SIMULATED DRIFT RATES OF LIGHTNING. J.A. Bond, J.L. Griffin, D.A. Peters, J.M. Ellis, S.D. Linscombe, and J.L. Godley, Louisiana State University Agricultural Center, Baton Rouge, LA 70803 and R & D Research Farm, Inc., Washington, LA 70589.

ABSTRACT

Lightning, a premix of the imidazolinone herbicides imazethapyr and imazapyr, is used postemergence in imidazolinone-resistant (IR) corn (*Zea mays* L.) for grass and broadleaf weed control. An increase in acreage of IR corn and imidazolinone-tolerant rice (*Oryza sativa* L.) will increase the likelihood of off-target movement of imidazolinone herbicides to sensitive crops. Field studies were conducted over two years with corn at the R & D Research Farm near Washington, Louisiana and at the Ben Hur Research Farm near Baton Rouge, LA, and with rice at the Rice Research Station in Crowley, LA, to evaluate crop injury, growth response, and yield when exposed to simulated drift rates of Lightning.

Drift rates represented 0.8, 1.6, 3.2, 6.3, and 12.5% of the use rate of 1.28 oz pr/A (0.056 lb ai/A) of Lightning. A nontreated, weed-free control of both crops was included for comparison. The experimental design for the corn study was a randomized complete block with four replications. Treatments were applied early postemergence (EPOST) to non IR 'Dekalb 687' corn at the 6-leaf stage on May 4, 1998 and April 27, 1999. For the rice study, the experimental design was a randomized complete block with a two-factor factorial arrangement of treatments with four replications. Treatments were applied EPOST to non imidazolinone resistant/tolerant 'Cypress' rice prior to establishment of the permanent flood when rice was at the 2- to 3-leaf stage on May 20, 1998 and May 25, 1999. Late postemergence (LPOST) application was made to flooded rice with 2 to 3 tillers at panicle initiation on June 19, 1998 and June 30, 1999. Application timings were selected to coincide with time during the crop cycle when drift would most likely occur. A CO_2 backpack sprayer calibrated to deliver 15 gallons/A of spray solution was used to apply herbicide treatments. Data collected for both crops included visual injury and height 7, 14, and 28 days after treatment (DAT), and yield. Days to 50% heading was determined in rice. Data were subjected to analysis of variance and means were separated using Fisher's protected Least Significant Difference (LSD) ($p = 0.05$).

Lightning at 12.5% of the use rate reduced corn height 11% compared with the nontreated control 7 DAT, but height was not affected by any of the other treatments. Differences in visual injury and corn height among drift rates were not observed 14 and 28 DAT. Corn yields were equivalent regardless of Lightning rate and ranged from 160 to 180 bu/A.

Rice height was reduced by Lightning at 12.5% of the use rate compared with lower rates when applied EPOST and LPOST. Visual injury 7 DAT, however, was more evident when Lightning was applied early at the 12.5% or 6.3% rates rather than late (35 or 19 vs. 0%, respectively). Visual injury for the early timing was not reflected in reduced rice height at maturity. Delaying application of Lightning until panicle initiation resulted in a delay of 3 to 6 days to 50% heading and a rice yield reduction of 30% when Lightning was applied at the 12.5% rate and 12% for the 6.3% rate. Yield was reduced 9% by the 12.5% rate at the early timing. The nontreated, weed-free control yielded 6530 lb/A.

In conclusion, yield was not affected by Lightning applied to 6-leaf corn at 12.5% of the use rate. Rice visual injury was minimal when Lightning was applied at panicle initiation, but yield reductions were significant. Rice was able to recover from injury observed when Lightning was applied to 2- to 3-leaf rice with no negative effect on yield. Producers should be extremely cautious when applying Lightning near rice fields, especially when application to IR corn coincides with the panicle initiation growth stage of rice.

DO HERBICIDE RESISTANT CORN HYBRIDS PRODUCE ACCEPTABLE YIELDS? E.P. Prostko, University of Georgia, Tifton, GA 31793; W.J. Grichar, B.A. Besler, and K.D. Brewer, Texas Agricultural Experiment Station, Yoakum, TX 77995.

ABSTRACT

Over the past several years, a majority of weed science research has focused on the use of herbicide resistant crop technologies. While most of this research has focused on weed efficacy, few studies have addressed the issue of yield performance. The objectives of this research were to compare the yields of herbicide resistant corn hybrids to the yields of conventional hybrids and to determine if yield loss occurred in response to the various herbicides associated with these technology systems. Small-plot, replicated field trials were conducted in 1999 at Stephenville and Yoakum utilizing the following corn hybrids: conventional (Triumph 2010, Pioneer 3223, Dekalb 668); IMI® (Triumph 1514A, Pioneer 3395IR); Roundup Ready® (Triumph 1506RR, Dekalb 512RR, Dekalb 580RR), Liberty-Link® (Dekalb 687GR, Pioneer 34A55); and Poast Protected® (Dekalb 683SR). At both locations, the plot area was maintained weed-free and the appropriate postemergence herbicides were applied according to labeled directions. At Stephenville, no differences in silage or grain yield were observed between any hybrid when herbicides were applied. In Yoakum, Dekalb 668 produced higher grain yields than Dekalb 580RR, Dekalb 683SR, and Dekalb 687GR. Triumph 1506RR produced higher grain yields than Triumph 2010 and Dekalb 668. Triumph 2010 produced more grain than Dekalb 683SR. Yield loss was observed in Dekalb 580RR and Dekalb 687GR. These results suggest that there can be significant differences in the yield performance of herbicide resistant corn hybrids and that yield loss can occur when the associated herbicide

is applied at labeled rates. Consequently, producers should plant these hybrids on a limited basis until their long-term yield histories can be determined.

ALTERNATIVES TO ATRAZINE FOR WEED CONTROL IN TRANSGENIC CORN. O.C. Sparks, L.R. Oliver, and J.W. Barnes. Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville 72704.

ABSTRACT

The advent of transgenic corn cultivars that tolerate in-crop applications of nontraditional herbicides have transformed the methods by which a grower can attain superior weed control. Field experiments were conducted in 1999 at the Northeast Research and Extension Center, Keiser, AR, on a Sharkey silty clay (Vertic Haplaquept, very fine montmorillinitic, nonacid, thermic) and at the Main Experiment Station Fayetteville, AR, on a Taloka silt loam (fine, mixed, thermic, Mollic Albaqualfs) to compare the weed control in glufosinate-, glyphosate-, and imidazolinone-resistant cultivars and to evaluate the need for atrazine in these systems.

Each experiment was conducted as a randomized complete block design with four replications. Experimental units were 4 by 8.2 m broadcast sown with velvetleaf (*Abutilon theophrasti*), pitted morningglory (*Ipomoea lacunosa*), entireleaf morningglory (*Ipomoea hederacea var. integriuscula*), large crabgrass (*Digitaria sanguinalis*), and prickly sida (*Sida spinosa*). Following incorporation of weed seeds, Dekalb 580RR, Pioneer 34A55LL, or Pioneer 3395 IR corn was planted at 65,000 seed ha^{-1} to a depth of 4 cm. Treatments consisted of repeated applications of glufosinate at 0.3 or 0.4 kg ai ha^{-1} on 3- to 6-cm weeds and repeated at 3- to 6-cm regrowth or glyphosate at 0.84 kg ae ha^{-1} on 5- to 10-cm weeds fb (followed by) 0.63 kg ae ha^{-1} on 5- to 10-cm or 10- to 15-cm weeds. Single applications of imazapyr + imazethapyr at 0.063 or 0.112 kg ai ha^{-1} were applied to 3- to 6-cm weeds. Preemergence (PRE) applications of atrazine 1.46 kg ai ha^{-1} or a package mixture of metribuzin + flufenacet at 0.81 kg ai ha^{-1} tank-mixed with isoxaflutole at 0.063 kg ai ha^{-1} fb a single application of glyphosate at 0.84 kg ha^{-1}, glufosinate at 0.3 kg ha^{-1}, or imazapyr + imazethapyr at 0.063 kg ha^{-1}. A PRE application of s-metolachlor at 1.55 kg ai ha^{-1} + atrazine 1.4 kg ai ha^{-1} fb atrazine 1.4 kg ai ha^{-1} at four-leaf corn served as the competitive standard.

All treatments provided good control of large crabgrass and prickly sida (>85%). Applications of metribuzin + flufenacet tank-mixed with isoxaflutole provided 85% control of velvetleaf 2 weeks after planting (WAP) while PRE applications of atrazine alone and s-metolachlor + atrazine provided only 52 to 62% control of velvetleaf. At 6 WAP all treatments provided greater than 89% control of velvetleaf. PRE applications of s-metolachlor + atrazine or metribuzin + flufenacet tank-mixed with isoxaflutole provided good control (>85%) of large crabgrass at 2 WAP, and by 6 WAP control was greater than 93%. There was no advantage to using atrazine as compared to two applications of glufosinate for any weed species. The addition of atrazine did, however, improve control of pitted morningglory as compared to glyphosate at 0.84 fb 0.63 kg ha^{-1} and single applications of imazapyr + imazethapyr at 0.063 kg ha^{-1}. Injury (16%) was noted on the glyphosate-resistant cultivar treated with metribuzin + flufenacet tank-mixed with isoxaflutole, there was also a significant yield loss in the imidazolinone-resistant cultivar. However metribuzin + flufenacet tank-mixed with isoxaflutole provided the best control of pitted morningglory 2 WAP, which was greater than PRE applications of s-metolachlor tank-mixed with atrazine or atrazine applied alone. There was no difference in yield between treatments receiving sequential applications of glufosinate, glyphosate, or single applications of imazapyr + imazethapyr as compared to a standard program of s-metolachlor + atrazine PRE fb atrazine on four-leaf corn.

WOOLYLEAF BURSAGE CONTROL IN TRANSGENIC COTTONS ON THE TEXAS SOUTHERN HIGH PLAINS. J.D. Everitt, J.W. Keeling, and P.A. Dotray, Research Assistant, Professor, Texas Agricultural Experiment Station, Lubbock, TX 79401; and Associate Professor, Department of Plant and Soil Sciences, Texas Tech University, Lubbock, TX, 79409.

ABSTRACT

Producers on the Texas Southern High Plains use preplant incorporated and preemergence herbicides to control many annual weed species. However, these herbicides are not effective on perennial weeds including woollyleaf bursage (*Ambrosia grayi*). The use of glyphosate and bromoxynil in their respective tolerant cotton varieties offers new options to control many perennial weeds in-season. The objectives of this research were to: 1) evaluate glyphosate and bromoxynil applied alone or in combination with cultivation for woollyleaf bursage control, 2) determine effects of weed control systems on cotton yield and economic returns, and 3) evaluate woollyleaf bursage control in the years following applications to determine the long-term reduction of perennial weed populations.

Field studies were established in 1998 and plots were retreated in 1999 at the Texas Agricultural Experiment Station in Halfway, TX. Plot sizes were 13 by 100 feet and arranged in a complete randomized block with 3 replications. Glyphosate and bromoxynil were applied three times throughout the growing season. All herbicide treatments were used with and without cultivation. Glyphosate at 0.75 lb ae/A was applied postemergence-topical (PT) and postemergence-directed (PD). Bromoxynil was applied PT at 0.5 lb ai/A. These applications were made at the 1-2 leaf, 3-4 leaf, and first bloom stages of growth. A commercial standard weed control system was compared to the Roundup Ready and

BXN systems. The commercial standard system consisted of an early PT application of MSMA at 1.5 lb ai/A and a fall application of dicamba at 1.0 lb ai/A. Weed control ratings were recorded 14 days after all applications at each location.

In 1998 glyphosate controlled woollyleaf bursage 72% at the end of the season, and control increased to 89% when cultivation was added. Bromoxynil controlled woollyleaf bursage 43% without cultivation, and control increased to 78% with cultivation. The commercial standard system controlled woollyleaf bursage 20%, while woollyleaf bursage control was 35% with cultivation alone.

Prior to any treatments in 1999, woolyleaf bursage densities were recorded to determine the effect of the 1998 treatments. The Roundup Ready system reduced weed densities by 45-50%, while the commercial standard system reduced woollyleaf bursage 75%. However, by the end of the 1999 season the commercial standard system provided 12% control of woollyleaf bursage. At the end of the second season, glyphosate alone controlled woollyleaf bursage 94%, while control increased to 98% when cultivation was added. Bromoxynil alone controlled woollyleaf bursage 50% and control increased to 77% with cultivation. Cultivation alone provided 15% woollyleaf bursage control.

Both Roundup Ready and BXN cotton weed control systems increased cotton yields and net returns over weed control costs as compared to cultivation alone in both 1998 and 1999. Long-term weed control will continue to be investigated in the 2000 growing season.

EFFICACY OF PREMERGENCE AND POSTEMERGENCE RESIDUAL HERBICIDES IN ROUNDUP READY COTTON. J.W. Keeling, P.A. Dotray, T.S. Osborne, and J.D. Everitt. Texas Agricultural Experiment Station, Lubbock.

ABSTRACT

Postemergence Roundup Ultra applications in Roundup Ready cotton provides excellent control of many problem annual and perennial weeds. The continued use of residual herbicides may be needed to reduce both early-season weed competition and the need for repeated Roundup Ultra applications. Field experiments were conducted in 1998 and 1999 to evaluate residual herbicides in combination with Roundup applications for Palmer amaranth (*Amaranthus palmeri*), devil's-claw (*Probiscidea louisianica*) and yellow nutsedge (*Cyperus esculentus*) control. Herbicide treatments included preplant incorporated (PPI) and preemergence (PE) herbicides applied alone or in combination with Roundup Ultra applied postemergence-topical (PT) and postemergence-directed (PD) compared to Roundup Ultra applied alone. Paymaster 2326RR cotton was planted in 1998 and 1999 trials. A shielded sprayer was used for PD applications. Visual weed control ratings were made during the growing season and cotton lint yields were determined.

In 1998, Palmer amaranth control ranged from 96-100% with any combination of residual herbicide followed by (fb) Roundup Ultra PT, while Roundup Ultra PT alone controlled Palmer amaranth 87%. In 1999, all treatments controlled Palmer amaranth 96-100%. Roundup Ultra PT alone or in combination with residual herbicides controlled devil's-claw 73-85% in 1998 and 90-100% in 1999. In both years, the most effective season-long Palmer amaranth and devil's-claw control was achieved with Prowl PPI fb Roundup PT fb Roundup PD. This treatment produced the highest lint yields in both years. When Roundup Ultra was applied PT alone or in tank mixture with Staple, no visual cotton injury was observed. Roundup Ultra PT alone controlled Palmer amaranth 85-90% late-season, but control improved to 94-100% when Staple was tank mixed with Roundup Ultra PT. Staple PT controlled Palmer amaranth at least 96%, whereas Treflan fb Caparol controlled Palmer amaranth 88%. Staple tank mixed with Roundup Ultra PT improved late-season devil's-claw control (87%) compared to Roundup Ultra PT alone (48-57%). Devil's-claw was controlled at least 87% when Staple at 0.047 lb/A was tank mixed with Roundup Ultra. Staple PT controlled devil's-claw 70-83%, whereas Treflan fb Caparol controlled devil's-claw 23%. Treflan fb Roundup Ultra or Caparol fb Roundup Ultra controlled Palmer amaranth and devil's-claw at least 93%, but yellow nutsedge was controlled less than 70%. When Dual Magnum was applied preemergence at 1.3 lb/A or applied PT at 1.0 lb/A in a tank mixture with Roundup Ultra, all weeds were controlled at least 96%. No visual injury was observed following Dual Magnum and Roundup Ultra tank mixes.

These studies indicate that broad spectrum weed control may be achieved when residual herbicides are used in combination with Roundup Ultra in Roundup Ready cotton. Weed species present will dictate which residual herbicides are most appropriate.

PREEMERGENCE/POSTEMERGENCE HERBICIDES CONTROL LANCELEAF SAGE (SALVIA REFLEXA) IN TEXAS HIGH PLAINS COTTON. T.S. Osborne, J.W. Keeling, P.A. Dotray, and J.D. Everitt. Texas Agricultural Experiment Station, Lubbock.

ABSTRACT

Lanceleaf sage *(Salvia reflexa)* is unique weed in that it is found primarily in the southwestern regions of the cotton belt. Despite recent advances in chemical weed control lancleaf sage continues to be a major weed problem for some cotton producers on the Texas Southern High Plains. Three independent field experiments in 1999 were conducted northeast of Lubbock in Floyd and Crosby counties evaluating weed control using Roundup Ultra, Buctril, Staple, and Command

systems. The first experiment included treatments of Staple applied preemergence (PRE) at 0.032 lb ai/A in combination with Caparol at 1.2 lb ai/A, the same treatment followed by (Fb) Staple applied postemergence (POST) at 0.047 lb ai/A, Roundup Ultra applied POST at 0.75 lb ai/A, Roundup Ultra at 0.75 lb ai/A plus Staple at 0.032 lb ai/A, Buctril applied POST at 0.50 lb ai/A, and Buctril plus Staple applied POST at 0.5 plus 0.047 lb ai/A. Treatments observed in the second trial consisted of Staple applied POST at 0.032, 0.047, and 0.063 lb ai/A, Buctril applied POST at 0.38 and 0.50 lb ai/A, and tankmixes of Buctril plus Staple at all possible combinations of the previously mentioned rates. Treatments observed in the third trial conducted were Command at 0.50 or 0.75 lb ai/A applied PRE in combination with Staple at 0.032 lb ai/A Fb Staple applied POST at 0.032 lb ai/A, Command applied PRE at 0.75 or 1.0 lb ai/A Fb Roundup Ultra at 0.56 lb ai/A, Command applied PRE at 0.75 or 1.0 lb ai/A Fb Staple POST at 0.063 lb ai/A, and Roundup Ultra applied POST alone at 0.56 lb ai/A. A blanket application of Treflan was applied preplant incorporated over all three trial locations at 0.75 lb ai/A and all POST applications were made to 1-4" weeds. Results from the first trial indicated that Staple plus Caparol Fb Staple or Roundup Ultra tankmixed with Staple controlled lanceleaf sage greater than 90% 10 weeks after planting. These treatments were more effective than Staple plus Caparol applied PRE, Buctril applied POST or a tankmix of Buctril plus Staple. Results from the second trial indicated that Staple applied POST alone at 0.063 lb ai/A or tankmixes of Buctril plus Staple (regardless of rate) controlled lanceleaf sage at least 95% 10 weeks after planting. Buctril plus Staple tankmixes controlled lanceleaf sage more effectively in this trial due to a smaller weed size at application. The third trial conducted indicated that Command applied PRE Fb Roundup Ultra controlled lanceleaf sage 73-80% 10 weeks after planting, while Command applied PRE Fb Staple controlled lanceleaf sage greater than 97% 10 weeks after planting.

USE OF PREEMERGENCE HERBICIDES IN GLYPHOSATE-TOLERANT COTTON. A.S. Culpepper, Department of Crop and Soil Sciences, University of Georgia, Tifton, GA 31793; A.C. York and R.B. Batts, Crop Science Department, North Carolina State University, Raleigh, NC 27695-7620.

ABSTRACT

A series of three field experiments were conducted at nine locations in North Carolina from 1996 through 1999 to examine the role of soil-applied herbicides in glyphosate-tolerant cotton weed management programs. All experiments were conducted in fields heavily infested with weeds. Species present at one or more of the locations included large crabgrass (*Digitaria sanguinalis*), broadleaf signalgrass (*Brachiaria platyphylla*), seedling johnsongrass (*Sorghum halepense*), mixtures of morningglory species (*Ipomoea* spp.), common cocklebur (*Xanthium strumarium*), sicklepod (*Cassia obtusifolia*), common ragweed (*Ambrosia artemisiifolia*), smooth pigweed (*Amaranthus hybridus*), Palmer amaranth (*Amaranthus palmeri*), common lambsquarters (*Chenopodium album*), prickly sida (*Sida spinosa*), smooth groundcherry (*Physalis subglabrata*), and jimsonweed (*Datura stramonium*). Soil-applied herbicides included Treflan (trifluralin) PPI + Cotoran (fluometuron) PRE in the first experiment, Prowl (pendimethalin) PPI + Cotoran PRE in the second experiment, and Command (clomazone), Cotoran, Prowl, Staple (pyrithiobac), Zorial (norflurazon), Command + Cotoran, Prowl + Cotoran, Prowl + Staple, Staple + Cotoran, and Zorial + Cotoran PRE in the third experiment. Soil-applied herbicides were applied at normal use rates.

Total postemergence systems with Roundup Ultra (glyphosate) overtop followed by Roundup or Caparol (prometryn) + MSMA directed controlled weeds well. Late-season weed control was generally greater than 90%. Soil-applied herbicides had little effect on late-season weed control and had no effect on cotton yield in systems with Roundup applied overtop at 1- and 3- to 4-leaf cotton. When Roundup application was delayed until 3- to 4-leaf cotton in the absence of soil-applied herbicides, weeds competed enough with the crop prior to Roundup application to reduce yield at two-thirds of the locations. Yields with soil-applied herbicides plus one overtop application of Roundup were similar to yields with two overtop applications without soil-applied herbicides.

It is recognized that there are some weeds, such as Florida pusley (*Richardia scabra*), that are not controlled by Roundup. If such species are expected, a soil-applied herbicide would be advised. Otherwise, excellent weed control and cotton yields can be achieved with total postemergence systems. However, two overtop applications of Roundup, with the first application initiated about the 1-leaf stage of cotton, will usually be needed to avoid early season weed competition. The primary value of soil-applied herbicides in a Roundup Ready system is the flexibility they provide in timing of Roundup. Because of time, labor, and equipment constraints, many growers have difficulty making two timely overtop Roundup applications. When soil-applied herbicides are included in the system to provide some early season control, Roundup application can be delayed until cotton reaches the 3- to 4-leaf stage.

LAY-BY HERBICIDES FOR WEED CONTROL IN ROUNDUP READY® COTTON. H.R. Hurst, Delta Research and Extension Center, Stoneville, MS 38776.

ABSTRACT

An experiment was conducted during 1998 and 1999 to evaluate ivyleaf morningglory, nodding spurge, and browntop millet control in Roundup Ready cotton. A randomized complete block design with eight replications was used. The entire area was treated PRE (preemergence) with pendimethalin (Prowl®) 1.0 lb ai/A + fluometuron (Cotoran®) 1.25 lb ai/A and OT (over-the-top) with Roundup Ultra 1 lb ai/A to 3- to 4-leaf cotton broadcast in 1998 and on a 20-inch

band centered on the row in 1999. "Burn-down" herbicides before planting and cultivation after planting (in 1999) were used for early weed control. Roundup alone and in mixtures were applied in 10 gal/A broadcast volume while other herbicides were applied in 20 gal/A total volume. Individual lay-by treatments were none (check), glyphosate (Roundup Ultra®) 1 lb ai/A, cyanazine (Bladex® or Cy-Pro®) 0.75 lb ai/A + nonionic surfactant (NIS) 0.25% v/v, Bladex 0.75 lb ai/A + MSMA (Herbicide 912) 1.0 lb ai/A, diuron (Karmex®) 0.75 lb ai/A + NIS, Karmex 0.75 lb ai/A + Herbicide 912 1.0 lb ai/A, Roundup Ultra 1 lb ai/A + Bladex 0.75 lb ai/A, and Roundup Ultra 1 lb ai/A + Karmex 0.75 lb ai/A. Lay-by herbicides were applied broadcast in a manner to provide maximum weed contact and minimum cotton foliar contact. Foliar injury to cotton ranged from 12 to 19% in 1998 with treatments except there was no injury with the check and Roundup only treatments. There was no foliar injury in 1999. Visual weed control was greatest in 1998 with Roundup only, Bladex + Roundup and Karmex + Roundup (87, 88, and 86%, respectively). These were not different but were greater than all other treatments except Karmex + MSMA (74%). In 1999, 0.41 inch of rain occurred very soon after lay-by herbicides were applied. After two weeks, control was very low with Roundup only indicating possible "wash-off" had occurred. An additional Roundup Ultra 0.75 lb ai/A was applied. At four weeks after the original application, the Roundup only treatment gave 100% control. Treatments with Bladex or Karmex + Roundup gave 89 and 88% control, respectively. Cotton stand was not affected by any treatment. Seed cotton yield in 1998 was greatest with Bladex + Roundup (2780 lb/A) but was not different from other treatments (2263 to 2664 lb range) except Roundup only (2250 lb) and the check (1807 lb). In 1999, seed cotton yield was greatest with Bladex + Roundup (2595 lb/A), Roundup only (2535 lb), and Bladex + NIS (2538 lb). These treatments were greater than Karmex + MSMA (2129 lb) and check (2055 lb) but were not different from other treatments (2308 to 2504 lb range).

POTENTIAL INTERACTIONS OF CGA-362622 APPLIED WITH COTTON INSECTICIDES. B.W. Minton, J.W. Wells, and S.A. Senseman. Novartis Crop Protection, Greensboro, NC; Novartis Crop Protection, Cypress, TX; and Texas Agricultural Experiment Station, College Station.

ABSTRACT

CGA-362622 is a new sulfonylurea herbicide being developed by Novartis Crop Protection for post-emergence weed control in cotton and sugarcane. It controls a wide spectrum of weeds including important cotton weeds such as sicklepod (*Cassia obtusifolia* L.), common cocklebur(*Xanthium strumarium* L.), common sunflower (*Helianthus annuus* L.), pitted morningglory (*Ipomoea lacunosa* L.), ivyleaf morningglory [*Ipomoea hederacea* (L.) Jacq.], redroot pigweed (*Amaranthus retroflexus* L.), smooth pigweed (*Amaranthus hybridus* L.), hemp sesbania [*Sesbania exaltata* (Raf.) Rydb. ex A. W. Hill], seedling johnsongrass [*Sorghum halepense* (L.) Pers.], and yellow nutsedge (*Cyperus esculentus* L.). The product is formulated as a 75 WDG with the rates of 5-15 g ai/ha in cotton and 15-50 g ai/ha in sugarcane. Application in cotton can be made from early post over the top through directed at lay-by. The addition of a nonionic surfactant or crop oil concentrate enhances postemergence weed control.

CGA-362622 at 7.5 g ai/ha was applied alone and in combination with recommended rates of the following insecticides: profenofos, malathion, dimethioate, dicrotophos, azinphos-methyl, acephate, oxamyl, spinosad, pymetrozine, emamectin benzoate and thiamethoxam. Pyrithiobac at 71 g ai/ha alone and with malathion was also evaluated. Cotton phytotoxicity was less than 10% with both pyrithiobac and CGA-362622 applied alone. Increased foliar injury occurred with CGA-362622 applied with malathion, profenofos, or dimethioate and with pyrithiobac applied with malathion. Foliar leaf injury generally dissipated by 22 days after application. However, slight cotton stunting was observed at one location with CGA-362622 + malathion and pyrithiobac + malathion. There was no increase in cotton injury with the tank-mixture of CGA-362622 with dicrotophos, azinphos-methyl, acephate, oxamyl, spinosad, pymetrozine, emamectin benzoate, or thiamethoxam compared to CGA-362622 applied alone. Seed cotton yield was not adversely affected by any treatment compared to the untreated control.

CGA 362622 FOR POSTEMERGENCE WEED CONTROL IN COTTON. B.J. Brecke, University of Florida, West Florida Research and Education Center, Jay, FL 32565; D.C. Bridges and T. Grey, University of Georgia, Griffin, GA 30223.

ABSTRACT

Studies were conducted during 1998 and 1999 at the University of Florida, West Florida Research and Education Center, Jay, FL and the University of Georgia, Griffin, GA to evaluate CGA 362622 for postemergence weed control in cotton. Cotton (either DP 5414RR or DP 458RR was planted in mid-May to early-June in areas naturally infested with a broadspectrum of both annual grass and broadleaf weeds. Treatments were applied postemergence with either a Backpack CO_2 or tractor mounted compressed air sprayers operated at 20 psi to deliver 20 gpa spray volume. Plots were either 2 or 4 rows wide by 25 to 35 ft long. Crop damage and weed control were visually rated during the growing season using a scale of 0 to 100 (0 = no control or crop damage and 100 = complete control or crop death).

CGA 362622 applied at rates of 0.0045 to 0.018 lb a.i./A did not cause little crop damage and the cotton rapidly recovered from any injury observed. CGA 363622 provided good to excellent control of sicklepod (*Senna obtusifolia* (L.) Irwin and Barnaby), redweed (*Melochia corchorifolia* L.), purple nutsedge (*Cyperus rotundus* L.), and Florida beggarweed (*Desmodium tortuosum* (Sw.) DC.). Control of browntop millet (*Brachiaria ramosa* (L.) Stapf), large

crabgrass (*Digitaria sanquinalis* (L.) Scop.), pitted morningglory (*Ipomoea lacunosa* L.), and redroot pigweed (*Amaranthus retroflexus* L.) ranged from fair to excellent depending on timing and rate of application. Generally the earlier timing and higher rates were required for effective control of these species. Smallflower morningglory (*Jacquemontia tamnifolia* (L.) Griseb.) and prickly sida (*Sida spinosa* L.) were not controlled at any rate or timing of CGA 362622 application.

WEED MANAGEMENT IN NON-TRANSGENIC AND TRANSGENIC COTTON WITH CGA 362622. J.W. Wilcut, S.D. Askew, and D. Porterfield, Crop Science Department, North Carolina State University, Raleigh, NC 27695-7620 and Novartis Crop Protection, Cary, NC 27502.

ABSTRACT

Field studies were conducted at Clayton, NC in 1998 and at Goldsboro, NC in 1998 and 1999 to evaluate weed control and non-transgenic Stoneville 474, BXN 47, and Paymaster 1220RR cotton response to CGA 362622. The experimental design was a split plot randomized complete block design with varieties as main plots and herbicide systems as subplots. Herbicide systems for each variety (non-transgenic, BXN, and Roundup Ready) included 1) untreated check, 2) Treflan at 0.5 lb ai/ac PPI followed by (fb) Cotoran PRE at 1.25 lb ai/ac, 3) Treflan PPI fb Cotoran PRE fb Caparol at 1.2 lb ai/ac plus MSMA at 2.0 lb ai/ac late post-directed (LAYBY), 4) Treflan PPI fb Cotoran PRE fb LAYBY and kept weed free with weekly hand weedings, 5) Treflan PPI fb Cotoran PRE fb CGA 362,622 early postemergence (EPOST) at 0.0067 lb ai/ac fb LAYBY, 6) Treflan PPI fb [a)Staple at 0.063 lb ai/ac EPOST for non-transgenic cotton], [b)Buctril at 0.5 lb ai/ac EPOST for BXN cotton], or [c)Roundup Ultra at 0.75 lb ai/ac EPOST for Roundup Ready cotton fb LAYBY], 7) Treflan PPI fb Cotoran PRE fb CGA 362622 at 0.0067 lb/ac plus [a) Staple at 0.032 lb/ac for non-transgenic cotton], [b) Buctril at 0.5 lb/ac for BXN cotton], or [c) Roundup Ultra at 0.75 lb/ac fb LAYBY for Roundup Ready cotton], 8) [a) CGA 32622 at 0.0067 lb/ac plus Select at 0.125 lb ai/ac EPOST fb CGA 362622 at 0.0067 lb/ac plus Select at 0.125 lb/ac POST fb LAYBY for non-transgenic cotton], [b) Buctril at 0.5 lb/ac plus Select at 0.125 lb/ac EPOST fb Buctril at 0.5 lb/ac plus Select at 0.125 lb/ac POST fb LAYBY for BXN cotton], or [c) Roundup Ultra at 0.75 lb/ac EPOST fb Roundup Ultra at 0.75 lb/ac POST fb LAYBY for Roundup Ready cotton], 9) [a) CGA 362622 at 0.0067 lb/ac plus Select at 0.125 lb/ac EPOST fb LAYBY for non-transgenic cotton], [b) Buctril at 0.5 lb/ac plus CGA 362622 at 0.0067 lb/ac plus Select at 0.125 lb/ac EPOST fb LAYBY for BXN cotton], or [c) Roundup Ultra at 0.75 lb/ac plus CGA 362622 at 0.0067 lb/ac EPOST fb LAYBY for Roundup Ready cotton], and 10) [a) CGA 362622 at 0.0067 lb/ac plus Select at 0.125 lb/ac POST fb LAYBY for non-transgenic cotton], [b) CGA 362622 at 0.0067 lb/ac plus Buctril at 0.5 lb/ac plus Select at 0.125 lb/ac POST fb LAYBY for BXN cotton], or [c) Roundup Ultra at 0.75 lb/ac plus CGA 362,622 at 0.0067 lb/ac POST fb LAYBY for Roundup Ready cotton]. All herbicides were applied at 15 GPA at 18 PSI. All CGA 362622 alone treatments, Staple, and LAYBY treatments were applied with NIS at 0.25% (v/v). All Select tank mixtures were applied with COC at 1.0% (v/v).

CGA 362622 treatment injured cotton approximately 35 to 40% when applied EPOST with no differences between varieties or with tank mixture treatments. Injury was primarily expressed as stunting and yellowing of the foliage. Injury was transient. Staple injured non-transgenic cotton equivalent to CGA 362622. In this and other trials, cotton injured from CGA 362622 appeared to recover more rapidly than it did from Staple-induced injury. CGA 362622 provided excellent (>95%) early season control of common lambsquarters, jimsonweed, entireleaf morningglory, Palmer amaranth, pitted morningglory, sicklepod, slender amaranth, smooth pigweed, and tall morningglory. Control of these species was equivalent to control seen with Roundup Ultra. CGA 362622 provided better control of sicklepod and common lambsquarters than Staple. However, both Staple and Roundup Ultra were more effective for EPOST control of prickly sida. CGA 362622 did suppress prickly sida long enough to get good (>80%) control with a LAYBY treatment of Caparol plus MSMA. However, prickly sida control with a CGA 362622 EPOST containing system was less than that achieved with a Staple, Buctril, or Roundup EPOST containing system. No antagonism of any species was noted with CGA 362622 tank mixed with Buctril, Staple, or Roundup Ultra. CGA 362622 did antagonize Select activity on goosegrass and large crabgrass. CGA 362622 did not appear to provide any appreciable residual control of any species evaluated. Non-transgenic lint yield was equivalent for a Staple or CGA 362622 EPOST containing system but less than yields with a CGA 362622 plus Staple EPOST tank mixture system. A similar yield response was noted with BXN cotton with the highest yield being achieved with a system that contained Buctril plus CGA 362622 EPOST. Lint yields of Roundup Ready cotton were similar for systems that contained either Roundup Ultra, CGA 362622, or Roundup Ultra plus CGA 362622 EPOST. In separate trials at two locations in 1998 and 1999 in a weed-free environment, 7 cotton varieties (Stoneville 474, BXN 47, DP 51, Bollguard 33B, Suregrow 125, Paymaster 1220 RR and 1220 RRBG responded and yielded similarly to CGA 362622 EPOST (4 to 5L cotton) at 0.0067 or 0.0134 lb/ac plus a NIS at 0.25% (v/v).

COTTON WEED CONTROL IN MISSISSIPPI WITH CGA-362622. K.M. Bloodworth[1], D.B. Reynolds[1], J.C. Holloway[2], and R.M. Cobill[1]. [1]Mississippi State University, Mississippi State. [2]Novartis Crop Protection, Greenville, MS.

ABSTRACT

Novartis Crop Protection recently introduced a new broad spectrum herbicide for over-the-top postemergence applications in cotton, CGA-362622. This herbicide is a sulfonylurea herbicide with the proposed common name of trigloxysulfuron sodium. Application will be made at 2-6 g ai/A. Target weeds include sicklepod, pitted morniggloryy, yellow nutsedge, coffee senna, hemp sesbania, and johnsongrass. In 1999, two experiments were conducted to evaluate the efficacy of CGA-362622 for weed control in conventional and transgenic weed control systems at the Blackbelt Branch Experiment Station near Brooksville, MS. Stoneville BXN 47 and Paymaster 1220 BG/RR were planted on 38 inch rows. Plots were four rows wide by forty feet long. All treatments received 1.25 lbs ai/A Cotoran (fluometuron) preemergence (PRE). In addition to PRE applications of Cotoran, the BXN system received 1.0 lbs ai/A Prowl (pendimethalin) due to the limited grass control obtained with Buctril (bromoxynil). In the conventional weed control system, treatments consisted of CGA-362622 (at 2.02 g ai/A) applied alone postemergence over-the-top (POT), CGA-362622 POT followed by (fb) 1.0 oz ai/A Staple (pyrithiobac) POT, CGA-362622 fb CGA-362622, CGA-362622 fb CGA362622 plus 2.0 lbs ai/A MSMA post-directed (PD), CGA-362622 fb CGA-362622 plus 0.5 lbs ai/A Caparol (prometryn) PD, and Staple applied alone. Treatments in the transgenic weed control systems included CGA-362622 tankmixed with Roundup (glyphosate) or Buctril (0.75 or 0.75 lbs ai/a) POT, CGA-362622 tankmixed with Staple POT, Staple POT fb CGA-362622 POT, Roundup Ultra/Buctril POT fb CGA-362622 POT, or Roundup Ultra/Buctril POT fb 3.04 g ai/A CGA-362622 PD. All treatments were rated at mid-season and season long intervals. Treatments containing sequentials were applied between the two evaluation intervals

The use of CGA-362622 in conventional weed control systems provided equal control of pitted morningglory and prickly sida compared to a single application of Staple. Pitted morningglory control ranged from 82 to 85% and 78 to 85% at the mid-season and season long intervals, respectively, for all treatments. Prickly sida control at the mid-season rating exhibited a significant crop variety interaction where BXN treatments providing 85% control compared to 78% control for Roundup Ready. By the season long rating, prickly sida control ranged from 73 to 82% and did not differ among treatments regardless of variety. Control of grasses at the mid-season rating differed between varieties with BXN systems providing 81% control compared to 30% control in the Roundup Ready System. This difference between varieties can be attributed to multiple weed flushes and the use of Prowl in the BXN system. Sicklepod was only present in one location with treatments containing CGA-362622 providing 75 to 85% control at mid-season and 70 to 83% at the season long rating. Sicklepod control with Staple at mid-season and season long was 52 and 0%, respectively. Treatments did not cause any significant injury to the cotton crop. Seed cotton yields differed between varieties with the Roundup Ready system yielding 1284 lbs/A seed cotton compared to 895 lbs/A seed cotton for the BXN system.

Pitted morningglory control in transgenic systems, at the mid-season rating, was significantly better with treatments containing CGA-362622 compared to Staple alone. Treatments with CGA-362622 provided 73 to 84% control compared to 52% with Staple. Season long pitted morningglory control ranged from 74 to 82% but did not differ among treatments. Mid-season prickly sida control containing CGA-362622, Roundup, or Buctril ranged from 77 to 90% and was significantly better than the 50% achieved by Staple alone. Season long prickly sida control ranged from 77 to 83% and did not differ among treatments. Mid-season grass control exhibited a variety by treatment interaction due to the use of Prowl in the BXN system. Treatments in the BXN system provided at least 73% grass control compared to 20% for treatments in the Roundup Ready system. Sicklepod control was significantly better with treatments containing CGA-362622 compared to Staple alone at the mid-season rating. Control ranged from 85 to 75% with CGA-362622 treatments compared to 72% for Staple alone. By mid season ratings treatments that contained CGA-362622 as follow up treatments provided significantly greater control than all other treatments with control ranging from 83 to 87%. No significant injury was observed at any evaluation interval regardless of treatment or weed control system. Seed cotton yield exhibited a variety by treatment interaction. With the treatments of Roundup fb CGA-362622 POT or PD significantly out yielding all other treatments.

EFFICACY AND TOLERANCE OF GLUFOSINATE IN LIBERTY LINK COTTON. L.L. Somerville, R.H. Walker and J. Belcher, Ala. Agric. Exp. Stn., Auburn University., AL 36849-5412.

ABSTRACT

Field experiments were conducted in 1998 and 1999 in east central Alabama to evaluate glufosinate weed control systems and tolerance in Liberty Link cotton. In the first study, glufosinate was applied postemergence over-the-top (POST) at (a) 0.27, 0.36, 0.54 to 2-and 4-leaf (2 and 4-L) cotton (b) 0.27 lb ai/A to 4-and 8-leaf (4 and 8-L) cotton following preemergence (PRE) applications of fluometuron, norflurazon and pendimethalin applied at 1.25, 1.25 and 0.75 lb ai/A respectively (c) or 0.27, 0.36 lb ai/A to 8-L cotton following a preemergence tank mix of fluometuron and norflurazon. Weed species evaluated were broadleaf signalgrass, entireleaf and pitted morningglories, prickly sida, spiny pigweed, and sicklepod.

In the second study, pendimethalin was applied PRE to all plots at 0.75 lb ai/A while all plots remained weed free by cultivation and hoeing. POST applications of glufosinate included (a) single applications at 0.36 and 0.72 lb ai/A to 2, 4, 8-L and first bloom (FB) cotton, (b) double applications at 0.36 lb ai/A to 2 and 4-L, 4 and 8-L cotton (c) triple applications at 0.24 lb ai/A applied to 2, 4, 8-L or 4, 8-L, FB cotton.

Weed control was greater than 82% for all species and treatments except for spiny pigweed, which was controlled 76% when glufosinate was applied alone at 0.27 lb ai/A to 2, 4-L cotton. Increasing the rate improved overall weed control slightly, with 85% spiny pigweed control, however seed cotton yield was not significantly improved. Control of all weeds was greater than 90% with fluometuron or norflurazon applied PRE followed by glufosinate at 0.27 lb ai/A at 4, 8-L stage, while pendimethalin applied PRE provided less overall weed control ranging from 81-83% for all weeds. Seed cotton yields showed no differences among PRE applications except for pendimethalin. Applications of glufosinate at 0.27 or 0.36 lb ai/A at 8-L following fluometuron plus norflurazon applied PRE showed no significant differences in weed control or seed cotton yield.

Results from the second study showed that there were no detrimental effects on seed cotton yield at any application rate or stage of application. Liberty Link cotton was tolerant of single, double and/or triple applications of glufosinate totaling 0.72 lb ai/A applied at various stages as late as FB.

WEED MANAGEMENT IN CONVENTIONAL-TILLAGE AND STRIP-TILLAGE BXN COTTON. I.C. Burke, J.W. Wilcut, and S.B. Clewis. North Carolina State University, Raleigh, NC 27695.

ABSTRACT

Field studies were conducted in 1999 at Rocky Mount, NC, with Staple, MSMA, and Buctril applied alone and in tank mixtures early postemergence (EPOST) to compare herbicide efficacy and BXN cotton response in strip- and conventional-tillage environments. Roundup Ultra (1.0 lb ai/ac) was applied approximately 30 days prior to planting in both tillage systems for burndown of the wheat cover crop. Gramoxone Extra (0.75 lb ai/ac) was applied to the strip-tillage plots the same day as the preemergence (PRE) treatments for burndown of existing vegetation. Conventional-tillage plots received either Prowl (0.75 lb ai/ac) preplant incorporated (PPI) or Prowl PPI plus Cotoran (1.0 lb ai/ac) PRE. Strip-tillage plots received either Prowl PRE or Prowl PRE plus Cotoran PRE. EPOST treatment options for conventional and strip-tillage plots included 1) Nothing, 2) Staple (0.032 lb ai/ac), 3) MSMA (1.0 lb ai/ac), 4) Buctril (0.5 lb ai/ac, 5) Buctril plus MSMA, 6) Staple plus MSMA, and 7) Staple plus Buctril plus MSMA. Each EPOST treatment received a later treatment of MSMA (2.0 lb ai/ac) postemergence directed (PD). The EPOST treatments were combined in a factorial with LAYBY treatments of 1) Nothing or 2) Caparol (1.2 lb ai/ac) plus MSMA (2.0 lb ai/ac) in a split plot with tillage as main plot and herbicide systems as subplots. Only plots that received Prowl PRE plus Cotoran PRE received EPOST, PD, and LAYBY treatments. All PRE treatments and Staple-containing EPOST treatments were applied with a non-ionic surfactant at 0.25%(v/v).

In conventional-tillage, Prowl PPI plus Cotoran PRE provided >90% control of goosegrass [*Eleusine indica* (L.) Gaertn.] and large crabgrass [*Digitaria sanguinalis* (L.) Scop.]. In strip-tillage, Prowl PRE plus Cotoran PRE provided <50% control of goosegrass and large crabgrass. Conventional-tillage EPOST systems with and without LAYBY treatments provided >95% control of goosegrass and large crabgrass. Strip-tillage systems with LAYBY treatments that included Staple, Buctril, or Buctril plus MSMA EPOST provided >90% goosegrass and large crabgrass control. Strip-tillage systems without LAYBY treatments provided between 70 and 90% control of goosegrass and large crabgrass, except the EPOST tank mix of Staple plus Buctril plus MSMA EPOST, which provided >90% control of both grasses.

Strip- and conventional-tillage treatments of Prowl PRE plus Cotoran PRE provided >95% control of eclipta (*Eclipta alba* L.) and common lambsquarters (*Chenopodium album* L.). The addition of EPOST treatments with or without LAYBY treatments did not improve eclipta or common lambsquarters control in either tillage system. Prowl PRE plus Cotoran PRE did not adequately control entireleaf morningglory (*Ipomoea hederacea* var. *integriuscula* Gray) or ivyleaf morningglory [*Ipomoea hederacea* (L.) Jacq.] in conventional- or strip-tillage systems. Conventional-tillage EPOST treatments provided >90% entireleaf morningglory and ivyleaf morningglory control. Strip-tillage EPOST treatments controlled entireleaf and ivyleaf morningglory as well as the conventional-tillage EPOST treatments, except MSMA EPOST and Buctril plus MSMA EPOST, which required LAYBY treatments for >90% control. The LAYBY treatments in both tillage systems provided little improvement in morningglory control, which may be due to the droughtiness of the 1999 growing season in North Carolina before Labor Day.

Cotton yields were good in both tillage systems where good season long weed control was provided. In a drought year (1999), strip-tillage averaged 804 lb lint/ac compared with 763 lb lint/ac for conventional-tillage with no difference in treatments.

EFFECT OF SIMULATED DRIFT RATES OF ROUNDUP ULTRA, BUCTRIL, AND LIBERTY ON GROWTH AND YIELD OF CONVENTIONAL COTTON. D.K. Miller, B.R. Leonard , P.R. Vidrine, E.M. Holman, R.W. Costello, C.F. Wilson, and D.R. Lee, Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

A field study was conducted in 1999 at the Macon Ridge Research Station in Winnsboro LA to determine the effect of Roundup Ultra (glyphosate), Liberty (glufosinate), and Buctril (bromoxynil) simulated drift rates on conventional cotton. The experimental design was a randomized complete block with a 3 (herbicide) x 7 (rates) x 3 (timing) factorial arrangement of treatments replicated four times. Plot size was 6.67' x 35'. Simulated drift rates of 0, 1/4, 1/8, 1/16, 1/32, 1/64, and 1/128x of the labeled rate of Roundup Ultra (1.0 lb ai/A), Liberty (0.365 lb ai/A), and Buctril (0.5 lb ai/A) were applied to STV 474 cotton at the 2, 5, and 9 node growth stage. Applications were broadcast with a handboom at 15 GPA. Physical barriers eliminated drift between plots. Supplemental furrow irrigation as needed and standard weed, insect and fertility practices were utilized. Parameters measured included visual injury 14 days after each application timing (DAT), plant height 30 DAT (10 random plants/plot), whole plant dry weight 30 DAT (1m section of row/plot), nodes above white flower (NAWF) (10 random plants/plot) mid-season, green and open boll (1 m section of row/plot) late season, final plant population prior to harvest, and seedcotton yield. Dry weight and height data are presented as a percent reduction from the nontreated control (0 rate). For ease of analysis, data were analyzed by herbicide.

Roundup Ultra. No significant differences in NAWF, open boll, plant population, and seedcotton yield were noted compared to the nontreated control. A significant rate by timing interaction was noted for injury, height, and dry weight. A stepwise reduction in injury was observed for the 1/4x rate at the 2 (52%), 5 (45%), and 9 (21%) node timings with all greater than the nontreated check. Injury with 1/8 (33%) and 1/16 (14%) x rates at the 2 node timing was greater than at the 5 or 9 (< 4%) node timing and the nontreated check. Rates of 1/32x or less resulted in no significant injury (<7%). Only the 1/4x rate at the 2 (43%) and 5 (22%) node timing resulted in significant height reduction compared with the nontreated check. Similarly, 1/4x rate applied to 2 (69%) and 5 (39%) node cotton resulted in significant dry weight reduction compared with the nontreated check. A significant rate effect was observed for green boll counts. Averaged across timings, green boll number was significantly greater than the nontreated check only for the 1/4x rate.

Liberty. Liberty application resulted in no significant differences in NAWF, green boll, open boll, plant population, or seedcotton yield compared to the nontreated check. A significant rate by timing interaction was noted for injury only. A stepwise reduction in injury for the 1/4x rate was observed at the 2 (67%), 5 (41%), and 9 (27%) node timing with all greater than nontreated check. All applications at the 1/8 and 1/16 x rates, although not different from each other, and the 2 node application of the 1/32 x rate, resulted in injury ranging from 10 to 25% which was greater than the nontreated check. All other applications resulted in no significant injury. A significant rate effect was noted for height and dry weight. Averaged across timings, significant height reductions of 14 and 18% were observed for only the 1/4 and 1/8x rates, respectively. Dry wt was reduced 38, 20, 20, and 20% by the 1/4, 1/8, 1/16, and 1/64x rates, respectively.

Buctril. No significant differences in NAWF or open boll were noted. Due to mixing error, 1/8x rate was excluded from the analysis. A significant rate by timing interaction was noted for injury, dry weight, plant population, and seedcotton yield. A stepwise reduction in injury was noted for the 1/4x rate at the 2 (92%), 5 (77%), and 9 (64%) node timing with all greater than the nontreated check. Injury with the 1/16x rate was equivalent among timings ranging from 49 to 56%, with all greater than the nontreated check. At the 1/32x rate, significant injury ranging from 35 to 47% was observed. The 1/64 and 1/128x rate at the 2 (33 and 17%, respectively) and 5 (36 and 25%, respectively) node timing resulted in greater injury than their respective 9 node timings and the nontreated check. No significant injury was noted only for the 1/128x rate at the 9 node timing. For the 1/4x rate, height reduction at the 2 (54%) and 5 (45%) node timings were greater than at 9 node (15%), with all greater than the nontreated check. For the 1/16 x rate, height was significantly reduced at the 2 (20%) and 5 (23%) node stages only. With the exception of 1/32x rate applied at the 5 node stage (14%), all other applications did not result in significant height reductions. For the 1/4x rate, dry weight reduction was greater for the 2 (91%) and 5 (72%) node timing than at 9 (34%) node. These respective treatments, in addition to the 1/16x rate at the 2 node timing which resulted in a 51% reduction, were different from the nontreated check. All other treatments resulted in no greater than a 14% reduction. Plant population and seedcotton yield were significantly reduced with only the 1/4x rate applied at 2 node timing. A significant rate effect was noted for green boll. Averaged across timings, the 1/4x rate significantly increased green boll number compared to the nontreated check.

COMPARING ULTRA-NARROW ROW AND CONVENTIONAL ROW COTTON CROPPING SYSTEMS. S.B. Belcher, M.G. Patterson, C.H. Burmester, W.H. Faircloth, and D.O. Stephenson, IV. Department of Agronomy and Soils, Auburn University, Auburn, AL 36849.

ABSTRACT

Field trials were conducted at the Tennessee Valley Substation (TVS), Belle Mina, AL and the Wiregrass Substation (WGS), Headland, AL in 1998 and 1999 to compare weed control systems and plant growth regulator (PGR) requirements for ultra-narrow row (UNR) and conventional row (CR) cotton (*Gossypium hirsutum* L.). Trials at both locations were planted in a no-till system using Paymaster 1220 BG, RR cotton. UNR cotton rows were 19.1 cm apart

while the CR cotton rows were 101.6 cm apart (TVS) and 91.4 cm apart(WGS). Treatments were arranged as a 2 x 2 x 2 factorial in a randomized complete block experimental design. The two levels of weed control were a preemergence (PRE)+ postemergence (POST) system compared to a POST only system. The two levels of PGR were mepiquat chloride (MC) applications at a low rate (level I) and a high rate (level II). The final factor was cotton row spacing; ultra-narrow row and conventional row. Each trial was managed as a grower would manage his crop.

PRE herbicides (pendimethalin, 0.90 kg/ha + fluometuron 1.3 kg/ha) were activated and provided excellent control in 1998 and 1999 at TVS. Final weed control ratings 10 weeks-after-planting (WAP) ranged from good to excellent both years due to timely applications of glyphosate, pyrithiobac, prometryn, cyanazine, MSMA, and sethoxydim. Plant populations for the UNR cotton at TVS were 333,000 and 195,000 plants per hectare while populations in CR cotton were 98,000 and 100,000 plants per hectare in 1998 and 1999. Total nodes per plant and height measurements for both years were significant for row spacing. CR cotton was always taller and contained more nodes than UNR cotton, and cotton grown using the PRE+POST weed control system had more nodes and was taller in 1999. Counts of bolls per plant were significant in 1998 with CR cotton possessing more bolls per plant; however, in 1999, no significant differences were evident. Lint yields between row spacings for both years were not significantly different although UNR yield was numerically greater. The gin turnouts were 36% and 34% for the CR cotton at TVS in 1998 and 1999 while the UNR cotton had turnouts of 31% and 33% in 1998 and 1999, respectively. Final economic analysis suggests that total costs are higher for UNR cotton as compared to CR cotton at TVS and that a PRE+POST weed control system tends to provide the highest profit per hectare. Approximately $54.49 of profit per hectare was made with UNR cotton while $7.51 per hectare was made with CR cotton.

Preemergent weed control 2 WAP at WGS was good in 1998 but unacceptable in 1999. Final weed control ratings were equal due to good to excellent control provided by POST applications. Plant populations averaged 380,000 plants per hectare for UNR cotton and 104,000 plants per hectare for CR cotton in both years. Node counts and corresponding height measurements 2 WAT (after initial MC application) were significant for row spacing for both years with CR cotton being taller and having more nodes than UNR cotton while cotton grown using the PRE+POST weed control system had more nodes and was taller in both years. MC level I cotton was also taller than level II cotton both years. CR cotton had more bolls per plant than UNR cotton both years, and bolls per plant was also significant for weed control program in 1998 with the PRE+POST system having more bolls per plant. Lint yield was significant for row spacing with UNR cotton averaging 1,089 kg/ha while the CR cotton averaged 896 kg/ha over both years. Gin turnouts at WGS were 39% and 38% for the CR cotton in 1998 and 1999 while the UNR cotton had a turnout of 31% for both years. Total costs were higher for UNR cotton at WGS compared to CR cotton. However, UNR cotton provided $388.05 of profit per hectare while CR cotton provided $205.93.

Overall, good to excellent weed control was achieved with the PRE+POST and POST only systems. However, the PRE+POST system provided better economic returns at TVS while economic returns at WGS were mixed. MC level I provided better economic returns at TVS, but level II provided better returns at WGS. Lint yield was not significant at TVS, but UNR cotton was significantly greater at WGS. In conclusion, UNR cotton had higher total costs, but also had higher profits than CR cotton at both locations. The difference in the economics is yield.

WEED MANAGEMENT IN CONSERVATION TILLAGE, ULTRA-NARROW ROW, AND CONVENTIONAL TILLAGE COTTON CROPPING SYSTEMS. A.L. Helm, J.W. Keeling, P.A. Dotray, D.T. Carmichael, Texas Agricultural Experiment Station, Texas Tech University, Lubbock, Texas.

ABSTRACT

Conservation tillage cotton cropping systems using a winter cover crop have increased the need for better weed management practices without the use of cultivation. Two conservation tillage-cropping systems and one ultra-narrow system were compared to conventional tillage at the AG-CARES research farm near Lamesa TX, to evaluate the use of glyphosate applied postemergence topical (PT) and postemergence directed (PD) in Roundup Ready® cotton cropping systems. The conservation tillage systems consisted of cotton on 40" rows and a rotational system consisting rye and sorghum followed by cotton (R-S-C)or an ultra-narrow row (UNR) system. Rye was planted as a winter cover crop in the conservation tillage 40" rows and the UNR and terminated with glyphosate in late March. All systems consisted of the following treatments 1) pendimethalin preplant incorporated (PPI) followed by (fb) prometryn preemergence (PRE) + cultivation (2X, except in the UNR system) + glyphosate spot spray + hand hoe; 2) pendimethalin fb glyphosate PT fb postemergence directed PD; 3) glyphosate PT fb PD (the UNR system received a late PT glyphosate application instead of the PD application). Each plot in this Latin Square design was 26 feet by 300 feet and received 13 inches of irrigation through a LEPA irrigation system. Two cotton varieties (Paymaster HS26 and 2326RR) were planted on May 12, 1999. The variety HS26 was planted in the treatments that did not receive any glyphosate applications.

Prior to any of the glyphosate applications, treatments 1 and 2 both provided adequate control of both Palmer amaranth (*Amaranthus palmerii*) and Russian thistle (*Salsola iberica*) in all systems. Fall applications of glyphosate provided up to 78% silverleaf nightshade (*Solanum elaeagnifolium*) control in the treatments that did not include glyphosate as an in-season application. Two years of in-season glyphosate applications provided up to 90% control of silverleaf nightshade. Preplant tillage operations such as herbicide incorporation and rod-weeding provided some level of control in the conventional tillage (treatment 3) prior to any glyphosate application. In all systems, residual herbicides followed

by two applications of glyphosate provided at least the same level of control as the residual herbicides + cultivation. Glyphosate PT fb PD provided 80-90% control of all weed species except in the UNR system, which had only one application of glyphosate. Season long Palmer amaranth control in the residual herbicides + glyphosate (PT fb PD) gave the same level of control as the residual herbicides + cultivation + spot spray + hand hoe; however, glyphosate alone did not provide the same level of control. Pendimethalin fb glyphosate PT/PD provided similar level of Palmer amaranth control as pendimethalin fb prometryn + cultivation. Glyphosate PT fb PD did not provide the same level of Palmer amaranth control as the two treatments that include residual herbicides. Residual herbicides fb glyphosate in the conventional tillage and the UNR systems produced higher net returns than residual herbicides + cultivation or glyphosate alone. Glyphosate alone gave higher net returns in the conservation tillage 40" rows and in the rotation systems.

GIBBERELLIC ACID, PLANTING DEPTH, AND COMMAND INJURY IN RICE. R.T. Dunand, Rice Research Station, Louisiana Agricultural Experiment Station, LSU AgCenter, Crowley, LA 70527.

ABSTRACT

Gibberellic acid, a plant growth regulator, is labeled as a seed treatment in drill-seeded rice to promote seedling vigor. Semidwarf rice can be planted up to 3 inches deep with the seed treatment compared with 1 ½ inches or less without gibberellic acid. Command applied postplant and preemergence is in close proximity to shallow planted seed and causes loss of green pigmentation and reduces seedling vigor in rice. This type of injury increases with increases in rate. Seed placement below the soil surface was investigated to determine the effect of planting deep, facilitated by gibberellic acid, on injury from Command.

An early season variety, Cypress, was drill-seeded on 7-inch rows at 100 lb/A. Plot size was 6 x 30 ft. Soil type was Crowley silt loam. Standard agricultural chemicals were applied as recommended for insect and disease control. Gibberellic acid (Release, Abbott Laboratories, North Chicago, IL) was applied at 10 g/cwt. Seed treated with gibberellic acid was planted 3 inches deep. Seed without gibberellic acid was planted 1.5 inches deep. On the day after planting, clomazone (Command 3ME, FMC Corporation, Philadelphia, PA) was applied at 0.375 (recommended rate for silt loam soil types), 0.5625, and 0.75 lb ai/A using a CO_2 driven back pack sprayer with a delivery rate of 15 gal/A. Experimental design was a randomized complete block with four replications. There was a factorial arrangement of two planting depths and four herbicide treatments (three rates of Command 3ME and a control).

Injury to seedlings from Command increased with rate and was unaffected by depth of planting. At 7 days after emergence (DAE), 1- to 2-leaf stage seedlings exhibited abnormal pigmentation (white, pale green, and yellow coloration). Abnormal pigmentation occurred in 3, 6, and 9 plants/ft^2 with the three rates of Command, respectively. Seedling density (stand) and height were similar for the control and Command treatments. Stand ranged between 16 and 18 plants/ft^2, and seedlings ranged between 17 and 19 cm in height. At 16 DAE (3- to 4-leaf stage), all measurements of seedling vigor were negatively impacted by Command at the intermediate (0.5625 lb ai/A) and high (0.75 lb ai/A) rates. Stand was reduced from 16 plants/ft^2 in the control and 17 plants/ft^2 with the lowest rate of Command to 14 and 12 plant/ft^2 for the intermediate and high rates of Command, respectively. Abnormal pigmentation occurred in 1, 4, 6, and 7 plants/ft^2 in the control and three rates of Command. Seedling heights were 22, 21, 19, and 16 cm, respectively. The effects of Command on pigmentation, seedling height, and stand had moderated noticeably but were visually apparent at 24 DAE. Ranking treatments (1, best through 8, worst) according to visual appearance taking stand, pigmentation and height into consideration produced rankings of 2, 4, 6, and 7 for the control and three rates of Command.

At harvest, crop stature, maturity and production were unaffected by planting depth and Command. Mature plant height ranged between 95 and 97 cm, grain moisture ranged between 18 and 18.4%, and grain yield ranged between 6600 and 7100 lb/A across both planting depths and all herbicide treatments. Grain yield was not impacted because stand of all treatments exceeded 10 plants/ft^2, the minimum necessary for maximum grain production.

Injury from Command in rice was manifested in altered pigmentation, loss of stand, and reduced height. Injury occurred at the recommended rate, increased with rate, increased with seedling age, and was unaffected by planting depth. Injury was limited to the seedling stages and did not reduce plant density below the minimum necessary for optimum yields. Consequently, injury from Command did not negatively impact crop production.

RICE TOLERANCE AND SEDGE CONTROL WITH HALOSULFURON-METHYL. B.J. Williams; Northeast Research Station, St. Joseph, LA, Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

Rice (*Oryza sativa*) tolerance to halosulfuron-methyl was evaluated in 1997 and 1998 at the Northeast Research Station near St. Joseph, LA on a Sharkey clay soil and in 1999 at the Macon Ridge Research Station near Winnsboro, LA on a Gigger silt loam soil. Studies were also conducted in 1997 and 1998 at the Northeast Research Station to evaluate the effect of halosulfuron-methyl rate and timing on hemp sesbania (*Sesbania exaltata*) and annual sedge (*Cyperus iria*)

control. Combinations of bensulfuron and halosulfuron-methyl were evaluated for yellow nutsedge (*Cyperus esculentus*) control in 1999 at the Northeast Research Station. Rice 'Cypress' in 1997 and 1998 and 'Cocodrie' in 1999, was drill-seeded at 140 kg/ha in rows19 cm apart. Permanent floods were established 4 to 5 weeks after planting. Nitrogen, in the form of prilled urea, was applied at 126 kg/ha just before permanent flood. At panicle initiation and additional 42 kg/ha of nitrogen was applied. Herbicide treatments were applied, in 140 L/ha of water using a CO_2 pressurized backpack sprayer, to plots measuring 2 by 4.5 m. The experimental design in all years was a randomized complete block with three replications. Weed control ratings, rice injury ratings, and rice yield data were subjected to analysis of variance. Means were separated using Fisher's Protected LSD at the 5% level.

Halosulfuron-methyl at 0.07 and 1.4 kg ai/ha applied preemergence reduced rice vigor 13% 2 weeks after rice emergence (WAE) in 1997. By 4 WAE rice had recovered, and suffered no yield loss. Halosulfuron-methyl did not injure rice when applied EPOST, MPOST or post-flood at any rate. Rice was not injured by 0.07 or 1.4 kg ai/ha halosulfuron-methyl at any application timing in 1998. In 1999 on the Gigger silt loam soil, 0.07 and 1.4 kg ai/ha halosulfuron-methyl reduced rice vigor by 60 and 80% 2 WAE, respectively. At 8 WAE rice vigor was still reduced 20 and 30% from 0.07 and 1.4 kg ai/ha halosulfuron-methyl, respectively. Hemp sesbania control was 60, 60, 70 and 90% when 0.013, 0.026, 0.052 and 0.068 kg ai/ha halosulfuron-methyl was applied late post. Annual sedge control was 70, 83, 90 and 95% when 0.013, 0.026, 0.052 and 0.068 kg ai/ha halosulfuron-methyl was applied late post. Hemp sesbania control from 0.068 kg ai/ha halosulfuron-methyl was reduce from at least 95% with EPOST and MPOST applications to 70% when applied post-flood. Application timing did not influence annual sedge control. Yellow nutsedge control was 83, 95 or 95% when halosulfuron-methyl at 0.013, 0.026 or 0.40 kg ai/ha plus 3.3 kg ai/ha propanil was applied LPOST. Bensulfuron at 0.026 or 0.40 kg ai/ha plus 3.3 kg ai/ha propanil only controlled yellow nutsedge 70 or 75%, respectively. Halosulfuron-methyl at 0.013 kg ai/ha plus 0.026 kg ai/ha bensulfuron plus 3.3 kg ai/ha propanil controlled yellow nutsedge 98%. Increasing halosulfuron-methyl and bensulfuron rates above 0.013 kg ai/ha and 0.026 kg ai/ha, respectively, did not improve yellow nutsedge control when they were tank-mixed with each other and propanil.

This research indicates that halosulfuron-methyl as the potential to injure rice when applied preemergence, especially on silt loam soils. Hemp sesbania and annual sedge control was reduced and less consistent at halosulfuron-methyl rates lower than 0.068 and 0.04 kg ai/ha, respectively. Additionally, post-flood applications of halosulfuron-methyl were less efficient in controlling hemp sesbania. Halosulfuron-methyl rates as low as 0.0.13 kg ai/ha controlled moderate infestations of yellow nutsedge when applied with bensulfuron and propanil.

WEED MANAGEMENT SYSTEMS FOR CONTROL OF FLORIDA BEGGARWEED (*DESMODIUM TORTOUSUM*) AND SICKLEPOD (*SENNA OBTUSIFOLIA*) IN PEANUTS. C.L. Main, J.A. Tredaway, and G.E. MacDonald, University of Florida, Gainesville, FL.

ABSTRACT

The most troublesome weeds in Florida peanut fields in 1998 were 1. Florida beggarweed (*Desmodium tortuosum*) 2. hairy indigo (*Indigofera hirsuta*) and 3. sicklepod (*Senna obtusifolia*) (Dowler 1998). Peanut yields have been reduced 15.8 to 30.2 and 6.1 to 22.3 kg/ha, respectively by Florida beggarweed and sicklepod (Hauser et al. 1982). A field experiment was conducted at Marianna, FL in 1999 to determine the effectiveness of diclosulam and flumioxazin as a component of peanut (*Arachis hypogaea L.*) weed management systems for the control of Florida beggarweed (*Desmodium tortuosum*) and sicklepod (*Senna obtusifolia*) in 'Georgia Green' peanuts. Treatments were arranged in a randomized complete block design with four replications. Ethalfluralin was applied at 0.75 lbs. ai/A to all plots for control of small seeded broadleaf weeds and grasses. Diclosulam and flumioxazin were applied pre-plant incorporated (PPI) and pre-emergence (PRE), respectivly, alone and in treatment combinations. All treatments included in lbs. ai/A included 1.) diclosulam at (0.024), 2.)flumioxazin at (0.094), and 3.) no PPI or PRE. Post-emergence (POST) treatment combinations evaluated with each PPI or PRE herbicide include 1.) early post-emergence (EPOST) bentazon (0.25) + paraquat (0.125) + 2,4-DB (0.20) followed by middle post-emergence (MPOST) 2,4-DB (0.20), 2.) (EPOST) bentazon (0.25) + paraquat (0.125) + 2,4-DB (0.20) followed by MPOST) 2,4-DB (0.20) followed by late post-emergence (LPOST) 2,4-DB (0.20), 3.) (EPOST) bentazon (0.25) + paraquat (0.125) + 2,4-DB (0.20) followed by (LPOST) chlorimuron (0.008) + 2,4-DB (0.20), 4.) (EPOST) bentazon (0.25) + paraquat (0.125) + 2,4-DB (0.20) followed by (MPOST) imazapic (0.063), 5.) (MPOST) imazapic (0.063). 6.) Weed-free check. 7.) Weedy check. All post-emergence treatments included a non-ionic surfactant at 0.25% v/v. Treatments were applied using a CO2 tractor-mounted sprayer delivering 20 gallons per acre (GPA) of water carrier. Data collected included Florida beggarweed and sicklepod control and peanut injury early, middle, and late season. Peanut yield was recorded 150 days after planting (DAP) in lbs./A. Peanuts were also evaluated for total sound mature kernels (TSMK), extra large kernels (ELK), sound-splits (SS), and other kernels (OK).

No differences were observed for any PPI, PRE, or POST treatment or treatment combinations for crop injury. Flumioxazin alone controlled sicklepod 95.5% and Florida beggarweed 98% which was greater than diclosulam at 75% and 85% respectively. This trend continued through out the growing season. All POST treatments controlled sicklepod >83% and Florida beggarweed >89% by the end of the growing season. Plots maintained weed free and plots receiving a herbicide treatment yielded greater than the weedy check. No differences in peanut grades for TSMK, ELK, SS, and OK were observed for any herbicide treatment, weed free check, or weedy check.

TILLAGE AND PEST MANAGEMENT CONSIDERATIONS IN A PEANUT-COTTON ROTATION. W.C. Johnson, III, T.B. Brenneman, S.H. Baker, A.W. Johnson, and D.R. Sumner. USDA-ARS and Univ. of Georgia, Coastal Plain Experiment Station, Tifton, GA 31793.

ABSTRACT

Studies were conducted from 1994 to 1998 in Tifton, GA on the effects of tillage on crop and pest management in a peanut-cotton rotation. Tillage systems evaluated were conventional-, reduced-, and no-tillage. Conventional-tillage plots were harrowed, deep-turned, bedded, and planted in the spring each year. Reduced tillage plots were harrowed in the fall after previous crop harvest, planted to a rye cover crop, treated with glyphosate in the early spring to kill the rye, and crops planted into the killed cover using a strip-tillage planter. No-till was neither tilled nor planted to rye after crop harvest, remained nontilled during the winter, treated with glyphosate in the early spring to kill emerged winter weeds, and crops planted directly into the previous crop debris using a strip-tillage planter. Maintenance weed control in both crops was based on weeds present, by tillage system. Plots planted to peanut were further split into treated with flutolanil fungicide and nontreated. Parameters measured were peanut yield, cotton yield, incidence of peanut diseases, damage from plant parasitic nematodes, and weed species composition.

Neither peanut yields nor cotton yields were affected by tillage over the duration of the study. Similarly, incidence of Rhizoctonia limb rot (*Rhizoctonia solani*) and white mold (*Sclerotium rolfsii*) in peanut were not affected by tillage, which is contrary to earlier theories of greater disease incidence in reduced- and no-tillage systems than in conventional-tillage systems. Flutolanil effectively controlled Rhizoctonia limb rot and white mold in peanut, and increased yields accordingly. There was not a statistical interaction between tillage and flutolanil treatment for fungal disease incidence and peanut yield. This indicates that tillage cannot replace the need for flutolanil treatment and resulting disease control. Regardless of tillage system, the benefits of flutolanil for fungal disease control in peanut justify its use in this rotation.

Spotted wilt (tomato spotted wilt tospovirus) incidence was consistently greater in conventional tillage peanut than either reduced- or no-tillage peanut. Incidence of spotted wilt was not affected by flutolanil treatment. The benefits of reduced- and no-tillage systems in managing spotted wilt have been included in the Tomato Spotted Wilt Virus Risk Assessment Index, developed for peanut growers by the University of Georgia.

Plant parasitic nematodes present in the trial were peanut root knot nematode (*Meloidogyne arenaria*) and lesion nematode (*Pratylenchus penetrans*). Populations of both species were low throughout the trial. At the populations present in these trials, there was no tillage effect on nematode damage in both peanut and cotton.

Weeds were successfully controlled in peanut and cotton across all tillage systems. However, weed densities and species diversity increased during the duration of the trial, necessitating more intensive weed control efforts, especially in reduced- and no-tillage systems. For example, peanut weed control costs in reduced- and no-tillage systems increased by 700% after four years. Weed species that increased in reduced- and no-tillage systems in the peanut-cotton rotation were ivyleaf morningglory (*Ipomoea hederacea*), spotted spurge (*Euphorbia maculata*), bermudagrass (*Cynodon dactylon*) and volunteer peanut.

In summary, crop yields were sustained in continuous reduced- and no-tillage systems in a peanut-cotton rotation for five years, using flutolanil for soil-borne fungal disease control. Peanut grown in reduced- and no-tillage systems also had less incidence of spotted wilt than peanut grown in conventional-tillage systems. However, crop production costs may increase over time in reduced- and no-tillage systems due weed species shifts and need for more intensive herbicide use.

DICLOSULAM SYSTEMS FOR WEED MANAGEMENT IN GEORGIA PEANUT. K.L. Johnson and W.K. Vencill, University of Georgia, Athens, GA 30602.

ABSTRACT

Field studies were initiated in 1999 in Midville and Plains, GA to evaluate diclosulam systems and use rates for weed control in peanut. In Midville, eight treatments were evaluated: diclosulam PPI at 25 g/ha and 50 g/ha, diclosulam + flumioxazin PPI at 25 + 87 and 50 + 87 g/ha, diclosulam + norflurazon PPI followed by (fb) paraquat EPOST at 25 + 1650 fb 138 and 50 + 1650 fb 138 g/ha, imazapic EPOST at 69 g/ha, and ethalfluralin PPI at 825 g/ha across all treatments and as a check. Additional treatments at Plains included diclosulam + dimethenamid PPI at 25 + 1650 and 50 + 1650 g/ha. Weed control and crop injury were evaluated on a scale of 0-100 %.

At Midville, treatments were evaluated for yellow nutsedge and common cocklebur control. All treatments except ethalfluralin provided > 80 % season long control of both weeds. Yellow nutsedge, sicklepod, Florida beggarweed, prickly sida, wild poinsettia, and morningglory species control were evaluated at Plains. All treatments containing diclosulam provided ^{3} 90 % control of prickly sida, Florida beggarweed and morningglory species. All diclosulam treatments except diclosulam + flumioxazin PPI at 50 + 87 g/ha provided >90 % control of yellow nutsedge. Diclosulam PPI at 25 and 50 g/ha, diclosulam + dimethenamid PPI at 25 + 1650 and 50 + 1650 g/ha, and imazapic at 69 g/ha

controlled wild poinsettia > 85 %. Imazapic at 69 g/ha was the only treatment to provide >80 % control of sicklepod. In Plains, peanut treated with imazapic EPOST at 69 g/ha yielded the highest amongst treatments evaluated.

WEED MANAGEMENT IN TEXAS PEANUT WITH DICLOSULAM. P.A. Dotray, B.L. Porter, J.W. Keeling, T.A. Baughman, W.J. Grichar, E.P. Prostko, and R.G. Lemon. Texas Agricultural Experiment Station, Lubbock and Yoakum, Texas Agricultural Extension Service, Lubbock, Vernon, Stephenville, and College Station, and Texas Tech University, Lubbock.

ABSTRACT

Diclosulam is an ALS-inhibiting herbicide that belongs to the triazolopyrimidine sulfonanilide family of herbicides. Registration in peanut (*Arachis hypogaea*) is expected in spring of 2000. Diclosulam has been reported to have excellent activity on Florida beggarweed (*Desmodium tortuosum*), eclipta (*Eclipta prostrata*), tropic croton (*Croton glandulosus*), golden crownbeard (*Verbesina encelioides*), bristly starbur (*Acanthospermum hispidum*), common ragweed (*Ambrosia artemisiifolia*), and pigweed species (*Amaranthus* sp.), but is weak on sicklepod (*Cassia obtusifolia*). One important attribute of diclosulam is crop rotation flexibility with cotton (*Gossypium hirsutum*). Field studies were conducted near Lubbock to examine the influence of application timing and method on diclosulam activity. Additional studies were conducted near Lubbock, Olton, Plains, Stephenville, Wellington, and Yoakum to determine diclosulam efficacy on a variety of Texas weeds. Diclosulam at 0.024 lb ai/A applied PPI or PRE controlled Palmer amaranth (*Amaranthus palmeri*) 81 to 95% and devil=s-claw (*Proboscidea louisianica*) at least 97% late season. Diclosulam plus ethafluralin applied PPI controlled Palmer amaranth 98%. Postemergence-topical applications of diclosulam were not effective. Diclosulam applied 90 days before planting controlled Palmer amaranth and devil=s-claw 85 and 99%, respectively. This control was similar to diclosulam applied PRE. Peanut injury (10-20%) was observed following all diclosulam applications in 1999, but injury was not observed at the end of the season and was not reflected in yield. Near Plains, diclosulam applied PRE controlled Palmer amaranth and common sunflower (*Helianthus annuus*) 100%, whereas near Olton in a fine sand soil, Palmer amaranth was controlled 75%. Near Wellington, diclosulam controlled Palmer amaranth 95%, regardless if applied PPI or PRE, and controlled large crabgrass (*Digitaria sanguinalis*) 18 to 63%. Ethafluralin plus diclosulam improved large crabgrass control. Near Stephenville, hophornbeam copperleaf (*Acalypha ostryifolia*) was controlled more effectively when diclosulam was applied PPI (78%) compared to diclosulam applied PRE (38%). Ethafluralin applied PPI followed by diclosulam PRE controlled hophornbeam copperleaf 81%. Near Yoakum, ethafluralin plus diclosulam controlled yellow nutsedge (*Cyperus esculentus*) 53 to 73%, pitted morningglory (*Ipomoea lacunosa*) 73%, and Texas panicum (*Panicum texanum*) 78%. No difference in efficacy was observed when comparing diclosulam applied PPI to diclosulam applied PRE. Pitted morningglory and Texas panicum control was less effective with diclosulam was applied PPI alone. These tests illustrate that diclosulam has a broad spectrum of activity and will be a valuable tool to Texas peanut producers.

WEED MANAGEMENT IN PEANUT WITH DICLOSULAM AND IMAZAPIC. C.W. Swann, Tidewater Agric. Res. and Ext. Center, 6321 Holland Road, Suffolk, VA 23437.

ABSTRACT

Field studies were conducted in 1998 and 1999 at the Tidewater AREC, Suffolk, VA, to evaluate peanut response (var. NC-V 11) and weed control efficacy with diclosulam (PPI) or imazapic (EPO) used alone and as sequential treatments. All herbicide treated plots received ethalfluralin PPI (0.62 kg/ha) approximately 2 weeks prior to planting. In both years 42% metam sodium (70 l/ha) was applied as an in-furrow treatment, at least 2 weeks prior to planting for suppression of Cylindrocladium black root rot (CBR).

In both years diclosulam was evaluated (PPI) at 8.8 (.33x), 17.7 (.66x) and 26.5 (1x) g ai/ha, both alone and as treatments in which each rate of diclosulam was followed with imazapic (EPO) at 35.3 (.5x), 52.9 (.75x) and 70.6 (1x) g ai/ha. Imazapic (EPO) alone was evaluated at 70.6 g ai/ha (1x) in 1998 and at 35.3 (.5x), 52.9 (.75x) and 70.6 (1x) g ai/ha in 1999. Imazapic treatments were applied with 4.6 l/ha COC.

In 1998 diclosulam (PPI) alone provided 50, 75 and 75 percent control of yellow nutsedge (*Cyperus esculentus* L.) at the .33x, .66x an 1x rates respectively with all rates providing 100 percent control of common ragweed (*Ambrosia artemisiifolia* L.). In 1999 diclosulam (PPI) alone provided 85, 92 and 92 percent control of yellow nutsedge and 78, 95 and 97 percent control of common ragweed with .33x, .66x and 1x rates respectively.

In 1998 the 1x rate of imazapic (EPO) provided 98 percent control of yellow nutsedge and 87 percent control of common ragweed. In 1999 imazapic (EPO) provided 83, 93 and 92 percent control of yellow nutsedge, and 50, 67 and 73 percent control of common ragweed at the .5x, .75x and 1x rates respectively.

In 1998 and 1999 sequential programs of diclosulam (PPI) followed by imazapic (EPO) provided 88 percent and 95 percent or greater yellow nutsedge control respectively. All sequential programs of diclosulam (PPI) followed by imazapic provided complete control of common ragweed in 1998 and 88 percent to 100 percent control of common ragweed in 1999.

Yield of peanut treated with sequential programs of diclosulam (PPI) followed by imazapic (EPO), regardless of rates utilized did not differ significantly from yields of peanut treated with the 1xrate of diclosulam or imazapic applied alone. The sequential use of combinations of reduced rates of diclosulam and imazapic offers substantial potential for broadspectrum

STRONGARM AND DUAL MAGNUM COMBINATIONS FOR WEED CONTROL IN TEXAS PEANUT. T.A. Baughman, P.A. Dotray, W.J. Grichar, J.W. Keeling, R.G. Lemon, E.P. Prostko, B.L. Porter, B.A. Besler, K.D. Brewer, V.B. Langston, and R.B. Lassiter. Texas Agricultural Extension Service, Vernon, Lubbock, and College Station; Texas Agricultural Experiment Station, Yoakum and Lubbock; University of Georgia, Tifton; and DowAgro Sciences, The Woodlands, TX, and Little Rock, AR.

ABSTRACT

The potential use of Strongarm (diclosulam) for weed control in Texas peanut production is of interest to growers across the state. Texas peanut production is distributed over several geographical regions, with each having varying environmental patterns. However, similar weed species occur in all regions, with yellow nutsedge (*Cyperus esculentus*) being one of the primary problems. Therefore, trials were established in Central, North, South, and West Texas to evaluate the use of Strongarm in combination with Dual Magnum (*s*-metolachlor) for yellow nutsedge control. The trials included applying Strongarm preemergence at 0.15, 0.30, and 0.45 oz/A. All rates of Strongarm were applied alone or followed by a postemergence application of Dual Magnum at 0.5, 1.0, or 1.33 pt/A. Dual Magnum was applied at these rates postemergence alone, as well. All locations, except South Texas, included a standard herbicide application of Cadre (imazapic) at 1.44 oz/A for comparison. Peanut injury and yellow nutsedge control were evaluated at all locations, and peanut yield was recorded at the South Texas location. A second location was conducted in Central Texas to evaluate these same herbicide programs for control of entireleaf morningglory (*Ipomoea hederacea var. integriuscula*).

Peanut injury from Strongarm was less than 10% at all locations prior to the POST applications. Injury was less than 10% mid-season at all locations with the exception of Strongarm applied at 0.45 oz/A in West Texas. However, this injury was no longer visible late season. Yellow nutsedge control was greater than 80% prior to POST applications with all rates of Strongarm, except in North Texas and the 0.15 oz/A rate in South Texas. Dual Magnum POST alone provided less than 75% control at all locations except late season in Central Texas (1.0 and 1.33 pt/A). Yellow nutsedge late season control with Cadre was 95, 95 and 70% respectively in Central, North, and West Texas. Strongarm applied at 0.45 oz/A alone controlled yellow nutsedge at least 75% mid-season at all locations. Late season control was less than 75% with Strongarm applied alone except in Central Texas with the 0.3 and 0.45 oz/A rates. Yellow nutsedge control was increased late season when 0.15 oz/A of Strongarm was followed by 1.33 pt/A of Dual Magnum at all locations. Control was also increased in North, South, and West Texas when 0.3 oz/A of Strongarm was followed by 1.0 or 1.33 pt/A of Dual Magnum. Morningglory control was less than 70% with all Dual Magnum applications applied alone. Control was greater than 90% when Strongarm was applied alone at 0.30 or 0.45 oz/A, which was similar to the standard Cadre application.

STRONGARM AND VALOR SYSTEMS FOR WEED MANAGEMENT IN PEANUTS. A.J. Price, G.H. Scott, S.D. Askew, J.W. Wilcut and C.W. Swann, Crop Science Department, North Carolina State University, Raleigh, NC 27695-7620 and Virginia Tech, Suffock.

ABSTRACT

Four field studies were conducted in Rocky Mount and Lewiston, NC in 1998 and 1999 to evaluate weed control, peanut response, and net returns for diclosulam (Strongarm) and flumioxazin (Valor) systems. Peanut cultivars used were 'NC 7' and NC 10C.' Dual II Magnum was applied PPI at 1.27lb ai/A to all plots. Preemergence herbicide options were: 1) nothing, 2) Strongarm at 0.024 lb ai/A, or 3) Valor at 0.078 lb ai/A, in a factorial arrangement with postemergence (POST) herbicide options which included: 1) nothing, 2) Storm at 0.75 lb ai/A, or 3) Starfire at 0.125 lb ai/A plus Basagran 0.25 lb ai/A early postermergence (EPOST) fb Storm at 0.75 lb ai/A POST. All EPOST and POST herbicides were applied with NIS at 0.25% (v/v). All herbicides were applied at 15 GPA at 18 psi.

Peanut injury from all herbicides systems was minor (<12%). Dual PPI fb Strongarm or Valor PRE controlled common lambsquarters (*Chenopodium album*), common ragweed (*Ambrosia artemisifolia*), entireleaf morningglory (*Ipomoea hedereacea* var. *integuiscula*), large crabgrass (*Digitaria sanguinalis*), and yellow nutsedge (*Cyperus esculentus*), as well as or better than Dual PPI fb the POST commercial standards of Storm or Starfire plus Basagran EPOST fb Storm POST. Dual PPI plus Valor PRE controlled common lambsquarters better than Dual PPI plus Strongarm PRE. There was no difference in peanut yield and net returns between Dual PPI fb either Strongarm and Valor PRE when POST herbicides were used.

Common ragweed was controlled 76% with Valor PRE while Strongarm controlled 100% with no differences in treatments. Metolachlor PPI fb EPOST and POST herbicides controlled common ragweed 63%. Dual II Magnum did not control entireleaf morningglory while Strongarm and Valor PRE improved control to at least 78% with no differences among treatments. Ivyleaf morningglory (*Ipomoea hedereacea*) was controlled at least 62% with Strongarm and Valor PRE. There were very few differences in peanut yields among Strongarm and Valor-treated peanuts. The addition of POST or EPOST fb POST herbicides improved yields for Strongarm and Valor systems in 2 of 16 comparisons. Net return data mirrored many of the trends seen in peanut yield with the highest and most consistent returns seen with Strongarm and Valor systems.

PERFORMANCE OF IMAZETHAPYR IN NON-FLUSHED, DRILL SEEDED RICE. J.A. Kendig, G.A. Ohmes, P.M. Ezell, and R.L. Barham, University of Missouri Delta Center, Portageville, MO 63873.

ABSTRACT

Imazethapyr was investigated preplant incorporated (PPI), preemergence (PRE) and early postemergence (POST) at 70, 105, and 140 g/ha on an imidazolinone-resistant rice cultivar in 1988 and 1989. A 175 g/ha rate was evaluated in 1988. Common Missouri planting methods were used where rice is not flushed after planting. Rainfall within the first six days after planting was generally 1 cm or less. On a Portageville clay, Barnyardgrass control from incorporated imazethapyr increased from 8 up to 39 and 43% as the rate was increased from 70 to 140 g/ha. On a Crowley silt loam control increased from 55 and 70 to 83 and 90% as the rate was increased from 70 to 140 g/ha. With similar post-plant, preemergence surface applications barnyardgrass control on a Portageville clay increased from 14 and 20% at 70 g/ha to 30 and 45% at 140 g/ha and on a Crowley silt loam increased from 28 and 58% at 70 g/ha to 70 and 90% at 140 g/ha. Higher herbicide sorption likely decreased control on the clay relative to the silt loam soil. However, control was generally inadequate from the targeted use rate of 70 g/ha, regardless of soil. Although activating rainfall was limiting, incorporated treatments generally performed worse than preemergence treatments, and pendimethalin- and quinclorac-treated plots in adjacent areas usually provided good barnyardgrass control. Postemergence applications at the 2- to 3-leaf barnyardgrass stage at any of the tested rates provided 75% or greater barnyardgrass control on a Crowley silt loam. On a Portageville clay, 140 and 105 g/ha were required to provide greater than 70% barnyardgrass control in 1988 and 1999 respectively. Sequential applications (PPI or PRE) followed by a POST application were generally similar to single POST applications. No crop injury was observed from any imazethapyr treatment. In an additional study two POST applications of imazethapyr + imazapyr at 47 + 16 g/ha, imazamox at 45 g/ha and nicosulfuron at 35g/ha of nicosulfuron provided excellent barnyardgrass control without noticeable crop injury. A PRE application of imazaquin at 140 g/ha and two POST applications of pyrithiobac at 70 g/ha caused no crop injury, but provided poor barnyardgrass control. Two POST applications of rimsulfuron at 26 g/ha controlled barnyardgrass but caused severe crop injury.

INTERACTION OF CLETHODIM WITH BROADLEAF HERBICIDES FOR WEED CONTROL IN PEANUT (*Arachis hypogaea* L.). W.J. Grichar, B.A. Besler, and K.D. Brewer, Texas Agricultural Experiment Station., Yoakum, TX 77995; T.A. Baughman, Texas Agricultural Extension Service, Vernon, TX 76384.

ABSTRACT

Field studies were conducted at Yoakum in south central Texas during the 1996, 1997, and 1999 growing seasons to evaluate broadleaf signalgrass [*Brachiaria platyphylla* (Griseb.) Nash.] and southern crabgrass [*Digitaria ciliaris* (Retz.) Koel.] control with clethodim alone and in various combinations with POST broadleaf herbicides. Treatments included clethodim at 0.105 kg/ha applied alone, clethodim + acifluorfen at 0.56 kg/ha, clethodim + acifluorfen at 0.28 kg/ha + bentazon at 0.56 kg/ha, clethodim + imazapic at 0.07 kg/ha, clethodim + imazethapyr at 0.07 kg/ha, clethodim + lactofen at 0.22 kg/ha, clethodim + 2,4-DB at 0.28 kg/ha, clethodim followed by broadleaf herbicides 24 h later or broadleaf herbicides followed by clethodim 24 h later.

Clethodim alone controlled > 80% broadleaf signalgrass and southern crabgrass when rated 9 weeks after treatment (WAT). All tank-mix combinations of clethodim with a broadleaf herbicide were antagonistic for broadleaf signalgrass control. Acifluorfen + bentazon (Storm) and imazethapyr were antagonistic for broadleaf signalgrass control with all sequential applications of clethodim.

Clethodim tank-mixed with acifluorfen, acifluorfen + bentazon, lactofen, or 2,4-DB were antagonistic for southern crabgrass control over clethodim alone. With sequential applications, clethodim followed by (fb) acifluorfen + bentazon, lactofen, or 2,4-DB 24 h later was antagonistic for southern crabgrass control.

INFLUENCE OF FUNGICIDES ON EFFICACY OF SELECT AND 2,4-DB. D.L. Jordan, A.S. Culpepper, R.B. Batts, and A.C. York, Crop Science Department, North Carolina State University, Raleigh, NC 27695; J.A. Tredaway, University of Florida, Gainesville, FL 32611.

ABSTRACT

Potential interactions of clethodim (Select) and 2,4-DB (Butyrac 200) with the manufacturer's suggested use rates of the fungicides chlorothalonil (Echo, Bravo Weather Stick, and Bravo Ultrex formulations), tebuconazole (Folicur), azoxystrobin (Abound), chlorothalonil + propiconazole (Bravo Weather Stick + Tilt), cupric hydroxide + sulfur (Kocide), mancozeb and copper hydroxide (Mankocide), and iprodione (Rovral) were evaluated in North Carolina and Georgia in 1999. Select was applied at 0.08 lb ai/acre in spray volumes of 10 (flat fan nozzles) or 25 (hollow cone nozzles) gallons of water per acre (GPA). Butyrac 200 at 0.25 lb ai/acre was applied at 10 GPA in a separate experiment. In the Butyrac 200 experiment, fluazinam (Omego) also was included. Herbicides were also applied without fungicide and a non-treated control was included. Crop oil concentrate (Agri-Dex) at 1.0% (v/v) was included with Select. Butyrac 200, either alone or with fungicide, was not applied with a spray adjuvant. Visual estimates of percent weed control were recorded 2 and 4 weeks after treatment (WAT) in the Select experiment and 1 and 2 WAT in the Butyrac 200 experiment.

Kocide and Mankocide reduced control of large crabgrass [*Digitaria sanguinalis* (L.) Scop.], Texas panicum (*Panicum texanum* Buckl.), and crowfootgrass [*Dactyloctenium aegyptium* (L.) Willd.] by Select and control of sicklepod [*Senna obtusifolia* (L.) Irwin and Barneby] and redroot pigweed (*Amaranthus retroflexus* L.) by 2,4-DB in all experiments. There was general trend for reduced efficacy of Select when herbicides were applied in 25 GPA rather than 10 GPA. Most of fungicides reduced control when compared with the most efficacious treatment of Select alone in 10 GPA. With the exception of Folicur, fungicides reduced efficacy of Select in at least three of four experiments. When comparing among chlorothalonil formulations, Bravo Ultrex was the most antagonistic of the fungicides toward Select. Folicur, Bravo Ultrex, and Abound were antagonistic toward 2,4-DB. However, the fungicides Echo, Bravo Weather Stick, Rovral, and Omego did not affect sicklepod or redroot pigweed control by 2,4-DB. Collectively, these data suggest that fungicides can reduce efficacy of Select and 2,4-DB. These data also suggest that antagonism of Select activity often was greater when pesticides were applied in higher spray volume.

YELLOW NUTSEDGE (*Cyperus esculentus* L.) MANAGEMENT IN TEXAS HIGH PLAINS PEANUT PRODUCTION. B.L. Porter, P.A. Dotray, J.W. Keeling, and T.A Baughman. Texas Tech University, Texas Agricultural Experiment Station, Lubbock, and Texas Agricultural Extension Service, Vernon.

ABSTRACT

Yellow nutsedge (*Cyperus esculentus* L.) infestations continue to increase on the Texas Southern High Plains. Metolachlor has been used to control yellow nutsedge in peanut for several years. Due to concern about potential injury from preplant incorporated and preemergence application, many growers apply metolachlor early postemergence, with varying results. Experiments were conducted in 1999 to evaluate yellow nutsedge control with metolachlor applied preemergence (PRE), at ground crack (GC), and early postemergence (POST); to compare metolachlor alone to metolachlor combinations that included diclosulam PRE; and to determine the added benefit of bentazon and pyridate applied POST with the above combinations. AT 120, a runner-type peanut was planted near Loop, TX in a field heavily infested with yellow nutsedge. Metolachlor at 1.27 lbs ai/A, diclosulam at 0.024 lbs ai/A, pyridate 0.94 lbs ai/A, and bentazon at 0.25 lbs ai/A was applied using a tractor-mounted compressed air sprayer or a CO2 backpack sprayer calibrated to deliver 10 gallons per acre at 24 psi. POST applications were made 24 days after planting (DAP) when yellow nutsedge was approximately 4 inches tall. Yellow nutsedge control and peanut injury was evaluated at 24, 39, and 51 DAP. Metolachlor PRE controlled yellow nutsedge at least 80% at all rating dates. Diclosulam PRE provided similar control. Metolachlor GC and POST were less effective at all rating dates. The metolachlor timing/diclosulam PRE combinations controlled yellow nutsedge at least 85% at all rating dates. Yellow nutsedge control was not improved when POST treatments were added to the metolachlor timing/diclosulam PRE combinations. Pyridate POST improved yellow nutsedge control following metolachlor GC from 69% (metolachlor GC alone) to 90% 51 DAP, and improved yellow nutsedge control from 8% (metolachlor POST alone) to 75% (pyridate POST + metolachlor POST) 39 DAP. Bentazon POST improved control following metolachlor GC both 39 and 51 DAP. Bentazon POST + metolachlor POST did not improve yellow nutsedge control over metolachlor POST alone 39 DAP. At 51 DAP, bentazon POST + metolachlor POST did improve yellow nutsedge control (70%) over metolachlor POST alone (42%). No injury was observed from any metolachlor treatment. Stunting was observed in all diclosulam treated plots, and ranged from 10% to 15%.

YELLOW NUTSEDGE (*Cyperus esculentus*) CONTROL IN PEANUTS. J.R. Sholar, V.B. Langston, R.B. Lassiter, and J.N. Nickels; Department of Plant and Soil Sciences, Oklahoma State University, Stillwater, OK 74078 and Dow AgroSciences, Indianapolis, IN.

ABSTRACT

Yellow nutsedge, (*Cyperus esculentus* L.), is a major weed problem in irrigated peanut, (*Arachis hypogaea* L.), fields in Oklahoma. Yellownutsedge is a perennial reproducing by small, hard tuberons at the end of the roots, by seed, and by thread-like stolons. Yellow nutsedge is a member of the *Cyperaceae* family and identification is aided by the triangular stem which is characteristic of members of the sedge family. This weed prefers moist conditions and has increased in severity due to the high percentage of the peanut crop that is irrigated. Pursuit (imazethapyr) applied PRE or POST, Dual (metolachlor) applied PRE, Basagran (bentazon) applied POST, and Cadre applied POST have been the only control options. Control is frequently erratic with these herbicides. Earlier research has shown that Strongarm (diclosulam) applied PRE is effective in controlling yellow nutsedge as well as a broad spectrum of broad leaf weeds. A field experiment was conducted in 1999 to evaluate several combinations of Strongarmand Dualon yellownutsedge and peanuts as compared to Cadre and Pursuit. Yellow nutsedge control with Strongarm alone was rate dependent. Strongarm alone at rates of 0.008 lb ai/ac, 0.016 lb ai/ac, and 0.024 lb ai/ac controlled yellow nutsedge 75%, 80%, and 82%, respectively at 52 days after planting (DAP). Cadre at 0.063 lb ai/ac controlled yellow nutsedge 86% at 52 DAP while Pursuit at 0.063 lb ai/ac controlled yellow nutsedge 40% at 52 DAP. Dual applied Post following application of Strongarm increased yellow nutsedge control over Strongarm alone. Strongarm at 0.024 lb ai/ac followed by Dual at 1.0 lb ai/ac controlled yellow nutsedge 94%. All herbicide treatments increased peanut pod yields over the check. Herbicide treatments did not affect pod quality as measured by per cent Total Sound Mature Kernels.

EVALUATION OF HALOSULFURON FOR BROAD SPECTRUM WEED CONTROL IN RICE. K.L. Smith, F.L. Baldwin, L.D. Earnest, and J.W. Branson. University of Arkansas Cooperative Extension Service, Little Rock and Southeast Research and Extension Center, Monticello.

ABSTRACT

Halosulfuron, sold under the trade name Permit® has been used effectively to control a broad spectrum of weeds, including yellownutsedge, in corn. Yellow nutsedge is often a problem weed in rice as are several broadleaf weeds that are not common to corn and are not listed on the Permit® label. These studies were established to validate the efficacy of halosulfuron for control of yellow nutsedge in a rice cropping culture, evaluate halosulfuron for control of broadleaf weeds common to rice, and to evaluate crop safety under various application rates and timings.

Two studies were established using conventional small plot research techniques. The nutsedge location was on a silt loam soil at Lodge Corner, AR and the broadleaf location was on a silty clay soil at Rohwer, AR. Halosulfuron exhibited good activity on nutsedge growing in a rice cropping culture. Near perfect control of nutsedge was achieved at 0.047, 0.063, and 0.094 lb ai/A when applied at the 2-3 leaf, preflood and postflood timings. Less than 10% visual herbicide symptomology was noted on rice growing on the slit loam soils following 0.047, 0.063, and 0.094 lb ai/A applications of halosulfuron at the 2-3 and preflood timings. The postflood applications were more injurious than the earlier timings at all rates with a maximum of 23% visual injury noted for the 0.047 lb ai/A rate. No injury was noted on the silty clay soil location.

Halosulfuron at 0.047 lb ai/A applied to 3 leaf rice and 6 inch hemp sesbania (SEBEX) provided 43%, 80%, and 90% control of sesbania at 5, 12, and 46 DAT, respectively. The control provided at 5 and 12 DAT was less than that provided by propanil, propanil + molinate, propanil + molinate + thiobencarb, and propanil + quinclorac. Control provided by halosulfuron at 46 DAT was near and not significantly different from that provided by these same treatments. Triclopyr at 0.38 lb ai/A and bensulfuron at 0.038 lb ai/A failed to provide acceptable control of hemp sesbania. A tankmix of 0.047 lb ai/A halosulfuron + triclopyr increased control of sesbania in the 5 and 12 DAT evaluations over either herbicide alone. Control at 46 DAT was similar to halosulfuron alone and superior to triclopyr alone. When halosulfuron was tankmixed with bensulfuron, control of sesbania was not different from that achieved with bensulfuron alone and less than that provided by halosulfuron alone.

Halosulfuron applied at 0.047 lb ai/A to 4 leaf palmleaf morningglory (IPOWR) provided less than 20% control at 5, 12, and 46 DAT. Triclopyr, propanil + quinclorac, and carfentrazone provided greater tan 90% control at 12 and 46 DAT. Propanil, propanil + molinate, bensulfuron, and propanil + molinate + thhiobencarb provided less than 50% control of palmleaf morningglory. Combination of halosulfuron with these treatments did not improve the performance on palmleaf morningglory.

Ivyleaf morningglory (IPOLA) control was greater than palmleaf morningglory with all treatments. Halosulfuron at 0.047 applied to 4 leaf ivyleaf morningglory provided 12%, 38%, and 82% control at 5, 12, and 46 DAT, respectively. This was less control than provided by propanil + quinclorac, triclopyr, carfentrazone and propanil + molinate + thiobencarb. But control provided by halosulfuron at 46 DAT was greater than that provided by propanil and propanil + molinate at the same evaluation. Combining halosulfuron with these treatments did improve the performance, but not greater than halosulfuron alone.

ANNUAL WEED CONTROL IN RICE WITH BISPYRIBAC-SODIUM, FENOXAPROP + AEFE04360, and CYHALOFOP-BUTYL. B.J. Williams; Northeast Research Station, St. Joseph, LA, Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

Efficacy of bispyribac-sodium, fenoxaprop plus AEF04360, and cyhalofop-butyl combinations in controlling barnyardgrass, Amazon sprangletop, and annual sedge in dry-seeded rice (*Oryza sativa*) was evaluated in 1999 at the Northeast Research Station near St. Joseph, LA on a Sharkey clay soil. Rice 'Cocodrie' at 140 kg/ha was drill seeded in rows19 cm apart. Permanent floods were established 4 to 5 weeks after planting. Nitrogen, in the form of prilled Urea, was applied at 126 kg/ha just before permanent flood. At panicle initiation and additional 42 kg/ha of nitrogen was applied. Herbicide treatments were applied, in 140 L/ha of water using a CO_2 pressurized backpack sprayer, to plots measuring 2 by 4.5 m. The experimental design was a randomized complete block in a factorial treatment arrangement. Weed control ratings, rice injury ratings, and rice yield data were subjected to analysis of variance. Means were separated using Fisher's Protected LSD at the 5% level.

Barnyardgrass (*Echinochloa crus-galli*) control 3 WAA was at least 90% with 0.074 kg ai/ha fenoxaprop, 0.022 kg ai/ha bispyribac with 0.5% v/v Kinetic, 0.022 kg ai/ha bispyribac plus 0.21 kg ai/ha cyhalofop with 0.5% v/v Kinetic, 0.022 kg ai/ha bispyribac plus 0.21 kg ai/ha cyhalofop with 1% v/v COC and 0.022 kg ai/ha bispyribac plus 0.074 kg ai/ha fenoxaprop with Kinetic. Cyhalofop at 0.21 kg ai/ha with 1.0% v/v COC only controlled barnyardgrass 73% 3 WAA. Barnyardgrass control 8 WAA was best (88%) from fenoxaprop alone. Barnyardgrass control was 60% or less 8 WAA when cyhalofop and bispyribac were applied alone. Barnyardgrass control 8 WAA was 77, 83, and 70% when bispyribac was applied with cyhalofop with Kinetic, cyhalofop with COC and fenoxaprop, respectively. Amazon sprangletop (*Leptochloa panicoides*) control 3 WAA was at least 90% with fenoxaprop alone, bispyribac plus cyhalofop with Kinetic, bispyribac plus cyhalofop with COC and bispyribac plus fenoxaprop. Sprangletop control 8 WAA was above 90% with fenoxaprop alone, cyhalofop alone and bispyribac plus fenoxaprop. Bispyribac plus cyhalofop with Kinetic and bispyribac plus cyhalofop with COC controlled sprangletop WAA 88 and 77%, respectively. Sprangletop control 8 WAA with bispyribac alone was 60%. Annual sedge (*Cyperus iria*) control 3 and 8 WAA was at least 93% with bispyribac alone, bispyribac plus cyhalofop plus Kinetic, bispyribac plus cyhalofop plus COC and bispyribac plus fenoxaprop. Fenoxaprop and cyhalofop applied alone did not provide any annual sedge control.

This preliminary research indicates that cyhalofop and fenoxaprop can potentially be tank-mixed with bispyribac to control sprangletop, without reducing barnyardgrass or annual sedge control. However, this research also indicates that cyhalofop rates may have to be increased and that adjuvant selection may be an important factor to controlling sprangletop with bispyribac and cyhalofop tank-mixes.

NEW STRATEGIES FOR LATE-SEASON WEED CONTROL IN RICE. R.E. Talbert, L.A. Schmidt, and E.F. Scherder. Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR 72704.

ABSTRACT

Dry seeded rice production relies on effective herbicide programs and flooding to keep weed infestations under the economic threshold. Growers rely heavily on these two approaches to maintain a weed free environment, therefore maximizing yield. When grasses or broadleaf weeds escape the flood, farmers may be reluctant to spray because of added input costs (herbicide cost and application fees) or low infestations of escaped weeds. These late-emerging weeds may cause a late-season yield loss and contaminate the harvested grains if not controlled. New strategies for late-season control of weeds using existing technologies and newer herbicides were evaluated.

One study was conducted in 1998 and 1999 to evaluate efficacy of quinclorac at 0.42 kg ai/ha at a post -flood timing. This study had a factorial arrangement of treatments with factors of flood depth (0- to 5- and 10- to 15- cm), barnyardgrass (*Echinochloa crus-galli*) height (8- to 13- and 15- to 25- cm), and formulation of quinclorac [dry flowable (DF) and granular (GR)]. Two studies were conducted in 1999 evaluating carfentrazone at 0.02 and 0.03 kg ai/ha for mid-season control of hemp sesbania (*Sesbania exaltata*), and bispyribac-sodium at 0.02 kg ai/ha in a program approach for grass and broadleaf weed control.

Quinclorac did not completely control barnyardgrass at a post-flood timing with either formulation. There was an interaction between flood depth and grass height 40 days after treatment (DAT) and formulation and grass height 40 DAT. The DF formulation was more effective on barnyardgrass (80% for 0- to 5-cm flood and 77% for 10- to 15- cm flood) than the GR (45% for 0- to 5- cm flood and 56% for 10- to 15- cm flood). At a 0- to 5- cm flood depth, 8- to 13- cm grass was controlled significantly better (70%) with quinclorac than 15- to 25- cm grass (55%). The opposite was true with 15- to 25- cm barnyardgrass; a 10- to 15- cm flood gave better control (66%) than a 0- to 5- cm flood (55%). Yields were significantly higher with the DF formulation regardless of flood depth or grass height as compared to the GR formulation.

Carfentrazone applied mid-season to hemp sesbania (1 to 1.5 m tall) provided > 97% control 35 DAT at both 0.02 and 0.03 kg/ha rates. This level of control was equivalent to acifluorfen at 0.14 kg ai/ha (100%) and significantly better than triclopyr at 0.28 kg ae/ha (74%). Yield differences were not detected among the four herbicides; however, severe yield loss had already occurred due to earlier competition. From this research an earlier application timing is needed to maximize yield.

In trials in 1998, bispyribac-sodium was shown to be a versatile herbicide due to its activity on grasses and broadleaf weeds common to rice. This trial evaluated pendimethalin at 1.12 kg ai/ha delayed pre (DPRE) followed by (fb) bispyribac-sodium at 0.02 kg/ha at a middle post (MP) and a post-flood (POF) timing. Clomazone at 0.34 kg ai/ha DPRE fb bispyribac-sodium 0.02 kg/ha preflood (PRF) and POF. The standard comparisons were pendimethalin 1.12 kg/ha and clomazone 0.34 kg/ha fb propanil at 2.5 kg ai/ha + molinate at 2.5 kg ai/ha MP and PRF respectively. Bispyribac-sodium was also evaluated as a stand-alone herbicide with applications of 0.02 kg/ha MP fb 0.03 kg/ha POF. All treatments gave control of barnyardgrass. Bispyribac-sodium alone failed to controll broadleaf signalgrass (*Brachairia platyphylla*). Hemp sesbania control was achieved by 28 days after the POF application with all treatments (>84%) except pendimethalin fb bispyribac-sodium MP (73%). Bispyribac-sodium was significantly better in a program approach with pendimethalin at the POF timing than at MP. Northern jointvetch (*Aeschynomene virginica*) control followed the same trends as hemp sesbania control.

LIBERTY-LINK AND ARROSOLO WEED CONTROL PROGRAMS IN CONVENTIONAL AND STALE SEEDBED RICE. P.K. Bollich, Rice Research Station, LSU AgCenter, Crowley, LA 70527; E.P. Webster, Dept. of Plant Pathology and Crop Physiology, LSU AgCenter, Baton Rouge, LA, 70803; M.E. Salassi, and G.G. Giesler, Dept. of Agricultural Economics, LSU AgCenter, Baton Rouge, LA 70803.

ABSTRACT

The commercialization of Liberty-Link rice (*Oryza sativa* L.), rice that is resistant to the herbicide glufosinate, will result in new approaches to weed control. Its use will be especially important in the control of red rice (*Oryza sativa* L.), which is one of the most troublesome weeds in rice. The broad-spectrum activity of Liberty will also make it attractive for general rice weed control, even where red rice is not a production limitation. A study was conducted in Crowley, LA in 1998 and 1999 on a Crowley silt loam to compare Liberty-Link and Arrosolo weed management programs on both conventional tillage and stale seedbeds. In 1998, the variety Cypress and a Cypress-derived Liberty-Link experimental line were evaluated. In 1999, the variety Bengal and its Liberty-Link counterpart were evaluated. Arrosolo and Liberty were applied to the conventional varieties and Liberty-Link lines, respectively. An untreated control was included for each weed management system. Arrosolo was applied at 6.0 lb/A early postemergence (EP), 3.0 lb/A EP plus 3.0 lb/A late postemergence (LP), or 6.0 lb/A LP. Liberty was applied at 0.75 lb/A EP, 0.38 lb/A EP plus 0.38 lb/A LP, or 0.75 lb/A LP. The experimental design was a randomized complete block with a complete factorial arrangement of two management systems, two tillage methods, and four herbicide levels with all treatment combinations replicated four times. Days to 50% heading, plant height, and main crop grain yield (ratoon and total crop in 1999) adjusted to 12% were determined. An economic analysis was also performed. The study was conducted in an area free of red rice, and there were no weed control ratings taken. The predominant weeds present were barnyardgrass [*Echinochloa crus-galli* (L.) Beauv.] and Amazon sprangletop [*Leptochloa panicoides* (Mart.) Griseb.].

In 1998, an interaction between tillage and herbicide occurred for days to 50% heading. With Liberty, maturity was similar with all application timings, but 50% heading occurred earlier in the untreated control. With Arrosolo, maturity was delayed with the split application and with the LP application. The days to 50% heading were decreased with the EP application and in the untreated control. Heading was not affected in 1999. Plant height was decreased in the untreated control in 1998. An interaction between tillage and herbicide occurred for plant height in 1999. Plant height was decreased in the untreated control in each weed management system, but the reduction was much greater with the stale seedbed. Grain yields were similar for all application timings in 1998, and all treatments yielded higher than the untreated control. An interaction between tillage and weed management system occurred for grain yield in 1998. Grain yields with the Liberty-Link system were significantly lower in each tillage system, but the difference was much greater in the conventional seedbed. An interaction between tillage and herbicide treatment occurred in 1999 for grain yield. Grain yields were significantly lower in the untreated control within each weed management system, but the yield differential was much greater with the stale seedbed. Ratoon crop yields were not affected by tillage, weed management system, or herbicide treatment. Total grain yields were significantly higher with the Arrosolo weed management system. An interaction between tillage and herbicide treatment occurred for total grain yield. Grain yields in the untreated control were significantly lower within each weed management system, but the differential was greater in the stale seedbed. Yield reductions in all of the untreated controls reflected significant infestations of barnyardgrass and sprangletop.

In the economic analysis, all grain yields were compared with the conventional untreated Arrosolo control. In 1998, marginal net returns above the Arrosolo control were averaged across tillage method. In the Liberty program, dollar losses ranged from $6.86 with the EP treatment to $44.29 with the untreated Liberty control. In the Arrosolo program, increased net returns ranged from $83.41 with the EP treatment to $108.97 with the EP plus LP treatment. In 1999 with conventional tillage, increased net returns in the Liberty program ranged from $14.24 with the LP treatment to $18.47 with the EP treatment. With the Liberty untreated control, the net loss was $58.45. Increased net returns in the Arrosolo program ranged from $74.21 with the EP treatment to $74.41 with the LP treatment. In the stale seedbed system, net

returns in the Liberty program ranged from $106.81 with the EP treatment to $115.23 with the LP treatment. With the Liberty untreated control, the net loss was $19.48. In the Arrosolo program, net returns above the untreated control ranged from $168.71 with the EP treatment to $179.91 with the LP treatment.

When considering a fit for the new Liberty-Link technology, production costs and returns need to be considered. Another important consideration will be the weed spectrum needing control. With significant red rice infestations, the decision is easier to make since there is no control with conventional postemergence weed control measures.

EFFICACY AND CROP TOLERANCE OF CYHALOFOP PROGRAMS APPLIED PRE-FLOOD IN DIRECT SEEDED RICE. G.A. Ohmes, J.A. Kendig, D.L. Grant, R.B. Lassiter, D.M. Simpson, M.E. Kurtz, A.D. Klosterboer, R.E. Talbert, F.L. Baldwin, and B.J. Williams. University of Missouri Delta Center, Portageville, MO 63837, DowAgro Sciences, Mississippi State Univ., Texas A&M, Univ. of Arkansas, and Louisiana State Univ.

ABSTRACT

Currently there are limited choices for postemergence (POST) grass weed control in rice. There are crop safety concerns with fenoxaprop. Resistance to other current compounds is an increasing problem. Drift to non-target crops is another issue with several current compounds. The development of selective graminicides for rice could help reduce drift concerns to broadleaf crops while offering more choices for POST grass control. Currently research is being conducted on three graminicides for rice. One of those compounds is cyhalofop (trade name Clincher).

The objectives of this research were to evaluate crop tolerance and grass weed control with Clincher alone and in programs.

Research was conducted in 1999 in 5 states. Clincher, alone, was evaluated at the University of Missouri Delta Center for salvage control of large grass. Ten Clincher program studies were evaluated in Arkansas, Mississippi, Louisiana, and Texas. All studies utilized a randomized block design with four reps. Standard weed science methods were used to apply treatments. Clincher alone at 6.7 and 10 oz/A was applied to 2- to 3-leaf, 4- to 5-leaf, 6- to 8-leaf (preflood), and 10- to 12-leaf (postflood) grass. Clincher at 10 oz/A was incorporated into several sequential weed control programs for broadspectrum weed control. The 2- to 3-leaf barnyardgrass applications included: 1) Clincher alone, 2) Clincher + Prowl (1 lb ai/A), 3) Clincher + Bolero (3 lb ai/A), 4) Clincher + Stam (2 lb ai/A), 5) Ricestar (0.045 lb ai/A), 6) Stam (4 lb ai A) + Facet (0.375 lb ai/A), and 7) Facet alone. Preflood applications included: 1) Clincher + Grandstand (0.375 lb ai/A) 2) Ricestar + Grandstand, 3) Stam + Grandstand, 3) Grandstand alone, and 4) Clincher + Aim (0.02 lb ai/A). Barnyardgrass (*Echinochloa crus-galli*), Amazon sprangletop (*Leptochloa panicoides*), and broadleaf signalgrass (*Brachiaria platyphylla*) were the grass species evaluated in the tests. Time of ratings after application ranged from 1 to 3 weeks after application (WAA) for the salvage test. Ratings were taken 1- to 3-weeks and 6- to 8-weeks after the preflood applications in the program tests.

In the salvage test the 2- to 3-leaf application provided more control of barnyardgrass than later timings. However, overall control from any timing with one application of Clincher was poor. Clincher at 10 oz/A on 2- to 3-leaf grass provided 68% control of barnyardgrass. The program studies indicated that split applications of Clincher improved overall grass control. Tank mixing with a broadleaf compound did not seem to reduce the amount of grass control. There was no additional control from tank mixing Clincher with residual compound when Clincher was applied in a sequential program. However, a residual compound tank mixed with or followed by Clincher provided equivalent control of barnyardgrass to sequential Clincher applications. Sequential applications of Clincher improved control of Amazon sprangletop over traditional sequential applications of Stam and/or Stam + Facet programs. Clincher plus Prowl on 2- to 3-leaf grass provided equivalent control of Amazon sprangletop to sequential applications of Clincher. Sequential applications of Clincher provided 75% control of broadleaf signalgrass compared to sequential applications of Ricestar and Stam at 1- to 3-WAA. The addition of Stam tank mixed with Clincher improved control over Clincher alone on 2- to 3-leaf grass at 1- to 3-WAA. However, at 6- to 8-WAA all treatments provided 100% control of broadleaf signalgrass.

SOIL-APPLIED HERBICIDES WITH ROUNDUP IN ROUNDUP READY SOYBEAN. T.H. Koger, D.R. Shaw, and S.B. Blanche, Department of Plant and Soil Sciences, Mississippi State University, MS 39762.

ABSTRACT

Roundup Ready systems have become an integral weed control tool in todays farming systems. Production of Roundup Ready soybean by U.S. farmers has risen from 2% of total soybean production in 1996 to 55% in 1999. Glyphosate provides excellent broad-spectrum weed control during the growing season and can be applied sequentially to control successive weed flushes. Glyphosate has also proven to be successful in controlling weeds such as yellow nutsedge (*Cyperus esculentus* L.) and prickly sida (*Sida spinosa* L.) that can be difficult to control with conventional herbicide programs. However, a total POST glyphosate program has sometimes proven to be weak in controlling hemp sesbania [*Sesbania exaltata* (Raf.) Rydb. ex. A. W. Hill] and morningglory species (*Ipomoea* spp.). Control of these weeds is often directly correlated to weed size at time of application. Herbicide applications can be delayed when environmental

conditions do not warrant timely applications, thus resulting in decreased weed control in a total POST glyphosate system due to the weeds being too large at time of the delayed application. Recent studies have shown that the application of a PRE herbicide in a Roundup Ready system can improve weed control and extend the time frame when glyphosate can be applied. The objectives of this research was to evaluate the influence of soil-applied herbicide when applied in a Roundup Ready soybean system on season-long weed control, and to determine the effect of glyphoste rate and time of application in conjunction with soil-applied herbicides.

Field studies were conducted in 1997 at the Black Belt Branch Experiment Station (BBES) near Brooksville, MS and at the Coastal Plain Branch Experiment Station (CPES) near Newton, MS. Experiments were also conducted in 1998 at BBES, CPES and the Brown Loam Experiment Station near Raymond, MS. Each experiment was arranged in a randomized complete block design with a factorial arrangement of treatments. Factors included: PRE herbicides, glyphoste application, and glyphoste rate. PRE herbicides and rates evaluated were: 842 g ai/ha pendimethalin; 842 and 138 g ai/ha pendamethalin + imazaquin; 842, 187, 37 g ai/ha pendimethalin + sulfentrazone + chlorimuron; 842, 358, and 60 g ai/ha pendamethalin + metribuzin + chlorimuron; 70 and 2097 g ai/ha flumetsulam + metolachlor. PRE herbicides were applied alone and in conjunction with POST glyphosate (Roundup Ultra) applications. Roundup was applied as total POST treatments and following PRE herbicides. Roundup was applied 3 WAP (560 g ai/ha), 3 WAP (840 g ai/ha), and sequentially 3 and 5 WAP (840 fb 560 g ai/ha). Evaluations included weed control at 9 WAP and end of season before soybeans were harvested, and soybean yields. Weeds evaluated were pitted morningglory (*Ipomoea lacunosa L.*), sicklepod [*Senna obtusifolia* (L.) Irwin and barnaby], and hemp sesbania [*Sesbania exaltata* (Raf.) Rydb. Ex. A.W. Hill].

In all experiments, sequential applications of Roundup without a PRE herbicide controlled all weeds 10 to 25% better than the 560 g ai/ha rate and 5 to 15% better than the 840 g ai/ha rate. At 9 WAP, pendimethalin PRE did not improve control of pitted morningglory or sicklepod compared to glyphosate applied sequentially. Pitted morningglory and sicklepod control with the sequential application of glyphosate was 88 and 80%, respectively. Control of hemp sesbania was, however, improved with the pendamethalin treatments fb sequential applications of glyphosate (90%) compared to glyphosate alone (80%). By end of season (EOS), hemp sesbania control with the pendamethalin fb glyphosate sequential treatment was 95%, compared to 88% with glyphosate applied sequentially alone. Control of pitted morningglory was 80% with pendamethalin + sulfentrazone + chlorimuron fb glyphosate applied sequentially and pendamethalin + imazaquin fb glyphosate applied sequentially, compared to 74% with the glyphoste sequential alone treatment. Sicklepod control was improved with the flumetsualm + metolachlor fb by glyphosate applied sequentially program, with 90% control compared to 80% control with the glyphoste sequential alone program. Overall, previous research has shown better weed control with the use of PRE herbicides in a Roundup Ready system than this research as shown. However, unsatisfactory weed control with the PRE herbicide programs may be attributed to no rainfall necessary for activation of PRE herbicides. No experiment received rainfall within two weeks after PRE herbicides were applied. Soybean yield was not different between treatments in 1997 and 1998, with 1997 soybean yields between 28 and 31 bu/A. Soybean yields in 1998 ranged from 17 to 25 kg/ha.

INFLUENCE OF BASAGRAN ON SOYBEAN RESPONSE TO TOUCHDOWN 5 AND ROUNDUP ULTRA.
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ABSTRACT

Field observations at 2-4 pounds ai/acre Touchdown (trimesium salt of glyphosate) application rates indicated a potential for soybean injury when applied POST to glyphosate-tolerant soybeans. At > 2 pounds ai/acre injury symptoms from Roundup Ultra (isopropylamine salt of glyphosate) consisted of " yellowing" of the top soybean leaves and yellowing of the new growth that emerged after application. Touchdown at > 2 pounds ai/acre caused more necrosis on soybean leaves present at application, but new growth was mostly unaffected. To examine the difference of the two glyphosate salts and determine the potential reduction of any observed injury, a series of field studies were conducted.

Field studies were conducted in 1999 using small plot techniques. Glyphosate tolerant soybeans were planted and a PRE broad-spectrum herbicide (Squadron) was applied to minimize the confounding effects of early-season weed control. Some studies also evaluated weed control in the absence of a soil-applied herbicide. Soil moisture was adequate to excessive at the time of glyphosate application. Environmental conditions were warm and moist, and this was conducive to the maximum expression of herbicide activity. Data collected included crop response, weed control, and soybean yield. Experiments utilized a randomized complete block design with three to four replications.

Touchdown 5 at 1.6 pints/acre caused 5 to 10 % soybean injury, described as a flecking of the soybean leaves. Touchdown 5 at 4.8 pints/acre caused 15 to 25 % crop injury. The addition of Basagran (bentazon) at 1.0 fluid oz/acre greatly reduced the visual injury (< 5%). The injury was temporary, in that it was not detectable 28 days after treatment. The injury also did not reduce soybean yield in three studies. A separate study indicated that at least 1.0 fluid oz/acre of Basagran was needed to completely eliminate Touchdown 5 injury to soybean. Weed control data indicated that the addition of Basagran to Touchdown 5 did not antagonize weed control, although it slowed herbicidal activity in one study.

Roundup Ultra at 2.0 pints/acre caused minimal soybean injury (< 2%). Roundup Ultra at 6.0 pints/acre caused up to 5% soybean injury, and the addition of Basagran did not reduce the injury. The injury was temporary, in that it was not detectable 28 days after treatment. The injury also did not reduce soybean yield in three studies.

Touchdown 5 caused more soybean response than Roundup Ultra to glyphosate tolerant soybeans. There was no yield effect fromthis soybean response. Basagran at low rates (1 fluid oz/acre) reduced the cosmetic injury from Touchdown 5.

WEED CONTROL SYSTEMS WITH TOUCHDOWN® 5 IN GLYPHOSATE TOLERANT SOYBEANS. J.N. Lunsford, C.V. Greeson, J.D. Smith, and J. Mink. Zeneca Ag Products, Enterprise, AL, Pikeville, NC, Jackson, TN, and Leland, MS.

ABSTRACT

Touchdown® 5 herbicide, sulfosate (glyphosate-trimesium), was evaluated in glyphosate tolerant soybeans as postemergence spray applied alone, following preemergence herbicides, and tank-mixed with other broadleaf herbicides. The trials were conducted during the 1998 and 1999 growing seasons. Canopy®, Canopy® XL, Squadron®, Prowl® 3.3 EC, Scepter®, FirstRate*, Broadstrike* and Dual Magnum™ were used preemergence at recommended rates for the soil type. Postemergence broadleaf tank-mix treatments included Flexstar®, Reflex®, FirstRate*, and Classic® applied at rates lower than the recommended rates ofthe products applied alone. Common cocklebur (XANST), bristly starbur (ACHNI), Florida beggarweed (DEDTO), or redroot pigweed (AMARE) were very susceptible to postemergence applications of Touchdown® 5 alone at .75 or 1.0 lb ai/A. Control of those species was not improved when Touchdown® 5 was applied postemergence following the preemergence treatments. However, control of pitted morningglory (IPOLA), ivyleaf morningglory (IPOHE), sicklepod (CASOB), hemp sesbania (SEBEX), Florida pusley (RCHSC), tall water hemp (AMATU), velvetleaf (ABUTH), prickly sida (SIDSP), and yellow nutsedge (CYPES) was improved when Touchdown® 5 was applied postemergence over the preemergence herbicide. Preemergence herbicides, Canopy® and Canopy® XL tank-mixtures provided the highest levels of overall weed control.. Sequential applications of Touchdownâ 5 at .75 or 1.0 lb ai/A provided weed control similar to that observed with preemergence herbicides followed by Touchdown 5 (except for hemp sesbania). Sicklepod, cocklebur, Florida pusley, large crabgrass (DIGSA), and barnyardgrass (ECHCG) control was not improved when Touchdown® 5 at .75 and 1.0 lb ai/A was tank-mixed with Flexstar®, Reflex®, FirstRate*, or Classic®. Common lambsquarters and velvetleaf control was increased when Touchdown® 5 was tank-mixed with FirstRate*. Smallflower morningglory (IAQTA), ivyleaf morningglory, pitted morningglory, common lambsquarters, prickly sida and common ragweed (AMBEL) control was increased when Touchdown® 5 was tank-mixed with Flexstar® or Reflex®. Flexstar® was more active than Reflexâ at a lower rate.

EVALUATION OF TANK-MIX COMBINATIONS OF FIRSTRATE (CLORANSULAM) AND ROUNDUP ULTRA (GLYPHOSATE) FOR WEED CONTROL IN SOYBEAN. J.W. Barnes and L.R. Oliver, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR 72701.

ABSTRACT

Field and greenhouse experiments were conducted in 1998 and 1999 to determine the weed control potential of cloransulam and glyphosate tank-mix combinations. The experimental design for all experiments was a factorial arrangement of treatments conducted in a randomized complete block design with four replications. The factors consisted of four cloransulam application rates (0, 4.5, 9, and 18 g ai/ha) and four glyphosate rates (0, 420, 560, 840). Field experiments consisted of eight weed species planted in strips with treatments broadcast across the strips. The species evaluated were velvetleaf, prickly sida, sicklepod, Palmer amaranth, smooth pigweed, hemp sesbania, and pitted and entireleaf morningglory. Treatments were applied at a late POST timing in a volume of 187 L/ha. Crop oil concentrate was added to all treatments at a rate of 1% v/v. Weed control evaluations were taken 2 and 3 weeks after treatment. The weed species evaluated in the field were also evaluated in the greenhouse experiments. Application timing for the greenhouse experiment was similar to the field experiment. At two weeks after treatment, the plants were harvested, and fresh weights were determined. The fresh weight data were converted to percent of the untreated control treatment. All data were subjected to analysis of variance and were combined over runs of each respective experiment type. To determine if the tank-mix combinations provided additive, antagonistic, or synergistic responses, expected values were calculated by Colby's Method. Differences between expected and observed values were determined by comparing the difference between the values with the $LSD_{0.05}$.

cloransulam at 18 g ai/ha provided at least 60% control of the morningglory species and velvetleaf under both field and greenhouse conditions. Cloransulam provided better control of the morningglory species than glyphosate, which failed to control these species more than 60%. Glyphosate provided at least 55% control of sicklepod, prickly sida, Palmer amaranth, and smooth pigweed. Of the 112 treatment combinations evaluated, 56 antagonistic and 56 additive responses were observed. Of the 56 antagonistic interactions observed only nine resulted in weed control that was significantly lower than the herbicides provided when applied alone. These nine severe antagonistic interactions were confined to entireleaf morningglory and sicklepod. With both of these species, the antagonism was overcome by increasing the glyphosate rate in the tank mixture. The other weed species exhibited varying levels of antagonism ranging from14 of

18 combinations resulting in antagonism for hemp sesbania to no antagonismobserved with smooth pigweed or Palmer amaranth. Velvetleaf control was antagonized in 13 of 18 combinations while pitted morningglory and prickly sida had only three antagonistic interactions. In general, combinations of cloransulam with glyphosate resulted in a broader weed control spectrum than when the herbicides were applied alone especially when cloransulam was applied at 18 g ai/ha and glyphosate was applied at 840 g ai/ha.

FLORIDA PUSLEY (*RICHARDIA SCABRA*) CONTROL IN ROUNDUP READY SOYBEANS. E.C. Murdock, Clemson University, Pee Dee Research and Education Center, Florence, SC 29506-9706.

ABSTRACT

Florida pusley control in Roundup Ready soybeans was evaluated in 1998 and 1999 at an on-farm site in Horry County, SC. Two experiments were conducted each year. Hartz 7550RR soybeans were planted July 18, 1998, and June 25, 1999 in 38-inch wide rows. Florida pusley was 1- to 3-inches tall when POST treatments were applied. In Experiment I, Roundup Ultra applied POST @ 2 pt/ac with and without ammonium sulfate (AMS) @ 3 lb/ac controlled Florida pusley 98 to 100, 98 to 99, and 96 to 99% 1, 3, and 7 weeks after POST application (WAPOST), respectively. Sequential applications of Roundup Ultra with and without AMS controlled Florida pusley 98 to 100% 3 and 7 WAPOST. Control was similar at all evaluation dates with and without AMS. Prowl @ 2.4 pt/ac applied PRE followed by (fb) Roundup Ultra applied POST @ 1.5 and 2 pt/ac provided complete control of Florida pusley. Prowl fb Classic + surfactant (0.5 oz/ac + 0.25% v/v) controlled Florida pusley 90 and 78% 3 and 7 WAPOST, respectively. Soybean yields were similar with single and sequential applications of Roundup Ultra with and without AMS, and ranged from 20 to 25 bu/ac. Soybean seed yields attained with Prowl fb Classic and in the untreated check were 16 bu/ac.

In Experiment II, Roundup Ultra applied POST @ 1, 1.5, and 2 pt/ac with and without Quest @ 1 qt/ac controlled Florida pusley 87 to 99, 88 to 99, and 85 to 99% 1, 3, and 6 WAPOST, respectively. Control with and without Quest was similar at all evaluation dates. Averaged across the presence or absence of Quest, Roundup Ultra @ 1.5 and 2 pt/ac provided better control (93 to 98% 1, 3, and 6 WAPOST) than Roundup Ultra @ 1 pt/ac (88 to 96% 1, 3, and 6 WAPOST). Soybean seed yields attained with Roundup Ultra @ 1, 1.5 and 2 pt/ac with and without Quest ranged from 21 to 23 bu/ac, and were greater than the soybean seed yield in the untreated check (15 bu/ac). Averaged across Roundup Ultra rates, soybean seed yields with and without Quest were 21 and 22 bu/ac, respectively.

REDVINE AND TRUMPETCREEPER MANAGEMENT IN ROUNDUP READY SOYBEAN FOLLOWING SPRING APPLICATION OF GLYPHOSATE. K.N. Reddy and D. Chachalis. USDA-ARS, Southern Weed Science Research Unit, Stoneville, MS 38776.

ABSTRACT

Redvine [*Brunnichia ovata* (Walt.) Shinners] and trumpetcreeper [*Campsis radicans* (L.) Seem. ex Bureau] are deciduous perennial woody dicot vines distributed extensively in the southern United States. Greenhouse and field experiments were conducted to study glyphosate efficacy on redvine and trumpetcreeper. In greenhouse studies, glyphosate was applied to redvine (about 25 cm tall, 5- to 7-leaf) and trumpetcreeper (about 20 cm tall, 4- to 7-leaf) plants raised from rootstocks. Redvine control ranged from 67% at 1.12 kg/ha to 98% at 4.48 kg/ha and glyphosate rate above 1.12 kg/ha, greatly (>89%) reduced regrowth from rootstocks attached to the treated plants. Trumpetcreeper control ranged from 62% at 1.12 kg/ha to 78% at 3.36 kg/ha and glyphosate above 1.12 kg/ha completely inhibited regrowth of rootstocks.

In Roundup Ready soybean, control of redvine and trumpetcreeper may be less than satisfactory with normal use rates of glyphosate. A field study was conducted in 1998 and 1999, near Stoneville, MS to evaluate control of redvine and trumpetcreeper in Roundup Ready soybean following spring application of glyphosate. Glyphosate at 3.36 kg/ha was applied in the spring 3 weeks prior to planting. A no spring application of glyphosate was included as control. Roundup Ready soybean (DP 5806 RR) was planted on June 3, 1998 and May 14, 1999. The herbicide treatments in soybean included: glyphosate early POST (EPOST) at 1.12 kg ai/ha; glyphosate EPOST at 1.12 followed by late POST (LPOST) at 1.12 kg ai/ha; acifluorfen EPOST at 0.56 kg ai/ha; glyphosate + acifluorfen EPOST (1.12 + 0.56 kg ai/ha); clomazone PRE at 1.40 kg ai/ha followed by glyphosate EPOST at 1.12 kg ai/ha followed by LPOST at 1.12 kg ai/ha or lactofen EPOST at 0.22 kg ai/ha; and a no herbicide control. PRE treatments were applied at planting, EPOST at 3 weeks after planting (WAP), and LPOST at 5 WAP. Experimental plots consisted of 8 rows of 4.6 m long and 57 cm apart. The experiment was conducted in a split plot design with spring application of glyphosate as main plots and herbicide treatments in soybean as subplots with four replications. The same experimental site and setup were used in both years. Visual weed control ratings for each species were made at 4 weeks after EPOST. Weed counts and dry weights were recorded from two 0.84 m^2 areas at 6 weeks after EPOST

Redvine control (86 vs. 71%) was higher and dry weight (84 vs. 134 kg/ha) was lower with spring application of glyphosate vs. no glyphosate. Redvine control in soybean ranged from 80 to 86% among herbicide treatments with the exception of acifluorfen (72%). Overall, redvine density was higher in 1999 compared to 1998. For example, in glyphosate EPOST + LPOST, redvine density increased from 4 plants/m^2 in 1998 to 8 plants/m^2 in 1999. Trumpetcreeper

control (73 vs. 63%) was higher and dry weight (131 vs. 186 kg/ha) was lower with spring application of glyphosate vs. no glyphosate. Herbicide treatments controlled 78 to 88% of trumpetcreeper in soybean with the exception of clomazone + lactofen (53%) and acifluorfen (63%). Overall, trumpetcreeper density slightly declined in 1999 compared to 1998. For example, in glyphosate EPOST + LPOST, trumpetcreeper density decreased to 1 plants/m^2 in 1999 from 4 plants/m^2 in 1998. Soybean crop failed in both years due to hot and dry weather.

EVALUATION OF GLYPHOSATE FORMULATIONS IN A ROUNDUP READY SOYBEAN SYSTEM. C.T. Leon, D.R. Shaw, and J.L. Norris, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Southern soybean production systems are increasingly relying on glyphosate for in-season weed control. Experiments were conducted in 1998 and 1999 at the Black Belt Branch Experiment Station, Brooksville, MS, the Coastal Plain Branch Experiment Station, Newton, MS, the Brown Loam Branch Experiment Station, Raymond, MS, and the Plant Science Research Center, Starkville, MS, to assess weed control and soybean tolerance to two forms of glyphosate, Roundup Ultra and Touchdown. Experimental factors in the weed control study included 2 herbicide formulations, 3 glyphosate rates, and 2 timing intervals. Applications were made at 2 week after planting (WAP) and at 4 WAP. Early applications were made to 8 and 15-cm weeds, respectively. Glyphosate rates included 212, 423, and 624 g ai/ha. Sicklepod [*Senna obtusifolia* (L.) Irwin and Barnaby], hemp sesbania [*Sesbania exaltata* (Raf.) Rydb. Ex A. W. Hill], pitted morningglory (*Ipomoea lacunosa* L.), and entireleaf morningglory (*Ipomoea hederacea* var. *integriuscula* L.) control were rated at 7 and 14 days after treatment (DAT). Experimental factors in the soybean tolerance study included 2 formulations, 4 glyphosate rates, and sequential application timings at 2, 4, and 6 WAP. Glyphosate rates included 423, 557, 836, and 1114 g ai/ha indicated by low, medium, high, and very high rates, respectively. Soybean tolerance was evaluated 7 and 14 DAT. Soybean yield was also measured.

Formulation of glyphosate had little or no influence on control of any species. Control of sicklepod and hemp sesbania was generally better when timely applications were made to 8 than 15 cm weeds. Rate was less important regardless of weed size. Pitted morningglory and entireleaf morningglory control was significantly better for 8 than 15 cm weeds, with medium and high rates providing better control in most instances. By 14 days after treatment (DAT), increasing the rate did not improve the level of control. Soybean injury across all locations ranged from 0 to 19% at 7 DAT. The high and very high rates were more likely to injury soybean more than 15%. By 14 DAT, injury was usually <15% regardless of the rate used. Soybean yield at Starkville (1998 and 1999) and Brooksville (1999) ranged from 17 to 26 bu/A. Yields at Raymond (1999) ranged from 9 to 12 bu/A. Soybean yield was not significantly affected by rate.

AN ALTERNATIVE APPROACH TO NO-TILLAGE, DRILLED ROUNDUP READY SOYBEANS. G.A. Ohmes, J.A. Kendig, R.L. Barham, and P.M. Ezell. University of Missouri Delta Center, Portageville, MO 63837.

ABSTRACT

Traditional no-tillage in drilled Roundup Ready soybeans consists of a burndown application of a broadspectrum herbicide followed by one or two in-season applications of Roundup. Several approaches to weed management in drilled Roundup Ready soybeans have been tested. Applications of a preemergence herbicide followed by Roundup, sequential postemergence applications of Roundup, and Roundup tank mixes have provided similar control and yield (Payne and Oliver 1998). Research has also shown that there is a 3 week window to initiate a Roundup only weed control program and a preemergence herbicide can delay that initial application (Kendig et al. 1998). Research has shown that Roundup is good on annual grass and most broadleaves. It also has indicated weaknesses in Roundup. One area of weakness is on winter annuals such as cutleaf eveningprimrose (*Oenothera laciniata*) and perennials such as curly dock (*Rumex crispus*). In many cases 2,4-D is applied prior to planting in order to control tough broadleaf weeds; however, 2,4-D does not control grass. The objectives of this research were to determine the feasibility of using 2,4-D alone as a burndown, not using a burndown at all, determine if burndown application timing influences when to start in-season Roundup applications and the necessity of a second in-season application.

The study was conducted in 1998 and 1999 at the University of Missouri Delta Center. Soybeans were planted into no-till plots using a no-till drilled with 7.5 inch row spacing. Standard weed science methods were used to establish plots and apply treatments. The study design was a randomized block with a 4 X 5 X 2 factorial treatment arrangement and 2 replications. The treatments consisted of four burndowns, five Roundup timings, and sequential application of Roundup. The burndown treatments were Touchdown at 1 lb ai/A applied 14 and 7 days early preplant (EPP), 2,4-D alone at 0.5 lb ai/A applied 14 EPP, and no burndown application. Roundup at 1 lb ai/A was applied at planting (preemergence), 1 week, 2, weeks, and 3 weeks after planting and not at all. The third set of treatments consisted of plots receiving or not receiving a sequential Roundup at 1 lb ai/A application.

Soybean yields were 10 to 20 bushels/A higher on average in 1998 than 1999, probably due to a 15 inch difference in rainfall from May through August. Despite the difference in yield the treatments produced similar results in both years. Regardless of burndown timing, Roundup at 3 weeks after planting (WAP) provided optimum yield. In 1998, soybeans

receiving one application of Roundup without a burndown yielded as well as Roundup following a burndown. Roundup without a burndown in 1999 produced similar results; however, yield was lower than Roundup following Touchdown 14 EPP. In both years soybean yield from one Roundup in-season application, regardless of burndown treatment, was higher than Roundup PRE or no Roundup application. Soybean yield in both 1998 and 1999 was equivalent among burndown applications and across Roundup timings when a second application of Roundup at 5 WAP was applied.

In conclusion, 2,4-D alone was a feasible burndown treatment when following Roundup. Treatments without a burndown were less consistent, but were similar to equivalent burndown treatments in some instances. Burndown timing did not influence the optimal in-crop timings. Roundup was optimal at 3 WAP with a single application. The necessity of a second application depended upon performance of earlier applications.. Two applications resulted in slightly higher yields and may offer more flexibility in burndown programs.

EFFECT OF HARVEST-AID TANK MIXTURES ON JOHNSONGRASS (*SORGHUM HALEPENSE* L.) CONTROL WITH ROUNDUP D-PAK. R.M. Cobill, D.B. Reynolds, H.C. Smith and W.F. Bloodworth. Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Field studies were conducted in 1995 at the St. Joseph Research Station near St. Joseph, LA, and in 1998 and 1999 at the Plant Science Research Center near Starkville, MS to evaluate the effects of tank mixing harvest aids with Roundup D-Pak (glyphosate) on johnsongrass control. Treatments were arranged in a three-factor factorial arrangement of treatments in a randomized complete block design with 4 replications. Experimental units were 6.67 by 40 feet. Factor A was 15 and 20 oz/A Roundup D-Pak. Factor B was defoliants: 0.05 and 0.1 lb ai/A Dropp 50WP (thidiazuron), 0.56 and 1.125 lb ai/A Folex 6EC (tribufos), 0.25 and 0.3 lb ai/A Harvade 5F (dimethipin), and no defoliant. Factor C was either 1.0 lb ai/A Prep (ethephon) or no Prep. Visual control ratings were taken at 14 and 28 days-after-treatment (DAT).

Roundup D-Pak rate had no significant effect on johnsongrass control, regardless of evaluation interval. In 1995, Johnsongrass control with 0.05 and 0.1 lb ai/A Dropp with no Prep decreased control below that of Roundup alone 14 DAT, and also in 1995, johnsongrass control with Roundup + 0.1 lb ai/A Dropp increased with the addition of 1.0 lb ai/A Prep 14 DAT. Johnsongrass control with Roundup + 0.05 lb ai/A Dropp with no Prep was less than control with Roundup + 1.125 lb ai/A Folex and both rates of Harvade 14 DAT in 1995. Johnsongrass control 14 DAT with Roundup + 0.1 lb ai/A Dropp with no Prep was less than all treatments without Prep added in 1995. Also in 1995, johnsongrass control 14 DAT with Roundup + 0.56 lb ai/A Folex + 1.0 lb ai/A Prep and Roundup + 0.3 lb ai/A Harvade + 1.0 lb ai/A Prep was greater than with Roundup + 0.05 lb ai/A Dropp + 1.0 lb ai/A Prep. In 1998, there were no differences in control among defoliants applied with or without 1.0 lb ai/A Prep tank-mixed with Roundup. The addition of 1.0 lb ai/A Prep to 0.1 lb ai/A Dropp or 0.56 lb ai/A Folex tank-mixed with Roundup increased johnsongrass control 14 DAT when compared to mixtures with 0.1 lb ai/A Dropp or 0.56 lb ai/A Folex without Prep. Johnsongrass control 14 DAT with Roundup was lower with the addition of 1.0 lb ai/A Prep to 0.3 lb ai/A Harvade in 1999. Johnsongrass control 28 DAT was not affected by Prep. Harvest aids had no effect on johnsongrass control with Roundup 28 DAT in 1995. Johnsongrass control 28 DAT in 1999 with Roundup + 0.3 lb ai/A Harvade was less than that achieved by Roundup when mixed with either rate of Folex or Dropp. In 1999, johnsongrass control with Roundup + 0.25 lb ai/A Harvade was less than with Roundup + 1.125 lb ai/A Folex 28 DAT.

PLANT POPULATION, ROW SPACING, AND RYE COVER CROP EFFECTS ON HERBICIDE INPUTS FOR ROUNDUP READY SOYBEANS. E.C. Murdock, Clemson University, Florence, SC 29506-9706, P.A. Bauer, USDA/ARS, Florence, SC 29506-9706, and R.F. Graham, Clemson University, Florence, SC 29506-9706.

ABSTRACT

Two field experiments were conducted in 1999 to evaluate the effects of plant population, row spacing, and rye cover crop on weed management in Roundup Ready soybeans. Treatment factors in Experiment I were the presence or absence of rye cover crop, soybean seeding rate (2, 4, 6 seed/row ft), and herbicide (none, glyphosate (Roundup Ultra) @ 1 qt/ac POST, pendimethalin + imazaquin (Squadron) @ 3 pt/ac PRE, and Squadron followed (fb) Roundup Ultra. Hartz 7550RR soybeans were planted May 27, 1999, with a John Deere 750 no-till drill (7.5-inch row spacing). POST herbicides were applied 5 weeks after planting (WAP) when soybeans, goosegrass/southern crabgrass, tropic croton, sicklepod, and yellow nutsedge were 8, 8, 7, 4, and 13 inches tall, respectively. Rye cover crop did not affect total weed biomass 5, 8, and 10 WAP. Total weed biomass 10 WAP in herbicide-treated plots (averaged across seeding rates) was 105 and 125 lb/ac with and without rye, respectively. The average reduction in total weed biomass 10 WAP compared to the untreated check with Roundup Ultra, Squadron, and Squadron fb Roundup Ultra was 53, 99, and 100%, respectively.

In Experiment II, treatment factors were the presence or absence of rye cover crop, row spacing (7.5, 15, 30 inches), and herbicides (none, Roundup Ultra @ 1 qt/ac POST, and Roundup Ultra fb Roundup Ultra. Weed biomass following the single application of Roundup (8 WAP) increased as row spacing decreased (101, 86, and 52 lb/ac with 7.5-, 15-, and 30-inch rows, respectively). However, by 10 WAP weed biomass with the 7.5-, 15-, and 30-inch row spacings was 27,

0, and 108 lb/ac, respectively. The single and sequential applications of Roundup Ultra reduced total biomass 10 WAP compared to the untreated check 96 and 100%, respectively (averaged across row spacing and $\pm$ rye cover crop).

EVALUATION OF ETHEPHON AND TRINEXAPAC-ETHYL FOR FOLIAR SUPPRESSION OF TURFGRASS SPECIES. F.H. Yelverton, M.J. Fagerness, and J.D. Hinton, Crop Science Department, North Carolina State University, Raleigh.

ABSTRACT

Plant growth regulators (PGRs) are known to reduce biomass production in turf-type bermudagrass and also enhance turfgrass visual quality and shoot density. Most commercial PGRs in fine turf inhibit gibberellic acid but a new available formulation of ethephon instead alters ethylene production. Experiments were therefore conducted to compare the new ethephon material to commercial standard PGRs, with respect to foliar tissue production and turfgrass quality, on three turfgrass species. Tall fescue, 'Arizona' common bermudagrass, and 'Tifway' hybrid bermudagrass field plots were nontreated or treated with either trinexapac-ethyl (TE) or ethephon (EP) at 0.1lb a.i./A or 5 oz./1000 ft^2, respectively. Tall fescue was additionally treated with mefluidide (MF) at 24 oz./A while bermudagrass was additionally treated with paclobutrazol (PB) at 0.5 lb a.i./A. PGRs were applied initially to tall fescue 4-9-99 while bermudagrass species were treated 7-8-99 and 8-6-99.

Beginning 1 week after initial treatment (WAIT), clippings were harvested weekly from equal-sized plot areas for each turfgrass species investigated. Clippings were collected through 13 WAIT for tall fescue maintained at 3" while clippings were collected through 9 WAIT for both bermudagrasses, which were maintained at 3/4". Turfgrass quality was visually assessed over the same intervals using a 1-9 scale: 1=dead, desiccated turf; 9=ideal turf). Analysis of variance was conducted on weekly dry weight clipping production or turfgrass quality data to assess treatment differences.

Results demonstrated that, while EP had little effect on turfgrass quality for any species, it did effectively reduce foliar biomass production, particularly in tall fescue. Both TE and MF significantly reduced tall fescue quality through 7 WAIT. Foliar suppression from EP in the two bermudagrasses was either absent or more briefly observed. TE was the most effective suppressor of foliar biomass in either bermudagrass species but briefly reduced turfgrass quality 1-2 WAIT. PB only showed foliar suppression in 'Tifway' bermudagrass and had little impact on bermudagrass quality. Post inhibition growth enhancement was clearly evident in tall fescue 11-13 WAIT with MF or TE, was suggested in common bermudagrass with EP or PB, and was not evident in 'Tifway' bermudagrass. Overall, results suggest EP may be more suitable for use in tall fescue than TE or MF. However, EP was relatively ineffective in bermudagrass, suggesting limited utility as compared to gibberellin inhibitors such as TE or PB.

PRE SOUTHERN CRABGRASS CONTROL WITH HERBICIDE COMBINATIONS. S.T. Kelly, LSU Agricultural Center, Louisiana State University, Winnsboro, LA 71295, and G.E. Coats, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Three experiments were conducted in 1998 or 1999 to evaluate herbicide combinations for PRE control of southern crabgrass (*Digitaria ciliaris*). All experiments were conducted at the Plant Science Research Center near Starkville, MS on a common bermudagrass turf overseeded with southern crabgrass immediately after initiation. All granular treatments were applied using a box containing seven layers of 0.25 inch hardware cloth spaced 6 inches apart, which was placed over the plot and the pre-weighed quantity sprinkled over the box using a shaker jar. All sprayable treatments were applied using a CO_2 powered backpack sprayer calibrated to deliver 25 gallons per acre. Experimental design was a randomized complete block with five replicates. Southern crabgrass control was evaluated monthly fromJune through September.

The first experiment was conducted to evaluate combinations of dithiopyr and oxadiazon. Treatments included dithiopyr (0.25%) on a fertilizer carrier (40-0-0, N-P-K) at 0.375 lb ai/A, and 0.375 fb 0.375 lb/A 60 days after the initial application (DAIT), dithiopyr + oxadiazon (0.13 + 0.54%, respectively) applied at two rates (0.3 + 1.25 lb ai/A, or 0.38 + 1.5 lb/A). These treatments were compared to a single application of oxadiazon (2% granule) at 3.0 lb/A, and a split application of 1.5 fb 1.5 lb/A 60 DAIT. From 161 to 190 DAIT, both treatments containing dithiopyr + oxadizon, or 0.375 lb/A dithiopyr applied Pre and 60 DAIT, controlled southern crabgrass equally (at least 75%). A single application of dithiopyr or either oxadiazon treatment controlled southern crabgrass 75% or less from 133 to 190 DAIT. Results from this experiment indicate that combining dithiopyr and oxadizon increased southern crabgrass control over either herbicide alone at the rates evaluated in this experiment.

The second experiment evaluated dithiopyr (0.164%) on a fertilizer granule (40-0-0, N-P-K) at 0.375 lb/A, dithiopyr + quinclorac (0.375 + 0.75 lb ai/A) on a fertilizer carrier, and a comparison treatment of MSMA + dithiopyr (2.0 + 0.375 lb/A) fb MSMA (2.0 lb/A), 7 days later. Each treatment was applied to southern crabgrass at two growth stages: 2 to 3 leaf, and 1 to 2 tiller and larger. Dithiopyr alone controlled southern crabgrass at least 85% for the duration of the experiment when applied to plants in the 2 to 3 leaf stage. However, when applied to plants that had tillered, control was less than 65%. Dithiopyr + quinclorac controlled plants in the 2 to 3 leaf stage less than 55% at any point during

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the experiment, however, if plants had tillered, control ranged from 85 to 75% during the experiment. The comparison treatment containing MSMA controlled either stage of southern crabgrass at least 77% throughout the experiment.

Experiment three was also conducted to evaluate combinations for controlling southern crabgrass at differing growth stages: 2 to 3 leaf, 1 to 2 tiller, and 2 tiller and larger. Treatments included: dithiopyr (0.164% or 0.25%) on a fertilizer carrier (40-0-0, N-P-K) at 0.25, 0.375 or 0.5 lb/A, and two combination products of dithiopyr + quinclorac (0.18 or 0.27%) at 0.25 + 0.75 or 0.375 + 0.75 lb/A, respectively. Dithiopyr at 0.375 lb/A or less controlled 2 to 3 leaf southern crabgrass 68% or less throughout the experiment, while 0.5 lb/A controlled 2 to 3 leaf southern crabgrass 82% at 44 DAIT, but control declined to 40% and less through the remainder of the experiment. If dithiopyr applications were delayed until plants had tillered, poor control (less than 48%) was observed. While the addition of quinclorac to dithiopyr enhanced initial control of tillered plants, control declined quickly.

REMOVAL OF PERENNIAL RYEGRASS AND ROUGH BLUEGRASS FROM TIFWAY BERMUDAGRASS WITH HERBICIDES. R.H. Walker and J. Belcher. Agronomy and Soils Department, Alabama Agric. Exp. Stn., Auburn University, AL 36849-5412.

ABSTRACT

It is common practice to overseed bermudagrass sports turfs with either perennial ryegrass (*Lolium perenne L.*) or a mixture of perennial ryegrass and rough bluegrass (*Poa trivialis* L.). These cool season species add color, reduce winter weed infestations, and protect the dormant bermudagrass against excessive wear. However, both can easily persist into June and thereby compete against the bermudagrass during transition. Removing overseeded species with mechanical methods such as vertical mowing, core aerification, and/or reduced irrigation is inadequate with the more persistent cultivars that are now available for these species. Therefore, objectives of this research were: 1) evaluate herbicides and rates for removal of perennial ryegrass and rough bluegrass when overseeded into 'Tifway' bermudagrass; 2) evaluate effects of these herbicides on Tifway bermudagrass during transition and during full green-up.

Study 1. Established Tifway bermudagrass managed as a fairway was overseeded with either 'Medalist III' perennial ryegrass at 15 lb /M^2 or 'Sabre' rough bluegrass at 8 lb/M^2 on October 15, 1998. Each overseeded species occupied half of a 10,000 square foot tier at the Auburn Turfgrass Research Unit. Treatments were arranged in a RCB design within each grass block with three replications. Herbicide treatments were applied to both studies on April 19, 1999 in a volume of 30 gallons/acre (GPA) and surfactant was included at 0.25% v/v. Herbicides and rates (lb ai/A) evaluated were: Sencor 0.5, 0.75; Aatrex 1.0, 1.5; Princep 1.0, 1.5; Illoxan 1.0, 1.5; Kerb 1.0, 1.5; Escort, Beacon and rimsulfuron 0.032, 0.064. Visual ratings were taken 30 days after treatment (DAT) for control of the overseeded species and 30 and 40 DAT for bermudagrass injury. Good to excellent control of perennial ryegrass was obtained with Aatrex (81%), Illoxan (83%), Escort (89%), Beacon (90%) and rimsulfuron (96%) with the lower rates, while marginal to poor control was recorded for Kerb (73%), Sencor (64%), and Princep (56%). At higher rates, all herbicides except Kerb (77%) provided 82 to 97% control of perennial ryegrass. Only Beacon (88%) and rimsulfuron (91%) provided good to excellent control of rough bluegrass at the lower rates, while control with Kerb and Aatrex averaged 77%. The higher rate of Kerb resulted in 93% control of rough bluegrass while control was good (85 to 88%) with Aatrex, Princep, Beacon, and rimsulfuron but poor with Illoxan (24%), Escort (44%) and Sencor (64%). Bermudagrass injury was acceptable ($\leq$ 20%) with all herbicides and lower rates. However, the higher rates of Sencor, Aatrex and Princep produced 32 to 35% bermudagrass injury 30 DAT. Bermudagrass injury declined to $\leq$ 22% 40 DAT for all treatments.

Study 2. In a separate area, Tifway bermudagrass sod was treated July 20, 1999 with the same herbicides and rates used in Study 1. Aatrex and Princep were not included since it is well documented that actively-growing hybrid bermudagrass is not tolerant of these herbicides. Treatments were arranged in a RCB design and there were four replications. Spray volume was 30 GPA and non-ionic surfactant was included at 0.25% v/v. Visual injury ratings were taken at 10 and 30 DAT and clipping weights determined at the same time. At 10 DAT, bermudagrass dry weights were reduced by all herbicides and this reduction was generally rate dependent. However at 30 DAT, bermudagrass dry weights for all herbicide-based treatments were equal to or higher (Illoxan 1.0, Beacon 0.064) than the nontreated. Bermudagrass injury ratings were unacceptable only for Sencor. Transitory dry weight reductions with Beacon, Escort, Illoxan and rimsulfuron were not objectionable since turf quality was maintained due to the observed growth-regulator effects produced by these four herbicides.

THE EFFECTS OF ETHEPHON ON THE ROOTING OF SEVERAL TURFGRASS SPECIES IN GREENHOUSE TRIALS. P.L. Hipkins and S.W. Bingham; Department of Plant Pathology, Physiology and Weed Science, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.

ABSTRACT

The chemical ethephon is a plant growth regulator that releases ethylene in plant tissues. It has many uses related to flower induction as well as fruit set, color enhancement, and abscission. Additionally, it is used to reduce lodging in various small grains. Proposed uses include growth inhibition of turfgrasses for which certain research has been conducted.

Greenhouse trials were conducted in the fall of 1998 and repeated in the fall of 1999 to assess the affects of ethephon on rooting of bluegrass (*Poa pratensis* L. 'Kelly'), perennial ryegrass (*Lolium perenne* L. 'Palmer II'), tall fescue (*Festuca arundinacea* Schreb. 'Rebel II'), and bermudagrass (*Cynodon dactylon* L. 'Vamont'). Plugs of each species were cut 10 cm in diameter and 1.9 cm thick and placed on silica sand in 10 cm plastic pots. The pots were placed in a greenhouse and bottom watered. After 48 hours the pots were removed to an outside paved area and treatments 1-3 applied at 280 L ha^{-1}. After 4 hours the pots were returned to the greenhouse and maintained with bottom watering at 24.5ºC. The pots were arranged in a randomized complete block design with 5 replications and 3 pots per plot.

The ethephon formulation (Proxy 2SL) was applied in treatments 1-3 at 2.28, 4.56, and 9.14 kg ai ha^{-1} respectively with treatment 4 being an untreated control plot. Evaluations were made 4 weeks after treatment. Each plug was gently removed fromthe wet sand, rinsed and the length of the longest root recorded. Subsequently, the roots were harvested, patted dry on paper towels and the fresh weight recorded. They were then placed in #1/2 brown paper bags. After drying at 75ºC for 48 hours in a constant temperature cabinet, the dry weights were recorded and the percent dry weight calculated.

The bluegrass treatments had similar root length responses between 1998 and 1999 with untreated root lengths of 11.6 and 12.8 cm respectively. All treated plots had root lengths significantly less than the untreated ranging from 5.5 cm in treatment 3 in 1998 to 11.0 cm in treatment 1 in 1999. Fresh weight varied greatly between years ranging from 216.0 mg in 1998 to 1016.0 mg in 1999 for the untreated plugs. Treated plots followed similarly and all treatments were significantly lower than the check ranging from 45.3 and 392.0 mg in treatment 1 to 24.9 and 97.3 mg in treatment 3 for 1998 and 1999 respectively. Percent dry weight was significantly lower for treatment 3 (6.3%) from the untreated (14.3%) in 1998 but there was no significant difference in 1999.

The root length response for the ryegrass was also very similar in 1998 and 1999 with the untreated root lengths being 17.2 and 17.1 cm respectively. Only the root length for treatment 1 (14.5 cm) in 1998 was not significantly less than the check with greatest inhibition at the high rate (7.7 cm) in 1999. All fresh weights were significantly less than the check (790.7 mg) in 1998 but only the high rate (260.4 mg) was significantly different from the check (1084.6 mg) in 1999. Dry weights paralleled fresh weights in significance for all treatments and there was no significant difference in % dry weight.

Tall fescue root lengths were all significantly different from the check (20.4 cm) in 1998 while only treatments 2 and 3 were in 1999. All fresh weights were significantly different from the check in both years with weights ranging from 2411.3 mg for the check in 1999 to 209.3 mg for the high rate in 1998. Dry weights paralleled fresh weights in both years and % dry weight exhibited no significant differences amongst treatments.

All root lengths, fresh weights, and dry weights were significantly less than the untreated check in the bermuda. There was no significant difference in % dry weight.

This data indicates the ethephon has the potential to significantly reduce root growth of both cool and warm season grasses and such activity should be considered when using this compound as a turfgrass growth inhibitor.

***BRYUM ARGENTEUM* (SILVERY THREAD MOSS) MANAGEMENT ON CREEPING BENTGRASS PUTTING GREENS.** K.D. Burnell, F.H. Yelverton, T.W. Gannon, and J.D. Hinton. North Carolina State University, Raleigh, NC 27695.

ABSTRACT

Silvery thread moss has recently become a problematic weed on golf course putting greens, due to deregistration of mercury-based fungicides and increased emphasis on aggressive cultural inputs. The unique biology of moss makes difficult traditional weed control principles and control strategies in turf need to be developed. Two experiments were each initiated at three golf courses in western North Carolina with high silvery thread moss populations in 'Penncross' creeping bentgrass putting greens. Experiments were initiated during the summer and continued into the fall to evaluate the usefulness of various products for the suppression of silvery thread moss. Plots were 3 ft. by 3 ft. and arranged in a randomized complete block design with four replications. 'Penncross' creeping bentgrass putting greens were maintained at 5/32". The soil was a United States Golf Association standardized mix. Spray treatments from each experiment were applied with a CO_2 propelled backpack sprayer while granular materials were applied using a shaker can.

Experiments were initiated on August 16, 1999. Moss control, phytotoxicity and turf quality data were taken weekly through 10 weeks after initial treatment (WAIT). Moss control was rated on a 0-100% scale with 0= no effect and 100= complete control while turf quality was rated on a 1-9 scale with 1= desiccated turf and 9= ideal turf.

In experiment 1, the treatments were arranged as follows: 4-0-0-18%Fe (Izonizer) at 14.2 lb./1000ft^2, 1-0-0-4.5%Fe (Ironite) at 15lb/1000ft^2, Tee Time 2.3 lb/1000ft^2 + Peter's 20-20-20 1.67 lb/1000ft^2, Ultra Dawn dishwashing soap at 4 fl oz/1000ft^2, and oxadiazon at 1.5 lb. a.i./A, applied alone or included with previous treatments, but only applied initially. Iron sulfate at 2 lb. Fe/1000ft^2 + ammonium sulfate at 3 lb. N/1000ft^2 was also applied as a treatment. Dawn

was applied weekly until 3 WAIT but treatments were then discontinued due to turf injury. All other treatments were reapplied 4 WAIT (expect for oxadiazon). Moss control with the 18% Fe was 49% 1 WAIT, increased to 98% 6 WAIT, and then dropped to <30% 10 WAIT. Moss control with 4.5 % Fe was 29% 1 WAIT, increased to 62% 6 WAIT and then fell to <30% 10 WAIT. Moss control with Tee Time + Peter's 20-20-20 was 56% 1 WAIT, then fell to 40% and >10% 6 and 10 WAIT, respectively. Moss control with Peter's 20-20-20 + oxadiazon was 68% 1 WAIT, then fell to 59% and >25% 6 and 10 WAIT, respectively. Dawn applied 3 times at 1 week intervals provided 74% and <30% control 6 and 10 WAIT, respectively. One application of 1.5 lb. a.i./A of oxadiazon controlled moss 55% and 25% 6 and 10 WAIT, respectively. The combination of iron sulfate and ammonium sulfate produced 86% control 1 WAIT and gave 98% and <30% control 6 and 10 WAIT, respectively. Turf quality was reduced by the use of Ultra Dawn. Granular iron (18% Fe) and the liquid iron sulfate + ammonium sulfate provided the most effective moss control in Experiment 1. The addition of oxadiazon at 1.5 lb. a.i./A did not enhance moss control at the Jefferson Landing location.

In Experiment 2, treatments included two rates of chlorothalonil (ZN) (6 and 11oz/1000ft^2) and Weather Stik (W/S) (4 and 8oz/1000ft^2) at two different spray volumes (218 gal/acre and 436 gal/acre). All treatments were applied with the surfactant Kinetic at a concentration of 0.25% v/v. All treatments were reapplied 2 WAIT. A nontreated check was included for comparison. Control for all treatments was >90% 6 WAIT and ~50% 10 WAIT. Differences were not seen between formulation, GPA, or rate of application. Overall, all of the chlorothalonil treatments were effective in moss control and provided more persistent control than any treatments from Experiment 1. Turf quality was not reduced by any treatment in Experiment 2.

CONTROL OF SMOOTH CRABGRASS (*Digitaria ischaemum*) WITH TWO COMMERCIAL PRODUCTS AT VARIOUS RATES AND TIMINGS. B.T. Bunnell, J.K. Higingbottom, and L.B. McCarty. Clemson University, Department of Horticulture Clemson, SC. 29634-0375, R.D. Baker, The Scotts Company, Marysville, OH 43041.

ABSTRACT

Smooth crabgrass (*Digitaria ischaemum)* control is performed with a variety of chemicals at various application timings and rates. Smooth crabgrass is a spring and summer annual which invades uniform turf areas with its coarse texture, off green color, and prostrate growth habit. A current control trend involves spring applications of preemergence herbicides attached to a fertilizer carrier. The objective of this research was to observe the efficacy of two commercial products at various rates and timings for preemergence and early postemergence control of smooth crabgrass.

Two studies were performed the spring and summer of 1999. One study was performed in the greenhouse and the other on a golf course in Clemson on common bermudagrass (*Cynodon dactylon*). Treatments included two fertilizer and herbicide combinations at various rates and growth stage applications. Products used were TurfBuilder + Halts 1.21 G (30-3-4 + pendimethalin) at 1.5 lbs. ai/A and 1.75 lbs. ai/A and Sta-Green 0.14 G (28-3-4 + dithiopyr) at 0.18 lbs. ai/A and 0.22 lbs. ai/A. Applications were made at three stages of smooth crabgrass growth: preemergence, one-leaf stage, and three-leaf stage. The greenhouse study observed smooth crabgrass seed germination in 4 X 4 inch pots. The field study observed smooth crabgrass control in a common bermudagrass golf course rough with plot size of 5 X 10 ft. Ratings were taken every 2 weeks and monthly for the greenhouse and field study, respectively. Smooth crabgrass control was rated on a 0-100% scale with 100=complete control. Minimal acceptable smooth crabgrass control was 70%.

The greenhouse study showed best (>90%) smooth crabgrass control with preemergence applications of TurfBuilder+ Halts at both rates at 3 WAT (weeks after treatment), 6 WAT and 9 WAT. Sta-Green provided >90% control at 6 and 9 WAT. Early postemergence applications at the one-leaf stage showed >90% control with both products and rates at 8 WAT and ~80% control at 5 WAT. High rates of Sta-Green and Turf-Builder +Halts provided 80 and 85% control, respectively. Low rates of both products provided 75% control. Three-leaf stage applications provided 75% smooth crabgrass control with both rates of Turf-Builder + Halts at 7 WAT.

The field study provided similar results with preemergence applications of both rates of Turf-Builder + Halts providing 85% smooth crabgrass control at 12 WAT and 75% control at 22 WAT. Early postemergence applications of both rates of Turf-Builder + Halts at the one-leaf stage provided good (80-90%) smooth crabgrass control through 20 WAT. Three-leaf stage applications of Turf-Builder +Halts at the low rate provided 70% control at 9 and 19 WAT, high rates provided 80% control on the same dates. Sta-Green did not provide acceptable smooth crabgrass control.

Research will continue with preemergence and early postemergence products combining herbicides and fertilizers for crabgrass and other grassy weed control. Adjustments in application timings, rates, and fertilizer formulation may improve herbicide efficacy and health of desired turf.

POSTEMEGENT WEED CONTROL IN DORMANT BERMUDAGRASS. I.R. Rodriguez, J.K. Higingbottom. and L.B. McCarty, Department of Horticulture, Clemson University, Clemson, SC 29634.

ABSTRACT

Winter annual weeds can reduce the aesthetics of non-overseeded dormant bermudagrass. These weeds can proliferate while the bermudagrass is defoliated and not competing. The green color of these weeds creates an unsightly contrast with the brown turf.

A study was conducted to examine the effectiveness of using post-emergence herbicides for control of annual bluegrass, mouseear chickweed, parsley-piert, and cudweed in dormant bermudagrass turf. The study was conducted on a golf course driving range in Pendleton, SC in 1999. Seventeen treatments were applied in a randomized complete block replicated 4 times. Plot size was 5 ft ´ 10 ft. Treatments were applied using a CO_2 backpack sprayer calibrated at 30 gal/A and 8003 flat fan tips. Treatments included a control, Atrazine 4L (atrazine), Reward (diquat) + Optima (adjuvant), Envoy (clethodim) + Dash (crop oil), Envoy + Optima, Envoy + Reward + Optima at three rates, Roundup Pro (glyphosate), Finale (glufosinate), Roundup Pro + Reward, Roundup Pro + Envoy, Roundup pro + Finale, Finale + Envoy + Optima, Kerb (pronamide), Image (imazaquin), and Metsulfuron. Treatments were applied on 5 February 1999.

Visual control ratings were taken starting 3 days after treatment and weekly until seven weeks after application. Weed control ratings were based on a scale of 0 to 100% with 0 representing no control and 100 representing complete control. Bermudagrass was rated at the conclusion of this study to determine if the treatments delayed green-up.

When rated 7 weeks after treatment, Envoy + Reward at all three rates, Finale, Finale + Roundup Pro, and Finale + Envoy provided > 90% control of annual bluegrass. Atrazine, Roundup Pro, and Roundup Pro + Envoy provided 70 – 89% control of annual bluegrass. Atrazine, Roundup Pro, Finale, Roundup Pro + Envoy, and Finale + Roundup Pro provided > 90% control of mouseear chickweed, while Roundup Pro + Reward and Finale + Envoy provided 70 – 89% control. Atrazine and Finale provided > 90% control of parsley-piert, while Finale + Roundup Pro provided 70 – 89% control. Roundup Pro, Finale, Roundup Pro + Envoy, Finale + Roundup Pro, and Finale + Envoy provided > 90% control of cudweed. When compared to the control, none of the treatments hindered bermudagrass green-up.

BERMUDAGRASS ENCROACHMENT MANAGEMENT IN BENTGRASS PUTTING GREENS. D.B. Lowe, T. Whitwell and L.B. McCarty, Department of Horticulture, Clemson University, Clemson, SC 29634-0375.

ABSTRACT

Creeping bentgrass (*Agrostis palustris* Hubs.) is a highly desirable turfgrass species for golf course putting greens. Its fine leaf texture and ability to withstand low mowing heights provides a smooth, fast putting surface. Bentgrass is a cool-season turfgrass and its growth decreases during summer months. Bermudagrass, meanwhile, thrives in warm climates and often encroaches into bentgrass putting greens. Herbicide and plant growth regulator combinations were, therefore, evaluated for bermudagrass encroachment management into bentgrass putting greens.

Treatments were applied to a 'Crenshaw' creeping bentgrass putting green at the Walker Golf Course located in Clemson, South Carolina. A 'Tifway' bermudagrass (*Cynodon dactylon* Burtt-Davey X *C. transvaalensis* L. Pers.) collar and rough surrounded the green and was encroaching into it. Plots (5 ft X 10 ft) were located within the putting green perimeter. Experimental design was a randomized complete block utilizing four replications.

Treatments were applied on June 11, July 21 and August 29, 1999. Treatments included Tupersan (siduron) at 24 lb ai/A, Acclaim (fenoxaprop-p-ethyl) at 0.15 lb ai/A, TGR (paclobutrazol) at 0.25 lb ai/A + Acclaim at 0.15, TGR at 0.25 lb ai/A + Sentinel (cyproconazole) at 0.13 lb ai/A and Cutless at 0.75 lb ai/A (flurprimidol) + Prograss (ethofumesate) at 0.38 lb ai/A. Optima surfactant (0.5% v/v) was added to all treatments. Treatments were applied with a CO_2-powered backpack sprayer calibrated to deliver 30 GPA. Spray boom width was 5 ft and treatments were applied so that boom center was located on the interface of the putting green perimeter/bermudagrass collar.

Perennial ryegrass (*Lolium perenne* L.) was seeded into the bermudagrass collar for winter color in Fall 1998 and had >80% stand density at study initiation. Ryegrass, bermudagrass and bentgrass injury was rated visually on a 0 to 100% scale with 0% = no injury and 100% = total plant death. Ryegrass and bermudagrass cover in treated areas was also visually estimated (0-100%). Ryegrass cover was visually estimated in treated bermudagrass collars (2.5 ft X 10 ft) and bermudagrass cover was estimated in treated section of bentgrass green perimeter. Data were subjected to ANOVA with means separation using LSD (p=0.05).

Bentgrass injury occurred most with Acclaim and TGR + Acclaim treatments throughout the study. Unacceptable (^{3}20%) injury was observed following Acclaim treatments at one week after initial treatment (WAIT) and at one week after third treatment (WATT); however, injury decreased to <5% by 3 WAIT and 3 WATT. TGR + Acclaim provided worst bentgrass injury (30%) at 1 WAIT compared to all other treatments; however, <20% injury was recorded at all other ratings.

Bermudagrass injury was often difficult to rate in the green's perimeter due to its shoot density/texture at <0.25 inch mowing height and quick regrowth following treatment application. Bermudagrass cover in the bentgrass green perimeter averaged 19% among all plots prior to treatment applications (June 11). By December 14, only Tupersan decreased bermudagrass cover (9%) compared to untreated plots (34%).

Minimal ryegrass injury (9-16%) was observed with all treatments at 2 WAIT but recovered (<9%) by 3 WAIT. On July 16 (5 WAIT), ryegrass cover in untreated bermudagrass collars began to diminish (19%) due to the warm/humid climate, bermudagrass competition and golf course maintenance practices; however, ryegrass cover was between 46 to 70% in all treated plots. The ryegrass used in our study is commonly overseeded on golf courses in the southeastern U. S. Ryegrass cover diminished to 0% in untreated plots by early August while treatments providing best ryegrass cover (TGR + Sentinel, TGR + Acclaim) provided between 30 to 43% ryegrass cover.

Bermudagrass encroachment management into bentgrass greens requires an integrated approach. Future research should focus on the use of ryegrass and/or fescue (*Festuca sp*.) varieties that can be mowed low (~0.5 inch) and can tolerate warm/humid climates. Their use as collars surrounding bentgrass greens along with bermudagrass-active herbicides may offer effective encroachment control options for golf course superintendents.

PREEMERGENCE *POA ANNUA* CONTROL IN NON-OVERSEEDED TURF. A.G. Estes, J.K. Higingbottom and L.B. McCarty. Clemson University, Department of Horticulture, Clemson, SC. 29634-0375.

ABSTRACT

Annual bluegrass (*Poa annua)* is a winter annual weed common in overseeded and non-overseeded turf. In the temperate zone, warm-season grasses go dormant leaving large areas of brown turf if not overseeded. *Poa annua* is a bunch-type grass with light green leaves, which produces prolific seedheads. In recent years, there has been an increased occurrence of *Poa annua* resistance to dinitroaniline and triazine herbicides. The purpose of this research was to determine the effects of different preemergence herbicides for *Poa annua* control on non-overseeded turf.

In the fall of 1998, a trial was conducted at Southern Oaks Golf Course, in Piedmont, SC on a non-overseeded bermudagrass golf course driving range for preemergence Poa *annua* control. The study consisted of twelve treatments, replicated 3 times. Plot size for each treatment measured 10 ft by 10 ft. Treatment applications were applied using a CO_2 backpack sprayer at 20 GPA with 8003 flat fan nozzle tips. The golf course maintenance staff maintained the experimental area. Initial preemergence applications were made, on September 2, 1999, with Surflan 4.0 SL (oryzalin) at 1.5 lb ai/A, Pendulum 60 WG (pendimethalin) at 1.5 lb ai/A, Barricade 65 WG (prodiamine) at 0.5 lb ai/A, Team Pro 0.86 G (benfin + trifluralin) at 3.0 lb ai/A, XL 2.0 G (benefin + oryzalin) at 3.0 lb ai/A, Ronstar 2.0 G (oxadiazon) at 3.0 lb ai/A, Dimension 1 EC (dithiopyr) at 0.5 lb ai/a. Four additional treatments of Surflan, Pendulum, Barricade, and Dimension were also applied initially. These received an additional treatment, applied at the same rate, on October 28, 1998.

Visual *Poa annua* control ratings were taken on January 7, February 5, February 17, March 16, and April 27 1999. Rating were based on a scale of 0-100% with 0% representing no control and 100% representing no *Poa annua* present. Minimum acceptable *Poa annua* control was 70%. This study was concluded on April 27, 1999. In the final visual ratings, excellent control (90%-100%) resulted from single applications of Barricade 65 WG and XL 2G and dual applications of Pendulum 60 WG and Barricade 65 WG. Good control (80%-89%) resulted from single applications of Pendulum 60 WG, Team Pro 0.86 G, and Ronstar 2G and a dual application of Surflan 4SL. Fair control (70%-79%) resulted from a dual application of Dimension 1 EC. Unacceptable control (<70%) resulted from single applications of Surflan 4 SL and Dimension 1 EC.

ENVOY (CLETHODIM) FOR BERMUDAGRASS CONTROL AND CENTIPEDEGRASS TOLERANCE. C.J. Cox, L.B. McCarty, J.K. Higingbottom. Department of Horticulture, Clemson University, Clemson SC.

ABSTRACT

Bermudagrass is a problematic weed for sod producers in the Southern United States. A two-year study was conducted to evaluate the efficacy of Envoy 0.94 EC for bermudagrass (*Cynodon dactylon)* control and centipedegrass (*Eremochloa ophioroides)* tolerance. The study was conducted on a commercial sod operation in Orangeburg, South Carolina. The primary objective for the study during year one was to determine the effective usage of surfactants in correlation with Envoy at three different rates, (17, 34, and 68 oz/A) comparing each rate with Vantage (1 EC) at 36 oz/A, which had been the industry standard. During year two, best application timings using the three most effective rates from year one, with treatments applied pre and post-greenup of the turf were examined.

Treatments applied at greenup were sprayed on May 7, 1999. The 17oz/A rate at greenup continued for three additional applications (May 23, June 11, July 3), while the 34 oz/A rate sprayed on May 23 with one additional application June 11. Also on May 23, the post-greenup treatments were applied, with the 17 oz/A rate continuing for three additional applications, ending July 25. The 34 oz/A post-green-up treatment was also applied initially on May 23 with one

additional application on June 11. Vantage was also applied post-greenup, with the initial application occurring on May 23, with one additional treatment applied June 11. Treatments were applied to 10 x 10 foot plots of centipedegrass naturally infested with bermudagrass. Three replications of each treatment were rated on the basis of visual bermudagrass control (%) and centipedegrass injury (%). An arbitrary value of 30% was used for maximum commercially acceptable centipedegrass injury. Treatments were applied using a CO_2 backpack sprayer calibrated at 20gal/A and fitted with 8003 flat fan tips. All final ratings occurred on September 8, 1999.

In 1998, eight treatments were studied to determine their effectiveness with the addition of non-ionic or crop oil surfactants. Overall best treatments were two applications of Envoy (with Dash surfactant) at rates of 34 oz/A and 68 oz/A. Both treatments provided >85% control. Although the 68 oz/A rate incurred some injury to the centipedegrass (13%), the turf fully recovered within four weeks.

In 1999, best results occurred using repeat applications of Envoy at 17 oz/A with 1% v/v crop oil surfactant. Four applications of Envoy applied at green-up provided 87% control with 0 centipedegrass injury. Envoy at 17 oz/A, applied four times post-greenup, provided 85% control of bermudagrass and 0 injury to centipedegrass. Envoy treatments at 34 oz/A applied during green-up provided only 18% bermudagrass control. When applied post-greenup, the 34 oz/A rate provided 65% bermudagrass control with 12% injury to centipedegrass after the second application. Within one month, the centipedegrass had fully recovered. Vantage provided <40% control of bermudagrass and <2% injury to centipedegrass

In conclusion, four applications of Envoy at a rate of 17 oz/A, using a crop oil surfactant provided the best bermudagrass control without any injury to the centipedegrass turf either during or post-greenup. Vantage, the industry standard for bermudagrass control, proved to be ineffective when applied post-greenup.

RESPONSE OF OKS 91-11 AND OKS 95-1 TO COMMONLY USED POST-EMERGENT HERBICIDES. T.B. Scroggins, D.L. Martin, D.S. Murray, and G.E. Bell. Oklahoma State University, Stillwater, OK 74078.

ABSTRACT

Bermudagrass (Cynodon spp.) is one of the most widely used turfgrasses in the southern United States. For years turf managers have been faced with the challenge of chemical weed control without injury to the turf. Herbicide injury to turf can be caused by many factors such as, improper application rates, incorrect calibration, overlapping spray patterns, or species intolerance to the herbicide. The objective of this research was to examine the color, quality, phytotoxicity, and clipping yield response of OKS 91-11 and OKS 95-1 seeded bermudagrasses to commonly used post-emergent herbicides at 1x and 2x label rates. This research focused on the newly released seeded bermudagrass OKS 91-11 and the promising experimental variety OKS 95-1.

Field experiments were conducted in 1999 at the Oklahoma State University Turf Research Center, Stillwater OK. A randomized complete block design with 3 replications was used with plot sizes of 1.4 x 2.6 m. The experiment was seeded with OKS 91-11 and OKS 95-1 at 49 kg of pure live seed ha^{-1} on 5 May 1999. The soil type was a loam soil containing 2.2% organic matter and having a pH of 7.2. Prior to establishment and every 4-5 weeks after, the area was fertilized with 49 kg N ha^{-1} using a 46-0-0 (N-P-K) source. Irrigation was applied 2-3X wk^{-1} from an automatic irrigation system to prevent wilting. All plots were mowed at a normal fairway height of 1.3 cm. The week of application, nitrogen was applied at 98 kg N ha^{-1} using a 40-0-0 (nutralene) source that gave an extended fertilization period during data collection.

Herbicide treatments consisted of sprayable formulations of 2,4-D + MCPP + dicamba (1.85 and 3.7 kg ha^{-1}), triclopyr + clopyralid (0.83 and 1.66 kg ha^{-1}), imazaquin (0.56 and 1.12 kg ha^{-1}), MSMA (3.37 and 6.74 kg ha^{-1}), MSMA + metribuzin (3.37 + 0.18 and 6.74 + 0.36 kg ha^{-1}), metribuzin (0.56 and 1.12 kg ha^{-1}), pronamide (1.67 and 3.34 kg ha^{-1}), halosulfuron (0.049 and 0.098 kg ha^{-1}), bentazon (1.24 and 2.48 kg ha^{-1}), quinclorac (0.83 and 1.66 kg ha^{-1}), and diclofop-methyl (1.13 and 2.26 kg ha^{-1}). Treatments were applied using a compressed air-pressurized bicycle sprayer with 11003VS flat fan tips on 6 August 1999.

Phytotoxicity ratings were collected weekly starting at 7 DAT and continuing for 8 weeks. Ratings were taken on a 0-10 scale with 0 equaling no phytotoxicity. Clippings (dry matter yield) from a 0.5 x 2.6 m area with in each plot were taken 1X wk^{-1} during 7-56 DAT. An ANOVA was performed on each data set and an LSD test was used to separate treatment means at the $P < 0.05$ level.

Data showed that both 1x and 2x rates of triclopyr + clopyralid produced the longest period of phytotoxicity, over 35 DAT. Metribuzin and 2,4-D + MCPP + dicamba at the 2x rate showed extended phytotoxicity for at least 21 DAT. Clipping yields showed that triclopyr + clopyralid at 1x and 2x rates reduced clipping yields for at least 21 DAT. Both 1x and 2x rates of 2,4-D + MCPP + dicamba produced a significant reduction in clipping yields for at least 7 DAT.

Each cultivar had a unique phytotoxicity response to the herbicides but overall, OKS 95-1 phytotoxicity response peaked more quickly and it recovered more quickly. The recovery rate of OKS 95-1 can be attributed to the grass's aggressive growth rate. Due to the vigorous growth rate of OKS 95-1, clipping yields tended to recover faster and provided an

overall higher yield than OKS 91-11. With air temperatures excessively high and the bermudagrasses not completely mature, these 1999 research results represent a near worst case scenario. Data showed that some common post-emergent herbicides can cause injury to both OKS 91-11 and OKS 95-1, even when applied at the labeled rates under nonoptimal environmental conditions.

WINTER WEED CONTROL WITH REDUCED RATES OF ISOXABEN. J.W. Boyd and B.N. Rodgers, University of Arkansas, Little Rock, AR 72203.

ABSTRACT

Preemergence herbicides for annual bluegrass control must be applied during early September to provide effective control. Because many grass herbicides provide inconsistent control of broadleaf winter annuals, an additional herbicide application is required for broad-spectrum control. Simazine is commonly used for winter annual control but must be applied later than annual bluegrass herbicides. Isoxaben has sufficient residual properties to allow application in early September along with an annual bluegrass herbicide. Our objective in evaluating reduced rates of isoxaben for broadleaf control was to look for a means of making this herbicide a viable option by reducing its cost per acre.

Three experiments were conducted at Lonoke and North Little Rock in central Arkansas from 1997 to 1999 to evaluate isoxaben at reduced rates in combination with full rates of annual bluegrass herbicides. Treatments were applied in early September and evaluated early the following spring. The weed species present were field madder (*Sherardia arvensis*), common chickweed (*Stellaria media*) and henbit (*Lamium amplexicaule*).

Isoxaben rates at the North Little Rock location included 0.25, 0.5, and 0.75 lb/ai/a. Isoxaben was tank mixed at these rates with pendimethalin, prodiamine, dithiopyr and oryzalin at 3.0, 0.75, 0.5 and 2.0 lb/ai/a, respectively. Simazine at 1.0 lb/ai/a alone and tank mixed with each grass herbicide was included as a standard. Isoxaben did not control field madder during either year. Oryzalin was the only treatment that provided effective control of field madder. Oryzalin averaged 94% control of field madder across five treatments in the spring of 1998. Tank mixing oryzalin with isoxaben or simazine did not improve control. In 1998, control with isoxaben averaged 42%. This may be due in part to heavy rainfall immediately before and after the application.

The Lonoke site received the same treatments as North Little Rock with the addition of isoxaben and simazine alone at 1.0 lb/ai/a 2.0 lb/ai/a and tank mixed with pendimethalin, prodiamine, dithiopyr and oryzalin at the rates listed above. All 20 treatments that included isoxaben provided 100% control of henbit. Eighteen of the 20 provided 100% control of common chickweed. The remaining two isoxaben treatments, isoxaben + pendimethalin (0.25 + 3.0 lb/ai/a) and isoxaben + dithiopry (0. 5 + 0.5 lb/ai/a) provided 90% control of common chickweed. Simazine alone provided no control of henbit and chickweed. Alone, or tank mixed with simazine, pendimethalin, prodiamine, dithiopyr and oryzalin gave 50 to 60% control of henbit and chickweed. The Lonoke study, applied on September 17, 1997, was rated for crabgrass control on May 27, 1998. The prodiamine, oryzalin, pendimethalin and dithiopyr treatments averaged 80, 51, 27 and 0 % control, respectively.

PREEMERGENCE CRABGRASS CONTROL WITH CONSUMER PRODUCTS. J.W. Boyd and B.N. Rodgers, University of Arkansas, Little Rock, AR 72203.

ABSTRACT

The active ingredients in consumer herbicides are a normal part of university trials, but the actual products are rarely evaluated. These products warrant investigation because the amount of active ingredient delivered by homeowner formulations is often significantly less than would normally be recommended for a commercial applicator.
Studies were conducted at Lonoke, North Little Rock and Fayetteville, Arkansas during 1998 and 1999 to evaluate various homeowner-targeted products for preemergence crabgrass control. The Fayetteville site was irrigated tall fescue. The Lonoke (irrigated) and North Little Rock (dryland) locations were common bermudagrass. The products evaluated were granular and applied with a 3 ft by 4-ft Scottsbox. Experimental design was a randomized block with four replications. Each site had a native stand of large crabgrass (*Digitaria sanguinalis*) and was supplemented by overseeding. Balan 2.5G, Crab Ex, Hi-Yield Crabgrass Control and Pendulum 2G did not contain nutrients. The other products used supplied approximately 1 lb of N per 1,000 sq ft.

Treatments common to both years of the study were Pendulum 2G (pendimethalin at 3.0 lb/ai/a), Scotts Turf Builder Plus Halts 28-3-4 (pendimethalin at 1.66 lb/ai/a), Fertilome Crabgrass 20-3-3 (benefin + trifluralin at 2.0 + 1.0 lb/ai/a), Hi-Yield Crabgrass Control (benefin + trifluralin at 2.0 + 1.0 lb/ai/a) and Blue Seal Safe 'n Simple (corn gluten at 871 lb/a). Crabgrass control averaged over years and locations at 110 to 120 days after treatment (DAT) for Fertilome, Pendulum, Turf Builder, Hi-Yield and Safe n' Simple was 87, 82, 82 63% and 0%, respectively.

Treatments unique to 1998 were Pennington 28-3-4 (prodiamine at 0.35 lb/ai/a), Howard Johnson 24-6-12 (prodiamine at 0.75 lb/ai/a), Fertilome Prevent 18-6-12 (isoxaben + benefin + trifluralin at 1.1 + 2.0 + 1.0 lb/ai/a), Vigoro Team 28-3-4 (benefin + trifluralin at 1.8 + 1.0 lb/ai/a), K-Grow Team (benefin + trifluralin at 1.8 + 1.0 lb/ai/a) and Balan 2.5G

(benefin at 3.0 lb/ai/a). Average crabgrass control (3 locations) in 1998 at 100 to 110 DAT was Fertilome Prevent 91%, Pennington 78%, Vigoro Team 71%, Howard Johnson 70%, K-Grow Team 41%, and Balan 37%.

Treatments unique to 1999 were RegalKade 32-3-12 (prodiamine at 0.75 lb/ai/a), Crab Ex 28-3-4 (dithiopyr at 0.16 and 0.19 lb/ai/a), Crab Ex 28-3-4 (dithiopyr at 0.19 lb/ai/a) and Crab Ex (dithiopyr at 0.3 lb/ai/a). Average crabgrass control (3 locations) in 1999 at 100 to 149 DAT was RegalKade 84%, Crab Ex 28-3-4 (0.19 lb ai/a) 50%, Crab Ex 28-3-4 (0.16 lb/ai/a) 27%, and Crab Ex (0.3 lb/ai/a) 56%.

In general, the most effective consumer products were Fertilome Crabgrass, Fertilome Prevent, Scotts Turfbuilder + Halts. These products were comparable to the commercial standards Pendulum 2G and RegalKade.

INFLUENCE OF BROWN PATCH (*RHIZOCTONIA SOLANI*) CONTROL ON PREEMERGENCE HERBICIDE EFFICACY IN TALL FESCUE. T.R. Murphy Crop and Soil Sciences Department, and L. Burpee, Plant Pathology Department, University of Georgia, Griffin, GA 30223-1797.

ABSTRACT

Brown patch (*Rhizoctonia solani*) is a major disease of tall fescue during the hot, humid summer months. Affected leaves develop dark brown lesions, wilt and eventually turn brown. Tall fescue growth and density is decreased in affected areas. Fungicides such as azoxystrobin are available for the control of brown patch in turfgrasses. Various preemergence herbicides are commonly used to control crabgrass (*Digitaria* spp.) in tall fescue. Previous research conducted in Georgia showed that pendimethalin provided better crabgrass control in common bermudagrass than in tall fescue. However, in tall fescue and common bermudagrass oxadiazon provided similar levels of crabgrass control.

A field experiment was conducted in 1999 in Griffin, GA to determine if the use of azoxystrobin (Heritage) improved the efficacy of selected preemergence herbicides in controlling smooth crabgrass (*Digitaria ischaemum*) in established 'Ky 31' tall fescue. Sequential (+) and single treatments of pendimethalin at 1.5 + 1.5 and 3.0, prodiamine at 0.65 + 0.5 and 1.15 and oxadiazon at 2.0 + 2.0 and 4.0 lbs. ai/acre were evaluated. Sequential treatments were applied February and April 14, 1999. Single treatments were applied on February 16, 1999. Azoxystrobin (Heritage 50 WDG) at 0.54 lbs. ai/acre was applied to one-half of the plots on May 26, June 30 and August 4, 1999. A randomized complete block design with 5 replications and a factorial treatment arrangement was utilized. Brown patch infestation, smooth crabgrass control and tall fescue quality were evaluated at various times during the summer months.

Azoxystrobin effectively reduced the infestation level of brown patch until late August. Additionally, azoxystrobin increased tall fescue quality at the late August evaluation for each herbicide and rate with the exception of prodiamine at 0.65 + 0.5 lbs. ai/acre. Azoxystrobin increased smooth crabgrass control at the late August evaluation 17 and 23% for pendimethalin 1.5 +1.5 and 3.0 lbs. ai/acre, respectively compared to pendimethalin at the same rates with no azoxystrobin. Prodiamine and oxadiazon at all rates, with or without azoxystrobin, provided equivalent levels of smooth crabgrass control. These data indicate that controlling brown patch in tall fescue will improve the control of smooth crabgrass in tall fescue with pendimethalin. However, no increase in smooth crabgrass control occurred when brown patch was controlled in tall fescue treated with either single or sequential applications of prodiamine and oxadiazon.

PREEMERGENCE CRABGRASS (*Digitaria sp.*) AND GOOSEGRASS (*Eleusine indica*) CONTROL IN BERMUDAGRASS. M.F. Gregg, J.K. Higingbottom, D.B. Lowe and L.B. McCarty. Department of Horticulture, Clemson University, Clemson S.C. 29634-0375.

ABSTRACT

Crabgrass and goosegrass are among the most common summer annual grass weeds in bermudagrass turf. These species thrive in compacted and/or closely mowed areas, such as golf course fairways and roughs. Field studies were conducted in March and September 1999 to evaluate herbicides for preemergence control of crabgrass and goosegrass in bermudagrass turf.

Preemergence crabgrass control was evaluated in a common bermudagrass golf course rough maintained at 3 inches in Pendleton, S.C. Plot size measured 5ft x 10ft and four replications were utilized. The preemergence goosegrass control study was conducted in a golf course driving range maintained at 0.75 inches in Anderson, S.C. Plot size for the goosegrass study measured 10ft x 20ft with three replications. Experimental design of each study was a randomized complete block. Data were subjected to ANOVA with means separated using LSD (p=0.05).

The crabgrass control study included 15 treatments and consisted of either one or two application(s) at 4 or 8 weeks after initial treatment (WAI). All treatments were initially applied to dormant turf on March 10, 1999. Treatments applied only once included Surflan 4 SL (oryzalin) at 3.0 lb ai/A, Barricade 65 WG (prodiamine) at 0.5 lb ai/A, Ronstar 2 G (oxadiazon) at 3.0 lb ai/A, Pendulum 60 DG (pendimethalin) at 3.0 lb ai/A and Dimension 1 EC (dithiopyr) at 0.5 lb ai/A. Treatments applied on March 10 and 4 WAI included Pennant Magnum 7.6 EC (metolachlor) at 1.5 lb ai/A, Pennant Magnum 7.6 EC at 2.0 lb ai/A, Pennant 8.0 EC (metolachlor) at 2.3 lb ai/A and Pennant 8.0 EC at 3.0 lb ai/A.

Treatments applied on March 10 and 8 WAI included Surflan 4 SL at 1.5 lb ai/A, initially Team Pro 0.9 G (benefin + trifluralin) at 2.0 lb ai/A followed by Surflan 4 SL at 1.5 lb ai/A (8 WAI), Team Pro 0.9 G at 2.0 lb ai/A, Barricade 65 WG at 0.38 lb ai/A, Pendulum 60 DG at 1.5 lb ai/A, and Dimension 1 EC at 0.38 lb ai/A. Treatments were applied with a CO_2 pressurized sprayer calibrated to deliver 30 gal/A.

The goosegrass control study included 12 treatments and consisted of either one application or an initial application followed by a sequential application at 8 WAI. All treatments were initially applied on March 30, 1999. Treatments applied only once included, Ronstar 2 G at 3.0 lb ai/A, Barricade 65 WG at 0.5 lb ai/A, Pendulum 60 at 3.0 lb ai/A, Surflan 4 SL at 3.0 lb ai/A, Dimension 1 EC at 0.5 lb ai/A, and Regal Star 1.2 G (oxadiazon + prodiamine) at 3.0 lb ai/A. Treatments applied on March 30 and 8 WAI included Ronstar at 1.5 lb ai/A, Barricade 65 WG at 0.38 lb ai/A, Pendulum 60 DG at 1.5 lb ai/A, Surflan 4 SL at 1.5 lb ai/A, Dimension 1 EC at 0.38 lb ai/A, and Regal Star at 1.5 lb ai/A. Treatments were applied with a CO_2 pressurized sprayer calibrated to deliver 20 gal/A.

Crabgrass control was rated July 9, 1999 and September 21, 1999; while goosegrass control was rated on July 14, 1999 and September 23, 1999. Weed control was visually rated on a 0-100%, scale with 0% = no control and 100% = complete control.

All treatments provided >80% crabgrass control on July 9. On September 23, most treatments provided >80%. Exceptions included, Barricade at 0.5 and 0.38 lb ai/A and Pennant at 2.3 lb ai/A which provided 74-75% control; whereas Ronstar at 3.0, Dimension at 0.5 and Pennant Magnum at 1.5 lbs ai/A provided 48-66% control at the time.

Ronstar at 3.0 lb ai/A and Regal Star at 3.0 and 1.5 lb ai/A provided best goosegrass control (92, 88, and 83%, respectively) on July 14 and September 23 (88, 90, and 77%, respectively). Ronstar at 1.5 lb ai/A provided 75% goosegrass control on July 14 and 62% on September 23. Pendulum at 3.0 lb ai/A provided 42% and 60% control on July 14 and September 23, respectively. All other treatments provided < 40 % goosegrass control at either rating date.

YELLOW NUTSEDGE (*CYPERUS ESCULENTUS*) AND PURPLE NUTSEDGE (*CYPERUS ROTUNDUS*) MANAGEMENT WITH GLYPHOSATE/MSMA COMBINATIONS. A. S. Culpepper, Department of Crop and Soil Sciences, University of Georgia, Tifton, GA 31793; A. C. York, Crop Science Department, North Carolina State University, Raleigh, NC 27695-7620; and Ted Webster, USDA, Tifton, GA 31793.

ABSTRACT

Nutsedge is one of the most troublesome and common weeds infesting cotton throughout the Southeast. With the rapid adoption of glyphosate-tolerant cotton, nutsedge can be controlled effectively early season by applying Roundup Ultra (glyphosate); however, multiple applications of Roundup are often needed. Although two applications of Roundup may be applied overtop of glyphosate-tolerant cotton prior to the fifth leaf, growers are often limited to a single over-the-top application of Roundup because of operation size and labor and time constraints. With only a single application of Roundup, nutsedge is usually only suppressed. Growers also have the option of using MSMA (Bueno 6) overtop of cotton for nutsedge control in several southeastern states. Due to the potential for cotton injury, MSMA at rates registered for over-the-top application to cotton only suppresses nutsedge. Since neither a single application of Roundup nor MSMA applied overtop of glyphosate-tolerant cotton adequately controls nutsedge, tank mixtures of Roundup and MSMA may be more effective than each herbicide applied alone. Field and greenhouse studies were conducted in Georgia and North Carolina to compare nutsedge control by Roundup plus MSMA mixtures to Roundup and MSMA applied alone.

Deltapine 458 BG/RR cotton was planted in fields historically infested by yellow nutsedge in 1999. Greenhouse studies consisted of planting both yellow and purple nutsedge in 6-inch diameter pots. Field and greenhouse treatments were arranged factorially and included five rates of Roundup (0, 0.25, 0.5, 0.75, and 1.0 lb ai/A) and four rates of MSMA (0, 0.5, 1.0, and 2.0 lb ai/A).

Roundup applied at 0.5, 0.75, and 1.0 lb/A controlled purple nutsedge 11 to 16% more effectively than yellow nutsedge. In contrast, MSMA controlled yellow nutsedge 12 to 13% greater than purple nutsedge. Adding MSMA at 0.5 lb/A with Roundup was of little benefit for controlling yellow or purple nutsedge. However, adding MSMA at 1.0 lb/A to Roundup increased yellow nutsedge control at least 9% when control by Roundup alone was less than 82%. Purple nutsedge was less responsive to the addition of MSMA at 1.0 lb/A to Roundup. Differing responses of yellow and purple nutsedge to MSMA in mixture with Roundup may be due to Roundup being more effective on purple nutsedge compared to yellow nutsedge, thereby reducing the potential benefit from the tank mix on purple nutsedge, and due to yellow nutsedge being more susceptible to MSMA than purple nutsedge. MSMA at 2.0 lb/A controlled yellow nutsedge 82 to 92%, and mixtures of Roundup plus MSMA were no more effective than MSMA applied alone. When purple nutsedge was controlled less than 82% by Roundup alone, adding MSMA at 2.0 lb/A increased control at least 12%.

Roundup applied alone did not injure cotton. MSMA injured cotton 5, 12, and 25% when applied at 0.5, 1.0, and 2.0 lb/A, respectively. Increasing the rate of Roundup in the Roundup plus MSMA tank mixtures increased cotton injury. For example, 0.75 to 1.0 lb/A of Roundup in mixture with MSMA injured cotton 8 to 15% more than MSMA applied alone at each rate.

Roundup plus MSMA mixtures tended to be more effective than either herbicide applied alone when nutsedge was controlled less than 82%. However, regardless of the tank mix, a mid- to late-postemergence directed application of MSMA or Roundup was necessary for adequate control in fields heavily infested with nutsedge. Additionally, greater cotton injury was noted with mixtures of Roundup plus MSMA compared with MSMA alone.

WEED MANAGEMENT DEMONSTRATIONS IN FLORIDA FORAGES. J.A. Tredaway, A.R. Blount, and G.E. MacDonald, University of Florida and North Florida Research and Education Center, Gainesville, FL 32611 and Marianna, FL 32446.

ABSTRACT

Forages are an integral part of Florida agriculture providing cash receipts of nearly $500 million per year. Grasslands occupy about 11.5 million acres in Florida, and are comprised of 5 million acres of grazed forest lands, 3 million acres of native range, and 3.5 million acres of planted pasture. Florida grasses provide approximately 95% of the nutritional needs for beef cattle, 60% for goats, 40% for horses, and 10 to 15% for dairy cattle. These forages provide grazing for about 1.2 million beef cattle. Few herbicides are labeled for use in forage crops and those labeled frequently have grazing and haying restrictions.

Demonstrations were conducted in the Florida panhandle, the North-central, and central areas of the state. These demonstrations were conducted to determine if any labeled herbicide may be used to effectively control problematic weeds in various forages. Herbicides were evaluated for Florida pusley (*Richardia scabra*)control in sorghum-sudangrass (*Sorghum bicolor*). Treatments included Remedy at 1,2, and 3 pt/A, Crossbow (2,4-D and triclopyr) at 1, 2, and 3 qt/A, 2,4-D at 1.5 qt/A, Banvel at 1 qt/A, and Weedmaster (2,4-D + dicamba) at 1.5 qt/A. The phytotoxic effects of Remedy and adjuvant combination was evaluated in bahiagrass (*Paspalum notatum*) for alyceclover (*Alysicarpus vaginalis*). Treatments included Remedy at 2 and 3 pt/A with Induce and Nu-Film (0.08 and 0.25%). An evaluation of herbicide treatments and timings for weed control is currently being conducted for wild radish (*Raphanus raphanistrum*) control in perennial peanut (*Arachis glabrata*). Timings for herbicide application include dormant, non-dormant, and POST-mowing. Herbicides labeled for use in peanut (*Arachis hypogaea*) were used including Basagran, Roundup, Select, Poast, Poast Plus, 2,4-D, Cadre, and Pursuit.

Observations for bahiagrass and sorghum-sudangrass suggest that Remedy at 3 pt/A was the best treatment for the control of Florida pusley and alyceclover. Initial observations on dormant periennial peanut suggest that Roundup, Cadre, Pursuit, and 2,4-D may provide wild radish control.

There is an on-going need for economical, weed control solutions in forages. These demonstrations provide information to specialists, county faculty, and growers for the compounds that are currently registered for use. They also provide valuable, real-world data when seeking new registration. At the present time, the current recommendation includes nutrient management and proper pH which will help reduce weed competition with the forage crop.

GRASS WEED CONTROL IN BERMUDAGRASS HAYFIELDS. D.B. Mask, J.D. Byrd, Jr., J.W. Barnett, Jr., Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Weedy grass species like dallisgrass (*Paspalum dilatatum*) and knotroot foxtail (*Setaria geniculata*) often occur, but are hard to control in hybrid and common bermudagrass hayfields. Two field experiments were conducted in Mississippi, in the summer of 1999 to evaluate control of these grasses. At one location, in Chickasaw county, dallisgrass infested 'Tifton 44' bermudagrass and at Leveck Animal Research Center at Mississippi State University, knotroot foxtail infested common bermudagrass. The herbicide treatments were Roundup at 8 or 16 fl oz/A, Touchdown at 6.4 or 12.8 fl oz/A, Finale at 21.8 or 43.5 fl oz/A, Plateau at 10 oz/A, Outrider at 1.33 oz/A, and Velpar at 32, 48, 72, or 96 fl oz/A. Kinetic surfactant at 0.25% (v/v) was used with all treatments except Roundup. Treatments were applied with a four-wheeler mounted CO_2 pressurized system calibrated to deliver 18 gallons per acre. By 28 and 37 days after treatment (DAT), Roundup at 16 oz/A, Touchdown at 12.8 fl oz/A, and all rates of Velpar gave good dallisgrass control. Roundup at 16 fl oz/A proved to be the most effective treatment with dallisgrass control at 80% and bermudagrass injury around 20%. Velpar treatments gave the highest percentage control, but bermudagrass injury was excessive at 80%. Finale at 21.8 fl oz/A, Plateau at 10 oz/A, and Outrider at 1.33 oz/A were the least effective for dallisgrass control but also showed the least bermudagrass injury. Knotroot foxtail control was very good with Roundup at 16 fl oz/A or Touchdown at 12.8 fl oz/A. These two treatments provided 80% control, respectively, with only 25% bermudagrass injury, which would be acceptable in most cases. Finale at 43.5 fl oz/A controlled dallisgrass 68% but caused 60% bermudagrass injury, which would not be an acceptable control strategy. Other treatments, such as Finale at 21.8 fl oz/A, Plateau at 10 oz/A, and Roundup at 8 fl oz/A were ineffective on knotroot foxtail as they provided only 17% or less suppression.

EFFECTIVENESS OF FLUROXYPYR AND PICLORAM FOR CONTROLLING MARSH-ELDER (*IVA ANNUA*), WESTERN RAGWEED *(AMBROSIA PSILOSTACHYA*), AND WOOLY CROTON (*CROTON CAPITATUS*). P.A. Baumann and J.W. Smith III, Texas Agricultural Extension Service, Texas A&M University, College Station, TX 77843.

ABSTRACT

Several herbicides were evaluated in 1999 to test their effectiveness on three common Texas pastureland weeds. Studies were initiated in Red River, Erath, and Brazos counties to examine control of marsh-elder, western ragweed and wooly croton, respectively. The herbicides chosen for this study were fluroxypyr (0.125, 0.188, 0.25 and 0.5 lb ae/A), fluroxypyr + picloram (1:1 ratio) (0.16, 0.25 and 0.4 lb ae/A), picloram + 2,4-D (Grazon P+D) (0.48 and 0.63 lb ae/A), picloram (Tordon 22K)(0.125 and 0.25 lb ae/A), dicamba + 2,4-D (Weedmaster) (0.73 lb ae/A), and 2,4-D (1.0 lb ae/A). All of the treatments were applied POST at each location. Forage tolerance was not evaluated at the Red River or Brazos County sites, due to the absence of uniform and adequate forage stands, caused by heavy weed pressures. Silver bluestem (*Bothriochloa laguroides*) was the predominant forage at the Erath County site, and exhibited excellent tolerance to all of the herbicides evaluated.

Western ragweed was the most sensitive of the weed species studied. All of the herbicides applied POST to 3-5 inch tall western ragweed provided in excess of 95% control at all rates examined, when evaluated up to 119 DAT. When the same treatments were applied to 3-6 inch tall wooly croton, rate responses were evident with all of the herbicides. When evaluated 46 DAT, fluroxypyr provided 78,86, 98, and 100% wooly croton control from the four rates applied, respectively. To achieve 90% Wooly croton control or better, 0.25 lb ae/A of fluroxypyr + picloram, 0.95 lb ae/A of Picloram + 2,4-D, or 1.0 lb ae/A of 2,4-D was required. All other treatments were less effective. Marsh-elder control was herbicide-dependent. Only the highest rate of fluroxypyr (0.5 lb ae/A) gave greater than 90% control. Fluroxypyr + picloram at 0.25 and 0.40 lb ae/A resulted in 89 and 97% control, respectively, 110 DAT. Picloram + 2,4-D controlled 95% of the marsh-elder at 0.63 lb ae/A, and Picloram at 0.125 lb ae/A provided 91% control. The 2,4-D ester treatment was the only other treatment that provided greater than 90% late season control of marsh-elder.

EVALUATING GRAZING MANAGEMENT SYSTEMS TO CONTROL GIANT SMUTGRASS (*Sporobolus indicus var. pyramidalis*). J.J. Mullahey, Southwest Florida Research and Education Center, Immokalee, FL 34142.

ABSTRACT

Smutgrass (*Sporobolus indicus* var. indicus) is an invasive non-native plant that has become a serious weed problem in pastures throughout Florida and the southeastern United States (Mislevy et al. 1980). In bahiagrass pastures, smutgrass shades the bahiagrass, resulting in lower forage production and forage quality. Mowing (7.6 cm stubble height, 4 frequencies) did not eradicate smutgrass but did reduce the basal diameter of the plants (McCaleb et al. 1966). Cultivation of pastures heavily infested with smutgrass did not control all the smutgrass plants, and new plants grew from seed in the soil. Applying 3.3 kg/ha of dalapon and fertilizing 5 weeks (and each year thereafter) after the dalapon treatment resulted in 80+% control of smutgrass for a 5-yr period (Mislevy and Currey, 1980).
Heavy (0.5 metric tons residual DM/ha after each grazing period) grazing pressure has been successful in controlling smutgrass (Valle, 1977), though smutgrass can be unpalatable when growing on mineral soils of Florida and Georgia. Andrade (1979) reported a 73.8% reduction in smutgrass ground cover during the first year of grazing and concluded that grazing pressure is an effective tool to control smutgrass. Information is lacking on the use of grazing, in combination with herbicides, for controlling giant smutgrass. This study was conducted to evaluate the effect of two grazing systems (continuous and rotational) and the application of Velpar on the control of giant smutgrass and the recovery of bahiagrass.

A rotational and continuous grazing system was evaluated using two twenty-acre paddocks in 1999. Each treatment was replicated twice; the continuous paddocks were divided into two 10-acre paddocks, and the rotational paddocks were divided into eight 2.5-acre plots. Forty Brangus-type bred cows grazed at a stocking rate of 1 cow/acre for each grazing system. Paddocks were mowed in January, fertilized in February, and grazing started in early March 1999 and continued until early August. Field variables recorded included grass (smutgrass, bahiagrass) ground cover, smutgrass seedhead production, forage quality, and animal performance (body condition score). Herbicide trial (1998-99) was a randomized complete block design with four replications evaluating four rates (0, 0.5, 1.0, and 1.5 lb a.i./a) of Velpar herbicide applied at 30 gallons/a on July 28, 1998, and 1999. Smutgrass control was recorded in addition to bahiagrass ground cover.

During the grazing period, smutgrass ground cover increased for the continuous (18-22%) treatment and decreased slightly for the rotational grazing treatment (14-11%). Bahiagrass ground cover increased with rotational grazing (83-88%) and remained constant with continuous grazing (77-75%). Forage quality (crude protein, energy) of the smutgrass and bahiagrass tended to be higher from the rotational grazed paddocks. Within each grazing system, the forage quality of the smutgrass was slightly higher than the bahiagrass. For both grazing treatments, cow body condition score increased (5 to 6) during the study period. This weight increase represents about 75-100 lb of gain, and the animals were in good condition for calving and rebreeding in the fall and winter months.

Successful control (>90%) l with Velpar herbicide occurred when applying 1.0 lb ai/a. Extent of bahiagrass recovery after application was dependent upon the initial bahiagrass ground cover when the Velpar was applied. In 1998, initial bahiagrass ground cover was 25-30% and the bahiagrass ground cover approached 56-94% at 3 months after treatment (MAT). In 1999, initial ground cover was only 7-15% and bahiagrass ground cover was only 16-38% at 3 MAT. Therefore, to have adequate amounts of bahiagrass for grazing, pastures that are densely (70% or greater) populated with smutgrass should be mowed or grazed prior to treating with Velpar.

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POTENTIAL USE OF DIFLUFENZOPYR IN COMBINATION WITH DICAMBA FOR WEED CONTROL IN PASTURES. M.C. Boyles, BASF Corp. Ripley, Ok., and K.L. Smith, University of Arkansas, Monticello.

ABSTRACT

Studies were conducted in Texas and Oklahoma in 1997, 1998, and 1999 to evaluate Diflufenzopyr applied alone and in combination with Dicamba for the control of key difficult to control weed species in pasture. No pasture injury was noted from any rate of Diflufenzopyr applied alone (0.01, 0.05, 0.075, 0.1 lbs ai) or in combination with 0.125 and 0.25 lbs ai of Dicamba on bermudagrass, little and big bluestem, and bahiagrass.

Results showed that Diflufenzopyr applied alone at 0.01, 0.05, 0.075, and 0.1 lbs ai did not provide acceptable weed efficacy on any species tested. Dicamba applied alone at 0.125 lbs ai also did not provide acceptable efficacy on any species. Dicamba applied alone at 0.25 lbs ai provided acceptable (>80%) efficacy on only spotted beebalm and camphorweed.

Diflufenzopyr applied at 0.05 and 0.075 lbs ai in combination with Dicamba (0.125, 0.25 lbs ai) provided increased (synergy/ Colby' formula) weed efficacy on all species tested compared to equal rates of Dicamba applied alone. Diflufenzopyr in combination with Dicamba provided synergy on yellow thistle, spotted beebalm, bullnettle, camphorweed, groundcherry, woolly croton, dogfennel, and sericea lespedeza. Research studies showed that the most efficacious and synergistic rate of Diflufenzopyr in combination with Dicamba was 0.05 to 0.075 lbs ai. Combinations of Diflufenzopyr and Dicamba also provided commercial control of annual broomweed, western ragweed and sericea lespedeza. Diflufenzopyr plus Dicamba (0.013 + .03 lb ai) applied alone provided equal or better efficacy on annual broomweed and western ragweed than Weedmaster (0.5 lbs ai), Rave (4 oz product per acre), Clarity plus Ally (0.125 lbs ai + 2/10 oz product per acre), or Ally (2/10 oz product per acre). Results also showed that Diflufenzopyr plus Dicamba (0.013 + 0.03 lbs ai) applied alone provided equal or better efficacy on sericea lespedeza than Weedmaster (0.5 lbs ai) or Rave (4 oz product per acre). Diflufenzopyr plus Dicamba (0.013 + 0.03 lbs ai) plus Ally (2/10 oz product per acre) provided equal or better efficacy on sericea lespedeza than that provided by Rave (4 oz product per acre), Weedmaster (0.5 lbs ai), or Clarity plus Ally at 0.125 lbs ai plus 2/10 oz product per acre. Diflufenzopyr plus Dicamba (0.05 + 0.125 lbs ai) applied alone provided excellent (>90%) efficacy on sericea lespedeza. Weedmaster, Ally, and Rave applied alone did provide acceptable efficacy on annual broomweed and western ragweed, but efficacy was unacceptable on sericea lespedeza.

PALMER AMARANTH (*Amaranthus palmeri*) RESISTANCE IN SOUTH CAROLINA TO THE ALS-INHIBITING HERBICIDES. B.J. Gossett, J.E. Toler, and H.D. Hunnicutt, Clemson University, Clemson, SC 29634-0359.

ABSTRACT

Acetolactate synthase (ALS)-resistant Palmer amaranth was recently confirmed at three locations in Clarendon County and sulfonylurea-resistant Palmer amaranth was suspected in Dillon County, South Carolina. All locations in Clarendon County had received either imazaquin or imazethapyr for weed control in soybeans each year for the previous five or six years and the Dillon location had received chlorimuron for weed control in soybeans for the previous four or five years. Field experiments were conducted in 1999 to measure the level of resistance at each location, the response of these biotypes to herbicides with various modes of action, and to measure the herbicide resistance patterns of the F_1 progeny of ALS-resistant x dinitroaniline-resistant Palmer amaranth. As shown by control ratings and fresh weight data, Palmer amaranth biotypes from Clarendon and Dillon counties were not controlled by imazaquin, imazethapyr, imazameth, pyrithiobac, nicosulfuron, primisulfuron, chlorimuron, thifensulfuron, flumetsulam and halosulfuron when applied up to four-times of their recommended rate. However, a susceptible biotype was controlled by each herbicide at the recommended rate. Resistance was limited only to the ALS-inhibiting herbicides, since herbicides with other

Successful control (>90%) l with Velpar herbicide occurred when applying 1.0 lb ai/a. Extent of bahiagrass recovery after application was dependent upon the initial bahiagrass ground cover when the Velpar was applied. In 1998, initial bahiagrass ground cover was 25-30% and the bahiagrass ground cover approached 56-94% at 3 months after treatment (MAT). In 1999, initial ground cover was only 7-15% and bahiagrass ground cover was only 16-38% at 3 MAT. Therefore, to have adequate amounts of bahiagrass for grazing, pastures that are densely (70% or greater) populated with smutgrass should be mowed or grazed prior to treating with Velpar.

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POTENTIAL USE OF DIFLUFENZOPYR IN COMBINATION WITH DICAMBA FOR WEED CONTROL IN PASTURES. M.C. Boyles, BASF Corp. Ripley, Ok., and K.L. Smith, University of Arkansas, Monticello.

ABSTRACT

Studies were conducted in Texas and Oklahoma in 1997, 1998, and 1999 to evaluate Diflufenzopyr applied alone and in combination with Dicamba for the control of key difficult to control weed species in pasture. No pasture injury was noted from any rate of Diflufenzopyr applied alone (0.01, 0.05, 0.075, 0.1 lbs ai) or in combination with 0.125 and 0.25 lbs ai of Dicamba on bermudagrass, little and big bluestem, and bahiagrass.

Results showed that Diflufenzopyr applied alone at 0.01, 0.05, 0.075, and 0.1 lbs ai did not provide acceptable weed efficacy on any species tested. Dicamba applied alone at 0.125 lbs ai also did not provide acceptable efficacy on any species. Dicamba applied alone at 0.25 lbs ai provided acceptable (>80%) efficacy on only spotted beebalm and camphorweed.

Diflufenzopyr applied at 0.05 and 0.075 lbs ai in combination with Dicamba (0.125, 0.25 lbs ai) provided increased (synergy/ Colby' formula) weed efficacy on all species tested compared to equal rates of Dicamba applied alone. Diflufenzopyr in combination with Dicamba provided synergy on yellow thistle, spotted beebalm, bullnettle, camphorweed, groundcherry, woolly croton, dogfennel, and sericea lespedeza. Research studies showed that the most efficacious and synergistic rate of Diflufenzopyr in combination with Dicamba was 0.05 to 0.075 lbs ai. Combinations of Diflufenzopyr and Dicamba also provided commercial control of annual broomweed, western ragweed and sericea lespedeza. Diflufenzopyr plus Dicamba (0.013 + .03 lb ai) applied alone provided equal or better efficacy on annual broomweed and western ragweed than Weedmaster (0.5 lbs ai), Rave (4 oz product per acre), Clarity plus Ally (0.125 lbs ai + 2/10 oz product per acre), or Ally (2/10 oz product per acre). Results also showed that Diflufenzopyr plus Dicamba (0.013 + 0.03 lbs ai) applied alone provided equal or better efficacy on sericea lespedeza than Weedmaster (0.5 lbs ai) or Rave (4 oz product per acre). Diflufenzopyr plus Dicamba (0.013 + 0.03 lbs ai) plus Ally (2/10 oz product per acre) provided equal or better efficacy on sericea lespedeza than that provided by Rave (4 oz product per acre), Weedmaster (0.5 lbs ai), or Clarity plus Ally at 0.125 lbs ai plus 2/10 oz product per acre. Diflufenzopyr plus Dicamba (0.05 + 0.125 lbs ai) applied alone provided excellent (>90%) efficacy on sericea lespedeza. Weedmaster, Ally, and Rave applied alone did provide acceptable efficacy on annual broomweed and western ragweed, but efficacy was unacceptable on sericea lespedeza.

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ABSTRACT

Acetolactate synthase (ALS)-resistant Palmer amaranth was recently confirmed at three locations in Clarendon County and sulfonylurea-resistant Palmer amaranth was suspected in Dillon County, South Carolina. All locations in Clarendon County had received either imazaquin or imazethapyr for weed control in soybeans each year for the previous five or six years and the Dillon location had received chlorimuron for weed control in soybeans for the previous four or five years. Field experiments were conducted in 1999 to measure the level of resistance at each location, the response of these biotypes to herbicides with various modes of action, and to measure the herbicide resistance patterns of the F_1 progeny of ALS-resistant x dinitroaniline-resistant Palmer amaranth. As shown by control ratings and fresh weight data, Palmer amaranth biotypes from Clarendon and Dillon counties were not controlled by imazaquin, imazethapyr, imazameth, pyrithiobac, nicosulfuron, primisulfuron, chlorimuron, thifensulfuron, flumetsulam and halosulfuron when applied up to four-times of their recommended rate. However, a susceptible biotype was controlled by each herbicide at the recommended rate. Resistance was limited only to the ALS-inhibiting herbicides, since herbicides with other

modes of action gave similar control of the resistant and susceptible biotypes. The F_1 progeny of ALS-resistant x dinitroaniline-resistant Palmer amaranth exhibited resistance to the ALS-inhibiting herbicides imazaquin, pyrithiobac, and chlorimuron, which demonstrates that the ALS-resistant trait is transmitted by pollen as well as by seed. No dinitroaniline-resistance was observed which indicates that this is a recessive trait that might appear in later generations. No resistance was observed to various herbicides with modes of action that differ from the ALS-inhibiting and dinitroaniline herbicides.

VEGETABLE WEED MANAGEMENT USING ALTERNATIVES TO METHYL BROMIDE. T.M. Webster, W.C. Johnson, III, C.C. Dowler, A.S. Csinos, A.W. Johnson, and D.R. Sumner. USDA-ARS and University of Georgia, Coastal Plain Experiment Station, Tifton, GA 31793-0748.

ABSTRACT

Around the world, approximately 67% of annual methyl bromide consumption is used for preplant soil fumigation. Methyl bromide use has been restricted and will cease by the year 2005, though current prices (which will continue to increase) are forcing many growers to find alternatives much sooner. Plasticulture systems have had success in suppressing many weeds, however the nutsedges (both yellow and purple) will readily pierce the plastic film barrier and compete with crops. An alternative to methyl bromide must address multiple pests. Multi-disciplinary field studies were conducted in 1998 and 1999 in Tifton, GA to evaluate various fumigant treatments on control of soil borne and foliar diseases, nematodes, and weeds. Two studies were conducted; the first was a three-crop rotation (all three crops grown in the same growing season) of squash-cucumber-squash grown in a plasticulture system with drip-tape irrigation. The second study was two crop per season rotation of bell pepper-squash. Treatments to the first crop in the sequence of both rotations included methyl bromide (400 lbs/A), chisel injected application of 1,3-dichloropropene (1,3-D) (19 gal/A), drip tape application of 1,3-D (19 gal/A), and a nontreated control. The squash-cucumber-squash test also included a combination of 1,3-D (12 gal/A) + chloropicrin (6.6 gal/A) + metham sodium (50 gal/A) in 1999. The pepper-squash test had a drip tape application of methyl iodide (400 lbs/A). The second and third crops received applications through the drip tape of metham sodium, 1,3-D, or were nontreated. In the initial crop, purple nutsedge populations were 74 to 100% lower in the methyl bromide treated plots relative to the nontreated control. The combination of 1,3-D + chloropicrin + metham sodium and the methyl iodide treatments suppressed purple nutsedge growth early in the season 76 and 91%, respectively. However, both treatments had nutsedge levels similar to the nontreated control by the end of the season. Chisel-injected 1,3-D reduced purple nutsedge levels greater than 90% in 1998 in the first crop of both the squash and pepper rotations. However, the level of weed control in 1999 from this treatment was not different than the nontreated control. While they are some options that will provide purple nutsedge suppression, the search for a methyl bromide alternative for nutsedge control continues.

EVALUATION OF ALTERNATIVES TO METHYL BROMIDE SOIL FUMIGANT FOR CONTROL OF YELLOW NUTSEDGE IN PLASTI-CULTURE TOMATO PRODUCTION. D.K. Robinson , R.A. Straw and C.A. Mullins. University of Tennessee, Knoxville, TN 37901-1071.

ABSTRACT

Pre-plant soil fumigation is an important component in plasticulture production of tomato and other vegetable and fruit crops. In 1998 Tennessee vegetable growers produced approximately 3,500 acres of tomato. Tomato production in the plasticulture system requires high input cost. Pre-plant soil fumigation is an important part of insuring return fromthis investment. Growers prefer the standard treatment of methyl bromide in combination with chloropicrin. However, methyl bromide for this and other uses is now being phased out. As a result, growers are seeking viable alternatives. A viable alternative needs to provide control of yellow nutsedge in addition to control of soil borne insects, diseases and nematodes. Proposed alternatives include metam, dazomet or 1,3-D + chloropicrin (alone or combined with metam or pebulate).

Objectives of this study were to evaluate tomato and yellow nutsedge response to these alternative treatments and to evaluate combinations of either halosulfuron or rimsulfuron with 1,3-D + chloropicrin. Treatments included metam (50 gallons/ acre), dazomet (400 lbs./ acre) or 1,3-D (61%) plus chloropicrin (35%) applied alone. Combination treatments included 1,3-D + chloropicrin with either metam, dazomet or either of the herbicides pebulate (3 lb/ acre), halosulfuron (0.024 lb/ acre) or rimsulfuron (0.024 lb/ acre). Treatments were compared to the standard treatment of methyl bromide/ chloropicrin (67/33%) (400 lb/ acre) and an untreated control. Metam, dazomet, pebulate, halosulfuron or rimsulfuron were applied to the soil surface and incorporated (in pre-moistened soil) prior to plant bed shaping and covering with black plastic mulch. Methyl bromide + chloropicrin or 1,3-D +chloropicrin were injected into prepared plant beds immediately prior to covering with the plastic row cover. Plastic row cover was cut between replications to prevent interplot gas movement. Transplanting was delayed for 21 days after application to allow fumigation and gas dissipation from fumigated plots.

Tomato growth and yield were not adversely affected by either metam, dazomet or 1,3-D + chloroprin applied alone or in combinations. Combination of 1,3-D + chloropicrin with either of the herbicides pebulate, rimsulfuron or halosulfuron did not adversely affect tomato growth or yield. These initial results thus indicate excellent tomato tolerance to these

herbicides applied under the plastic row cover in combination with 1,3-D + chloropicrin. In terms of yellow nutsedge, response no conclusions could be drawn as plants failed to consistently emerge through the plastic. This initial research indicates commercial tomato tolerance to either of the herbicides rimsulfuron or halosulfuron applied in combination with 1,3-D + chloropicrin in the plastic culture system. In this study, halosulfuron and rimsulfuron were applied and incorporated prior to bed preparation. In 2000, focus will be placed on evaluating these herbicides applied as a banded application to the prepared bed prior to covering with plastic.

CONTROL OF YELLOW NUTSEDGE IN WATERMELON IN A METHYL BROMIDE ALTERNATIVE SITUATION. W.M. Stall and R.C. Hochmuth. University of Florida, Gainesville, Fla. 32611 and North Florida Research and Education Center - Suwannee Valley, Live Oak, Fla. 32060.

ABSTRACT

Watermelon (Citrullus lanatus) production in Florida exceeds 32,000 acres annually with a worth of over $60 million. A large percent of the acreage is grown using polyethylene mulch and methyl bromide fumigation. Fifty percent of the methyl bromide use will be lost in 2001 with total use loss in 2005. Alternative measures must be obtained to control the pest complexes found in Florida watermelon production areas. A labeled alternative fumigant is 1-3,D plus chloropicrin (Telone C-35). This material has not been shown to control weed complexes, especially nutsedges. Another problem is that when it is injected and polyethylene mulch applied immediately, all labor in the field must wear protective clothing and masks. Reentry is 5 days, and if mulch is applied after that time, no protective clothing is needed. Halosulfuron is a herbicide that is obtaining a tolerance on cucurbits through the IR-4 program. It is very good in controlling nutsedges. Application timing, however, is critical. A 3x5 factorial experiment was carried out in the spring of 1998 and1999 to test the application methods of 1-3,D + chloropicrin and methyl bromide with application placements and timings of halosulfuron. Fumigant treatments were: 1.) Telone C-35 applied broadcast, after 5 days beds formed, herbicide and fertilizer applied and mulch applied, 2.) Telone C-35 injected into a bed with fertilizer and herbicide already applied and mulch applied immediately. 3.) Methyl bromide injected into the bed after fertilizer and herbicide applied as a check. Application rates of Telone C-35 were 25 GPA at both application placements in 1998, and 18 GPA broadcast and 36 GPA injected in-bed in 1999. Methyl bromide-cloropicrin (67-33) was applied at 400 lbs/A both years. Within each fumigant method, halosulfuron was applied at 0.024 lb a.i. as: 1.) no application or Check, 2.) to the soil surface before mulch was applied (Pre, Under mulch), 3.) Over the top of mulch and nutsedges that have emerged, but before the watermelons were transplanted (Pretransplant), 4.) Postemergence over the top of watermelon and nutsedges, (POST), and 5.) a combination of Pre UM, and POST timings. There were interactions by year, so each year was evaluated separately. In 1998, the 2 POST halosulfuron treatments were applied less than 2 weeks after transplanting. Phytotoxicity and vigor loss was seen in the watermelon plants in these two treatments. Early yield loss resulted, but there was no differences in total yield. Yellow nutsedge (Cyperus esculentus) control was excellent in the methyl bromide treatments and in all POST halosulfuron treatments. In 1999, the nutsedge control was excellent in the methyl bromide treatments and all Telone in-bed treatments except the check. Nutsedge control in the POST halosulfuron treatments was excellent in all fumigant treatments. The POST applications were made 4 weeks after transplanting and no phytotoxicity nor vigor loss was observed. Phytotoxicity and vigor loss was seen in the pretransplant treatments. Due to a planning error, the melon plants were transplanted 1 day after application. The transplants picked up the herbicide, presumably from the mulch. Early and total yield was significantly affected in those treatments. Early yield was significantly affected both years by fumigant treatment. Early yield from the in-bed Telone treatments and the methyl bromide treatments were significantly higher than the broadcast Telone application treatments. There were no significant differences in total yield due to fumigant treatment in 1998, but the Telone broadcast treatments were significantly lower than the other two fumigant treatments for total yield in 1999. The differences was probably due to the differences in nutsedge control.

EFFECTS OF WEED DENSITY AND DISTANCE ON WATERMELON GROWTH AND DEVELOPMENT. M. Biernacki, W. Roberts, J. Shrefler, J, Duthie, J. Edelson and M. Taylor. Lane Agricultural Center, Oklahoma State University - Wes Watkins Agric. Res. and Ext. Center, Lane, OK 74555-0128.

ABSTRACT

An extensive field survey over two growing seasons identified over 40 weed species associated with watermelon crops in Oklahoma. Tumble and redroot pigweed (*Amaranthus albus* and *Amaranthus retroflexus,* Amaranthaceae) were the most likely to be found on watermelon fields as compare to other identified weed species. Fully controlled factorial study was design to investigate effects of pigweed density and distances on watermelon growth, development, and reproduction. Tumble or redroot pigweed were grown from seed at densities ranging from 0 to 32 plants and at distance ranging from 10 cm to 80 cm from watermelon (*Citrullus lanatus*, cultivar "Sugar Baby"). Control watermelon treatment was without any weeds within 2.4 m zone. Study was replicated twice over growing seasons, with four replicate blocks per study and four treatment replicates per block. Information on watermelon performance was collected in weekly intervals over period of 14 weeks. Data was analyzed using regression and analyses of covariance. Data was transformed prior to analyses to fulfill assumptions of analytical procedures. After 2 weeks pigweed had highly significant effects on a survivorship of watermelon seedlings decreasing it up to 60% of control in treatment with greatest pigweed density and grown at distance of 10 cm from watermelon. Surprisingly, after two weeks, two greatest pigweed density

treatments (16 and 32 pigweed plant treatments) grown at 40 cm and 80 cm from watermelon did significantly increased survivorship of watermelon seedlings as compare to control with no weeds. Increased seedling survivorship was probably due to fact that weeds provided wind protection and /or shaded soil around seedlings increasing moisture content. However, after 9 weeks of treatment all weed treatments significantly decreased watermelon survivorship up to 25% survivorship of control plants in high weed density treatments and grown at short distance. Dry biomass of watermelon plants also decreased significantly after 9 weeks of exposure and was only around 8% of control in highest weed density and shortest distance treatments. Results for other treatments were intermediate. Lower dry mass of watermelon plants translated into decreased biomass of reproductive organs. Non watermelon plant surrounded by pigweed at shorter distance than 60 cm produced marketable fruit. Biomass allocated to reproductive organs in high density pigweed treatments and grown at 10 cm was below 10% of control plants. Watermelon surrounded by pigweed at lower densities and at greater distances produced some fruits but fruit biomass was lower than in control plants. Leaf surface area per unit mass in control watermelons was found to be around 130 cm^2/g of leaf dry mass. Watermelons grown in pigweed treatments had increased leaf surface area per unit of mass with values up to 230% greater than control. This indicates severity of stress experienced by watermelon and explains shift in relative biomass allocation from reproductive organs to vegetative tissues including leaf, shoot and root tissues. Mean Leaf Area Index (LAI) in control watermelon was around 1.8. The LAI represents leaf surface area of plant per unit of soil surface occupied by plant. It is a measure of plant ability to utilize available photosynthetically active radiation. Watermelon in all pigweed treatments had decreased LAI with values as low as 0.4. Decrease in watermelon LAI was proportional to an increase in weed density and with decrease in distance between watermelon and pigweed. Plants with LAI lower than 1.0 experienced decreased biomass allocation to reproductive tissues ranging from 3% to 45% of control treatment. Life-span of a leaf in first cohort (born in first week of plant growth) ranged from more than 80 days in control treatment to 16 days in highest weed density and shortest distance treatments. Watermelon plants in other treatments had intermediate leaf life-spans. Generally, life-span of leaves increased with decreased weed density and increased distance of weeds from watermelon. Number of female flowers produced by control watermelons was around 7. Watermelons exposed to pigweed had much lower numbers of pistillate flowers ranging from 1 to 6 per plant, with lowest numbers at greatest weed densities and at shortest weed distance treatments. Watermelons in all weed treatments had increased male to female flower ratio in range from 14 to 24 staminate flowers per each pistillate flower. Competition of watermelon with pigweed resulted in relative decreased of biomass allocation to female reproductive organs. Allocation to male reproductive organs changed little. Root surface area decreased from over 3500 cm^2 in control watermelon to less than 60 cm^2 in plants exposed to greatest weed densities and grown at shortest distance from weeds. Roots of watermelon seem to be more responsive to stress than aboveground plant organs. Other factors like plant diseases, insect pests and cultivation technology (transplanting or seeding) may also affect outcome of watermelon and pigweed competition.

INTERACTIONS OF OXAMYL WITH HALOSULFURON IN TOMATO. R.S. Buker III, W.M. Stall, B. Rathinasabapathi, G. MacDonald, and S.M. Olson, University of Florida, Horticultural Sciences Department, Gainesville, Fl. and North Florida Research and Education Center, Quincy, Fl.

ABSTRACT

Fresh market tomato's represent the most profitable vegetable crop in the state of Florida. In the 1997-1998 growing season sales of tomato's generated over $473,000,000. Production of tomato's in Florida is directly tied to methyl bromide. With the phase out of methyl bromide, other options will be needed for the control of nematodes, soil borne diseases and weeds. One potential option for the control of nematodes and weeds in tomato's is oxamyl and halosulfuron, respectively. Past research has shown that the use of carbamates and organophosphates can interfere with crop tolerance to herbicides. Greenhouse trials were initiated in the fall of 1999 to determine if there are any negative interactions between the use of oxamyl, halosulfuron and tomato variety.

Tomato plants were established in 20cm pots containing Metro Mix 200. Pots were arranged in a randomized complete block design with four replications per treatment. Treatments were oxamyl applied at 0, 0.55, and 1.13 kg/ha, and halosulfuron applied at 0 and 0.045kg/ha. These treatments were applied to each of the following varieties 'Fla 47', 'Fla 91', 'Equinox','Captiva', 'BHN 444', 'Mountain Spring', 'Carolina Gold', 'Cherry grande', and 'Celebrity'. Plants were treated with oxamyl 12 and 3 days before herbicide treatment. All applications were made with a CO_2 powered backpack sprayer equipped with LF4 110 nozzles. The sprayer was calibrated to deliver 468 and 280 l/ha for the oxamyl and halosulfuron treatments respectively. Shoots were harvested 20 days after the herbicide treatment was applied. This experiment was repeated twice over time.

ANOVA was used to detect significant interactions and differences among treatment means. The results from ANOVA indicated that there were no interaction between the experiments over time, so the data was combined. Data was further analyzed to determine if the variety affected the tolerance to halosulfuron. Control plants, those not treated with halosulfuron or oxamyl, were pooled with plants treated only with halosulfuron and analyzed. Halosulfuron tolerance was not affected by tomato variety. All data was then pooled and analyzed for interactions between oxamyl and halosulfuron. There was no significant interaction between the variety, oxamyl, and halosulfuron. Furthermore there was no interaction between oxamyl and halosulfuron. The data indicates that oxamyl does not interfere with tomato's tolerance to halosulfuron, and further field studies are warranted to determine if the use of both are compatible to in production systems.

WEED CONTROL IN SWEET POTATOES WITH DIMETHENAMID. W.C. Porter. Burden Research Plantation, Louisiana Agricultural Experiment Station, Baton Rouge, LA 70809.

ABSTRACT

Dimethenamid is an effective herbicide for controlling annual grasses and broadleaf weeds with some activity on sedges in soybeans and corn. Beginning in 1993, dimethenamid was screened for use in sweet potato production and was found to control annual grasses, broadleaves, and rice flatsedge.

In 1999, two studies were initiated to determine the response of sweet potatoes to method of application (MOA) and rates of dimethenamid. An active isomer (BAS 656 07)of dimethenamid was also evaluated.
Both herbicides were applied at 2 rates either preplant incorporated (PPI) or posttransplant (PT). They were also applied as a PPI - PT or PT - PT split application. Sweet potatoes were transplanted and treated at Baton Rouge on June 22 and at Chase on July 2. Irrigation was applied within 24 hours. Split applications were made on July 23 and July 26 respectively. Plots were harvested on October 9 at Baton Rouge and October 19 at Chase.

At Baton Rouge, crop vigor was lower in plots treated with BAS 656 07 at 0.98 lb/A PT and all rates of dimethenamid and BAS 656 07 applied PPI. At Chase, no PT application of either herbicide reduced crop vigor. Dimethenamid, 1.5 lb/A PPI and BAS 656 07 PPI reduced crop vigor.

At Baton Rouge, barnyardgrass control was fair (72% to 83%) with dimethenamid applied PT. Control with BAS 656 07 applied PT was erratic and poor. Barnyardgrass control by BAS 656 07 applied PPI was also poor. Goosegrass control with dimethenamid applied PT was poor to good and tended to be lower when PPI. Control of goosegrass with BAS 656 07 was generally poor at both rates and MOA. Both rates and MOA of dimethenamid provided good to excellent control of rice flatsedge. BAS 656 07 provided excellent (97 to 100%) control of rice flatsedge when applied PT but only fair to good (77% to 88%) control when applied PPI. Clomazone completely controlled barnyardgrass and goosegrass but not rice flatsedge. No herbicide controlled smooth pigweed, carpetweed, or wild mustard. Clomazone controlled common purslane. Overall weed control was better at Chase due to lower weed populations. Dimethenamid and BAS 656 07 provided excellent control of broadleaf signalgrass, carpetweed, and smooth pigweed. Clomazone controlled broadleaf signalgrass and smooth pigweed but not carpetweed.

Yield of No.1 grade sweet potatoes was lower in plots treated with dimethenamid, 0.75 lb/A, and BAS 656 07, 0.49 lb/A applied PT compared with the weed-free check at Baton Rouge. All plots treated PPI produced lower yields of No. 1 grade roots than the weed-free check plot. Plots treated PPI with either herbicide tended to be lower than plots treated PT. No differences occurred in yields for canner or jumbo grade sweet potatoes. Total marketable yields were lower in plots treated with dimethenamid, 0.75 lb/A PT, and all plots treated PPI. Yields of all grades of sweet potatoes in clomazone-treated plots were similar to the weed-free check. Plots treated with dimethenamid PPI produced a lower percentage of No. 1 grade roots than the weed-free check. At Chase, yield of No. 1 grade roots in plots treated with dimethenamid or BAS 656 07 applied PT was similar to the weed-free check . Plots treated with dimethenamid, 1.5 lb/A, and BAS 656 07, 0.98 lb/A, applied PPI had lower yields of No. 1 grade roots than the weed-free check. With few exceptions the yield of canner grade roots from plots treated with dimethenamid or BAS 656 07 exceeded those of the weed-free check plots. Plots treated with BAS 656 07 produced fewer jumbo size roots than the weed-free check. No herbicide-treated plots produced marketable yields lower than the weed-free check.

There were no statistical differences in root shape at Chase. In Baton Rouge, roots from plots treated with dimethenamid ,1.5 lb/A PT or PPI or 0.75 fb 0.75 lb/A PT, BAS 656 07, 0.98 lb/A PT or 0.49 fb 0.49 lb/A PT or PPI were rounder in shape than those in the weed-free check plots. Differences in root shape between the sites can be attributed to more rainfall in Baton Rouge, thus more herbicide in the root zone.

EVALUATION OF HERBICIDES FOR WEED CONTROL IN ECHINACEA (*ECHINACEA PURPUREA*) GROWN FOR MEDICINAL PURPOSES. A.J. Sutherland, J.W. Shrefler, Oklahoma Coop. Ext. Service, Chickasha, OK 73018 and Lane Agricultural Center, Lane, OK 74555.

ABSTRACT

Echinacea purpurea is a composite that is endemic to north American prairie lands and gathered for medicinal use. Recently, Okla. growers began producing the plant as a cash crop. Based on growers experience, mowing and cultivation were not found to give adequate weed control for large scale production purposes. A need was expressed to find chemical weed control measures for use in the crop. No herbicides are currently labeled for use in Echinacea grown for medicinal purposes.

Two field trials, one using preplant applications and another using postemergence (POST) applications were conducted at Hydro, Okla. to search for herbicides having potential for use in Echinacea production. In both trials, three replications were used, plot size was 6 feet by 12 feet, and E. purpurea was established from seed. Herbicides were applied at two rates, the greater being double the low rate. The preplant trial was established 7 May 1999 by applying herbicides whose low rates (in lb ai/A) were napropamide 2, metolachlor 3, trifluralin 1, oxyfluorfen 0.25, oryzalin 3,

pronamide 2, metribuzin 1, linuron 1.5, halosulfuron 0.03, bensulide 6, and pendimethalin 1.5. Herbicides were applied broadcast with a hand-held spray boom (four flat fan nozzles delivering 50 gpa) and incorporated to 1.5 inches with a field cultivator in the final seedbed preparation. Echinacea was sown 20 May 1999. Crop response to the high herbicide rates was evaluated by determining stand and leaf quantity per plant at 19 days after planting. Untreated plants had 2.4 leaves per plant at the time of evaluation. Oryzalin, halosulfuron and metribuzin at the high rates reduced stands by 50% or more (p=0.05) and reduced leaf number of surviving plants. Oxyfluorfen and trifluralin reduced leaf number by 30%. The remaining herbicides had no appreciable affect on Echinacea. Stand counts of pigweeds (Amaranthus spp.) were made at 29 days after planting. Of the herbicides found to be safe to the crop, pendimethalin was most effective, reducing weed stands by 70% at the low rate.

In the POST trial, echinacea was sown 24 Oct. 1998. On 12 May 1999 echinacea plants measured 1.5 inches in height and the field was cultivated to eliminate established weeds. Herbicides were then applied and 0.3 inch of overhead irrigation was used to incorporate herbicides. Herbicides and low rates (lb ai/acre) in the POST trial were napropamide 2, metolachlor 3, pronamide 2, linuron 1.5, halosulfuron 0.03, sethoxydim 0.3, terbacil 2, and oryzalin 3. At 37 days after treatment (DAT) the crop was either killed or was severely injured by high rates of linuron, terbacil, halosulfuron, and metolachlor. Of the remaining herbicides, oryzalin at the low rate gave complete control of Amaranthus spp. at 37 DAT and caused no appreciable crop injury at the high rate. In the POST trial, on 18 Aug. flowering plants were counted and their roots were harvested from plots of the untreated control and the low rate treatments of oryzalin, pronamid, and napropamide. Oryzalin increased the number of flowering plants by three-fold and increased root weights of individual flowering plants by 34%.

RESPONSE OF SELECTED CROPS TO SIMULATED DRIFT OF BISPYRIBAC-SODIUM. T.L. Dillon, R. Bevitori, R.E. Talbert, L.A. Schmidt, E.F. Scherder, and M.L. Lovelace. Department of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville, AR 72701.

ABSTRACT

With the increase of propanil-resisitant barnyardgrass in rice, new herbicides with different modes of action must be implemented to control this weed. Bispyribac-sodium (Regiment®) is one of the new herbicides that will be used in rice for control of propanil-resistant barnyardgrass and other weeds. Because this product will be used in aerial applications, comparisons were made in the response of crops that will be grown adjacent to rice. Soybean, cotton, grain sorghum, corn and tomato were subjected to simulated drift rates of bispyribac-sodium (0.02, 0.002, 0.0002, and 0.00002 lb/A) at two application timings. Plant response was evaluated at the Main Experiment Station at the University of Arkansas, Fayetteville. Tomato and cotton were the most sensitive to herbicide drift, with a rate of 0.002 lb/A (0.01x) causing leaf discoloration, stunting, and death of shoot tips. Sorghum and soybean also showed leaf chlorosis some stunting and delayed maturity to the 0.0002 lb/A rate (0.001x). Corn was fairly tolerant to applications of bispyribac-sodium at the 0.02 lb/A (1x) rate at the first application timing causing slight to moderate leaf chlorosis. These crops recovered from the drift rate symptoms but maturity was delayed.

PREEMERGENCE WEED CONTROL IN APPLE ORCHARDS WITH SEQUENTIAL APPLICATIONS OF AZAFENIDIN, DIURON, SIMAZINE, AND TERBACIL. W.E. Mitchem, A.W. MacRae, and D.W. Monks. Department of Horticultural Science, Mountain Horticultural Crops Research and Extension Center, Fletcher, and North Carolina State University, Raleigh.

Weed management goals in an apple orchard are to minimize competition, maximize radiant heat benefit, and manage orchard vegetation to promote worker efficiency. Typically, a weed management program consists of a spring applied PRE herbicide with a non-selective POST herbicide followed by several non-selective POST herbicide applications through the summer. A study was conducted in Henderson County, NC to determine if sequential PRE herbicide applications would improve annual weed control and eliminate the need for mid to late summer POST herbicide applications while minimizing competition and providing a clean orchard floor through harvest.

PRE herbicide application timings evaluated were a fall application followed by (fb) a late spring application, spring application fb an early summer application, and a single application in the spring representing the current grower standard. Fall, spring, late spring, and summer applications were applied on December 3, March 22, May 26, and June 22, respectively. Fall fb late spring herbicide combinations and rates included azafenidin at 0.375 lb fb azafenidin at 0.375lb, diuron at 1.6 lb fb diuron at 1.6 lb, diuron at 1.6 lb fb diuron at 1.6 lb + terbacil at 1.6 lb, simazine at 2 lb fb simazine at 2 lb, and simazine at 2 lb fb simazine at 2 lb + norflurazon at 2 lb. Spring fb early summer herbicide combinations and rates included azafenidin at 0.375 lb fb azafenidin at 0.375 lb, diuron at 1.6 lb fb diuron at 1.6 lb, diuron at 0.8 lb + terbacil at 0.8 lb fb diuron at 0.8 lb + terbacil at 0.8 lb, simazine at 2 lb fb simazine at 2 lb, and simazine at 2lb fb simazine at 2 lb + norflurazon at 2 lb. Herbicide combinations and rates applied as a single spring application included azafenidin at 0.75 lb, diuron at 3.2 lb, diuron at 1.6 lb + terbacil at 1.6 lb, simazine at 4 lb, and simazine at 4 lb + norflurazon at 4 lb.

All azafenidin treatments, and sequential treatments containing diuron and terbacil provided better than 80% spotted spurge control through August. Simazine and diuron applied sequentially, and simazine in the fall fb simazine +

norflurazon in late spring, and all herbicides applied as a single spring application, with exception of azafenidin, provided spotted spurge control ranging from 3 to 60 %.

Smooth pigweed control through August was better than 80% with all azafenidin treatments or when simazine was applied in the spring fb simazine + norflurazon in the summer. Simazine alone as a single or sequential application, diuron + terbacil as a single application, diuron alone, applied sequentially provided 53% control or less.

Annual grass control (predominantly a goosegrass, large crabgrass mixture) was better than 80% with all azafenidin treatments, as well as when simazine fb simazine + norflurazon, and diuron fb diuron + terbacil treatments applied at either sequential application time. Simazine or diuron alone, applied at either sequential application time provided 64% or less annual grass control.

A NEED FOR POSTEMERGENCE HERBICIDE FOR DIFFICULT-TO-CONTROL BROADLEAF WEEDS IN CITRUS GROVES. S.H. Futch, Citrus Research and Education Center, University of Florida, Lake Alfred, FL 33850.

ABSTRACT

The Florida citrus industry comprises 845,260 acres with an estimated annual weed control cost of $172 million. About 90 to 95% of the acreage receives one to three applications of POST herbicide per year. With only a few of the PRE herbicides having limited POST activity, the industry relies on the few non-selective POST products for controlling emerged weeds. Over the last 10 years, researchers have noted increasing problems in controlling various weed species with current POST herbicides including: Florida pusley (*Richardia scabra*), Brazil pusley (*Richardia brasiliensis*), dayflower (*Commelina communis*), goatweed (*Scoparia dulcis*), hairy beggar-tick (*Bidens alba*), phasey bean (*Macroptilium lathyroides*) and nutsedge (*Cyperus* spp.) species.

New products which are non-selective POST herbicide with a broad spectrum for the control of both broadleaf and grasses should be labeled for bearing trees, safe for use late in the crop season and have limited application restrictions.

VEGETATIVE COMPETITION ON REFORESTED AGRICULTURAL BOTTOMLANDS WITHIN THE CACHE RIVER WATERSHED, ILLINOIS. B.S. Kruse and J.W. Groninger, Southern Illinois University, Carbondale, IL 62902-4411.

ABSTRACT

During the early 1970's, thousands of acres of forested land in Southern Illinois were cleared for soybean agricultural. These sites are often subject to flooding and are now considered marginal for traditional row crops. Presently, these lands are frequently the focus of bottomland forest and wetland restoration efforts within government and private agencies. In 1993 a joint partnership between the U.S. Fish and Wildlife Service, Illinois Department of Natural Resources, The Nature Conservancy, and Ducks Unlimited entered into an agreement to protect and improve the biological and human environment in the 475,000 acre Cache River Watershed. The ultimate goal of this project calls for the return of 24,700 acres of former agricultural land to pre-agricultural conditions and to improve wildlife habitat. Unfortunately, limited information exists to guide these current reforestation efforts. The primary objective of this study is to investigate vegetative competition and tree stocking levels associated with reforested marginal agricultural bottomlands in Southern Illinois. An inventory of volunteer trees, planted trees and herbaceous vegetation along with soil series, stand history, and planting techniques was conducted on sites that had been in crop production for a minimum of 10 years and mainly planted to oak species for five to seven years.

Results indicate the dominant tree species were light seeded and of volunteer origin such as green ash (*Fraxinus pennsylvanica*), boxelder (*Acer negundo*), and sweetgum (*Liquidamber styraciflua*). Planted oaks, primarily cherrybark (*Quercus pagodaefolia*) and pin (*Quercus palustris*), were located on 12% of the plots and comprised only 4% of all trees. Light seeded tree species occupied 75% of the plots and 21% had no trees. Overall tree stocking averaged 1240 trees per acre. The height of the dominant oak and light seeded tree species averaged 6.3 ft and 7.3 respectively. Highest tree stocking for both light seeded trees and oaks was nearest to mature forest and tapered off with increasing distance. Oaks growing in association with light seeded tree species were 19% taller than those on plots occupied only by oaks. Late goldenrod (*Solidago gigantea*), rushes (*Juncus dudleyi*, *Juncus effusus*) and sedges (*Carex cristatella*, *Carex lupulina*) composed the majority of the herbaceous composition. Families of herbaceous species did not significantly differ in their influence on the height of oak or light seeded tree species. This study will serve to describe the vegetative interactions of these former agricultural lands within Southern Illinois and aid in the planning and implementation of future reforestation efforts.

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LONG-TERM EFFECTS OF CHEMICAL WEED CONTROL ON BLACK WALNUT PLANTATIONS. J.R. Bohanek and J.W. Groninger, Department of Forestry, Southern Illinois University, Carbondale, IL 62901.

ABSTRACT

For the past 50 years, nonindustrial private forest landowners in the Midwest have established plantations of black walnut, *Juglans nigra* L., for the high commercial value the tree possesses relative to other agricultural crops. Slow growth and poor quality have frustrated many of these tree farmers and, in some cases, has led to plantation neglect or abandonment. Efforts continue to improve black walnut productivity by shortening the rotation length while providing better growth and straighter boles in the crop trees.

It is well known that interfering, undesirable vegetation must be controlled during the first 3 to 5 years, known as the establishment phase, to ensure successful walnut establishment. In addition, controlling competing vegetation throughout the rotation is said to improve the growth of the trees through increased availability of moisture and nutrients. However, there has been little information on how post-establishment weed control may effect or influence the bole quality of walnut.

Nitrogen-fixing nurse crops, such as European black alder (*Alnus glutinosa* (L.) Gaeretn.), can also improve the growth and stem quality of black walnut when interplanted. The benefits of interplanting alder in black walnut plantations may include improved nitrogen fertility leading to more rapid growth, accelerated self-pruning, straighter boles, lower soil temperatures, suppression of weeds, control of walnut anthracnose, and protection from wind damage. While these benefits have been well-documented in young stands, there is a lack of information on the long-term impacts of this practice on tree growth and bole quality.

A study was established in 1965 on an alluvial bottomland site in south-central Illinois (black walnut site index=75) to determine how weed control and interplanting nitrogen-fixing nurse crops could improve the productivity and bole quality of planted black walnut. Prior to planting, the study site was disked, plowed, double-disked, and broadcast sprayed with simazine (4lbs a.i./ac) to establish a planting site for black walnut. During that spring, 1-0 walnut seedlings were planted in 4 plots at 18x18 and 8 plots at 26x26 foot spacings. Alder was interplanted the same year between the walnut seedlings to produce spacings of 9x9 and 13x13 feet, respectively. Four plots of 26x26 foot spacings remained without alder. During the first 5 years of stand establishment, the area was disked and mowed 2 to 3 times a year to control the competing vegetation. In the 6th and 7th growing seasons, half of the walnut trees were spot sprayed with a mixture of simazine (3oz/gal), atrazine (3oz/gal), dalapon (9.2oz/gal), and 2,4-D amine (2oz/gal) at the beginning and ending of each growing season to control the dense cover of weeds, primarily giant ragweed (*Ambrosia trifida* L.) and ivyleaf morningglory (*Ipomoea hederacea* (L.) Jacq.). Between 1969 and 1973, thinnings took place to remove the alder. Walnut heights and diameters were measured yearly from 1965 to 1983 to assess the impact of vegetation control and stand density on growth. In 1999, all walnut trees were measured for dbh, sweep, crown width, height to the first defect, and number of knots and live and dead limbs in the butt and upper 8 foot logs to test the effects of herbicide and interplanting alder at different densities on walnut bole quality.

Post-establishment herbicide treatment did not impact height and diameter growth. The number of faces with rot and frost seams (cracks) were twice as likely to occur with the herbicide treatments. Spacing and interplanting nitrogen-fixing alder did not impact black walnut height growth. On the other hand, wider spacings and lower tree densities resulted in increased diameter growth but also increased the incidence of butt rot. Interplanting alder reduced the number of defects, such as knots or suppressed bud clusters, 51.7% in the butt 8 foot log. Interplanting alder and the higher tree densities significantly improved the bole quality of the walnut but resulted in reduced bole diameter.

EFFECTS OF BEECH (*FAGUS GRANDIFOLIA*) CONTROL IN WEST VIRGINIA BLACK CHERRY (PRUNUS SEROTINA) STANDS. J.D. Kochenderfer and S.M. Zedaker. Department of Forestry, College of Natural Resources, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, 24061.

ABSTRACT

Recent surveys (1998) of harvesting practices have indicated that some type of diameter limit, or partial cutting, was used to harvest 80% of the cut over acres in West Virginia. Repeated partial cutting favors tolerant species, like American beech (*Fagus grandifolia*), and has resulted in a decreased stocking of intolerant species, like black cherry (*Prunus serotina*). Current stumpage prices for cherry sawlogs exceed $600 per MBF, more than ten times the value of beech. Crop-tree release has been a widely accepted method of improving species composition in partially cut Appalachian hardwood stands, but little work has been done to evaluate the cost effectiveness of different chemical methods and the potential returns from increase volume of more valuable species.

A completely randomized, incomplete factorial, design was used to evaluate the effects of different chemicals and application techniques on the control of beech and other weed tree species and the potential economic returns from increased cherry volume. The compete experiment (three replicates) of six different treatments was installed on 0.10 acre plots on each of three sites in West Virginia that had been partially cut between 19 and 33 years previously. Accord (glyphosate), Arsenal AC (imazapyr) and Garlon 3A (triclopyr) were injected by the hack-and-squirt method in metered

amounts to provide equal cost of application treatments. Garlon 4 (triclopyr ester) and Chopper (emulsified imazapyr) were applied in a metered low-volume basal treatment and a control (no application) treatment was also installed. Mortality and crown necrosis of weed and crop trees were determined one-year-after treatment and the change in relative basal area of weed and crop species were projected to final harvest at age 80 using the NE-TWIGS growth and yield simulator.

Almost complete control (99% average) of weed trees was achieved for all injected herbicides across all sites. Low-volume basal sprays were not effective, most likely due to the large size of the weed tree stems. Imazapyr treatments adversely affected crop trees; presumably as a result of the chemical's soil activity, relatively high translocation mobility and root grafting. Cost effectiveness for injections ranged from \$1.04 to \$0.84 per ft^2 of weed tree basal area controlled. The injection treatments more than doubled the projected basal area of black cherry in these partially cut stands. The real rate of economic return from these injection treatments was projected to range from 6.9% to 10.6%. If the value of black cherry remains high, relative to that of the tolerant tree species currently considered weeds, substantial economic returns could be achieved by reclaiming these highgraded, partially cut, stands.

ESTABLISHING A GREEN ASH PLANTATION USING MECHANICAL AND CHEMICAL SITE PREPARATION. D.A. Babassana and J.W. Groninger, Department of Forestry, Southern Illinois University, Carbondale, Il 62901.

ABSTRACT

Afforestation is an important consideration in nature conservation efforts in areas that have been subject to widespread land clearing for agriculture. In southern Illinois, lands not presently needed for food production are negatively impacted by erosion and invasion by undesirable herbaceous and shrub species.. Private land owners, with the help of government incentive programs, are increasingly interested in promoting the development of forest ecosystems in these areas. Rapid development of forest cover through the planting of fast growing tree species is consistent with this objective. Green Ash (*Fraxinus pennsylvanica* Marsh.) is recognized as an important species in bottomland hardwood reforestation because of its potential for rapid growth and high timber value. Reforestation techniques to improve early growth rates of this species remain poorly developed. The overall objective of this field study was to evaluate the effects of chemical and mechanical weed control methods, alone and in combination, on seedling development and herbaceous community development in a green ash plantation .

Mechanical treatment consisted of discing prior to planting. Chemical treatments consisted of Oust (Sulfometuron methyl) applied at a rate of two ounces of product per acre immediately following spring planting or Roundup (Glyphosate) applied as a spot treatment at 1.5 oz. product per gallon during July of the first growing season. Tree growth was evaluated on the basis of mid-growing season damage class and end of the growing season height and diameter. Weed community composition and density was also evaluated.

During the first growing season, dominant weed species were crabgrass (*Digitaria sanguinaris*), johnsongrass (*Sorghum halepense*), fall panicum (*Panicum dichotoniflorum*), horseweed (*Conyza canadensis*), trumpet creeper (*Campsis radicans*). Both herbicide and tillage treatments significantly reduced percent cover of herbaceous vegetation.. Both herbicide treatments significantly increased height and diameter growth with glyphosate producing significantly greater height growth than sulfometuron methyl. Tillage did not impact tree growth. Seedlings growing in grass-dominated herbaceous communities has reduced growth while those grown with broadleaf weeds were unaffected. Further analyses will explore the role of herbaceous community composition on the early growth of planted green ash.

RESPONSE OF NATIVE PLANT COMMUNITIES ONE YEAR AFTER HERBICIDE TREATMENT, MOWING, OR BURNING IN POWERLINE RIGHTS-OF-WAY. J.E. Settles and W.W. Witt, Department of Agronomy, University of Kentucky, Lexington, KY 40546-0091.

ABSTRACT

Vegetation management practices that maintain or enhance the integrity of native plant communities are desirable. Recently, extensive botanical surveys conducted within powerline rights-of-way in Kentucky have discovered numerous native plant communities within these corridors. Many of these communities are havens for sensitive and rare plant species. New populations of orange crested orchid (*Platanthera cristata*,), yellow fringed orchid (*Platanthera ciliaris*), spreading pogonia (*Cleistes divaricatus*), little ladies' tress (*Spiranthes tuberosa*), and rattlesnake master (*Eryngium yuccifolium*) were discovered. This study was developed to add insight into how utilities may better manage their powerline corridors to protect these communities of sensitive and rare plant species.

Five powerline corridors were selected for this study to observe the response of the plant communities to the three vegetation management practices: mowing, prescribed burning, and herbicide treatment. The experiment was conducted as a randomized complete block design with three replications of each treatment with a plot size of 15m by 30m. Three 10m permanent line transects were established within each plot, and species data were recorded at 1m intervals within each transect in late August or early September of 1998 and 1999. The surveys were conducted in 1998 to evaluate the

existing components of these communities. Treatments were initiated after the 1998 growing season. The mowing treatment was conducted in October and November of 1998, while prescribed burning was conducted in February or March of 1999. The herbicide treatment, consisting of a broadcast application at 20 GPA of an imazapyr / glyphosate (0.5%/2.0% v/v) tank mixture with a non-ionic surfactant (0.5% v/v), was implemented in May 1999. Square root transformations of the species per plot and total plants per plot data were analyzed with the general linear model procedure and Fisher's protected LSD.

Plant count data resulted in 7,425 plants surveyed in 1998 and 7,097 surveyed in 1999 for a total of 14,522 plants surveyed for the project. There were195 and 194 species in the plots in 1998 and 1999, respectively, with a total of 225 species for both years representing 63 plant families. Twenty-nine non-native species were found to occur in these rights-of-way. Two of the five sites contained 95% of the non-native species found, and these two sites had been subjected to anthropogenic influences. There were no significant differences in species numbers or plant numbers per plot before treatment initiation in 1998. Significant decreases in species per plot and plants per plot occurred in the herbicide treatment in 1999. No statistical differences for species per plot or total plants per plot were detected between the mowing and burning treatments for 1999. There was a significant increase in native forbs after burning in 1999, but there was a significant decrease in native forbs after the herbicide treatment in 1999. Similar results for the native grasses were noted. Tree numbers were significantly greater in the mowing and burning treatments in 1999, with a significant decrease in trees in the herbicide treatment in 1999. There were no significant differences in numbers of ferns and fern allies.

FLUROXYPYR/TRICLOPYR INTERACTONS IN FOREST WEEDS. M.L. Jackson and S.M. Zedaker, Virginia Polytechnic Institute and State University, Blacksburg, 24061.

ABSTRACT

The cost associated with registering new herbicides, as well as other factors, has precluded the introduction of new woody plant herbicides for over a decade. Finding ways to enhance the use of existing chemistry is important to improving forest weed management. European agronomists noticed increased efficacy of triclopyr when used in combination with fluroxypyr for broadleaf weed control. However, the nature and properties of the interaction between the two herbicides has not been described nor quantified. Radiolabeled triclopyr (as Garlon 3A) and fluroxypyr (as Vista) alone and in combination were applied to determine uptake and translocation interactions. Weed species examined were blackberry (*Rubus alleghaniensis*.), red (water) oak (*Quercus nigra*), and stinging nettle (*Urtica dioica*).

Container grown seedlings were presprayed with cold formulation using a hood sprayer. After drying, 2.4 :l of radiolabeled herbicide was applied using a microliter syringe to the adaxial surface of an uppermost fully expanded leaf. Plants were harvested at 1, 24 or 72 hours after treatment. The treated leaf was removed from the plant and washed with 3- 5 ml water rinses plus one 5 ml funnel rinse. The treated leaf was frozen and later oxidized in a Harvey Biological Oxidizer. The remaining stem and roots (washed of soil) were dried, ground, and subsampled to determine amount of radiotracer in each fraction. Amounts of radiolabeled herbicide were expressed as percent of total applied radiotracer. Mean separations were performed using standard ANOVA with Duncan's Multiple Range Test at " = 0.05.

Combining triclopyr and fluroxypyr significantly increased the amount of herbicide taken up and retained in the leaf above that of single herbicide applications. Garlon 3A rainfastness and herbicide retained within the treated leaf was significantly higher in the presence of fluroxypyr. Likewise, Vista rainfastness and leaf retention was promoted by the addition of Garlon 3A. Herbicide uptake was increased over time. Blackberry retained the highest amounts of herbicide in the leaves for all treatments, with no difference between oak and nettle. Translocation treatment effects were insignificant. Species and time were significant with regards to translocation, with nettle translocating the highest amount of herbicide regardless of treatment, and oak the least amount. The amount of herbicide moved out of the treated leaf and into the plant was too low at 72 hours to determine treatment differences.

Fluroxypyr in combination with triclopyr does enhance both rainfastness and amount herbicide retained within the treated leaf. Longer studies are needed to confirm whether translocation effects follow the same trend. Field trials are also needed to confirm whether the increased uptake of triclopyr with fluroxypyr enhances efficacy.

SILVICULTURAL GUIDELINES FOR THE RESTORATION OF AMERICAN CHESTNUT IN EASTERN FORESTS. P.T. Moore and J.J. Zaczek, Department of Forestry, Southern Illinois University, Carbondale, IL 62901.

ABSTRACT

The American chestnut tree has been a severely diminished component of the eastern deciduous forests, due to the introduction and spread of the chestnut blight fungus, for nearly one hundred years. A blight resistant chestnut is scheduled for release by The American Chestnut Foundation in the year 2006. To facilitate the successful reintroduction of this species into its original range, we must have a set of silvicultural methods in place at that time. Tree shelters, weed control using glyphosate, and the use of containerized stock were tested as silvicultural treatments to enhance the growth of first-year American chestnut seedlings. The silvicultural characteristics of American chestnut were compared to those of Chinese chestnut in order to determine whether the abundance of information presently available for Chinese chestnut is applicable to American chestnut.

In late April 1999, duplicate plantations were established at Dixon Springs State Park and Crab Orchard National Wildlife Refuge in Southern Illinois. Four treatments were direct-seeded American chestnut (AC D-S). Two of these AC D-S treatments received tree shelters (TS) (5' tall vented Tree-Pro). One of the TS and one unsheltered treatment were maintained under weed-free conditions through direct applications of glyphosate (H) (2% product as Accord) in a .5 m radius circle around the trees. Two treatments utilized American chestnut containerized stock (CONT) that had been raised in the greenhouse in the spring 1999. The containerized greenhouse stock was planted with and without shelters and both were maintained under weed-free conditions. Four D-S Chinese chestnut (CC) treatments D-S, D-S TS, D-S TS H, and D-S H were also planted for a total of ten treatments. At the end of the 1999 growing season height and stem diameter of each tree was measured and an overall survival rate was calculated for each treatment.

The responses to the treatments at the two sites were significantly different and therefore were analyzed separately. Chinese chestnut attained greater height and stem diameter than American chestnut in the first growing season at both sites. The use of shelters significantly increased the height of Chinese chestnut at both sites and the height of American chestnut at the Dixon Springs site only. Weed control did not impact height with the exception of a reduction in height of Chinese chestnut at the Dixon Springs site. This response was probably a result of etiolated growth in response to weed competition in untreated seedlings. The use of containerized stock did not increase height at either site, however stem diameter increased relative to AC D-S and AC TS D-S at both sites. In general, the more intensive strategies produced the greatest amount of planting success. The use of tree shelters is suggested over the use of herbicide to increase first-year height and survival. Chinese chestnut is silviculturally dissimilar to American chestnut.

TIME OF YEAR, RATE OF HERBICIDE APPLICATION, AND REVEGETATION: FACTORS THAT INFLUENCE THE CONTROL OF COGONGRASS [IMPERATA CYLINDRICA (L.) Beauv.]. E.R.R.L. Johnson, D.G. Shilling, G.E. MacDonald, J.F. Gaffney, B.J. Brecke. University of Florida, Gainesville, West Florida Research and Education Center, Jay, University of Florida, Gainesville, American Cyanamid, West Des Moines, IA, and West Florida Research and Education Center, Jay.

ABSTRACT

Cogongrass (*Imperata cylindrica* (L.) Beauv.) is a non-native, invasive grass from southeast Asia that has become a serious nuisance throughout the southeastern United States. Cogongrass is a major impediment to land restoration, mine reclamation, and pine establishment. Field studies were performed in Brooksville, FL to investigate the interaction of various components of an integrated management program for the control of cogongrass. Studies were initiated in 1995 and 1996 to investigate the interaction of time of year and rate of application of imazapyr and glyphosate for cogongrass control. Imazapyr and glyphosate were applied on May 15, August 20, November 21, and February 17; at 1.12, 0.56, 0.28, and 0.0 kg/ha and 2.24, 1.12, 0.56, and 0.0 kg/ha for imazapyr and glyphosate respectively. The study was a 4x4x2 factorial in a randomized complete block design with four application dates, four rates, and two herbicides. Both imazapyr and glyphosate were more efficacious at the highest rate, providing 96% and 80% respectively for the 95/96 study and 91% and 81% for the 96/97 study, for the November applications. Glyphosate was influenced by the time of year more so than imazapyr due to soil activity. During the fall months when both herbicides were most effective there is a net basipetal flow of photosynthates, so the herbicides are more likely to move from the treated foliage into the rhizomes.

The second study was designed to investigate the interactions of discing and herbicide application for cogongrass control. Studies were conducted in the Withlacoochee State Forest near Brooksville, FL. The study was arranged as a 3x5 factorial with three discing treatments and five herbicide treatments, replicated four times in a randomized complete block. There were three levels of discing including no discing,, light discing (3-8 cm depth), and deep discing (10-15 cm depth). The herbicide treatments included an untreated check, glyphosate at 3.36 kg/ha, glyphosate at 3.36 kg/ha tank mixed with 0.28 kg/ha of imazapyr, glyphosate at 3.36 kg/ha followed by imazapic at 0.025 kg/ha , and imazapyr at 1.12 kg/ha. Results reported reflect observations 12 months after application, as regrowth is the most accurate assessment of control for a perennial species. Imazapyr applied at 1.12 kg/ha provided the best control (83% and 86% for 97/98 and 98/99 respectively) of cogongrass. While the next best treatment was 3.36 kg/ha of glyphosate tank mixed with 0.28 kg/ha of imazapyr, which provided 81% for 97/98 and only 51% control of cogongrass for 98/99. None of the herbicide treatments benefitted from the addition of discing suggesting that adequate regrowth was not present at the time of herbicide application. A secondary goal of this study was to determine the potential for native plant recruitment in areas previously infested with cogongrass. A large number of native plant species were observed in plots were the cogongrass had been adequately suppressed including *Quercus geminata, Pinus palustris, Eupatorium capillifolium, Aristida berichyana, Pteridium aqulinum, and Licania michauxii*. This suggests that there is a potential for native plant recruitment.

WEED CONTROL AND SEEDLING PERFORMANCE USING OUST AND VELPAR+OUST IMPREGNATED DIAMMONIUM PHOSPHATE (DAP). M.E. Corbin and J.L. Yeiser. Stephen F. Austin State University, Nacogdoches, TX 75962.

ABSTRACT

Technology that combines herbicide and fertilizer treatments, thereby reducing the number of passes and application costs per acre, is needed. The objectives of this study were to evaluate the effectiveness of diammonium phosphate impregnated with Oust or Oust+Velpar DF for herbaceous weed control, newly planted loblolly pine seedling growth and tip moth damage. The study site was near Diboll in Angelina County of East Texas. Similar control of winter bentgrass, purple cudweed and swamp sunflower was achieved with the same herbicide and rate for liquid sprays and herbicide impregnated DAP. Panicgrass and overall control required 4 oz of Oust on DAP to achieve similar or less control than 2 oz of Oust as a liquid spray. Similarly, liquid Velpar+Oust (1 qt+2 oz) provided more weed control than Velpar DF + Oust (12.7 oz +2 oz) impregnated on DAP. Best survival resulted from liquid sprays of Oust (4 oz) and Velpar L + Oust (12.7+2 oz). Survival was intermediate for treatments of impregnated DAP. Seedling growth was similar for all liquid herbicide and herbicide+DAP treatments. All herbicide treatments provided better survival and growth than the untreated check. Tip moth damage was similar across all test treatments. Perhaps better weed control than achieved here would result from pre-emergent applications and more soil contact points. The weed and feed approach to weed control and fertilization for newly planted loblolly pine seedlings shows promise as a technology that may provide similar weed control and seedling growth while reducing application costs. Additional refinement of this technology is warranted.

INTRODUCTION

Use of herbicides for vegetation management continues to increase (1). Research has shown that control of unwanted vegetation does significantly increase growth and revenues fromtreated acres (2). Concern does exist over the amount of tip moth damage that may follow treatments for herbaceous weed control.

Forest fertilization has increased dramatically since the late 1960s. Applying fertilizer to deficient sites greatly improves loblolly pine (*Pinus taeda* L.) wood volume and dollar per acre revenues. In 1997, this justified the fertilization of almost one million acres of pine plantations. In the same year, approximately 200,000 acres of loblolly pine plantations in the southeast were fertilized at planting (1).

Combination plowing (subsoiling, disking and bedding) removes soil impediments that inhibit the rooting of pine seedlings. Once impediments are removed, seedling growth is significantly enhanced. Combination plowing, in addition to nitrogen (N) or nitrogen plus phosphorus (P) fertilizer at planting, can significantly increase growth (1).

Currently, managers treat newly planted loblolly pine seedlings for herbaceous weed control and nutrient deficiencies in two separate treatments and incur two application costs. Technology that combines compatible treatments, thereby reducing the number of passes and application costs per acre, is needed. The development of a weed and feed technology potentially offers to combine two technologies, herbaceous weed control and fertilization, into a single application. The objectives of this study were to evaluate the effectiveness of diammonium phosphate impregnated with Oust or Oust+Velpar DF for herbaceous weed control, newly planted loblolly pine seedling growth and tip moth damage.

METHODS

An Upper Coastal Plain site near Diboll in Angelina County of East Texas was tested. Soil there was a fine sandy silt loam. This site was clearcut during December of 1997, aerially treated with an Arsenal AC+Garlon 4 (14 oz+2 oz) mixture on September 1, 1998 and burned approximately six weeks later on October 9. On November 12, 1998, the site was subsoiled to a depth of 24 inches and bedded in a single pass with a mounted, combination plow (coulter-subsoiler-disc). Genetically improved loblolly pine seedlings were hand planted on a 6-ft X 10-ft spacing on February 5, 1999.

DAP was impregnated with herbicide by placing the fertilizer in a cement mixer. The appropriate herbicide and rate were mixed with water and alcohol and sprayed into the rotating mixer creating a slurry. The herbicide-DAP mixture was spread out in an open room and air-dried. Lumps were crumbled by hand, returning the mixture to the original texture and consistency of DAP. The cement mixer was cleaned and the process repeated for each DAP-herbicide combination.

Treatments were applied on March 22, 1999. Herbaceous competitors were less than 2 in. tall and provided approximately 40% ground cover. Species dominant on the site were rushes (*Juncus* spp), purple cudweed (*Gamochaeta purpurea* (L) Cabrera), narrow-leaf rushfoil (*Croton michauxii* Webster) and St. John's-wort (*Hypericum* spp), low panicgrasses (*Dichanthelium scoparium* (Lam.) Gould, *D laxiflorum* (Lam.) Gould and *D. acuminatum* (Sw.) Gould & C.A. Clark), swamp sunflower (*Helianthus angustifolius* L.) and winter bentgrass (*Agrostis hyemalis* (Walter) Britton, Sterns & Poggenb.). The site was free of woody weed species. Pine physiological activity was increasing with seedlings commonly (11/14) exhibiting swollen buds while others (3/14) remained unchanged. The impregnated DAP was broadcast by hand in a single application over the top of seedlings and at a rate of 125 lb. per acre. All liquid treatments were mixed with water until the total volume was 10 GPA. Herbicides were applied with a CO_2-pressurized backpack sprayer and hand-held "T" wand with four, 11015 nozzles.

The following eight treatments (product/acre) were tested:

1) Oust	2oz	SPRAY	5) Velpar DF+Oust	10.7oz+2oz	SPRAY
2) Oust+DAP	2oz+125lb	GRANULE	6) Velpar DF+Oust+DAP	10.7oz+2oz+125lb	GRANULE
3) Oust	4oz	SPRAY	7) DAP	125lb	GRANULE
4) Oust+DAP	4oz+125lb	GRANULE	8) Untreated Check		

Treatment plots were approximately 46 ft X 80 ft and visually evaluated for percent control at 30, 60, 90 and 120 days after treatment (DAT). Control was expressed in 10% intervals. Individual species providing at least 7% ground cover in all plots were followed. An assessment of all herbaceous plants as a group was also performed.

Treatment plots consisted of seven trees per row and eight rows or 56 seedlings. Measurement plots were internal to treatment plots and contained 30 seedlings configured as five seedlings per row within each of six rows leaving one line of buffer seedlings surrounding each plot. Also, an untreated buffer strip approximately 10 ft. wide surrounded each treatment plot.

Seedlings in measurement plots were measured on March 11, 1999 for initial total height (in.) and ground line diameter (in.). On August 22, 1999 (150 DAT) tip moth damage on planted seedlings was classified for location (terminal or lateral shoots) and tallied for frequency. Tip moth damage was assessed by the (1) percent of seedlings displaying terminal or lateral shoots damage, and (2) the mean number of damaged shoots per seedling. Survival and total height (in.) and ground line diameter (in.) were recorded on October 15, 1999 after one growing season. Volume was computed as total height X ground line diameter^2.

The study layout was a randomized complete block design with four blocks. Each block contained eight treatments. Seedling survival, volume and damage by tip moth were analyzed with an ANOVA according to the GLM procedure of SAS with means separated by Duncan's New Multiple Range test (3). All tests were conducted at the $p=0.05$ level.

RESULTS

Species such as winter bentgrass, purple cudweed and swamp sunflower were easily and similarly reduced by all herbicide and impregnated-DAP treatments at 30 and 60 DAT (Tables 1 & 2). Panicgrasses (30 and 60 DAT) were better controlled with liquid sprays than DAP impregnated with a comparable rate and brand of herbicide (Tables 1). Furthermore, for rushes (60, 90 and 120 DAT) and overall control of all herbs (30 and 90 DAT), DAP+4 oz. of Oust provided comparable control with 2 oz of Oust-spray. For panicgrasses, 2 oz of Oust as a liquid spray provided more control than DAP+4 oz of Oust (30 and 60 DAT). This is probably due to leaf and root uptake of liquids versus the root only uptake of the granulated DAP+herbicide treatments. Perhaps this disparity in control can be reduced by (1) a pre-emergence, rather than an early post-emergence application of impregnated DAP, (2) a higher rate of DAP which would provide more soil contact points per acre or (3) screening DAP particles for smaller sizes and more contact points.

Major differences were detected in seedling survival and growth (Table 3). Best survival was achieved with Oust (4 oz) or Velpar+Oust (1 qt+2 oz). Oust alone (2 oz) or treatments of impregnated-DAP provided intermediate survival. All spray and DAP-impregnated treatments provided similar seedling growth. Lowest survival and growth were recorded for the untreated check and DAP only plots. Survival and growth were probably impacted by the summer drought. During June, July, August and September the test site received 0.5 in., 4.1 in., 0.0 in. and 1.5 in. respectively. Temperatures during this same period were commonly 97°-103° F.

No differences were detected among treatments for tip moth damage to terminal shoots, lateral shoots, or the mean number of damaged shoots per seedling (Table 3). Shoot damage was considered high for all treatments regardless of the herbicide or impregnated-DAP treatment tested. This is contrary to some literature were superphosphate was applied at a rate of 50 lbs. of phosphorus per acre (equivalent to 250 lb. of DAP) and phosphorus levels in seedling shoots were negatively correlated with tip moth damage (4,5). Perhaps, the 125 lb. of DAP tested (1) provided insufficient phosphorus for seedling protection, (2) was poorly metabolized by seedlings due to drought, or (3) was over come by very high tip moth levels.

CONCLUSIONS

In conclusion, the weed and feed approach to controlling competing weeds and fertilizing newly planted loblolly pine seedlings shows promise. When compared with conventional approaches, this technology may provide similar weed control, similar seedling growth, reduced tip moth damage and reduced application costs. This test provided similar to somewhat lower control of herbaceous competitors with impregnated DAP versus liquid treatments of comparable herbicide brand and rate. Perhaps better weed control than achieved here would result frompre-emergent applications. Additional refinement of this technology is needed.

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Table 1. Control (%) of herbaceous competitors in a newly planted loblolly pine plantation in East Texas (Angelina County) by an early post-emergence, weed-and-feed treatment applied on March 22, 1999.

			DAYS AFTER TREATMENT[3]			
TREATMENTS	RATE AND FORMULATION[2]		30	60	90	120
winter bentgrass[1]						
Velpar+Oust	1qt+2oz	Spray	100a	100a	100a	-[4]
Oust	4 oz	Spray	100a	100a	100a	-
Oust	2 oz	Spray	100a	100a	100a	-
Oust+Velpar DF+DAP	2 oz + 10.7 oz + 125 lb	Granule	100a	100a	100a	-
Oust+DAP	4 oz + 125 lb	Granule	100a	100a	100a	-
Oust+DAP	2 oz + 125 lb	Granule	100a	100a	100a	-
DAP	125 lb	Granule	0b	0b	0b	-
panicgrass[1]						
Velpar+Oust	1qt+2oz	Spray	100a	95a	95a	88a
Oust	4 oz	Spray	99a	96a	96a	92a
Oust	2 oz	Spray	98a	90a	83ab	60b
Oust+Velpar DF+DAP	2 oz + 10.7 oz + 125 lb	Granule	92b	85b	81b	38b
Oust+DAP	4 oz + 125 lb	Granule	92b	83bc	80bc	43b
Oust+DAP	2 oz + 125 lb	Granule	85c	75c	73c	38b
DAP	125 lb	Granule	0d	0d	0d	0c
rush[1]						
Velpar+Oust	1qt+2oz	Spray	87a	90a	90a	90a
Oust	4 oz	Spray	73b	90a	89a	80a
Oust	2 oz	Spray	71b	73b	63b	63bc
Oust+Velpar DF+DAP	2 oz + 10.7 oz + 125 lb	Granule	70b	64b	50c	50c
Oust+DAP	4 oz + 125 lb	Granule	69b	68b	68b	68b
Oust+DAP	2 oz + 125 lb	Granule	58c	53c	48c	48c
DAP	125 lb	Granule	0d	0d	0d	0d

[1] Winter bentgrass, panicgrass and rush provided at least 7%, 10% and 10% ground cover, respectively, in each plot on application day.
[2] A single application and rate of 125 pounds of diammonium phosphate (DAP) was used.
[3] Treatment means within a column sharing the same letter are not significantly different (Duncan's New Multiple Range test, p=0.05 level).
[4] Winter bentgrass was no longer present in plots.

Table 2. Control (%) of unwanted herbs in a newly planted loblolly pine plantation in East Texas (Angelina County) with an early post-emergence, weed-and-feed treatment applied on March 22, 1999.

TREATMENTS	RATE AND FORMULATION[2]		DAYS AFTER TREATMENT[3] 30	60	90	120
purple cudweed[1]						
Velpar+Oust	1qt+2oz	Spray	100a	100a	100a	100a
Oust	4 oz	Spray	100a	98a	98a	98a
Oust	2 oz	Spray	100a	97a	92ab	87ab
Oust+Velpar DF+DAP	2 oz + 10.7 oz + 125 lb	Granule	100a	95a	83ab	75b
Oust+DAP	4 oz + 125 lb	Granule	98a	97a	95a	95a
Oust+DAP	2 oz + 125 lb	Granule	90a	85b	75b	72b
DAP	125 lb	Granule	0c	0c	0c	0c
swamp sunflower[1]						
Velpar+Oust	1qt+2oz	Spray	100a	100a	99a	99a
Oust	4 oz	Spray	100a	100a	100a	99a
Oust	2 oz	Spray	99a	98a	91a	91ab
Oust+Velpar DF+DAP	2 oz + 10.7 oz + 125 lb	Granule	93a	83a	85ab	63b
Oust+DAP	4 oz + 125 lb	Granule	99a	97a	70ab	85ab
Oust+DAP	2 oz + 125 lb	Granule	83a	81a	63b	70b
DAP	125 lb	Granule	0b	0c	0c	0c
all species[1]						
Velpar+Oust	1qt+2oz	Spray	95a	93a	89a	86a
Oust	4 oz	Spray	80b	86a	78ab	76b
Oust	2 oz	Spray	76bc	81a	55bc	60bc
Oust+Velpar DF+DAP	2 oz + 10.7 oz + 125 lb	Granule	71bc	68b	45cd	46cd
Oust+DAP	4 oz + 125 lb	Granule	64c	60bc	38cd	36de
Oust+DAP	2 oz + 125 lb	Granule	61c	50c	25d	21e
DAP	125 lb	Granule	0d	0d	0e	0f

[1] Purple cudweed, swamp sunflower and total ground cover by all herbaceous species was at least 7%, 7% and 40%, respectively, in each plot at application time.
[2] A single application and rate of 125 pounds of diammonium phosphate (DAP) was used.
[3] Treatment means within a column sharing the same letter are not significantly different (Duncan's New Multiple Range test, p=0.05 level).

Table 3. Newly planted loblolly pine seedling survival (S,%), volume (V,in^3) and tip moth damage to terminal shoots (%), laterals shoots (%) and mean shoot damage per seedling after one growing season.

Treatments[1]	Rate and Formulation[2]		S	V	Terminal	Lateral	Mean
Velpar+Oust	1qt+2oz	Spray	87a	3.9a	36ab	52a	1.8ab
Oust	4 oz	Spray	78ab	3.1a	40ab	35ab	1.4abc
Oust	2 oz	Spray	74b	3.7a	42ab	46a	1.7ab
Oust+Velpar DF+DAP	2 oz + 10.7 oz + 125 lb	Granule	73b	3.8a	49a	44a	1.9a
Oust+DAP	2 oz + 125 lb	Granule	72b	4.4a	35ab	38a	1.9a
Oust+DAP	4 oz + 125 lb	Granule	68b	3.2a	36ab	34ab	1.4abc
Check	None	-	40c	1.5b	22ab	11c	1.3bc
DAP	125 lb	Granule	18d	1.6b	16b	14bc	1.0c

[1] Treatment means within a column sharing the same letter are not significantly different (Duncan's New Multiple Range test, p=0.05 level).
[2] A single application and rate of 125 pounds of diammonium phosphate (DAP) was used.

LOBLOLLY PINE TOLERANCE TO HEXAZINONE PREADSORBED ONTO DIFFUSION-CONTROLLED CARRIERS. C.R. Ramsey, G.R. Wehtje, R.H. Walker, D.H. Gjerstad, and D.B.South, Dept. Agronomy and Soils and School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL 36849.

ABSTRACT

A herbaceous weed control field study on loblolly pine seedlings was conducted at E.V. Smith Agricultural Experiment Station, Macon County, AL. The study objective was to determine the effects of a powdered, charcoal carrier on weed efficacy and pine seedlings performance. The study was a randomized, complete block with four replications. It was a 2 x 5 augmented, factorial, with two hexazinone rates (1.12 and 2.24 kg ai/ha) and five charcoal rates (0, 5.6, 11.2, 16.8, and 22.4 kg/ha). Hexazinone, formulated as velpar-L, was preadsorbed onto the powdered charcoal for 72 h before the treatments were applied with a single nozzle CO_2 backpack sprayer. Treatments were applied three months after planting, which occurred the first week of January, 1999. The site was a fallow, agricultural field with no organic debris on the soil surface, nor any substantial weed cover at the time of application. The soil was a loamy sand with 79% sand, 14% silt, and 8% clay and a pH of 6 and 0.8% organic matter. Response variables were weed control and pine survival on a monthly basis, and pine groundline diameter growth (GLD_{final} - $GLD_{initial}$ at 6 MAT).

Factorial analysis reveals that weed control (6 MAT) was affected by hexazinone (Pr >F = 0.0012), but not by charcoal rates (Pr >F = 0.1891). Weed control increased from 80% to 93% (6 MAT), when averaged across all charcoal rates, as the hexazinone rate doubled. The pine GLD growth was affected by hexazinone (Pr >F = 0.0001) and charcoal rates (Pr >F = 0.0468). GLD growth increased from 4.2 mm to 8.6 mm for the water + hex (1.12 kg ai/ha) and the water + charcoal (16.8 kg/ha) + hex (1.12 kg ai/ha) treatments, respectively. Pine survival was affected by both hexazinone (Pr > F = 0.0001) and charcoal rates (Pr > F = 0.0001). Pine survival (6 MAT) increased from 58% to 85% for the water + hex (1.12 kg ai/ha) and the water + charcoal (16.8 kg/ha) + hex (1.12 kg ai/ha) treatment, respectively. The addition of powdered charcoal had little affect on weed efficacy, however pine seedling GLD growth and survival was significantly improved.

THIRD-YEAR SEEDLING PERFORMANCE FOR BOTH LOBLOLLY AND SHORTLEAF PINES ON AN INTENSIVE HERBICIDE/FERTILIZER STUDY IN SOUTHEAST ARKANSAS. J.A. Earl and R.A. Williams. Arkansas Agricultural Experiment Station and School of Forest Resources, University of Arkansas at Monticello, 71656.

ABSTRACT

Herbicides and fertilizers both play important roles in the establishment and growth of young pine plantations. This study looks at the effects of applying combinations of herbicide and fertilizer to both loblolly and shortleaf pines. Four combinations of herbicide and fertilizer were applied to trees in their second year of growth. After two more growing seasons, measurements of height and groundline diameter were taken to determine which treatments were most effective in promoting growth. Regardless of species, the 'herbicide only' and 'herbicide plus fertilizer' treatments significantly outperformed the 'fertilizer only' and 'control' treatments. The fertilizer only treatment provided the smallest increase in growth, although it was not statically different fromthe control. Loblolly pine showed the best growth for the period, although the study design does not allow statistical comparisons with shortleaf.

INTRODUCTION

Herbicides and fertilizers both play important roles in the establishment and growth of young pine plantations. Some research has shown that fertilizer has little or no effect on seedling growth in the first couple of years (3 Williams1998***), while others have shown that imazapyr tends to stunt growth for the first two growing seasons (1 Quicke***). One possible cause of early growth stunting with the use of fertilizer is that the accelerated growth of pines and competing vegetation cause a nutrient deficiency (2 Sword***). The herbicide stunting is a side-effect acknowledged by the manufacturer that can occur during periods of active growth.

This study looks at the effects of applying combinations of herbicide and fertilizer to both loblolly (*Pinus taeda*) and shortleaf (*Pinus echinata*) pines. Herbicide was applied in the form of imazapyr (as Arsenal AC) plus sulfometuron,(as Oust) to provide herbaceous weed control, while the fertilizer chosen was di-ammonium phosphate as a growth stimulant.

METHODS

The study site chosen is on nearly level uplands, with moderately well-drained soils in the Sacul series. The site indices at 50 years are 80 and 70 feet for loblolly and shortleaf pines, respectively. Approximately 8 acres were delineated by plow line in the spring of 1996, and the logging operation followed that summer. After logging, the debris was wind-rowed and burned. Before planting, a global positioning system (GPS) was used to trace the boundary and also to determine an east-west line that would divide the tract into approximate 4-acre blocks. The northern and southern blocks were planted with loblolly and shortleaf pines, respectively, in early April of 1997. The trees were planted between the wind rows on a 10' by 10' spacing.

Four treatments were selected for this study (Table 1): herbicide only, fertilizer only, herbicide plus fertilizer, and control. The herbicide treatments were mixed with water and applied at a volume of 15 gallons per treated acre. The manufacturer recommends 6 to 10 ounces of Arsenal (along with 2 ounces Oust) per treated acre, but a previous study showed that 4 ounces per treated acre to be equally effective (4 Williams1996***). Treatments were applied with a CO_2 backpack sprayer in a 5-foot band over the top of the seedlings in March 1998. Fertilizer treatments were applied in granular form and distributed by hand in a 5-foot wide band centered over the seedlings in early April 1998. Di-AmmoniumPhosphate (DAP), at 18-46-00, was chosen to provide 45 pounds of nitrogen and 50 pounds of phosphorous per treated acre.

Because there is only one planting site, the loblolly and shortleaf areas were considered separate and will be analyzed that way. In March 1998, study plots were established for each species in a randomized complete block design with four treatments. There are four blocks and, in these, four treatment rows were selected so that there was one buffer row in between treated rows. Treatments were randomly assigned to each row in the block. A treatment row consists of fifteen measurement trees.

Initial measurements for seedling height and groundline diameter (GLD) were taken in March 1998. One and two growing seasons after establishment of the study, the measurements were repeated. Height was measured with a meter stick to the nearest centimeter. GLD was measured using a dial caliper to the nearest millimeter.

Data for each species were analyzed separately using SAS (Proc GLM, SAS Instutute, Inc. Cary, NC) according to a randomized complete block design with subsampling. Analysis of variance was used to determine whether any differences existed in height or GLD among treatments; any differences between means were separated using Tukey's honestly significance difference procedure.

RESULTS AND DISCUSSION

Shortleaf. Analysis of variance showed that the overall F-test was significant for both height and diameter growth. This indicates that there are differences among treatments. Using the Tukey's procedure to separate the means, a similar pattern emerges for height and diameter growth. In both, the treatments containing herbicide grew much greater than those treatments without (Table 2). Treatments 1 and 3 averaged over 140 centimeters of height growth for two season period, as compared with just over 90 centimeters for treatments 2 and 4. The differences were significant at "=0.05. Diameter growth for treatments 1 and 3 averaged nearly 30 millimeters for the same two year period, while treatments 2 and 4 only managed 13 and 16 millimeters, respectively.

Loblolly. Analysis of variance once again showed that the overall F-test was significant for both height and diameter growth, indicating that there are differences among treatments. The Tukey's mean separation test was used to determine which treatments varied for height and diameter growth. As before, the treatments containing herbicide grew much greater than those treatments without (Table 2). Treatments 1 and 3 averaged nearly 180 centimeters of height growth for the two years, as compared with 104 and 114 centimeters for treatments 2 and 4, respectively. The differences were significant at "=0.05. Diameter growth for treatments 1 and 3 averaged nearly 37 millimeters for the same two year period, while treatments 2 and 4 only averaged 18 millimeters.

While the study design did not allow valid statistical comparisons between shortleaf and loblolly pines, one can make some casual observations. Loblolly outgrew shortleaf by approximately 25 percent in height and diameter for those treatments containing herbicide. For treatments without herbicide, the percentage was generally less.

CONCLUSIONS

Overall, the significant growth gains for height and diameter were achieved with the use of herbicides; both loblolly and shortleaf showed the same pattern. The addition of a fertilizer application with the herbicide added no significant height or diameter growth. In fact, the 'fertilizer plus herbicide' treatment grew slightly less than the herbicide treatment alone. The fertilizer only treatment grew less than the control, suggesting that application of fertilizer, either by itself or in conjunction with a herbicide, in the beginning stages of a pine rotation is not cost effective.

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Table 1. Summary of treatments for the study.

Treatment No.	Herbicide amount / ac	Fertilizer amount / ac
1	2 oz Oust + 4 oz Arsenal	-----
2	-----	250 lbs DAP
3	2 oz Oust + 4 oz Arsenal	250 lbs DAP
4	-----	-----

Table 2. Comparison of mean height and groundline diameter growth after two growing seasons[1]

Treatment	Shortleaf Height (cm)	Shortleaf GLD (mm)	Loblolly Height (cm)	Loblolly GLD (mm)
Herbicide only	143.1 A	30.0 A	182.4 A	38.0 A
Fertilizer only	90.5 B	13.6 B	104.5 B	17.4 B
Herb + Fert	140.2 A	29.4 A	178.0 A	36.2 A
Control	98.4 B	16.1 B	114.1 B	18.6 B

[1]Means within a column sharing a letter are not significantly different ("=0.05)

EFFECTS OF SITE PREPARATION, HERBICIDE, AND FERTILIZER ON LOBLOLLY PINE SEEDLING GROWTH IN SE ARKANSAS - 4 YEAR RESULTS. R.A. Williams and J.A. Earl. Arkansas Agricultural Experiment Station and School of Forest Resources, University of Arkansas at Monticello, 71656.

ABSTRACT

Herbicides are used to control competing vegetation, either herbaceous or woody, in newly established loblolly pine plantations. Additionally, fertilizer applications have provided additional growth responses in planted pine seedlings. The objective of this study was to compare various combinations of herbicide and fertilizer treatments in newly planted loblolly pine plantations in southeast Arkansas. The herbicide and fertilizer treatments were applied over two site preparation treatments. This study compared the results of herbicide and fertilizer treatments on "flat planting," meaning shearing only and "bedding," where the site was sheared and bedded in a one pass operation. Herbicides included Oust and Arsenal applied at 2 and 4 ounces per acre. Fertilizers included DAP (DiAmmonium Phosphate) and TSP (Triple Super Phosphate). Fourth year measurements showed that seedlings receiving the herbicide and fertilizer treatments significantly outgrew seedlings without treatment. Seedlings receiving just herbicides to control competing vegetation had significantly more growth than untreated control seedlings, but less than seedlings receiving herbicide and fertilizer. Pine seedlings receiving fertilizer without herbaceous vegetation control did not out preform untreated seedlings.

INTRODUCTION

Initial growth and survival of loblolly pine seedlings can be improved by controlling competing vegetation (1,4). Many mechanical site preparation methods do not reduce competing vegetation. This study examined two mechanical site preparation methods followed by herbaceous weed control and fertilization. One method was a shearing operation which was termed "flat plant" and the other is bedding. Flat plant areas were site prepared by shearing only. Bedding was accomplished using a shear blade and bedder in a one pass operation. Originally it was hoped that this study would be used to compare flat plant versus bedded plots. But due to protocol changes made before the study was implemented, there were not enough similar treatments to make a fair comparison. So instead, this report will focus on the results of the herbicide and fertilizer treatments compared with herbicide only treatments and untreated control areas. Observations of pine seedling growth on the bedded and flat plant sites will be discussed without statistical inference.

Fertilization is another silvicultural operation that can be used to enhance pine growth and development. Ford (2) noted that fertilization represents one of the most cost-efficient treatments to accelerate stand development and growth. Compared to control plots, fertilizer additions increased basal area growth by 1.1 to 3.4 ft^2/ac/yr (3). This study examines the effects of herbicides and fertilizers applied on newly planted loblolly pine stands in southeastern Arkansas and the effects of only applying fertilizers to young pine seedlings.

METHODS

The two sites chosen for the study are both in Ashley County, AR and both contain the somewhat poorly-drained, slowly-permeable Calloway series soil. The loblolly pine site index for this soil is 80 feet at 50 years. The site east of Highway 425 is level or nearly level; the site west of Highway 425 has slopes of 1-3 percent and a slight drainage running down the middle. In the fall and winter of 1994/95, both sites were site-prepared and planted. On each site, the complete study area was burned and then site prepared. On each site, about 85 percent of the area was sheared/bedded with a V-blade and bedding plow and the other 15 percent was sheared only. In February 1995, the study areas were planted with improved loblolly pine (*Pinus taeda*) seedlings at a spacing equivalent to 450 trees per acre. On the bedded areas, strips no less than seven rows wide were delineated and three reps were set up along each strip to receive the same treatment. Each row was randomly assigned a treatment; since both sites were flat (or nearly so), each plot within the row was not assigned randomly. Each plot was five rows wide by nine trees long (45 seedlings) and measured 1/10 of an acre in area. There was a minimum 14-foot buffer around the perimeter of each plot.

Five treatments were selected for testing on the bedded plots, while there were only three on the flat plant plots. Table 1 summarizes all bedded and flat plants treatments. A total of 2,700 treated or untreated seedlings were measured in this study. Fertilizer treatments included 250 lbs. per acre of DAP (DiAmmonium Phosphate) or 250 lbs. per acre of TSP (Triple Super Phosphate) which were applied with a hand held spreader. The herbicide mixture included 2 ounces of Oust and 4 ounces of Arsenal which was applied on plots receiving herbicide treatments. Herbicides were mixed with water to a total mixture volume of 15 gallons / treated acre. Using a CO_2 back-pack sprayer, herbicide treatments were applied in a 5-foot band centered over-the-top of loblolly pine seedlings. There was an equal number of untreated control plots compared with the herbicide and fertilizer treatments.

Trees were measured for heights and ground-line diameters at the end of the first growing season and again at the end of the second growing season. In February 1999, tree height and ground line diameters were measured which represented four complete growing seasons. This study is comparing the pine seedlings growth during the last two growing seasons (97-98 growing seasons). Heights were measured using a meter stick to the nearest centimeter; diameters were taken using a caliper to the nearest millimeter. Survival was computed as a percentage of live trees at the end of the fourth year over the total number planted.

Once the field work was over, data were entered into a spreadsheet and then exported into a text file for use in statistical processing. Data were analyzed using SAS (Proc GLM, SAS Institute, Inc., Cary, NC) according to a randomized complete block design. Analysis of variance was used to determine any differences in heights, diameters and survival by treatment. Means were separated using Ryan-Einot-Gabriel-Welsch multiple range test. Effects were considered significant at the 0.05 probability level.

RESULTS AND DISCUSSION

Flat Plant Plots

There were only two treatments and one untreated control on flat plant plots, and Table 2 summarizes the results. The one result that really stands out is the fourth-year height growth–where herbicide plus fertilizer produced a highly significant one-and-a-half times more height growth than untreated control. Both treatments did a significantly better job in increasing pine seedling height growth compared to untreated seedlings. This result was significant at the 95 percent level.

Ground-line diameter growth was definitely better for the herbicide plus fertilizer treatment, compared to ground-line diameter growth of seedlings treated with herbicide only or the control seedlings, although the differences were not as dramatic as height growth (Table 2). The average ground-line diameter growth of seedlings with herbicide and fertilizer was 9.6 millimeters greater than control seedlings and 4.1 millimeters greater than seedlings treated with herbicide only. These differences were statistically significant. Again, seedlings receiving herbaceous weed control vastly out-performed seedlings without weed control.

The survival rates were fairly similar, with the herbicide plus fertilizer treatments just slightly ahead of herbicide alone (76% and 71%, respectively). The treated plots survived better than untreated controls at a rate of 73% to 66%.

Bedded Plots

The bedded plots had two herbicide/fertilizer treatments, one herbicide only treatment, one fertilizer only treatment, and one untreated control. Table 3 summarizes the results. Both herbicide/fertilizer combinations significantly outperformed all other treatments in both height and diameter growth. In height growth, the herbicide plus DAP seedlings averaged only 2.6 cm more growth after the fourth second growing season than the herbicide plus TSP. The herbicide plus TSP treatment averaged 12.3 cm more height than just herbicide alone. Herbicide alone average nearly 26.3 cm more than TSP only and 33.2 cm more that control seedlings. A change occurred from the first reported measurements in that TSP plus herbicide were much closer to seedlings receiving DAP and herbicide. Fertilized only seedlings slightly outgrew untreated seedlings, but the difference was not significant. In fact, the untreated control averaged just slightly more than the TSP only treatment after the first reported measurements.

As with height growth, all treatments containing herbicide significantly outperformed seedlings without herbicide treatments in ground-line diameter growth (Table 3). Both herbicide/fertilizer treatments were nearly equal (50 mm and 49 mm), and both were statistically better than just herbicide alone (46 mm). Again, TSP and control seedlings were significantly lower at around 40 and 39 mm diameter growth, respectively. Seedlings treated with herbicides to control competing vegetation significantly outgrew seedlings without treatment.

Survival rate did not follow the patterns of height and diameter growth. The highest survival rate came from the herbicide only treatment at 90%. All treatments survived at least 80% and the untreated control was right in the middle at 85%. When comparing treated plots versus untreated, the survival rate was essentially equal.

CONCLUSIONS

It is unfortunate that a better comparison cannot be made between bedded and flat plant sites. A quick glance at the results indicate that bedded plots did far better than flat plant ones, at least for the two treatments that were applied on both the bedded and flat plant prepared areas. However, these results come at an increase in cost: the most recent figures show that bedding costs about $50 per acre which may be offset if the accelerated growth response decreases rotation length or the timing of the first thinning.

On flat plant sites, it is definitely better for height and diameter growth to have some kind of treatment as opposed to an untreated check. The herbicide/fertilizer treatment grew more than one and a-half times the control seedlings. The seedlings receiving herbicide alone produced significantly more growth than no treatment. For diameter growth, both treatments produced significantly more growth than the untreated seedlings.

The bedded sites had similar results as the flat plant sites, only that growth was even greater. Seedlings treated with herbicides and fertilizer or herbicide alone significantly outgrew the untreated seedlings. On bedded sites, it was interesting to note that seedlings receiving the TSP only treatment actually produced statistically the same height and diameter growth as the untreated seedlings. Apparently, the fertilizer stimulates the growth of all competitors as well as the seedlings. One has the cost of the fertilizer without the benefit of additional seedling growth. With no herbaceous weed control, fertilizers should not be applied to pine seedlings in southeast Arkansas.

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ADDENDUM

The above results were analyzed using conservative statistical methods to minimize outside sources of error. Only by doing this can differences in treatments truly represent the effects of herbicide, fertilizer or site preparation. This study was not established well enough to allow good comparisons between treatments across site preparations, and therefore no mention was made between flat plant versus bedding for the same treatments. All comparisons were made between herbicide/fertilizer, herbicide only, fertilizer only and/or control. However, there are some interesting comparisons that can be made, although some of the differences may be attributed to outside sources.

In every comparison, seedlings on the bedded sites outgrew ones planted on flat sites. Table 4 shows that regardless of the treatment, pine seedlings did better when planted areas that were bedded. Height growth on beds averaged greater than thirty percent more growth compared to flat planted trees. Diameter growth was even more impressive at fifty percent more growth on bedded sites compared to flat sites.

Table 1. Amounts of herbicide and fertilizer used with each treatment

Treatment	Herbicide (per acre)	Fertilizer (per acre)	Flat Plant	Bedded
Control	-----	-----	Y	Y
Herbicide Only	2 oz Oust + 4 oz Arsenal	-----	Y	Y
Herbicide + DAP	2 oz Oust + 4 oz Arsenal	250 lbs DiAmmonium Phosphate (18-46-00)	Y	Y
Herbicide + TSP	2 oz Oust + 4 oz Arsenal	250 lbs Triple Super Phosphate (00-46-00)	N	Y
TSP Only	-----	250 lbs Triple Super Phosphate (00-46-00)	N	Y

Table 2. Fourth-year mean height and ground-line diameter results for flat plant plots.[1]

Treatment	Height Growth (cm)	Ground-line Diameter Growth (mm)	Survival (%)
Herbicide + DAP	144.7 A	35.8 A	75
Herbicide Only	126.5 B	31.7 B	71
Untreated Control	95.7 C	24.2 C	66

[1]Means for each treatment within a column sharing a letter are not significantly different based on Ryan-Einot-Gabriel-Welsch multiple range test, $p \geq 0.05$.

Table 3. Second-year mean heights and ground-line diameter for bedded plots.[1]

Treatment	Height Growth (cm)	Ground-line Diameter Growth (mm)	Survival (%)
Herbicide + DAP	182.7 A	50.1 A	80
Herbicide + TSP	179.1 A	49.0 A	87
Herbicide Only	166.8 B	46.0 B	90
TSP Only	140.5 C	40.2 C	85
Untreated Control	133.6 C	39.8 C	83

[1]Means for each treatment within a column sharing a letter are not significantly different based on Ryan-Einot-Gabriel-Welsch multiple range test, $p \geq 0.05$.

Table 4. Fourth-year mean height and ground-line diameter comparison for bedded and flat plant plots.

Treatment	Height Growth (cm)		Groundline Diameter Growth (mm)	
	Bedded	Flat Plant	Bedded	Flat Plant
Herbicide + DAP	182.7	144.7	50.1	35.8
Herbicide Only	166.8	126.5	46.0	31.7
Untreated Control	133.6	95.7	39.8	24.2
All Treatments Combined	161.0	122.3	45.3	30.5

OPERATIONAL ASSESSMENT OF VELPAR L IMPREGNATION OF DAP FERTILIZER FOR SECOND YEAR WEED AND FEED APPLICATIONS. W.D. Mixson and S.S. Rogers. Dupont Co. Pensacola, FL and Pro-Source One, Helena, AL.

ABSTRACT

Intensive forest management practices have increased dramatically over the past several years. Two cultural treatments utilized by forest managers to realize and increase site productivity include herbaceous weed control and fertilization. The ability to integrate these two practices, as a simultaneous application would result in increased operational efficiency and cost savings.

An operational trial was established to evaluate the practice of "weed and feed" applications in the Interior Flatwoods of Sumter County Alabama. An 80-acre tract was selected that offered consistent soil attributes and vegetative competition. The established stand was beginning its 2nd growing season at the time of application. Site preparation had consisted of a burn and a one pass bedding plow. First year herbaceous weed control consisted of 2 oz Oust + 4 oz Arsenal AC applied in a 4-foot band over the beds in April 1998 (single nozzle backpack application). The study site consisted of three assessment areas: 1) 200 lbs/acre DAP fertilizer 2) 200 lbs/acre DAP fertilizer impregnated with 1 qt/l00 Velpar L herbicide 3) Untreated.

Velpar L + DAP was formulated by Pro-Source One (Terra) at their Atmore location and transported by tender trailer to the airstrip in Sumter County. Application was made on May 12, 1999 using a Turbine Thrush fixed wing aircraft and a Breckenridge spreader. Application was made with a racetrack swath pattern 55/60 feet wide. There were no special preparations in terms of patterning or calibration of the application equipment.

Prior to "weed & feed" applications height and D6 measurements were taken to establish base line information. After one growing season DAP+Velpar >Untreated > DAP Only. Diameter growth in the DAP + Velpar was dramatically different than the other areas. Height growth was only slightly better.
Second year survival was 100% in all areas. This site will be followed through 4 growing seasons (age 5).

LONGLEAF PINE *PINUS PALUSTRIS* RESPONSE AND HERBACEOUS WEED CONTROL EVALUATIONS ON A CONVERTED PEANUT FIELD IN SOUTHEAST ALABAMA. D.C. Sloan and W.D. Mixson, Dupont Co. New Orleans LA and Pensacola FL.

ABSTRACT

Increased interest in Longleaf Pine ecosystem restoration as well as favorable treatment from government cost-share programs has led to a significant amount of cropland conversion to Longleaf pine in Southeast Alabama. This particular site had previously been in peanut production for the past several years. Twelve (12) herbicide or herbicide combinations were looked at to determine seedling tolerance and growth response. Weed control evaluations were also made 120 days after treatment.

The site is a very well drained loamy sand. Peanuts were harvested, the site was disked and then planted with containerized Longleaf seedlings in the late fall/early winter of 1998. Weed species were typical of agricultural field conversion sites with the additional problem of residual peanuts that germinated after disking.

Herbicides tested included Oust, Arsenal AC, Velpar L, DPX-R6447(Azafenadin), DPX GH427 (Hexazinone + Sulfometuron) as well as selected tank mixes of these products. DPX-R6447 was formulated as an 80% dry flowable with the active ingredient Azafenadin. DPX-GH427 was formulated as a non-segregating blend of 63.2% Hexazinone + 11.8% Sulfometuron methyl. Herbicides were applied at 20 GPA spray solution using a CO2 hand held sprayer equipped with four 8002 nozzles spraying a 5 foot band. Treatments were replicated three times. All seedlings within the 66 ft treatment strips were pin flagged. Applications were made 4/6/99.

Seedlings were evaluated from 0-5 depending on growth and vigor. 0=dead, 1=brown,2=green with twisted needles,3=green ,4=green with new growth.

Using the seedling ratings a seedling improvement index was derived. If trees were as good or better than initial ratings 120 days after treatment they were counted as "improved" (treatments were not penalized for initial dead seedlings). All herbicide and herbicide combinations showed exceptional improvement of Longleaf seedlings except the untreated check, Arsenal AC at 6 oz/acre and DPX-R6447 10 oz/acre. Weed control was also poor for these treatments. Treatments that stood out in terms of weed control were 1) DPX-GH427 (Hexazinone + Sulfometuron) + Arsenal AC (10 oz + 2 oz) 2) DPX-GH427 + Oust (10 oz + 1.5 oz) and 3) Velpar L + Oust, 27 oz + 1.5 oz. Weed control, rated as % bare ground 120 days after treatment was 58%, 75% and 60% respectively. First year survival was similar for all treatments, including the untreated check.

PESTICIDES USED IN FORESTRY AND THEIR IMPACTS ON WATER QUALITY. J.L. Michael. USDA Forest Service, Southern Research Station, Auburn, AL 36849.

ABSTRACT

Approximately 2.1 billion kg active ingredient (a.i.) of pesticides are used in the US annually. Of the 890 a.i.s registered, 20 account for more than 95% of the pesticide used in forest vegetation management. Forest vegetation management, in the broader context, includes such activities as plant protection from animal, insect, bacterial, and fungal damage. It also includes pesticide uses for noxious weed control, conifer and hardwood culture, and improvement of recreational areas and wildlife habitat. Pesticide use is most intensive around home and gardens, followed by agricultural land, governmental and industrial land, and is least intensive on forest land. The most extensive use is on agricultural land. Contamination of surface and ground water have been monitored and observed to occur at relatively low levels. Maximum pesticide concentrations observed in water have been much lower than the maximum levels which EPA considers safe for consumption on a daily basis over a lifetime (HAL). Some studies have applied herbicides at several times the labeled rate directly to surface water in research studies. In some of these studies maximum herbicide concentrations observed in ephemeral to first-order streams exceeded the lifetime HAL, but were ephemeral lasting only a few hours and the highest concentrations did not exceed EPA's 1-day HAL. Even with the widespread use of pesticides in North America, those typically used in vegetation management programs have not been identified in surface or groundwater at sufficiently high concentrations as to impair drinking water quality. Their rapid break-down by physical, chemical, and biological routes coupled with current use patterns precludes the development of significant water contamination problems unless they are applied directly to water. Therefore, their use should be carefully planned and all agency, local, state, and federal laws should be followed. It is especially important to follow all label directions because pesticide labels are legal documents specifying federal laws pertaining to their use. Best management practices should be carefully adherred to and use around drinking water supplies should be avoided, except where permitted by

the label. Wherever pesticides are used, precautions should always be taken to protect drinking water sources from contamination.

INTRODUCTION

On forest and range land, management often must protect desirable vegetation from pathogens, competing vegetation, insects, and animals. Vegetation also is managed to clear road and utility rights-of-way, to improve recreation areas and wildlife habitat, and to control noxious weeds. Pesticides offer inexpensive and effective ways of getting these jobs done.

The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) allows the registration of pesticides for use in the U.S. The registration process is an extraordinary one which requires years of testing before sufficient efficacy, environmental safety, toxicology, and public safety data can be collected and evaluated in the support of registration of a new pesticide. While this process is designed to assure safety, new and old pesticides, following registration, continue to be studied by researchers in private, state, and federal agencies in an effort to identify any potential environmental or toxicological problems. This extremely thorough process has led to the registration of the safest pesticides possible with the caveat that to maintain this safety they must be applied according to directions approved by the U.S. Environmental Protection Agency (U.S. EPA) and included on the label of every registered pesticide. Currently there are about 890 active ingredients registered under FIFRA, most of which are conventional pesticides. These conventional pesticides represent about 21% of the total quantity of pesticides used annually while the remaining 79% of the 2.1 billion kg are a small group not normally thought of as pesticides (chlorine/hypochlorites, specialty biocides, petroleum, sulfur, and wood preservatives), but which are regulated under the authority of FIFRA (1).

A number of issues surround all pesticide use. Among them are (1) drinking water quality, (2) aquatic ecosystem impacts, (3) health effects of 'inerts', and (4) non-target species effects. In considering the impacts of pesticides on drinking water quality we will consider use patterns, pesticide contamination of surface and ground water, and the toxicology associated with those levels of contamination.

USE PATTERNS

Resistance to pesticide use in forestry generally focuses on perceived risks based on toxicology and stream contamination. The resistance to use of pesticides may arise in part from the writtings of authors concerned over the wide-scale use of pesticides on agricultural and forest sites and their potential adverse environmental impacts. This approach fails to recognize the far more intensive use by individuals and the potential adverse health impacts that accrue from that use. Two reports give similar statistics for pesticide use in the US (1, 28). Approximately 16 percent of the 9.3 million square kilometers of land in the United States is treated with pesticides annually (28). The most intensive use of pesticides occurs on land occupied by households. Households represent 0.4 percent of all land and receive 11-12 percent of all pesticides used in the US. Agricultural land (52 percent of all land) is the next most intensively treated receiving 75-77 percent of all pesticides used. Government and industrial land (16 percent of all land) receives 12 percent of all pesticides. The least intensive use of pesticides occurs on forest land (32 percent of the land). Pimentel and Levitan (28) point out that forest land receives only 1 percent of all pesticides used and that less than 1 percent of all forest land is treated annually. In the United States of America, National Forest System (NFS) land is treated with even smaller amounts of pesticides. Since 1990, less than 0.3 percent of NFS land received some form of pesticide treatment annually. As an example, data from 1997 indicates 120,674 of the 77.7 million ha of NFS land (approximately 0.16 percent) was treated with a total of 91,101 kg of active ingredient (43). The amount of pesticide used and the number of acres treated varies slightly from year to year.

It is difficult to determine exactly how much of each kind of pesticide is used in forest management in the private sector because of the proprietary nature of that information. It is clear that pesticide use, especially herbicide use, is more common on production forests than on NFS land. In the 12 southern states, herbicide use increased 53% from 1996 to 1998 and a total of 256,345 ha were reported treated with herbicides in 1998 (8). Most of this land was aerially sprayed (80 %) while the remainder was treated by mobile ground equipment or backpack sprayer (8).

Pesticide use in the public sector is well documented and the information is readily available. While vegetation management is frequently taken to mean the control of competing vegetation in timber management programs, there are many aspects of the broader context of vegetation management as practiced on NFS land. Nation-wide, 120,552 ha of NFS land were treated with pesticides in 1997 (43) while only 48169 ha were treated with herbicides (including also plant growth regulators and algicides). On NFS land, more area was treated to protect vegetation from animals (26 percent of all treated land) and insects (22.3 percent), and to control noxious weeds (19.5 percent) than for control of competing vegetation (17.9 percent) in FY97. Table 1 lists the use of pesticides on NFS land in 1997 by type and management objective.

PESTICIDE CONTAMINATION OF SURFACE AND GROUND WATER

Pesticides used in forest vegetation management are used around the world in agricultural, forest, range, and urban applications. Some have been found in surface water, shallow groundwater, and even in shallow wells (less than 10 m), but in concentrations far below levels harmful to human health and the occurrence is infrequent. Table 2 summarizes reports of pesticides most used in forest vegetation management that have been detected in water in the U.S. The 20 pesticides most used on NFS land in vegetation management (Table 3) represent more than 95% of all active ingredient applied to NFS land in 1997.

Reports of pesticide contamination of water are usually from agricultural (14, 15) or urban applications (3), but the potential exists for contamination from forest vegetation management. Water from forests is generally much less contaminated than water from other land uses. However, several studies on forest sites listed in Table 2 present data for water collected directly from treated areas. The concentration of pesticides from some of these sites is high compared to samples taken from large rivers and lakes. Pesticide concentrations are greatly reduced by dilution as they move from the treated sites to downstream locations. Degradation of pesticides by biological, hydrolytic and photolytic routes also contributes to downstream reductions in pesticide concentrations.

Larson and others (16) summarized the results of 236 studies throughout the United States on pesticide contamination of surface water by listing the maximum observed concentrations from each study. These studies were located principally around large river drainage basins and therefore represent cumulative pesticide contributions from a variety of uses. Monitoring results were reported for 52 pesticides approved for agricultural, urban and forestry use and their metabolic byproducts. Only six of the pesticides most used in vegetation management were reported to be present in surface water by Larson and others (16). They were carbaryl, 1 report; hexazinone, 1 report; chlorpyrifos, 3 reports; picloram, 4 reports; dicamba, 5 reports; and 2,4-D, 24 reports.

From 1985 to 1987, Cavalier and others (6) monitored 119 wells, springs, and municipal water supplies for occurrence of pesticides throughout the State of Arkansas. The wells were mostly located in eastern Arkansas, with 8 wells located in the Ouachita National Forest. Only wells considered highly susceptible to pesticide contamination were monitored. They included domestic, municipal, and irrigation wells. The laboratory detection limits for the 3 forestry pesticides (2,4-D, hexazinone, and picloram) were 70 to 800 times lower than their HALs. They did not detect well water contamination from any of the 18 pesticides monitored. Failure to detect pesticides in these high risk wells strongly indicates that ground water is not at risk from forestry pesticides applied according to label directions.

Michael and Neary (20) reported on 23 studies conducted on industrial forests in the South in which whole watersheds received herbicide treatment. Water flowing from the sites was sampled near the downstream edge of the treatments. The watersheds were relatively small (less than 300 acres) and the ephemeral to first-order streams draining these watersheds were too small to be public drinking water sources, but their flow reached downstream reservoirs. The maximum observed hexazinone, imazapyr, picloram, and sulfometuron concentrations in streams on these treated sites did not exceed HALs, except for one case in which hexazinone was experimentally applied directly to the stream channel. Even in this case in which hexazinone was applied directly to the stream at a very high rate, drinking water standards were exceeded for only a few hours. In another study, picloram was accidentally applied directly to streams, but maximum picloram concentrations did not exceed HALs during the year after application.

Bush and others (5) reported on use of hexazinone on two coastal plain sites (deep sand and sandy loam soils) that were monitored for impacts on groundwater. Hexazinone was not detected in groundwater at the South Carolina site for 2 years after application. In Florida, hexazinone was found infrequently in shallow test wells at concentrations up to 0.035 mg/L, much lower than the safe levels for daily exposure (0.400 mg/L). Water from these sites drains into other creeks and rivers, and is diluted before entering reservoirs.

Michael and others (21) reported the dilution of hexazinone downstream of treated sites. One mile below the treated site, hexazinone concentrations were diluted to 1/3 to 1/5 the concentration observed on the treated site. Hexazinone was applied for site preparation at 6 lb ai/ac to clay loam soils, a rate three times the normal, and it was applied directly to a stream segment, resulting in a maximum observed on-site concentration of 0.473 mg/L. This was slightly more than the lifetime HAL but considerably below the longer-term HAL of 9.0 mg/L (36). Following the application, on-site stream concentrations did not exceed the lifetime HAL.

Norris (26) reported contamination of streamflow with dicamba used for control of hardwoods on silty clay loam soils in Oregon. On a 603 acre watershed, 166 acres were aerially sprayed with 1 lb ai/ac of dicamba. A small stream segment was also sprayed causing detectable dicamba residues 2 hours after application began, approximately 0.8 miles downstream. Concentrations rose for approximately 5.2 hrs after treatment began and reached a maximum concentration of 0.037 mg/L, less than a fifth of the HAL (0.200 mg/L). No dicamba residues were detected beyond 11 days after treatment.

Glyphosate and 2,4-D have aquatic labels, which permit direct application to water. Stanley and others (30) found that when 2,4-D was applied to reservoirs for aquatic weed control, about half of water samples from within treatment areas contained 2,4-D, and the highest concentration (0.027 mg/L) was less than half of the HAL (0.070 mg/L). Newton and others (25) aerially applied glyphosate at three times the normal forestry usage rate (4 lbs ai/ac), no buffers were left, and all streams and ponds were sprayed. Initial water concentrations were 0.031 and 0.035 mg/L in Oregon and Georgia, and 1.237 mg/L in Michigan on the day of application. After day 1, glyphosate concentrations dropped to below 0.008 mg/L on all three sites for the duration of the study. HAL was exceeded on only one of three sites and then for only 1 day, the day of application.

There is little information on the movement of metsulfuron to streams. Michael and others (19) found trace residues of metsulfuron in shallow monitoring wells in Florida where 24 wells were sampled to a depth of 6 feet. Metsulfuron was detected (0.002 mg/L) in 1 of 207 samples collected during 2 months after application.

Pesticide movement into streams is well documented, but movement into ground water is not as well researched. Movement of pesticides into ground water should result in much lower concentrations than observed in surface water. Pesticides must pass through several physical barriers or layers before reaching ground water. As pesticides pass through each layer, they are degraded, diluted, etc. Surface water provides a medium for dilution, hydrolysis, metabolism, and photolysis. Aquatic vegetation can also degrade pesticides by metabolism. Microbes associated with coarse and fine particulate organic matter found naturally in streams also metabolize pesticides.

In order for water on the soil surface to carry pesticides into ground water, it must pass through the soil column. Here again, processes work to reduce the potential for pesticides to reach ground water. Pesticides percolating through the soil column are adsorbed to soil particles, reducing the amount reaching the ground water. Pesticides adsorbed onto soil particles may be irreversibly bound, released slowly, or further metabolized by microbes. Once pesticides reach ground water, they may degrade further. Cavalier and others (7) found that naturally-occuring microbes degraded herbicides, including 2,4-D, in ground water.

Thus, ground water concentrations of pesticides should be considerably lower than observed in surface water. Funari and others (11) reviewed the literature and reported the range of maximum concentrations of pesticides in ground water, including those used in forestry, agriculture, home and garden, and on industrial rights-of-way. The maximum range of values for 2,4-D (0.0002-0.0495 mg/L), hexazinone (0.009 mg/L), and picloram (0.00063-0.049 mg/L) are much lower than the HALs for those compounds.

The National Water-Quality Assessment (NAWQA) Program conducted by the U.S. Geological Survey began in 1991. The focus of NAWQA is to identify nutrient and pesticide contamination of the water resource throughout the United States. The 1999 NAWQA report (http://water.usgs.gov/pubs/circ/circ1225/index.html) makes little mention of forest sites or forestry pesticides, but concludes that: "Concentrations of nutrients and pesticides in streams and shallow ground water generally increase with increasing amounts of agricultural and urban land in a watershed." The report focused on more than 50 major river basins and aquifers supplying water to more than 60 percent of the population and approximately half of the United States. Few forestry pesticides other than 2,4-D are mentioned in these basins or aquifers.

Even in dominantly agricultural areas, the report states: "One of the most striking results for shallow ground water in agricultural areas, compared with streams, is the low rate of detection for several high-use herbicides other than atrazine. This is probably because these herbicides break down faster in the natural environment compared to atrazine." Atrazine is principally used in growing corn, but also has applications for general weed control in a host of areas including rangeland, pastures, and turf grass sod. It has not been used on NFS land since 1992. While not directly addressing forestry pesticides and drinking water, these NAWQA conclusions support the above research findings and conclusions that ground water contamination by pesticides should be lower than observed for surface water. Because surface water contamination from forest sites treated according to label directions does not exceed HALs, it is unlikely that ground water contamination would exceed HALs.

Several of the pesticides in Table 3 have not been reported in water. They include chloropicrin, chlopyralid, dazomet, and thiram. Chloropicrin and dazomet are soil fumigants which are gases in their active form and are used only for seedling production. Chlopyralid is a relatively new compound in the U.S. Thiram is a dimethyl dithiocarbamate fungicide, principally used in forestry for seed protection.

There is very little water quality data for pesticides used in nursery disease control and soil fumigation. More than 71 percent of fungicides and fumigants used on NFS land are applied in nurseries. Intense use in a nursery may result in localized groundwater contamination. Three pesticides (chloropicrin, dazomet, and methyl bromide) make up this group of intensively used agents. Chloropicrin is toxic to plants and is used in combination with other chemicals for fumigating seedbeds. Dazomet, a soil fumigant, is a gas and relatively insoluble in water (3 g/L). However, dazomet is unstable in water and quickly breaks down into methyl isothiocyanate (MITC), formaldehyde, monomethylamine, and hydrogen sulfide. All are toxic, but the most toxic is MITC. The RfD for formaldehyde is 0.2 mg/kg/d. EPA has classified formaldehyde as a compound of medium carcinogenic hazard to humans. Methyl bromide is very toxic. Data are insufficient to determine whether frequent use of these three pesticides adversely impacts water quality, either locally or over an expanded area.

TOXICOLOGY

One major issue with pesticide use is the impact on drinking water quality. To adversely impact drinking water, pesticides must (1) be harmful to humans, and (2) reach drinking water at concentrations exceeding toxic levels for humans. The toxicity of a chemical is a measure of its ability to harm individuals of the species under consideration. This harm may come from interference with biochemical processes, interruption of enzyme function, or organ damage. Toxicity may be expressed in many ways. Probably the best known term is LD_{50}, the dose at which 50 percent of the test animals are killed. More useful terms have come into popular usage in the last decade: no observed effect level

(NOEL), no observed adverse effect level (NOAEL), lowest observed adverse effect level (LOAEL), reference dose (RfD), and, relating specifically to water, the health advisory level (HA or HAL). The U.S. EPA uses these terms extensively in risk assessment programs to indicate levels of exposure deemed safe for humans, including sensitive individuals. They are derived from toxicological test data and have built-in safety factors ranging upward from 10, depending on U.S. EPA's evaluation of the reliability of the test data.

The NOEL is determined from animal studies in which a range of doses is given daily; some doses cause adverse effects and others do not (38). NOAEL is derived from the test data where all doses have some effect, but some of the observed effects are not considered adverse to health. When U.S. EPA has data from a number of these tests, the lowest NOEL or NOAEL is divided by a safety factor of at least 100 to determine the RfD. The RfD is an estimate of a daily exposure to humans that is likely to be without an appreciable risk of deleterious effects during a lifetime.

Drinking water standards are calculated for humans by assuming that an adult weighs 70 kg and consumes 2 L of water per day, and a child weighs 10 kg and consumes 1 L of water per day over the period of exposure. HALs are calculated for 1-day, 10-days, longer-term (10 percent of life expectancy), or lifetimes (70 years) by dividing the NOAEL or LOAEL by a safety factor and multiplying the resulting value by the ratio of body weight to amount of water consumed daily (38). The safety factor can range from 1, but is rarely less than 10, and goes as high as 10,000, depending on the available toxicological data. A safety factor of 10 is used when good NOAEL data are based on human exposures and are supported by chronic or subchronic data in other species. When NOAELs are available for one or more animal species but not humans and good data for LOAEL in humans is available, a safety factor of 100 is used. When good chronic data are available identifying an LOAEL but not an NOAEL for one or more animal species, a safety factor of 1,000 is used. For situations where good chronic data are absent, but subchronic data identify an LOAEL but not an NOAEL, the safety factor of 10,000 is used. EPA's estimates of safe levels for daily exposure to the pesticides most widely used in forest vegetation management are summarized in Table 3. Of the pesticides listed in Table 3, only elemental boron (potentially from borax) and methyl bromide are listed in EPA's drinking water contaminant candidate list (CCL) for consideration for possible regulation. Maximum Contaminant Levels (MCLs) have been established for 2,4-D (0.070 mg/L), glyphosate (0.700 mg/L), and picloram (0.500 mg/L) and these are the same as the already established lifetime HALs (Table 3). Additional information on specific pesticides can be retrieved from the National Pesticides Telecommunication Network at http://ace.orst.edu/info/nptn, USEPA site at http://www.epa.gov/epahome/search.html, Extension Toxicology Network at http://www.orst.edu/info/extoxnet, Material Data Safety Sheets at http://siri.uvm.edu/msds, US Forest Service at http://www.fs.fed.us/foresthealth/pesticide, and many others.

None of the pesticide concentrations in water reported in Table 2 exceeded U.S. EPA safe levels for human health (lifetime HAL, Table 3) except where application included placement directly in stream channels, and most were less than 0.002 mg/L. Where concentrations of pesticides in surface water exceeded the lifetime HAL, they lasted only for a few hours and did not exceed the 1-day HAL. Thus, use of these pesticides has not resulted in impairment of drinking water or water that would feed into drinking water systems. It is important to recognize that surface water is not necessarily drinking water. The studies summarized by Larson and others (16) dealt with surface water, principally in lakes, reservoirs, and rivers, which would be treated prior to use for drinking.

DISCUSSION AND CONCLUSIONS

Care must always be exercised in extrapolating data from local studies on drinking water to a regional or larger scale. However three strategies of "worst-case" scenarios used in the studies described by Michael et al. (18, 19, 21), Michael and Neary (20), and Newton et al. (25) mitigate against high levels of uncertainty: (1) several studies have investigated the impacts of pesticides applied directly to surface water, (2) several studies have investigated the impacts on water of pesticides applied at several times the prescribed rate, and (3) most of the studies conducted specifically on forestry sites treated the entire catchment from which water samples were taken, resulting in samples with levels of pesticide contamination greater than are likely to occur anywhere downstream. Research which investigated the impacts of pesticides applied directly to surface water used the worst-case scenario for operational treatments in which pesticide was applied at normal rates directly to surface water (ponds and streams). These studies in forest sites did not find any contamination of water at levels above the HAL for individual chemicals. Research investigating aquatic impacts for pesticides applied at several times the labeled rate used the worst-case scenario for operational treatments where an area might receive multiple applications in error or where small spills occurred. In these studies, HALs were exceeded by only a few percent and then for only a brief period of time, usually less than a few hours. Both worst-case scenarios just described were combined with the third worst-case scenario in which all sampling was conducted on surface water found within the treated area. In this case most of the water was from small pools or ephemeral to first-order streams. While water from ephemeral to first-order streams or pools would not be used for drinking water sources because of the low yield, they do represent the water sources most likely to be severely contaminated during normal forest pesticide applications. However, even these sources were not contaminated at levels exceeding HALs except in the worst-case scenario in which pesticide was applied at several times the labeled rate as indicated above. In addition, data on contamination of water for the pesticides in Table 2 have been taken from a number of studies conducted in North America and the findings are generally similar. These studies have, with a few exceptions, confirmed the absence of significant contamination of drinking water. The exceptions were those cases in which a pesticide was applied directly to water, and the high concentrations observed in those studies were at or only slightly above drinking water standards. These high concentrations lasted only a few hours at most before dropping well below current HALs. It is clear from the available literature that use of pesticides in strict accordance with label directions on forest land cannot be expected to contribute significantly to groundwater or drinking water contamination. It is also clear that pesticides, unless clearly labeled for aquatic uses, must not be applied directly to water, and that pesticides should be used around water resources which are particularly sensitive only after careful consideration of the ramifications.

Even with the widespread use of pesticides in North America, those typically used in vegetation management programs have not been identified in surface or groundwater at sufficiently high concentrations as to impair drinking water quality. Their rapid break-down by physical, chemical, and biological routes coupled with current use patterns precludes the development of significant water contamination problems unless they are applied directly to water. Therefore, their use should be carefully planned and all agency, local, state, and federal laws should be followed. It is especially important to follow all label directions because pesticide labels are legal documents specifying federal laws pertaining to their use. Best management practices should be carefully adherred to and use around drinking water supplies should be avoided, except where permitted by the label. Wherever pesticides are used, precautions should always be taken to protect drinking water sources from contamination.

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Table 1. Percent of all treated land and pesticide active ingredient applied by pesticide type and vegetation management objectives for pesticides used on USFS lands in FY97. Data extracted from Table 10 of the Annual Report of the Forest Service (43).

Pesticide type Management objective	Treated Land	Active Ingredient
Fungicides and fumigants		
General disease control	10.7	8.2
Fumigation, nursery disease and fungus control	0.1	30.4
Herbicides, plant growth regulators, algicides		
Noxious weed control	19.5	17.5
Planting site preparation	10.0	21.5
Conifer release	7.2	12.0
Hardwood release	0.4	0.5
Nursery weed and disease control	0.3	0.7
Wildlife habitat	0.8	1.3
Rights-of-way	0.3	1.2
Hardwood control	0.2	0.2
Seed orchard protection, recreation improvement, aquatic vegetation control	0.1	0.3
Rodenticides, repellents, acaricides, insecticides, pheromones, predacides		
Animal damage control	26.0	2.9
Insect control-biological	22.1	NA
Insect control- chemical	0.3	0.6
Vector/plague suppression	0.6	0.03
Seed orchard protection, recreation improvement, fish eradication	0.1	1.5

NA-not applicable. The biological control agents Nucleopolyhedrosis virus and *Bacillus thuringiensis* are measured in terms of billions of international units and not kg.

Table 2. Frequency and occurrence of surface and ground water contamination from pesticide use in North America.

Pesticide	Water Type[1]	Location	Maximum (mg/L)	Range (mg/L)	Comments	Literature Citation
2,4-D	S	Large River Basins Throughout US	0.0075	0.00004-0.0075[2]	24 reports of mainly urban, sub-urban, agricultural sources	16
	S	Streams in Oregon and California	2.0	nd-2.0	Highest concentrations observed from forest areas where no attempt was made to prevent application to water.	27
	G	Saskatchewan, Can	0.0000007	ng	Natural spring flow	44
	G	Connecticut, Iowa, Kansas, Maine, Mississippi, South Dakota	0.049	0.0002-0.049	Well water samples except for South Dakota from shallow sand and gravel aquifer	11
Borax		nr	nr	nr	nr	nr
Carbaryl	S	Mississippi River	0.0001	ng	1 report	16
	S	New Brunswick, Can	0.314	ng	Aerial spray spruce budworm control	11
	S	New Brunswick, Can	0.314	0.123-0.314	Budworm control	12
Chloropicrin		nr	nr	nr	nr	nr
Chlorpyrifos	S	Mississippi River, the Lower Colorado River, rivers and lakes in Kansas, and irrigation ditches in California, Arizona, Nevada	0.00015	0.00004-0.00015	3 reports	16
Clopyralid		nr	nr	nr	nr	nr
Dazomet		nr	nr	nr	nr	nr
Dicamba	S	USFS land near Hebo, OR	0.037	0.006-0.037	Treated 166 ac of 603 ac forest catchment. Highest concentration diluted to 0.006 mg/L 2.2 miles downstream.	26
Glyphosate	S	45 ha Coastal British Columbian catchment	0.162	0.0032-0.162	Highest concentration in streams intentionally sprayed, lowest in streams with smz	10
	S	Quebec	3.080	0.078 to 3.08	9 of 36 streams contained glyphosate after forest spraying	17
	S	Ohio	5.2	ng	No-tillage establishment of fescue	9
	S	Georgia Michigan Oregon	0.035 1.237 0.031	ng ng ng	Forest sites for scrub hardwood control and direct spray of streams	25
	G	Newfoundland, Can	0.045	0.004-0.045	Application of 4 lb ai/ac to power substations resulted in contamination of water in monitoring wells	29
Hexazinone	S	Mississippi River	0.00007	ng	Detected in 5 tributaries	16
	S	Alabama, Florida,	0.037	0.0013-	7 reports, each treated	20

Table 2. Frequency and occurrence of surface and ground water contamination from pesticide use in North America.

Pesticide	Water Type[1]	Location	Maximum (mg/L)	Range (mg/L)	Comments	Literature Citation
		Georgia		0.037	catchment containing ephemeral/first order streams	
	S	Alabama	2.400	ng	Applied directly to ephemeral channel and in first runoff water	22
	S	Alabama	0.473	0.422-0.473	Ephemeral/first order stream in catchments treated with 3X rate of hexazinone in liquid and pellet formulation with accidental application to streams	21
	S	Arkansas	0.014	ng	11.5 ha watershed drained by ephemeral to first order stream	2
	S	Georgia	0.442	ng	Ephemeral/first order stream in treated catchment, pellets applied to stream channel	24
	G	ng	0.009	ng	Only one value reported from a single study	11
Imazapyr	S	Alabama	0.680	0.130-0.680	2 reports, each treated catchment containing ephemeral/first order streams, herbicide accidentally applied to stream channel	20
Methyl bromide		nr	nr	nr	nr	nr
Metsulfuron	S G	Central Florida	0.008 0.002	ng	Water in surface depression in slash pine site and 1 of 207 shallow (6 feet) well samples	19
Picloram	S	Northcentral Arizona	0.32	ng	Pinyon-juniper site	13
		Streams and rivers in N. Dakota, Wyoming, and Montana	0.005	0.00001-0.005	4 reports from mainly range-land uses	16
	S	Alabama	0.442	ng	Pellets accidentally applied directly to forest stream	18
	S	Georgia, Kentucky, Tennessee	0.021	nd-0.021	6 study catchments with ephemeral/first order stream in each treated forest catchment	20
	S	North Carolina	0.01	ng	ephemeral/first order stream in treated forest catchment	23
	G	Saskatchewan, Can	0.000225		Natural spring flow	44
	G	Iowa, Maine, Minnesota, North Dakota	0.049	0.00063-0.049	Fewer than 2% of well samples were positive	11
Strychnine		nr	nr	nr	nr	nr
Thiram		nr	nr	nr	nr	nr
Triclopyr	S	Florida	0.002	ng	Coastal plain	4

Table 2. Frequency and occurrence of surface and ground water contamination from pesticide use in North America.

Pesticide	Water Type[1]	Location	Maximum (mg/L)	Range (mg/L)	Comments	Literature Citation
					flatwoods catchments near Gainesville, FL	
	S	Ontario	0.35	0.23-0.35	Intentional aerial application to boreal forest stream	32
Zinc phosphide		nr	nr	nr	nr	nr

[1] Surface water- S, Ground water- W
[2] Range of maximum values reported as summarized by Larson and others (16)
ng-not given, nr-no reports found in published literature

Table 3. Estimates of safe levels for daily exposure to the 20 pesticides most used on NFS lands in FY97 in the vegetation management program. These pesticides account for more than 95% of all active ingredient applied to NFS land in 1997.

Pesticide	RfD	NOEL	NOAEL	Lifetime HAL	Literature Citation
	mg/kg	mg/kg	mg/kg	mg/L	
Borax	0.09	NA	8.8	0.60[1]	36
Carbaryl	0.1	NA	9.6	0.700	35
Chloropicrin[2]	NA	NA	NA	NA	
Clopyralid	NA	NA	NA	NA	
Chlorpyrifos	0.003	0.03	NA	0.020	38
2,4-D	0.01	NA	1	0.070	35
Dazomet[2]	NA	NA	NA	NA	
Dicamba	0.03	NA	3	0.200	35
Dormant oil	NA	NA	NA	NA	
Glyphosate	0.1	20	NA	0.700	35
Hexazinone	0.05	5	NA	0.400	39
Imazapyr	NA	250	NA	NA	40
Methyl bromide	0.0014	NA	1.4	0.010	36
Metsulfuron	0.25	25	NA	NA	33
Picloram	0.007	7	NA	0.500	34
Putrescent egg solids	NA[3]	NA	NA	NA	
Strychnine	0.0003		NONE	NA	42
Thiram	0.005	5	NA	NA	37
Triclopyr	0.05	5	NA	NA	41
Zinc phosphide	0.0003		NONE	NA	42

NA Not available
[1]HAL for elemental boron.
[2]These fumigants are not expected to get into water.
[3] Made from food products, toxicology was waived by U.S. EPA.

NEW APPLICATIONS OF MULCHING EQUIPMENT FOR FOREST VEGETATION MANAGEMENT. D. Mitchell and Dr. R. Rummer, USDA Forest Service, Southern Research Station, Engineering Research Unit, 520 Devall Drive, Auburn, AL 36839.

ABSTRACT

Mulching machines have been used for clearing land for road and utility right-of ways, real estate development, and for the seismic industry. These machines are finding their way into forests. Some machines are being used to reduce fuel loading so that fire can be safely re-introduced into an area. Other forest managers are using the machines to perform strip pre-commercial thinnings, while still others are using them to reduce vegetation for wildlife habitat enhancement. Mechanical mulching treatments may be an effective tool in understory vegetation reduction, but little is known about the effects on regrowth, production, or site impacts of using these types of equipment in the southern pine forests.

Mulching machines may be divided into two major types: vertical and horizontal shafts (1). These designations refer to the axial spinning of the shaft that turns the cutting implements. Vertical shafts have been documented as severing the material without much mulching of the stems, while horizontal shaft machines sever and mulch stems. The cutting attachments range from circular sawblade heads to individually fixed teeth to free-swinging teeth. The machines are mounted on a variety of prime movers including modified tractors, harvesters and excavators.

A study was established during the winter of 1999 in two stands on the Croatan National Forest near the coast of North Carolina. The stands were a 70-year old longleaf pine stand (*Pinus palustris*) (Block A), and a 70-year old pond pine (*Pinus serotina*) stand (Block B). A side-by-side comparison was made between a rubber-tired, front-mount mulching machine (Woodgator T5) with a tracked boom-mounted mulching machine (Shinn SC-1). The stands were divided into strips which were paired by the number of trees per acre, then randomly assigned to each of the machines.

Machine owning and operating costs were calculated. Prior to treatment, data was collected on the test plots for: trees per acre, and amount and size of material to be reduced. Additional data was collected during and after treatment: production rates, damage to residual trees, visual soil disturbance, and chip size.

The Woodgator costs $84 per productive machine hour (including operator) with a production range of 0.53 1.59 acres/hour given the stand data shown in Table 1. The Shinn costs $141 per productive machine hour (including operator) with a production range of 0.18 - 0.78 acres/hour. The Woodgator T-5 was much cheaper to run and had a faster production rate. The Shinn produced a smaller chip size and trafficked less area. Both machines mulched the plots to an acceptable fuel level. The number of trees per acre had a significant impact on the production rates for both machines. The number of trees per acre was probably the cause of the damage to 16% of the residual trees. There was not a significant difference between the machines for residual stem damage. Production rates could be raised and damage reduced by not requiring all stems meeting the prescription to be reduced. Leaving pockets or islands of fuel may be acceptable for some treatments.

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Table 1. Stand Descriptions	Block A	Block B
Overstory		
Trees per Acre, average	55	285
Trees per Acre, range	14-126	145-486
DBH, average	15.5	8.7
DBH, range	10.7-19.6	7.1-10.5
Midstory (Stems/Acre)		
< ¼ inch, range	12-144	8-31
¼ - 1 inch, range	3-29	5-37
1 – 3 inches, range	0-6	0-18

MID-ROTATION RELEASE IN VIRGINIA: PLANT COMMUNITY AND WILDLIFE IMPACTS. K.L. Cheynet and S.M. Zedaker, Department of Forestry, College of Natural Resources, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, 24061.

ABSTRACT

Conservative estimates indicate that mid-rotation release to improve pine growth is now applied on over 100,000 acres annually in the Southeastern U.S. Although the yield benefits of mid-rotation release are well documented and continue to receive intensive research, ecosystem impacts are not well studied or documented. This is unfortunate, since the class of landowner who controls most of the forest area, the non-industrial private landowner, has objectives for their properties with much wider resource values. Surveys indicate that private landowners are more interested in the amenity and wildlife values that their lands produce than the incomes from timber management.

To evaluate the effects of mid-rotation release on plant communities and wildlife, two forms of release were studied on thinned and fertilized loblolly pine (*Pinus taeda*) plantations in Virginia: aerial imazapyr application and basal triclopyr application to control hardwoods. Measurement plots for imazapyr applications were installed in nine Piedmont and twelve Coastal Plain plantations that had been operationally released from one to four years before measurement. Replicate 5x20 m plots were installed in treated and buffer areas in the plantations to assess impacts on canopy, shrub, and ground (herbaceous) stratum plant communities. Triclopyr release measurement plots were installed within a controlled fertilization/release study including seven blocks in a randomized block experimental design spanning both regions. Habitat Suitability Index models for eight species of wildlife, representing different wildlife guilds, were examined for potential impacts of release on wildlife habitat. Paired T-tests were conducted on the data from the imazapyr plots and AOV was used to assess the impacts of triclopyr release.

Although no differences in pine volume were detected following triclopyr release, aerial imazapyr release resulted in significant volume gains. For all release dates combined, Piedmont plantations released with imazapyr averaged 0.06 m^3/tree (18%) greater than those areas unreleased and Coastal Plain released areas averaged 0.05 m^3/tree (14%) greater than the unreleased plantations. Significant reductions in hardwood basal area, stem density, and shrub stratum cover were observed for both imazapyr and triclopyr. Reductions in shrub stratum richness and diversity were also documented for imazapyr release, however trends indicate that richness and diversity as well as stem density and shrub stratum cover may recover after three years to pre-treatment levels. Total herbaceous vegetation was not affected by

imazapyr release, however, there was a significant increase in herbaceous vegetation following triclopyr release. Following imazapyr release, habitat suitability index (HSI) values for pine warblers (*Dendroica pinus* L.) and black-capped chickadees (*Parus atricapillus* L.) increased due to reductions in canopy hardwoods and increases in snags. Reduced shrub stratum density resulted in a lower bobwhite quail (*Colinus virginianus* L.) cover index on imazapyr-released areas. Triclopyr release generally did not alter wildlife suitability.

Acknowledgements: We are indebted to Jim Willis and Chesapeake Forest Products, and John Scrivani and the Virginia Department of Forestry for allowing access to released plantations for this research. We are also indebted to the Robert Kennedy Foundation for supplying the funding for this research.

KUDZU: POTENTIAL BIOCONTROL AGENTS FOR THE VINE THAT ATE THE SOUTH. K.O. Britton, USDA Forest Service, Athens, Ga. 30602-2044, D.B. Orr, North Carolina State University, and J. Sun, Northeast Forestry University, Harbin, China, C. Ping, and J. Jiafu, Anhui Agricultural University, Hefei, China, S. Jin, State Ministry of Forestry, Forest Pest Management, Hefei, China, Tian Ming-yi, and Jiang, Zi-de, South China Agricultural University, Guangzhou, China.

ABSTRACT

A systematic survey for kudzu biocontrol agents was initiated in May 1999. Four survey sites were selected with climatic characteristics similar to the southeastern United States. The focus of the survey was Anhui Province, but because kudzu grows mostly in mountainous regions in China, a survey site was also established further south, outside Guangzhou. At each site, five vines were chosen for sampling. Insect feeding, mating, and egg laying behavior was observed at 10 day intervals May through November. Representative insects, and herbarium specimens of their feeding damage were collected and preserved. Defoliation was visually estimated in five 1- foot square areas on each vine. The main vine and branches were monitored for feeding damage and gall formation.

The insects that fed on kudzu are still being identified. So far, 7 out of 25 species are known to feed on other crops (often beans), and therefore have been dropped from consideration. Leaf-feeding beetles and sawflies have been identified that have no other known hosts. Two kinds of weevils were found to attack the succulent stems, and eight kinds of large beetles lay eggs and develop as larvae in the main vines or roots. Six fungal pathogens have been identified, of which one may hold some potential as a biocontrol agent, if further investigations confirm its specificity.

A second year of survey data will be collected, to confirm these observations, and preliminary no-choice host testing against soybeans and peanuts will begin in China this year. As far as possible, initial host testing will be conducted in China, where quarantine facilities are not required for these native insects. In the later screening stages, extensive testing of American plants and crops will be conducted in U.S. quarantine facilities to ensure host specificity before any insect can be released.

HARDWOOD AND HERBACEOUS COMPETITION: UNDERSTANDING LOBLOLLY PINE RESPONSE TO RELEASE. D.K. Lauer, B.R. Zutter, G.R. Glover, School of Forestry and Wildlife Sciences, Auburn University, AL.

ABSTRACT

Site preparation is at disadvantage compared to release from an investment perspective because: 1) site preparation costs are usually higher due to the use of higher rates of herbicide, 2) delaying treatment costs several years to release a stand is often considered a shortening of the investment horizon, and 3) site prep costs are normally capitalized whereas release costs might be expensed for tax purposes. These considerations imply that site preparation should provide higher pine yields than release if site preparation is to be considered a viable investment. Miller and Edwards (2) conclude that yields were greater for site preparation than release in a survey of tracts that were either released or site prepared with herbicide. Busby, Miller, and Edwards (1) compared land expectation values of these same tracts and concluded that site preparation was a wiser investment than release.

Results from an Auburn University Silvicultural Herbicide Cooperative release study supports the conclusion that site preparation can often result in a larger response than release. These conclusions are the result of the analysis of a multi-location trial to estimate response from control of hardwoods (release) in young (ages 0-5) loblolly pine plantations. A modeling approach was used to relate age 8 pine basal area to age 8 hardwood basal area and stand height; age 8 stand height to hardwood level, age of release, and inclusion of herbaceous weed control; and age 8 pine yield to pine basal area and stand height. This approach could not be used for stands released past year 2 because pre-treatment level of hardwood affected the pine height-diameter relationship. Pine height alone was sufficient to account for pre-treatment hardwood level and herbaceous weed control in stands released at ages 0-2. These results imply that survey methods that rely solely on the relationship between pine basal area and hardwood basal area in older stands underestimate response to hardwood control because they do not account for the impact of hardwood on height nor the response to herbaceous control that may be part of the site preparation or release treatment.

Although the pine height-dbh relationship in age 8 stands was unaffected, height and stand volume were reduced by hardwood present before the third growing season. Response to hardwood control decreased with increasing age of release. Herbaceous weed control increased yield but the magnitude of the increase declined with increasing treatment age. The magnitude of response to site preparation and release depends on the level of hardwood controlled, age of treatment, level of herbaceous control, and site quality. Site preparation and early release prescriptions should consider control of herbaceous vegetation because this is an important component of response.

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EFFICACY OF MECHANICAL AND CHEMICAL TREATMENTS IN THE FLATWOODS. D.K. Lauer, School of Forestry and Wildlife Sciences, Auburn University, AL.

ABSTRACT

Bedding and combinations of bedding with herbicide applications were compared in terms of vegetation control at four locations in the Flatwoods region of North Florida. Loblolly pine was the crop species at one location, slash pine at the other three. Site preparation treatments were early single bed (EB), late single bed (LB), double bed (DB), EB with banded pre-plant herbicide application (PP), and EB with broadcast pre-plant herbicide application (BPP). Pre-plant herbicide applications varied by location but a combination of triclopyr and imazapyr was used at all four locations. Glyphosate was added to this combination at one location and metsulfuron was added to this combination at two other locations. Half of each site-preparation treatment also received an operational over-the-top post-plant herbicide application (HC) to improve control of herbaceous vegetation during the first growing season. HC treatments varied by location and consisted of imazapyr alone, sulfometuron + imazapyr, and sulfometuron + hexazinone.

Treatments varied with respect to vegetation control. DB improved control of woody shrubs over single bedding alone, but first-year shrub cover controlled by DB was replaced by first-year herbaceous cover. Both PP and BPP improved control of woody shrubs and first-year herbaceous vegetation compared to bedding alone. In addition, PP shifted herbaceous composition towards less competitive late-season grass species. HC treatments improved control of herbaceous vegetation but control was more complete following pre-plant herbicide than bedding only treatments. Single bed treatments provided poor shrub control but shrub cover on these single bed treatments was suppressed by HC treatments that contained imazapyr.

HC treatments were not robust with respect to control without pre-plant applications. For example, first-year herbaceous cover averaged 64, 44, 44, and 17% for DB, DB+HC, PP, and PP+HC, respectively. Treatments with imazapyr used at two locations controlled low panic grass but provided poor control of other species. The sulfometuron + hexazinone treatment at one location controlled composites but provided poor control of other species. Concerns for crop tolerance of slash pine and label restrictions preclude the use of post-plant metsulfuron + imazapyr where it may have improved control of bracken fern. There are large potential gains to be made through improved prescription and development of more robust HC treatments to be used with DB.

Pine response was related to the level of vegetation control achieved by these treatments. Greatest second year pine height was achieved following an early bed + fall pre-plant herbicide application at all three locations where pines had reached that age. There were no differences between PP and BPP at this early age indicating that inter-bed shrub vegetation and late-season grasses colonizing following PP had little effect on pine growth during the first growing season. DB without HC increased pine height compared to late single bedding at only one of three locations because improved shrub control was offset by increases in herbaceous cover. First-year shrub and first-year herbaceous cover are comparable in their effect on early pine growth.

LONG-TERM PINE GROWTH RESPONSE ASSOCIATED WITH HEXAZINONE USE IN FORESTRY SITE PREPARATION. G.N. Loyd, W.D. Mixson, C.E. Walls. DuPont Company, Raleigh, NC and Penscaola, FL, and Timberland Enterprises, Little Rock, AR.

ABSTRACT

Hexazinone is the chemical name for several products that have been or are currently being used in forestry for vegetation management. VELPAR® is the most widely used and best known product with this active ingredient. Foresters and forest researchers have reported that pine trees grow faster on sites where hexazinone is used for vegetation management. There are several theories as to why pine trees grow faster following a VELPAR® treatment.

- Residual weed control
- Enhanced water storage in soil prior to planting trees
- Increased Nitrogen mimeralization.
- Enhanced ectomycorrhizal activity
- Enhanced photosynthesis

Forest managers often use operational plots to evaluate forest herbicides. This paper will report on four such operational studies applied in the piedmont of Virginia, North Carolina and South Carolina. Each study consists of various treatments that were applied during the same season on the same site. All sites were burned following the site preparation treatments and planted with loblolly pine. Six one hundredth acre plots were established and monumented on each treatment at each site. The plots were measured during the dormant season after each growing season for average diameter, height and number of trees per acre. Total pine volume per acre was calculated.

Total pine volume per acre was higher on the VELPAR® sites compared to other herbicides on all sites. On two sites that were measured at the end of the eleventh field growing season, total volume on the VELPAR® sites averaged 2,716.4 cubic feet (outside bark) and 2,046.5 cubic feet (inside bark) compared to an average of 1,886.6 cubic feet (outside bark) and 1,395.1 cubic feet (inside bark) for other herbicide treatments. After the ninth growing season, the average volume gr™ owth on the VELPAR® sites was 1,956.0 cubic feet (outside bark) and 1,426.3 (inside bark). Therefore, the volume on the VELPAR® sites at age nine was approximately the same as on the other herbicide treatments at age 11.

INTRODUCTION

Hexazinone is the chemical name for several products that have been or are currently being used in forestry for vegetation management. "VELPAR" herbicide is the best known and most widely used trade name for hexazinone and is available in several formulations.

VELPAR® ULW™	75% active ingredient granule
VELPAR®-L	liquid product with 2 pounds of active ingredient per gallon
VELPAR® DF	75% active ingredient dry flowable product
VELPAR® GRIDBALL™	10% or 20% pellitized product (no longer available)
VELPAR® 90	90% active soluble powder product (no longer sold)

Hexazinone is also available and sold as:

PRONONE 10G % 10MG *	10% active ingredient granular product
PRONONE 25G *	25% active ingredient granular product
PRONONE POWER PELLET *	75% active ingredient pelletized product

Hezazinone was first used in commercially in forestry in 1978 as VELPAR® 90 for herbaceous weed control. In 1978, tests were conducted with VELPAR® GRIDBALL™ formulation with commercial sale the following year. VELPAR® GRIDBALL™ was used primarily for site preparation and for timber stand improvement. VELPAR® L was introduced in the early 1980's and is used for herbaceous weed control, and for site preparation. VELPAR® ULW™ was first sold in 1987 and is used primarily for site preparation in southern forestry. PRONONE was first developed and sold in the early 1980s. Depending on the formulation, PRONONE can be used for a variety of forest vegetation control uses.

Early on, foresters and forest researchers noticed that pine trees grew faster on sites were hexazinone was used for vegetation management. Lauer (5) reported on a site preparation study near Hodge, LA at age 9. The study was established in 1981. Loblolly pines planted following Hexazinone application for site preparation were taller and had bigger DBH than trees planted following Triclopyr or following a chop & burn treatment.

Sharpe and Atkins (9) reported in 1986 that compared to mechanical methods, hexazinone used for site preparation, doubled pine growth and ground line diameter at age two. This was based on measurement plots taken on twenty-four sites in the southeast where either loblolly pine or slash pine were planted.

Edwards and Miller (3) reported in 1991 the results of a five-year site preparation study for loblolly pine in central Georgia, which was applied in 1984. "Significant differences (a<0.05) among treatments were evident with height diameter, and volume after five years, according to the following order: VELPAR > Pronone > Tordon > Roundup > Garlon > Banvel > Check. Compared to the check, per-acre volume was about 3 times greater for the Banvel treatment and 6 times greater for the VELPAR treatment."

This growth response has been noted in other conifer species other than southern yellow pines. Buse (2) reported in 1992: "Height increment and root collar diameter were greater on areas treated with hexazinone formulation than untreated or glyphosate treated areas for both black spruce and jack pine established in the first season following herbicide treatment." This study was conducted near Thunder Bay, Ontario, Canada.

There are several theories as to why conifer trees grow faster following a VELPAR® treatment.

- Residual weed control
- Enhanced water storage in soil prior to planting trees
- Increased Nitrogen mineralization.
- Enhanced ectomycorrhizal activity
- Enhanced photosynthesis

The growth benefits of HWC are well known in forestry. The residual weed control of hexazinone is obvious on most sites where this product is used for site preparation. Most sites remain relatively free of herbaceous weeds during the early part of the season after trees are planted. Research by Rhodes (8) on the field dissipation of hexazinone showed that hexazinone has a field soil half-life of from one to six months. Also, hexazinone tends to remain in the upper part of the soil profile. Another reason for carry over weed control may be the reduction of a seed source. Since hexazinone is applied early in the growing season, weeds are killed before they can develop seeds.

In dry land farming areas, some agricultural lands are kept fallow following a crop year so that soil moisture can accumulate. This additional moisture helps insure a crop the next year. Hexazinone is applied to sites in the spring. The woody plants and herbaceous weeds quickly take up the herbicide and begin the process of dying. These plants soon stop transpiration and thus stop pumping water from the soil. Since the water is not removed from the soil, soil moisture will increase similar to a dry-land agricultural site during a fallow season. This increased soil moisture could be a reason for improved pine growth especially in dryer areas.

Andariese and Vitousek (1) found a significant increase in net nitrogen mineralization on a site where hexazinone was used for site preparation compared to mechanical means only. Neary (7) (1986) reported that application of hexazinone stimulated nitrifying bacteria within two days of application and that nitrate concentrations increased. This increase in available nitrogen nutrition may be part of the reason for early growth response on hexazinone treated sites.

The importance of ectomcorrrhizae to the growth and development of pine is well known by foresters and has been documented by Marx and Artman (6) and others. There is no research that would prove that hexazinone increases ectomycorrhiza activity, but it is common to see the fruiting bodies of ectomcorrhuza fungi on sites treated with hexazinone. If hexazinone does enhance the growth of ectomycorrhzia or perhaps kills vegetation that is allelopathic to ectomycorrhiza, this could explain the long-term growth response associated with the use of hexazinone.

Johnson and Stelzer (4) reported in 1991 that sub-lethal concentrations of hexazinone applied as a soil drench to containerized loblolly pine seedlings did stimulate photosynthesis. They speculated that hexazinone may function in a manner similar to cytokinins to stimulate photosynthesis.

METHODS

Forest mangers have longed used operational plots to evaluate forest herbicides. This paper will report on four such operational studies applied in the piedmont of Virginia, North Carolina and South Carolina. Forest managers established all these studies. Each study consists of various treatments that were applied during the same season on the same site. All sites were burned and planted with loblolly pine.

Six one hundredth acre measurement plots were randomly established in each treatment block at each site. The plots were marked with a permanent plot center and measured annually during the dormant season. The volume listed in this paper is based on a formula developed by the University of Georgia (0.0041783 X Diameter in inches^1.8653 X Height in feet^0.9359) for outside bark volume.

Virginia Site. This site is located in Appomattox County. The site was site prepared in 1985. Each of the herbicide treatments was applied by helicopter. The granular treatments were applied in May and the liquid sprays were applied in June. The balance of the tract was roller drum chopped. The chopped portion of the site was helicopter sprayed for woody release in the fall of 1988 with Arsenal @ 12 OZ + Roundup @ 1 QT. This tract was damaged by a severe windstorm after the 1993 growing season and no measurements have been made since then as many plots were damaged.

HERBICIDE	PRODUCT RATE	ACTIVE RATE
VELPAR® L	2 GAL	4.0 LB
PRONONE 10-G	40 LB	4.0 LB
PRONONE 10-G	30 LB	3.0 LB
ARSENAL AC	54 OZ	1.7 LB
ARSENAL AC	32 OZ	1.0 LB

North Carolina Site. This site is in Anson County and was site prepared in 1987. The VELPAR® ULW™ was applied in April and the liquid treatments were applied in June. Plots on this site were last measured in the dormant season after the 1998 growing season.

HERBICIDE	PRODUCT RATE	ACTIVE RATE
VELPAR® ULW™	4.67 LB	3.5 LB
ACCORD	5.0 QT	5.0 LB
ARSENAL AC	32 OZ	1.0 LB

South Carolina # 1 site. The site is on the border of Newberry County in Laurens Counties and was treated in 1987. The VELPAR® ULW™ was applied in April and the liquid treatments were applied in June. Plots on this site were last measured in the dormant season after the 1998 growing season.

HERBICIDE(S)	PRODUCT RATE	ACTIVE RATE
VELPAR® ULW™	4.67 LB	3.5 LB
ACCORD	5.0 QT	5.0 LB
ARSENAL AC + ACCORD	24 OZ + 2 QT	. 75 LB + 2.0 LB

South Carolina # 2 site. The site is in Laurens Counties and was treated in 1990. The VELPAR® ULW™ was applied in April and the liquid treatment in June. Plots on this site were last measured in the dormant season after the 1998 growing season.

HERBICIDE(S)	PRODUCT RATE	ACTIVE RATE
VELPAR® ULW™	5.33 LB	4.0 LB
ARSENAL AC + ACCORD	16 OZ + 2 QT	0.5 LB + 2.0 LB

RESULTS AND DISCUSSION

Virginia Site. At the end of the eighth growing season, the area treated with hexazinone had an average volume of 1,124.5 cubic feet per acre (outside bark) compared to an average of 732.0 cubic feet per acre (outside bark) on the Arsenal treatments and 673.3 cubic feet per acre (outside bark) for the portion of the site that was mechanically chopped and released.

North Carolina site. At the end of the eleventh growing season, the area treated with "VELPAR® ULW™ had an average volume of 2,863.2 cubic feet per acre (outside bark) compared to 1,822.2 cubic feet per acre (outside bark) for the Arsenal treatment and 1,795.6 cubic feet per acre (outside bark) for the Accord treatment.

South Carolina site # 1. At the end of the eleventh growing season, the area treated with "VELPAR® ULW™ had an average volume of 2,569.6 cubic feet per acre (outside bark) compared to 1,1964.5 cubic feet per acre (outside bark) for the Arsenal + Accord treatment and 1,1964.1 cubic feet per acre (outside bark) for the Accord treatment.

South Carolina site # 2. At the end of the eighth growing season, the area treated with "VELPAR® ULW™ had an average volume of 1,292.6 cubic feet per acre (outside bark) compared to 935 cubic feet per acre (outside bark) for the Arsenal + Accord treatment.

On the two sites (North Carolina site and South Carolina # 1 site) that were measured at the end of the eleventh field growing season, total volume on the VELPAR® treatment areas averaged 2,716.4 cubic feet (outside bark) and 2,046.5 cubic feet (inside bark) compared to an average of 1,886.6 cubic feet per acre (outside bark) and 1,395.1 cubic feet per acre (inside bark) for other herbicide treatments on these same sites. After the ninth growing season, the average volume growth on the VELPAR® treated areas was 1,956.0 cubic feet per acre (inside bark) and 1,426.3 per acre (outside bark). Therefore, the volume on the VELPAR® treated areas at age nine was approximately the same volume as on the other herbicide treatments at age 11.

CONCLUSIONS

Based on the pine measurements taken from these operational site preparation studies, pine trees do grow faster on sites that are prepared with hexazinone when compared to other herbicide treatments. This growth response was equivalent to about a two-year growth response on sites measured after 11 growing seasons.

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Virginia Site.

	TREATMENT	DBH	HEIGHT	VOLUME OB	TREES PER ACRE
AGE 6	VELPAR-L 2 GAL	3.62	19.90	504.1	
	PRONONE 10G 40 LB	3.30	17.65	379.1	
	PRONONE 10G 30 LB	3.09	17.33	313.2	
	ARSENAL 1.7 LB	2.91	16.43	245.3	
	ARSENAL 1.0 LB	2.67	15.61	227.6	
	CHOP & BURN + REL	2.43	14.27	171.2	
AGE 7	VELPAR-L 2 GAL	4.49	24.79	925.3	
	PRONONE 10G 40 LB	4.15	22.55	731.1	
	PRONONE 10G 30 LB	3.98	22.87	651.0	
	ARSENAL 1.7 LB	3.78	21.40	511.8	
	ARSENAL 1.0 LB	3.64	21.29	542.5	
	CHOP & BURN + REL	3.40	19.10	420.8	
AGE 8	VELPAR-L 2 GAL	5.04	27.76	1,276.1	666
	PRONONE 10G 40 LB	4.87	25.35	1,099.4	666
	PRONONE 10G 30 LB	4.81	24.75	998.0	633
	ARSENAL 1.7 LB	4.26	23.15	688.4	583
	ARSENAL 1.0 LB	4.17	23.79	775.6	666
	CHOP & BURN + REL	4.08	21.39	657.3	650

North Carolina Site.

	TREATMENT	DBH	HEIGHT	VOLUME OB	TREES PER ACRE
AGE 4	VELPAR ULW	2.47	13.96	181.7	
	ARSENAL	1.81	10.92	53.5	
	ACCORD	1.48	10.34	45.1	
AGE 5	VELPAR ULW	3.35	18.62	420.1	
	ARSENAL	2.73	14.98	154.1	
	ACCORD	2.38	14.48	149.8	
AGE 6	VELPAR ULW	4.05	21.56	686.6	
	ARSENAL	3.63	17.93	310.2	
	ACCORD	3.03	17.49	280.5	
AGE 7	VELPAR ULW	4.7	25.66	1,066.7	
	ARSENAL	4.46	21.84	547.8	
	ACCORD	3.81	21.73	526.9	
AGE 8	VELPAR ULW	5.20	29.16	1,451.8	
	ARSENAL	5.09	26.08	827.6	
	ACCORD	4.45	25.94	830.7	
AGE 9	VELPAR ULW	5.66	35.73	2,056.7	
	ARSENAL	5.69	31.26	1,207.0	
	ACCORD	4.96	31.95	1,236.1	
AGE 10	VELPAR ULW	5.86	36.04	2,158.2	
	ARSENAL	5.94	32.58	1,359.4	
	ACCORD	5.18	32.61	1,336.2	
AGE 11	VELPAR ULW	6.42	40.64	2,863.2	666
	ARSENAL	6.61	37.49	1,822.2	433
	ACCORD	5.67	36.47	1,795.6	583

South Carolina # 1

	TREATMENT	DBH	HEIGHT	VOLUME OB	TREES PER ACRE
AGE 4	VELPAR ULW	2.16	12.53	159.1	
	ACCORD	1.47	10.77	68.7	
	ACCORD + ARSENAL	1.54	10.82	59.3	
AGE 5	VELPAR ULW	3.00	16.66	383.3	
	ACCORD	2.20	14.36	190.7	
	ACCORD + ARSENAL	2.36	14.31	170.8	
AGE 6	VELPAR ULW	3.66	18.84	574.4	
	ACCORD	2.72	16.38	308.1	
	ACCORD + ARSENAL	3.02	17.31	307.6	
AGE 7	VELPAR ULW	4.26	22.77	910.3	
	ACCORD	3.41	20.11	569.2	
	ACCORD + ARSENAL	3.52	20.49	479.4	
AGE 8	VELPAR ULW	4.88	26.37	1,345.5	
	ACCORD	3.97	23.28	884.2	
	ACCORD + ARSENAL	4.40	25.33	909.1	
AGE 9	VELPAR ULW	5.31	31.41	1,855.2	
	ACCORD	4.55	27.87	1,349.9	
	ACCORD + ARSENAL	4.95	30.32	1,340.1	
AG 10	VELPAR ULW	5.49	35.50	2,213.8	
	ACCORD	4.77	31.67	1,661.6	
	ACCORD + ARSENAL	5.16	33.75	1,600.9	
AGE 11	VELPAR ULW	6.25	39.14	2,569.6	651
	ACCORD	5.55	33.53	1,964.1	718
	ACCORD + ARSENAL	5.92	37.90	1,964.5	568

South Carolina # 2

	TREATMENT	DBH	HEIGHT	VOLUME OB	TREES PER ACRE
AGE 2	VELPAR ULW	0.65	3.27		
	ARSENAL + ACCORD	0.60	2.93		
AGE 3	VELPAR ULW	1.20	5.36		
	ARSENAL + ACCORD	1.10	4.47		
AGE 4	VELPAR ULW	1.36	9.37	38.1	
	ARSENAL + ACCORD	0.98	7.74	17.7	
AGE 5	VELPAR ULW	2.48	14.29	173.5	
	ARSENAL + ACCORD	1.98	11.68	94.4	
AGE 6	VELPAR ULW	3.62	19.45	456.4	
	ARSENAL + ACCORD	2.92	17.03	277.2	
AGE 7	VELPAR ULW	4.32	25.06	804.5	
	ARSENAL + ACCORD	3.71	21.47	538.2	
AGE 8	VELPAR ULW	5.13	29.53	1,292.6	616
	ARSENAL + ACCORD	4.48	25.87	935.0	650

COMPARISON OF SITE PREPARATION METHODS AND HERBACEOUS RELEASES FOR LONGLEAF PINE (*PINUS PALUSTRIS*) ESTABLISHMENT IN AN OLD PECAN ORCHARD. M.J. Hainds, D.H. Gjerstad, and E.E. Johnson. Longleaf Alliance and the School of Forestry and Wildlife Sciences, Auburn University, AL 36849.

ABSTRACT

Approximately 100,000 acres of agricultural lands across the SE- U.S will be planted to longleaf pine (*Pinus palustris*) through the Conservation Reserve Program (CRP) during the 1999-2000 planting season. Many additional acres will be planted over the next few years through the CRP. Successful establishment of southern pines on agricultural lands has proven difficult, and successful longleaf pine establishment can be especially challenging. The most difficult sites to successfully plant appear to be agricultural lands with significant components of grass species. This study compares 3 site preparation methods: subsoiling only, scalping & subsoiling, and chemical site preparation with a tank-mix of Roundup Ultra (glyphosate) and Arsenal (imazpyr) plus subsoiling on an old pecan orchard with many grass and broadleaf weed species present including; *Cynodon dactylon, Paspalum notatum*, and *Digitaria spp*. This study also examines the effects of 11 different herbaceous releases on longleaf pine following the afore-mentioned site preparations. Scalping was found to be particularly effective in successfully establishing longleaf pine seedlings. Some herbaceous releases appeared very promising, especially those containing Oust (Sulfometuron) either as a stand-alone treatment, or as a tank-mix with Velpar (Hexazinone) or Arsenal (Imazapyr). Correct timing of the herbaceous release is an important factor when minimizing damage to longleaf pine seedlings and controlling herbaceous competition.

FIRST-YEAR RESPONSES OF POLE-SIZED LONGLEAF PINE (*PINUS PALUSTRIS* Mill.) TO THINNING WITH COMPLETE WEED CONTROL. J.A. Gatch and T.B. Harrington[1], Warnell School of Forest Resources, University of Georgia, Athens, GA 30602-2152.

ABSTRACT

A study designed to investigate the overstory effects of competition and needlefall deposition on the reintroduction of native understory plants into longleaf pine (*Pinus palustris* Mill.) plantations was established on three sites at the Savannah River Site, near New Ellenton, SC. Each of the three sites was established within the boundaries of previous research sites. At each of the three sites, two areas of equal size (3 to 7 ha in size) had either been thinned to a 50% stem density (620 to 650 trees/ha) or left in a fully stocked condition as part of the previous research. Competing vegetation in the midstory and understory had been controlled in the previous research through a broadcast treatment with Velpar L (Spring 1995), a basal stem application of Garlon 4 (Spring 1996), and either directed spray or stem injection of an Arsenal/Accord mixture (Summer 1996). As part of the current study, four plots, each approximately 0.1 ha in size, were established during the fall of 1998 at each of the three existing sites. One plot was established within the fully stocked area, and three plots were established within the previously thinned area. In order to investigate the effects of overstory light competition, the three plots within the previously thinned areas were further thinned to 50%, 25%, and 0% of the average basal area of the fully stocked plots. Complete removal of the midstory and understory vegetation was accomplished through broadcast applications of Accord in early fall of 1998 and in spring of 1999 in combination with brush cutting and application of Garlon 4 to the surface of the cut stumps. Monthly directed spraying of Accord was also used to keep the plots free of vegetation.

[1]The authors would like to thank the USDA Forest Service and the Savannah River Site, a National Environmental Research Park.

In addition to the original research goals, this combination of treatments offered us the unique ability to look at the effects of thinning in the presence of complete weed control. The effects of many thinning studies are often confounded with the effects of midstory and understory competition. In order to investigate the effects of thinning the diameter of all trees was remeasured, and the total height and the height to the base of the live crown were measured on a subsample of trees during the fall of 1999. Crown closure was also measured in the fall of 1998 and 1999 on sixty points per plot using a vertical densitometer. Data were analysed with an ANOVA to assess the effects of thinning level on crown closure change, average height, and average crown ratio. Stand basal area growth also was subject to an ANOVA using post-thinning basal area as a covariate in order to determine if thinning level had any effect on basal area growth rate. Individual tree basal area was regressed against post-thinning basal area and thinning level using weighted least squares to detect changes in individual tree growth rates due to thinning. Finally, crown closure was regressed against stand basal area to identify if a relationship existed between level of crown closure and stand basal area.

The trend for crown closure change was for more rapid crown growth to occur with higher levels of thinning, although these first-year results were not significantly different. No significant differences were detected in total tree height between thinning levels, but crown ratio was significantly higher in both the 50% and 25% basal area treatments. Both the occurrence of more rapid crown growth and higher crown ratio can be contributed to increases in available growing space for the crown and greater amounts of light penetration which resulted from the thin. Thinning intensity not only increased the intercept of the relationship of individual tree basal area growth to post-thinning individual tree basal area, but also caused a divergence in the trajectory of the curves (r^2=0.39, n=696). However, stand basal area growth was significantly lower in the 25% basal area treatment. This indicates that even though the basal area growth rate of an individual tree is increased by thinning, that early on the increase is not of a great enough magnitude to replace the basal area growth of the trees removed during the thin. Crown closure was found to have a quadratic relationship with basal area, in which crown closure increases with increasing basal area (r^2=0.80 n=18). The result of this relationship is that crown closure of a given stand can be projected knowing the current basal area.

EARLY COMPETITION SUPPRESSION ENHANCES MID-ROTATION VALUE OF LOBLOLLY PINE PLANTATIONS. T.R. Clason, Hill Farm Research Station, LSU AgCenter, Homer, LA 71040.

ABSTRACT

Six factorial combinations of herbaceous weed and woody brush suppression were used to evaluate the impact of competing vegetation on early pine plantation growth. Post-planting herbaceous weed suppression improved seedling survival and increased age 15 merchantable volume. Hardwood and pine suppression at age 4 did not affect age 15 volume, but did enhance crop tree growth and development.

INTRODUCTION

On cutover timber land, productivity of artificially regenerated commercial loblolly pine (*Pinus taeda* L.) plantations depends on planted seedlings competing successfully for finite levels of soil resources. Competitive pressure exerted by a well established indigenous plant community severely hampers early seedling growth and development. In addition to vegetative competition, stresses associated with the transplanting process limit soil exploitative potential during the first growing season. Transplanted seedlings experience an eight-month hiatus before stem and root cambial growth is resumed at rates similar to non transplanted seedlings. Preferential sucrose competition from elongating shoots delays stem cambial growth, while temporal sucrose metabolism restricts root cambial growth until the latter part of the growing season. Thus, competitive interference of unwanted vegetation with planted pine seedlings is a dynamic certainty that adversely affects growth and development of commercial pines plantations.

During the first growing season, competition from hardwood brush and herbaceous weeds reduces seedling survival and decreases early diameter and height growth. Thorough site preparation suppresses this initial interference, but as the growing season progresses, encroaching vines, resurgent hardwood brush and volunteer pine seedlings begin to compete vigorously for growing space. Competitive pressure of vines and nonarborescent woody shrubs during the latter part of the first growing season decreased second year pine seedling height by 2 feet, and arborescent hardwood brush reduced 10-year diameter growth by 1.2 inches. At age 3, pine diameter growth losses were detected in both dominant and intermediate crown classes, when pine stocking density exceeded 500 trees per acre (TPA). Since competitive interference during the seedling stage of plantation development is attributed to an array of vegetation components, a study was established to determine the interactive impact of these components on early plantation development.

METHODS and MATERIALS

Following a regeneration harvest clear-cut, the study area was chemically site prepared with glyphosate applied at 4 lbs. a.i./acre and loblolly pine seedlings were planted at a 8 ft x 8 ft spacing. Three levels of herbaceous weed and two levels of woody brush suppression were combined in a factorial manner to establish six vegetation management regimes of varying intensity. Vegetation management regimes, in descending order of intensity, were: VMR 1) post-planting herbaceous weed suppression for 2 years and woody brush (hardwood and pine) suppression; VMR 2) post-planting herbaceous weed suppression for 1 year and woody brush suppression; VMR 3) no herbaceous weed suppression and woody brush suppression; VMR 4) post-planting herbaceous weed suppression for 2 years and no woody brush suppression; VMR 5) post-planting herbaceous weed suppression for 1 year and no woody brush suppression; and VMR 6) no herbaceous weed suppression and no woody brush suppression. Regimes were replicated six times and assigned in completely random manner to 36 0.4 acre plots. Herbaceous weed suppression treatment was applied with a backpack sprayer using sulfometuron methyl at 1.5 oz. a.i./acre in early spring of the first and second growing seasons. Woody brush suppression treatment was a backpack application of triclopyr amine at 2 lbs. ae/acre in the spring of the fourth growing season to suppress hardwood brush and woody vines and to eliminate every third row of pine seedlings. Pine stocking density in the woody brush suppression treatment plots was reduced to approximately 350 TPA. After thinning, the equivalent of 125 crop TPA was identified on each treatment plot using diameter at breast height (dbh), tree form and spatial position as selection criteria.

Growth data were collected annually from planting to age 15, and included total height to age 15, groundline diameter to age 5, and dbh from ages 4 to 15. Individual pine merchantable volume data were computed to 3-inch inside bark diameter. Total plot and crop tree data were analyzed using SAS general linear model analysis of variance procedures at a 0.05 level of probability. Individual means were tested orthogonally with the following comparisons: (i) VMR 1, 2, 4, & 5 versus VMR 3, & 6; (ii) VMR 3 versus VMR 6; (iii) VMR 1 & 2 versus VMR 4 & 5; (iv) VMR 1 versus VMR 2; and (v) VMR 4 versus VMR 5.

RESULTS AND DISCUSSION

Plot Data Age 3 pine density and groundline diameter for all VMR treatments averaged 610 TPA and 1.7 inches, and differed significantly among treatments. Mean pine density and groundline diameter for VMR 1, 2, 4, and 5 exceeded VMR 3 and 6 by 60 TPA and 0.2 inches. No growth differences were detected between VMR 1 and 2, and VMR 4 and 5 treatments at age 3. By age 4, complete woody brush suppression had reduced mean pine density on the VMR 1, 2, and 3 treatments from 617 to 380 TPA.

Treatment merchantable volume at age 15 averaged 3,570, 3,340, 2,840, 3,550, 3,440, and 2,730 ft^3/acre for VMR 1, 2, 3, 4, 5, and 6, respectively. Herbaceous weed suppression had a significant effect on volume growth with mean volume for VMR 1, 2, 4, and 5 being 690 ft^3/acre greater than VMR 3 and 6 volume, but intensity of weed suppression had no detectable impact on volume growth. Although pine density between complete and no woody brush suppression treatments differed by 220 TPA, mean treatment volumes were similar averaging 3,245 ft^3/acre. Age 15 merchantable volume for the VMR 1 and 2, and VMR 4 and 5 treatments averaged 3,460 and 3,490 ft^3/acre, while VMR 3 and 6 averaged 2,840 and 2,730 ft^3/acre.

Crop Tree Data Both herbaceous weed and woody brush suppression affected crop tree growth, but woody brush suppression, particularly pine density reduction, had the greater impact from age 4 to 15. Age 15 mean treatment dbh for the largest 125 TPA was 9.9, 9.3, 9.3, 8.7, 8.2, and 7.8 inches for VMR 1, 2, 3, 4, 5, and 6, and mean age 15 tree merchantable volume for the respective treatments was 12.7, 11.0, 10.7, 8.5, 7.2, and 6.6 ft^3. Herbaceous weed suppression increased crop tree dbh and volume growth by 0.5 inches and 1.3 ft^3, while complete woody brush suppression growth increases were 1.3 inches and 4 ft^3. Age 15 crop tree dbh and volume growth differentials between VMR 1 and 2, and VMR 4 and 5 treatments were 1.1 inches and 4 ft^3, and VMR 3 and 6 differed by 1.5 inches and 4.1 ft^3.

Integrated forest vegetation management enhanced early plantation growth because age 15 crop tree dbh and merchantable volume differential between VMR 1 and VMR 6 treatments were 2.1 inches and 6.1 ft^3. In addition, management intensity level affected crop tree dbh distribution at age 15. The number of crop trees with a dbh larger than 10 inches was related to management intensity level as follows:

Management Level Comparison	Number of Trees with dbh > 10 inches
VMR 1, 2, 4, & 5 vs. VMR 3 & 6	57 TPA vs. 45 TPA
VMR 1, 2, & 3 vs. VMR 4, 5, & 6	83 TPA vs. 24 TPA
VMR 1 & 2 vs. VMR 4 & 5	92 TPA vs. 24 TPA
VMR 3 vs. VMR 6	67 TPA vs. 24 TPA
VMR 1 vs. VMR 6	114 TPA vs. 24 TPA

Although complete woody brush suppression did not increase merchantable volume at age 15, crop tree dbh distribution differed between suppressed and unsuppressed treatments suggesting a potential impact on future sawtimber production.

CONCLUSIONS

On chemically prepared planting sites, competitive interference from unwanted vegetation can be regulated by vegetation management regimes that include herbaceous weed and woody brush suppression. Post-planting herbaceous weed suppression increased early volume yields but decreased crop tree growth favoring short-term fiber production. Hardwood and pine suppression with and without herbaceous weed suppression increased early volume yields, while improving crop tree growth benefiting sawtimber production. Thus, plantation management objectives affect vegetation management regime intensity.

LESSONS LEARNED IN THE USE OF HERBICIDES TO ESTABLISH PINE PLANTATIONS ON FIELD SITES[1]. T.B. Harrington, School of Forest Resources, University of Georgia, Athens, GA 30602-2152.

ABSTRACT

Seven field sites were established by site preparation with herbicides and planting of loblolly pine (*Pinus taeda*) or slash pine (*Pinus elliottii*) in Georgia and South Carolina during 1997-99. The plantations were associated with ongoing studies regarding effects of taproot deformity on pine development or vegetation dynamics following control of kudzu (*Pueraria lobata*). Five factors associated with site preparation and planting of the fields were identified that limited subsequent survival and growth of the planted pines, and possible remedies were identified for each. First, site preparation during late June 1998 with a tank mixture of Arsenal® AC (24 oz/acre) and Accord® (4 qts./acre) to control field vegetation and volunteer pines stimulated the development in summer 1999 of a tall and dense herbaceous community dominated by dogfennel (*Eupatorium capillifolium*), camphorplant (*Heterotheca subaxillaris*), and common ragweed (*Ambrosia artemisiifolia*). The new community likely was far more competitive with pine seedlings than the original old-field community, so little was gained by the intensive site-preparation treatment. Second, broadcast burning of herbicide-deadened kudzu in December also stimulated the development of a tall and dense herbaceous community, apparently because the seed bank contained an abundance of agricultural weed species. Third, application of Arsenal® AC at a rate labeled for herbaceous weed control in newly planted slash pine (6 oz/acre) caused severe stunting of the terminal shoot and branches. In addition, this treatment had no detectable effect on soil water content at 0-18" depth during the 1999 growing season. Fourth, nutsedge (*Cyperus* spp.), a common monocot species on field sites, was found to tolerate high rates of Arsenal® AC (24 oz/acre) when applied as a site preparation treatment in the summer. As a result, a monospecific stand of nutsedge became the dominant competitor with planted pines. The final factor that limited survival and growth of planted pines was depth of planting. Roots of pine seedlings were placed at a depth of 4-6" by the planting contractor to expedite the operation and to avoid having to break through a hardpan layer in the soil horizon. Poor survival was attributed to the combined effects of shallow planting and the summer drought of 1999.

Possible remedies to the factors described above include the following. Instead of conducting site preparation with herbicides in the summer before planting it is suggested that herbicides be applied in the fall before planting or soon after planting, and that broadcast burning be avoided. This latter approach ensures the presence of a dead mulch at the beginning of the growing season, thereby providing conditions less likely to facilitate germination of seed stored in the soil or dispersed by wind than would result from an exposed mineral seed bed. For herbaceous weed control in newly planted slash pine, an alternative herbicide or Arsenal® AC at a lower rate (4 oz/acre) should be used to avoid stunting of shoot growth. If nutsedge is present, Arsenal® AC should be avoided for site preparation or herbaceous weed control since it will stimulate the plant's development by releasing it from interspecific competition. In subsequent replanting of several field sites, placement of the roots of pine seedlings at a depth of 8-10" was used to promote survival, particularly given the likelihood of another growing-season drought. Although planting seedlings at this depth required considerably more effort than shallow planting, seedling access to soil water deeper in the soil profile has been increased substantially.

In summary, several factors associated with site preparation and planting of fields were identified that limited survival and growth of planted pines. Treatments that exposed mineral soil prior to the beginning of the growing season were found to greatly stimulate development of agricultural weeds. Procedures should be used that simulate "no-till" agricultural systems, and efforts must be made to ensure that planting and herbaceous weed control practices do not interfere with subsequent development of pine seedlings.

COMPETITION CONTROL FOR SWEETGUM PLANTATIONS USING IMIDAZOLINE PRODUCTS IN PRE-AND POST-EMERGENT APPLICATIONS. A.W. Ezell and H.F. Quicke, Mississippi State University, Starkville, and American Cyanamid Co., Auburn, AL.

ABSTRACT

The objective was to evaluate prebudbreak and postbudbreak treatments of imidazolinone herbicides and pendimethalin. Treatments included 1) prebudbreak applications of sulfometuron in combination with imazethapyr, imazapic or pendimethalin, 2) prebudbreak applications of imazapic alone and 3) sequential applications of imazethapyr, imazaquin, imazapic or imazamox following a prebudbreak sulfometuron treatment. Sweetgum seedlings were planted on February 3, prebudbreak treatments applied February 23 and postbudbreak sequential treatments applied April 26.

Imazapic applied prebudbreak in a tank mix with sulfometuron or as a sequential directed treatment following prebudbreak sulfometuron, improved weed control and sweetgum growth over sulfometuron alone. For the prebudbreak tank mix treatments, there was little difference in sweetgum growth between 0.2 and 0.4 lb ae/A imazapic. For the sequential treatments, 0.4 lb imazapic resulted in better weed control but less growth response than 0.2 lb imazapic.

[1]Funding for this research was provided by the Georgia Forestry Commission, USDA Forest Service, and McIntire-Stennis Program. The author appreciates the technical assistance of J.A. Gatch, L.T. Rader, M.B. Edwards, and T.S. Price.

The best treatment in the cultivated area was 0.2 lb imazapic applied as a sequential treatment following a prebudbreak treatment of 1.5 ai/A sulfometuron (2 oz Oust®). Height growth was 24.2 cm compared to 15.9 cm for 1.5 sulfometuron alone (52% increase) and diameter growth was 5.5 mm compared to 3.3 mm for 1.5 lb sulfometuron alone (67% increase).

Imazethapyr applied as a prebudbreak tank mix with sulfometuron oras a sequential treatment following sulfometuron, also improved growth over sulfometuron alone. The best sweetgum growth was achieved with the lower rate of 0.125 lb imazethapyr.

METHODS

The study was located in Winston, Co., MS approximately 14 miles south of Starkville, MS. The site was abandoned agriculture land that had received annual mowing for 10-15 years prior to study installation. Soils were of clay loam textures with a pH of 5.5. Prior to study installation, half of the site was cultivated (double disced) to allow a comparison of treatment response in cultivated vs. uncultivated areas.

Objectives were to evaluate 1) different rates of imidazolinones and pendimethalin applied in prebudbreak tank mixtures with sulfometuron and 2) imidazolinones as sequential directed sprays following prebudbreak application of sulfometuron. Response variables included competition control, crop tree tolerance and crop tree growth.

Sweetgum seedlings (1-0, bareroot) were planted February 3, 1999, prebudbreak treatments applied February 23 and sequential directed spray treatments applied April 26 (62 days after prebudbreak treatments). All treatments were applied with a CO2-pressurized backpack sprayer using a 4-nozzle boom (8002 tips). A 6-foot wide swath was applied with the planting row as the center of the swath.

Separate studies were installed in the cultivated and uncultivated areas. The experimental design for each area was a randomized complete block with three replications. Each treatment plot was a row of ten measurement trees planted on 2-ft. spacings. A 10-ft. buffer space was established between treatment plots. Weed control and herbicide symptoms were assessed at 60, 90, 120, and 150 days after prebudbreak treatments. Weed free area and percent cover for grasses, broadleaf weeds, vines, and shrubs was ocularly estimated. Total tree height and groundline diameter were recorded prior to budbreak and at the end of the first growing season.

RESULTS

At the 60 day assessment weed free area was > 88% for all treatments compared to untreated weed free areas of 44% on cultivated plots and 13% on uncultivated plots (Table 1). At the 150 day assessment, weed free areas ranged from 30-63% for prebudbreak imazapic tank mixes and 53-85% for sequential imazapic treatments compared to 13-15% for 1.5 lb sulfometuron alone.

There was no visible herbicide damage from any treatment at any assessment and no clear survival rate trends (Table 2). The study site was subjected to a prolonged and extreme drought from May until December, and mortality is attributed to drought stress differentials on individual seedlings. With few exceptions, imidazolinones applied in tank mixes or as sequential sprays improved survival over 1.5 lb sulfometuron alone.

All average increases in groundline diameter in the cultivated area exceeded the average in the uncultivated area (Table 2). The impact of cultivation on competition control was not consistent. Cultivation may have increased rooting volume and allowed better infiltration of the poor supply of precipitation during the growing season.

Imazapic applied prebudbreak in a tank mix with sulfometuron or as a sequential treatment following sulfometuron, improved growth over sulfometuron alone. For the prebudbreak tank mix treatments, there was little difference in growth between 0.2 and 0.4 lb imazapic. For the sequential directed treatments, 0.4 lb imazapic resulted in better weed control but less growth response than 0.2 lb imazapic. The best treatment in the cultivated area was 0.2 lb imazapic applied as a sequential treatment. Height growth was 24.2 cm compared to 15.9 cm for 1.5 lb sulfometuron alone (52% increase) and diameter growth was 5.5 mm compared to 3.3 mm for 1.5 lb sulfometuron alone (67% increase).

Imazethapyr applied as a prebudbreak tank mix with sulfometuron or as a sequential treatment following sulfometuron, also improved growth over sulfometuron alone. The best growth was achieved with the lower rate of 0.125 lb imazethapyr.

SUMMARY

Imazapic and imazethapyr provided good weed control, crop tolerance and sweetgum growth response when applied in a tank mix with sulfometuron overtop dormant sweetgum or as directed sequential treatments after a prebudbreak sulfometuron treatment. The best treatment overall on the cultivated area was a directed sequential treatment of 0.2 lb imazapic following a prebudbreak sulfometuron treatment. In addition to broad spectrum broadleaf weed and grass control, a major benefit of imazapic treatment during the growing season is the ability to control morning-glory species.

These vines are often not controlled by early season treatments and cause serious problems in sweetgum plantations when they grow over the trees.

Table 1. Weedfree area at 60, 90, 120, and 150 days after prebudbreak treatments.

	Cultivated				Uncultivated			
	Days after treatment				Days after treatment			
Treatment * (application date)	60	90	120	150	60	90	120	150
	percent							
	96	59	45	13	93	33	28	10
0.4 lb imazapic (2/23)	98	83	62	20	96	68	37	17
1.5 oz sulfometuron (2/23)	94	55	35	13	94	73	63	15
+ 0.2 lb imazapic (2/23)	98	85	63	47	95	78	78	63
+ 0.4 lb imazapic (2/23)	98	89	77	30	96	60	52	37
+ 0.2 lb imazapic (4/26)	97	90	79	67	92	72	65	53
+ 0.4 lb imazapic (4/26)	97	90	90	83	93	82	86	85
+ 0.125 imazethapyr (2/23)	98	70	55	20	98	55	32	13
+ 0.250 lb imazethapyr (2/23)	97	77	60	10	91	67	47	10
+ 0.125 lb imazethapyr (4/26)	98	90	77	30	95	75	55	27
+ 0.250 lb imazethapyr (4/26)	96	87	75	33	92	73	63	33
+ 2 lb pendimethalin (2/23)	96	85	60	10	94	63	63	20
+ 4 lb pendimethalin (2/23)	97	73	35	15	88	63	60	5
+ 0.25 lb imazaquin (4/26)	96	67	55	13	91	67	50	10
+ 0.50 lb imazaquin (4/26)	98	80	67	23	92	63	63	27
+ 0.125 lb imazamox (4/26)	97	75	62	33	93	70	53	37
+ 0.250 lb imazamox (4/26)	98	88	78	37	93	78	57	23
2.25 oz sulfometuron (2/23)	96	87	60	10	94	57	60	12
Untreated	44	3	0	3	13	3	0	0

* Rates are acid equivalent per acre for imidazolinones, active ingredient for pendimethalin and sulfometuron
1.5 oz sulfometuron = 2 oz Oust ®
2.25 oz sulfometuron = 3 oz Oust ®

Table 2. Average sweetgum height growth, groundline diameter growth (GLD) and survival at the end of the first growing season after planting

	Cultivated			Uncultivated		
Treatment * (application date)	Height growth	GLD growth	Surv.	Height growth	GLD growth	Surv.
	…cm….	…mm…	…%…	…cm…	…mm…	…%…
0.2 lb imazapic (2/23)	21.3	3.1	90	15.6	2.2	93
0.4 lb imazapic (2/23)	22.9	3.9	90	11.5	2.6	57
1.5 oz sulfometuron (2/23)	15.9	3.3	73	11.0	2.3	73
+ 0.2 lb imazapic (2/23)	24.7	4.0	93	20.8	3.1	63
+ 0.4 lb imazapic (2/23)	23.0	4.1	77	16.7	3.0	83
+ 0.2 lb imazapic (4/26)	24.2	5.5	90	14.6	3.1	73
+ 0.4 lb imazapic (4/26)	17.8	4.2	93	13.0	2.7	93
+ 0.125 imazethapyr (2/23)	21.9	4.7	80	20.8	4.0	73
+ 0.250 lb imazethapyr (2/23)	21.4	3.5	93	13.6	2.4	77
+ 0.125 lb imazethapyr (4/26)	28.0	4.5	83	13.0	3.6	87
+ 0.250 lb imazethapyr (4/26)	17.3	3.9	87	11.1	2.4	87
+ 2 lb pendimethalin (2/23)	27.4	4.2	73	17.0	3.2	73
+ 4 lb pendimethalin (2/23)	17.1	3.9	67	7.5	2.0	80
+ 0.25 lb imazaquin (4/26)	15.9	4.2	73	17.0	3.2	73
+ 0.50 lb imazaquin (4/26)	22.8	3.5	87	9.8	1.8	73
+ 0.125 lb imazamox (4/26)	20.4	3.5	90	13.5	2.6	53
+ 0.250 lb imazamox (4/26)	18.2	3.7	93	15.5	2.9	93
2.25 oz sulfometuron (2/23)	16.7	3.2	90	11.4	2.7	80
Untreated	16.4	2.7	82	16.0	1.7	75

* Rates are acid equivalent per acre for imidazolinones, active ingredient for pendimethalin and sulfometuron
1.5 oz sulfometuron = 2 oz Oust ®
2.25 oz sulfometuron = 3 oz Oust ®

MID-SEASON HERBACEOUS WEED CONTROL SCREENINGS IN HARDWOOD PLANTATIONS ON AGRICULTURAL SITES IN THE COASTAL PLAIN AND PIEDMONT: FIRST-YEAR RESULTS. D.K. Lauer, R.L Muir Jr., and B.R. Zutter. School of Forestry and Wildlife Sciences, Auburn University, AL.

ABSTRACT

Operational herbaceous weed control in hardwood plantations relies on pre-emergent, early post-emergent chemistry applied before leaf-out to achieve control with minimal crop damage. Generally, these herbicides provide control for a maximum of 12 weeks. The objective of this study was to determine if duration of control could be improved without substantial crop damage on sites previously in agriculture by a second (mid-season) herbicide application.

Six mid-season herbicide treatments were compared following three initial pre-emergent herbicide treatments in a factorial arrangement. Initial treatments were oxyfluorfen at 1.0 lb ai/ac, sulfometuron at 1.125 oz ai/ac, and azafenidin at 16 oz ai/ac. The six mid-season herbicide treatments included imazaquin at 0.24 lb ai/ac, imazapic at 0.18 lb ai/ac, oxyfluorfen at 1.0 lb ai/ac, oxyfluorfen at 1.0 lb ai/ac in combination with pendimethalin at 3.3 lb ai/ac or in combination with a low and high rate of sulfometuron at 0.4 and 0.8 oz ai/ac, respectively. Initial herbicide treatments were applied in March over the top of hardwood seedlings prior to bud break. Mid-season herbicide treatments were applied as directed sprays away from crop tree foliage 11 weeks after initial treatments.

Herbaceous cover was compared among initial herbicide treatments 12 weeks after initial application (1 week after mid-season applications) and compared among mid-season treatments 24 weeks after application (12 weeks after mid-season application). Major weed species were pigweed, coffeeweed, crabgrass, horseweed, and dog-fennel. Initial treatments varied in their control. Oxyfluorfen provided poor control and averaged 83% cover. Sulfometuron averaged 27% cover due to suppression of crabgrass and control of horseweed and dog-fennel. Azafenidin averaged 41% cover with suppression of crabgrass, pigweed, and coffeeweed. After 24 weeks (12 weeks after mid-season) mid-season treatments differed in terms of control. Performance of mid-season treatments depended on the initial treatment with average cover following oxyfluorfen, sulfometuron, and azafenidin of 94%, 69%, and 63%, respectively. Imazapic was the only mid-season treatment to substantially improve control through control of coffeeweed. The imazapic mid-season treatment

averaged 76%, 33%, and 46% cover when combined with oxyfluorfen, sulfometuron, and azafenidin initial treatments, respectively.

Hardwood crop species included in this trial were sweetgum, sycamore, and cottonwood. Crop tolerance and growth was compared in terms of percent terminal damage at 24 weeks (TERM), year 1 survival (SURV), and year 1 height (HGT). Initial treatments differed for sycamore in that sulfometuron decreased TERM (17% vs. 26%), decreased SURV (83% vs. 93%), and in that azafenidin increased HGT (5.0 vs. 4.1 ft). Differences among initial treatments were more pronounced for sweetgum with oxyfluorfen increasing TERM (58% vs. 31%), decreasing SURV (26% vs. 76%), decreasing HGT (0.4 vs. 1.2 ft), and azafenidin increasing HGT (1.5 ft). Initial treatments did not differ for cottonwood except that HGT was significantly greater following azafenidin (4.4 vs. 3.1 ft). Mid-season treatments on sycamore differed in that imazapic increased TERM (92% vs. 29%) and decreased HGT (2.5 vs. 3.7 ft) compared to other treatments. Mid-season treatments on sweetgum differed only in that combinations with oxyfluorfen decreased TERM compared to oxyfluorfen alone (33% vs. 58%) and in that the high rate of sulfometuron decreased HGT slightly compared to the low rate of sulfometuron (0.9 vs. 1.2 ft). Mid-season treatments on cottonwood differed only in that imazapic increased TERM (92% vs. 29%) and decreased HGT (2.5 vs. 3.7 ft.).

Crop species were reasonably tolerant to all initial and mid-season herbicide treatments with the exception of imazapic on cottonwood and sycamore. The decrease in sweetgum survival and height from the initial treatment of oxyflurofen was probably the result of ineffective weed control. The high HGT ranking of azafenidin is indicative that crop species were probably most tolerant of azafenidin as an initial treatment. The lack of height differences among treatments after 1 year for both sulfometuron and imazapic treatments suggests that herbicides providing the best control may also be suppressing growth.

MID-SEASON HERBACEOUS WEED CONTROL SCREENINGS IN HARDWOOD PLANTATIONS ON CUTOVER SITES IN THE COASTAL PLAIN AND PIEDMONT: FIRST YEAR RESULTS. D.K. Lauer, R.L Muir Jr., and B.R. Zutter. School of Forestry and Wildlife Sciences, Auburn University, AL.

ABSTRACT

Herbicides used to control herbaceous vegetation in hardwood plantations often perform differently on cutover forested sites than on sites previously in agriculture. The objective of these trials was to determine if a second (mid-season) herbicide application would increase duration of control without substantial crop damage on cutover sites. The approach was to use initial pre-emergent applications to provide early season control and then apply mid-season treatments before the early season treatments lose efficacy.

Two trials were installed with similar but not identical treatments. Only one initial treatment of 2.25 oz ai/ac sulfometuron + 0.3 oz ai/ac metsulfuron at the Dorchester SC trial was followed 5 weeks later by ten mid-season treatments applied over-the-top of hardwoods. The ten mid-season treatments were sulfometuron at 2.25 and 3.0 oz ai/ac, 0.5 oz ai/ac metsulfuron combined with 1.5 and 2.25 oz ai/ac sulfometuron, imazapic at 0.09, 0.18, 0.24, and 0.36 lb ai/ac , and 1.5 oz ai/ac sulfometuron combined with 0.09 and 0.18 lb ai/ac imazapic. Three initial treatments of oxyfluorfen at 1.0 lb ai/ac, sulfometuron at 1.125 oz ai/ac, and azafenidin at 16 oz ai/ac were included at the Aiken SC trial. Mid-season treatments were applied as directed side sprays 12 weeks after initial treatment. The six mid-season herbicide treatments included imazaquin at 0.24 lb ai/ac, imazapic at 0.18 lb ai/ac, oxyfluorfen at 1.0 lb ai/ac, oxyfluorfen at 1.0 lb ai/ac in combination with pendimethalin at 3.3 lb ai/ac or in combination with a low and high rate of sulfometuron at 0.4 and 0.8 oz ai/ac, respectively.

Herbaceous cover was compared among initial herbicide treatments 8 weeks after the initial application (3 weeks after mid-season application) at the Dorchester trial and 12 weeks after initial application (1 week after mid-season applications) at the Aiken trial. Cover was compared among mid-season treatments 16 and 24 weeks after initial application at the Dorchester and Aiken trials, respectively. Control was near complete at the Dorchester trial with total cover averaging 3% 16 weeks after the initial treatment. Control was not as complete at the Aiken trial. Control was better following sulfometuron or azafenidin than oxyfluorfen initial treatments with average 12 week cover of 19%, 22%, and 36%, respectively. Sulfometuron controlled horseweed and dog-fennel. Azafenidin controlled ragweed and pokeweed. Only the imazapic mid-season treatment improved control at 24 weeks with suppression of ragweed. However, overall control was poor with 24-week cover of 46% and 64% for imazapic and other mid-season treatments, respectively.

Hardwood crop species included were sweetgum in the Dorchester trial, and sweetgum, sycamore, and cottonwood in the Aiken trial. Crop tolerance and growth was compared in terms of percent terminal damage at 24 weeks (TERM), year 1 survival (SURV), and year 1 height (HGT). There were no treatment differences for sweetgum at the Dorchester trial with averages of 6% TERM, 99.8% SURV, and 3.8 ft HGT. There were no intial treatment differences for sweetgum at the Aiken trial and mid-season treatments differed only in terms of HGT where treatments with oxyfluorfen averaged slightly taller than the imazapic and imazaquin treatments (1.9 vs. 1.7 ft). There were no initial treatment differences for sycamore at the Aiken trial and differences among mid-season treatments were small. Imazapic increased TERM (78% vs 60%), oxyfluorfen + pendimethalin increased SURV (93% vs. 83%), and treatments with oxyfluorfen were taller than the imazaquin and imazapic treatments (3.7 ft vs 3.1 ft). Initial treatments did not differ for cottonwood

at the Aiken trial and mid-season treatments differed in that imazapic increased TERM (56% vs. 11%) and decreased HGT (1.0 vs. 1.8 ft), and in that SURV was higher for the low rate of sulfometuron (72% vs. 51%).

Acceptable crop tolerance was achieved with all treatments with the exception of imazapic on cottonwood. However, the low TERM, high SURV, and HGT for sweetgum following over-the-top mid-season applications at the Dorchester trial suggests good seedling quality can significantly increase crop tolerance. The excellent control at the Dorchester trial compared to the Aiken trial suggests that quality of the initial treatment can determine the success of the mid-season treatments and that a 5 week delay between initial and mid-season applications was better than a 12 week delay.

COMPARISON OF SULFOMETURON METHYL FORMULATIONS FOR USE IN NUTTALL AND CHERRYBARK OAK PLANTATIONS. A.W. Ezell, Mississippi State University, Starkville.

ABSTRACT

Oust ® has a new formulation and this study was designed to compare the “new Oust” to the “current Oust” in field applications over-the-top of planted oak seedlings. Competition control and crop tolerance are both of principal concern in these situations.

A total of six herbicide treatments were applied over planted Nuttall and cherrybark oaks (Table 1). In addition an untreated check was incorporated for comparison. All treatments were replicated four times on the Nuttall and three times on the cherrybark seedlings. Percent ground cover was estimated ocularly in April, June, and September by vegetative category, and survival was measured in November.

The seedlings were planted in early February, pre-emergent treatments applied in early March, and “full leaf” treatments applied in mid-May. The soil was an Urbo silty clay loam with a pH=5.7.

As expected, competition control decreased as the growing season passed, but certain aspects of control were noteworthy. First, broadleaf control remained consistent throughout the growing season. Increases in forb coverage were slight to moderate and overall, the treatments provided excellent control. Many of the plots would have been relatively clear in September if not for vines. Second, grass competition (and coverage) resulted primarily from dallisgrass (*Paspalumdilatatum*). Other grass and sedge species did not pose a problem. Third, vine coverage increased throughout the growing season due to peppervine (*Ampelopsis arborea*). Oust will not control this species, and it is aggressive. Fourth, pre-emergent applications are much more effective than post-emergent. Finally, no differences could be detected between the formulations in weed control.

In an examination of crop tolerance, no damage resulted to the oaks from any of these applications. Of note is the fact that these two species had demonstrated a tolerance for post-emergent Oust applications in earlier non-statistical evaluations. All species may not exhibit this same tolerance.

The growing season of 1999 resulted in a most serious drought on the study site, which lasted fromMay until December. Undoubtedly, the drought exaggerated the difference between treated and untreated plots. For cherrybark oak, actual survival was 26-49% higher in treated plots. In Nuttall plots, actual survival was 33-53% higher than in untreated areas. Overall, no consistent trends existed between formulations in terms of survival. The differences were reflective more of microsite variation within treatment plots. Survival was very consistent in untreated areas.

List of treatments in 1990 Oust/oaks field study

Treatment No.	Formulation/Rate	Application Time
	- - - - - - - AI/A - - - - - - -	
1	New Oust (1.5 oz)	Pre-emergent
2	Current Oust (1.5 oz)	Pre-emergent
3	New Oust (2.25 oz)	Pre-emergent
4	Current Oust (2.25 oz)	Pre-emergent
5	New Oust (1.5 oz)	Full leaf
6	Current Oust (1.5 oz)	Full leaf
7	Untreated Check	

TWO-YEAR RESULTS FOR CROP TOLERANCE TESTING OF PRE- AND POST-EMERGENT APPLICATIONS OF GOAL 2XL OVER FIVE HARDWOOD SPECIES. A.W. Ezell, Mississippi State University, Starkville.

INTRODUCTION

Herbaceous weed control in newly established hardwood plantations continues to be a major concern. While this competition results in loss of survival and growth in years with normal precipitation, the growing seasons of 1998 and 1999 have demonstrated the extreme impact of competition during droughty years. Many hardwood plantations without adequate weed control suffered mortality in excess of 60 percent.

OBJECTIVES

The objectives of this study was to evaluate the crop tolerance of five species of hardwoods to pre- and post-emergent applications of Goal 2XL and to document treatment efficacy on herbaceous weed control.

STUDY SITE

The study site was located in Winston Co., Mississippi approximately 16 miles north of Louisville, MS. Soils were of a clay loam texture with a pH=5.5. The area was abandoned agricultural land, which had received annual mowing for more than 10 years.

METHODS

A total of 8 herbicide treatments were installed over recently planted hardwood seedlings (Table1). An untreated check was evaluated for comparison. Each treatment was replicated three times with a CRD plot layout in each replication. Each treatment was applied as a six-foot swath over-the-top of the planted seedlings with a CO2-powered backpack sprayer using a 4-nozzle boom with 8002 tips. Total spray volume was 20 gpa.

Ten seedlings of each of the five crop species were planted in each linear plot and formed the center line of the plot. The five species were yellowpoplar (*Liriodendron tulipfera*), sycamore (*Platanus occidentalis*), sweetgum (*Liquidambar styraciflua*), cherrybark oak (*Quercus pagoda*), and Nuttall oak (*Quercus nuttallii*). Seedlings were planted Feb. 4, 1999 and pre-emergent treatments were applied Feb. 23rd. Post-emergent treatments were applied April 27th after full leaf out.

Plots were evaluated at 30, 60, 90, and 120 days after pre-emergent treatment (DAT). During each evaluation, percent coverage for different vegetation categories was estimated ocularly and each seedling was assessed for any signs of damage. Total seedling height and groundline diameter (GLD) were recorded for each seedling at the time of planting and again in November 1999.

RESULTS

Crop Tolerance – There were no signs of any herbicide damage to any trees at any time (Table 2). Yellowpoplar suffered severe (almost total) mortality due to breaking dormancy early combined with the occurrence of a late freeze in March. A review of survival in Table 3 indicates the untreated yellow poplar suffered mortality equal to that in treated plots. Most, if not all, of the mortality in this study can be attributed to the severe drought which persisted on the study site from April until December. Other than yellow poplar, there was little or no mortality in mid-summer, but many seedlings died as the drought persisted. Thus, survival results varied more by microsite variations and species drought hardiness than by treatment influence.

Competition Control – All pre-emergent treatments worked very well on the herbaceous competition (Table 4). As early as late March, the site was being occupied by herbaceous vegetation, and while not much changed between 30 and 60 DAT (late April) competition pressure steadily increased in May and June. Overall, the pre-emergent applications were more efficacious as can be seen in Treatments 4 and 5, where post-emergent only applications failed to generate the clear ground as the pre-emergent treatments had done.

SUMMARY

Overall, the treatments in this study yielded very good results. No phytoxic symptoms were noted from any application. Since yellow poplar suffered severe freeze damage both years of the study, crop tolerance decisions may be reserved, but no damage was apparent.

Pre-emergent treatments were more effective than “post-emergent only” in competition control. Broadleaf species in this study were well controlled, and some control was exhibited in the grass and sedge component.

Overall, Goal 2XL promises to be a useful product in controlling herbaceous competition in hardwood plantations. Its use in cottonwood regeneration, both artificial and natural, may soon be expanded to include a number of other species.

Table 1. List of treatments in 1999 Goal 2XL hardwood field trial

Treatment No.	Pre-emergent Rates (oz/A)	Post-emergent Rates (oz/A)
1	Goal + Gramoxone Extra (64 + 32)	-
2	Goal + Gramoxone Extra (128 + 32)	-
3	-	-
4	-	Goal (32)
5	-	Goal (64)
6	Goal + Gramoxone (64 + 32)	Goal (32)
7	Goal + Gramoxone (64 + 32)	Goal (64)
8	Goal + Gramoxone (128 + 32)	Goal (32)
9	Goal + Gramoxone (128 + 32)	Goal (64)

Table 2. Percent damage to crop species by species and time of observation in 1999 Goal/hardwood field study (all treatments included)

	Time of Observation			
Species	30 DAT	60 DAT	90 DAT	120 DAT
	- - - - - - - - - - - -	- - - - - - percent	- - - - - -	- - - - - - - - - - - -
Yellow Poplar	90 *	95 *	-	-
Sweetgum	0	0	0	0
Sycamore	0	0	0	0
Cherrybark Oak	0	0	0	0
Nuttall Oak	0	0	0	0

* freeze damage

Table 3. Average survival of crop species in 1999 Goal 2XL hardwood study.

	Treatment Number								
Species	1	2	3	4	5	6	7	8	9
					percent				
Yellow Poplar *	0	0	10	0	10	0	0	0	0
Sweetgum	65	40	30	50	80	90	30	60	70
Sycamore	80	90	10	30	80	20	50	60	30
Cherrybark Oak	90	100	60	100	90	100	100	80	90
Nuttall Oak	100	100	70	90	100	90	90	80	100

* extreme freeze damage

Table 4. Percent clear ground in 1999 Goal/hardwoods field study by time of observation

	Time of Observation			
Treatment No.	30 DAT	60 DAT	90 DAT	120 DAT
		percent		
1	98	85	40	20
2	100	87	60	20
3	50	49	5	5
4	60	50	25	25
5	50	49	25	25
6	99	90	30	15
7	99	92	50	25
8	100	96	50	35
9	99	92	50	35

FOURTH-YEAR TESTS OF DICAMBA TANK MIXTURES FOR FOREST SITE PREPARATION. L.R. Nelson and A.W. Ezell. Clemson University, Clemson, SC, and Mississippi State University, Starkville.

ABSTRACT

Herbicide treatments were installed during the 1999 growing season at two locations to determine the effectiveness of three-way tank mixtures for site brownout and for woody stem control. Study sites included a piedmont site near Abbeville, SC and an upper coastal plain site near Louisville, MS. Dominant hardwood species included sweetgum, water oak, and red maple in SC and sweetgum, red maple, red oak spp. and winged elm in MS. Herbicide treatments included various three-way mixtures of dicamba (Vanquish®) @ 2 qt prod/ac, imazapyr (Arsenal Applicators Concentrate®) @ 10-12 ozprod/ac, glyphosate (Accord®) @ 3 qt prod/ac, triclopyr (Garlon 4®) @ 2 qt prod/ac, fosamine (Krenite UT®) @ 4 qt prod/ac and primisulfuron-methyl + prosulfuron (Exceed®) @ 1 oz prod/ac. Treatments were applied with a CO_2 backpack-pole sprayer in mid-August. A randomized complete block design was used at both locations. Evaluations were conducted 8 WAT. Measurements included ocular estimates of percent foliar brownout

of hardwoods and understory grasses and forbs. Foliar brownout of hardwoods was measured on a per species basis in SC.

Herbicide treatments resulted in low levels of brownout of understory grass species at both sites. In Mississippi dicamba + glyphosate + imazapyr and dicamba + primisulfuron-methyl + prosulfuron + triclopyr provided 60 and 50 % brownout respectively. In South Carolina dicamba + primisulfuron-methyl + prosulfuron + glyphosate and dicamba + glyphosate + imazapyr provided 60 and 57 % brownout of grasses, respectively. Brownout of grasses was significantly lower with all other tank mixtures.

All treatments resulted in greater than 75 % brownout of broadleaf forbs in MS and SC. These included dicamba + primisulfuron-methyl + prosulfuron + imazapyr, dicamba + primisulfuron-methyl + prosulfuron + glyphosate, dicamba + glyphosate + imazapyr, dicamba + primisulfuron-methyl + prosulfuron + tricloypr, dicamba + fosamine and dicamba + fosamine + imazapyr.

Three treatments resulted in effective hardwood control in MS. Dicamba + Fosamine + imazapyr, dicamba + primisulfuron-methyl + prosulfuron + triclopyr and dicamba + glyphosate + imazapyr provided 77, 85 and 88 % brownout, respectively. All other treatments provided less than 60 % brownout. None of the treatments provided effective (>75 %) hardwood brownout in South Carolina.

TANK MIXTURES OF DICAMBA WITH IMAZAPYR, GLYPHOSATE, TRICLOPYR, AND FOSAMINE FOR WOODY STEM CONTROL. A.W. Ezell and L.R. Nelson, Mississippi State University, Starkville, and Clemson University, Clemson, S.C.

ABSTRACT

A total of nine herbicide mixes were applied to evaluate the efficacy on brownout and woody stem control in site preparation situations. All treatments included dicamba and were replicated three times at two locations (Mississippi and South Carolina). Overall, brownout was acceptable, but many woody species were not controlled exceptionally well by these treatments. Time of application cold be an important factor. In Mississippi, Vanquish + Arsenal, Vanquish + Accord, and Vanquish + Arsenal + Krenite mixes gave best results. In South Carolina, the Vanquish + Arsenal, Vanquish + Arsenal + Garlon, Vanquish + Arsenal + Accord, and Vanquish + Arsenal + Krenite mixes gave best results.

INTRODUCTION

In a continuing effort to evaluate the use of dicamba in forestry site prep work various tank mixtures of Vanquish and other forestry herbicide were applied to a recently harvested area. Both woody stem control and brownout response will be evaluated.

METHODS

All 10 treatments were applied as per Novartis protocol (Table 1). Plot installation was in RCB design. Plot layout was a 25 ft. x 100 ft. linear plot marked with metal rebar center posts. Nylon string was stretched between the rebar and the sample area of 10 ft. x 80 ft. was centered in the treatment. All treatments were replicated 3 times with application completed in mid-August for both sites.

All woody stems in the sample area were tallied by species and height class prior to spray application. Plots were evaluated for percent brownout by vegetation class at 6 WAT. Plots were evaluated in November 1999 to determine woody stem control.

The study was installed at locations in both Mississippi and South Carolina. The Mississippi site is representative of upper coastal plain and the previous stand had been mixed pine hardwoods. The South Carolina site is representative of Piedmont and previous use had also been mixed pine and hardwoods.

RESULTS

The results of brownout evaluation were presented earlier. Overall, only treatments No. 6 and 7 gave good brownout on the grasses. This is partially due to the species present and coverage afforded by taller vegetation (especially broadleaf herbaceous). All treatments worked very well on broadleaves but Treatment 6 was best. In woody stems, Treatment 6 was best and Trt. 3 (Vanquish & Garlon 4), Trt. 5 (Vanquish & Arsenal & Garlon), and Trt. 7 (Vanquish & Arsenal & Finale) gave good brownout.

Woody stem control – Evaluation of the species present in sufficient numbers for statistical comparison provided results found in Tables 2 and 3. Overall, these treatments did not provide the level of control that would be most desirable. Fore red maple (*Acer rubrum*), only Treatment No. 1 (Vanquish/16 oz Arsenal) have good control. Green ash (*Fraxinus pennsylvanica*) was not controlled well by any of the treatments, but Trt. 4 (Vanquish/Garlon) and Trt. 5

(Vanquish/Accord) were the best in the study. Only the Vanquish/Arsenal/Finale mixture gave excellent control of persimmon (*Diospyros virginiana*). All except Trt. 7 gave excellent control of winged sumac.

For black cherry (*Prunus serotina*), only Trt. 6 (Vanquish/Arsenal/Accord) and Trt. 9 (Vanquish/Arsenal/Krenite) gave good control. Plum (*Prunus* spp.) was adequately controlled by Trts. 4, 6, 9, and 2 (Vanquish/Arsenal). Sweetgum (*Liquidambar styraciflua*) was readily controlled by Trts. 1, 5, 6, 8, and 9.

SUMMARY

The treatments in the study gave acceptable brownout, but most of the woody species were not controlled exceptionally well. The results of the "1998 Vanquish Timing Study" provided results which help explain these results as successful control with dicamba mixes appears to be dependent on time of application.

Table 1. List of treatments in 1998 Novartis Forestry Site Prep Field Trials

Treatment No.	Herbicide Product and Rate/A
1	Vanquish (2qts.) + Arsenal (16 oz)
2	Vanquish (2qts.) + Arsenal (10 oz)
3	Vanquish (2qts.) + Garlon 4 (2qts.)
4	Vanquish (2qts.) + Accord (3qts.)
5	Vanquish (2qts.) + Arsenal (10 oz) + Garlon 4 (1 qt.)
6	Vanquish (2qts.) + Arsenal (10 oz) + Accord (2qts.)
7	Vanquish (2qts.) + Arsenal (10 oz) + Finale (1 qt.)
8	Vanquish (2qts.) + Krenite (3qts.)
9	Vanquish (2qts.) + Arsenal (10 oz) + Krenite (2qts.)
10	Untreated Check

Table 2. Woody stem control (percent change) in 1998 Novartis site preparation study – Mississippi

	Species				
Treatment	Red Maple	Green Ash	Persimmon	Winged Sumac	Total
	---------- Percent[1] ----------				
1	- 72.2 a[2]	+39.1 c	-50.0 bc	-100.0 a	-81 a
2	+118.8 e	- 28.8 ab	-50.0 bc	*	-26 bc
3	- 43.5 b	+168.0 e	-66.7 b	-100.0 a	-34 b
4	+ 10.7 d	-40.0 a	-75.0 b	-100.0 a	-73 a
5	+ 22.6 d	-45.4 a	-20.0 c	-100.0 a	-64 ab
6	- 30.6 b	+53.8 cd	-50.0 bc	-100.0 a	-68 ab
7	+ 70.0 e	+133.0 d	- 100.0 a	- 50.0 c	-43 b
8	- 2.1 cd	+100.0 d	+100.0 d	-100.0 a	-11 c
9	- 66.7 a	-22.2 ab	+200.0 e	-100.0 a	-76 a
10	+ 850.0 f	+350.0 f	400.0	-71.4 b	+475 d

[1] Positive values indicate an increase in stems/acre
[2] Values followed by the same letter in a column do not differ at $p = 0.05$
* Insufficient stems for analysis

Table 3. Woody stem control (percent change) in 1998 Novartis site preparation study – South Carolina

Treatment	Species			
	Black Cherry	Plum	Sweetgum	Total
	-------	percent	-------	
1	-50 a *	-56 ab	-94 a	-75 ab
2	-42 a	-90 a	0 b	-49 bc
3	-50 a	-19 bc	-50 ab	-39 cd
4	-33 a	-100 a	0 b	-60 abc
5	+33 a	-75 a	-100 a	-74 abc
6	-100 a	-96 a	-100 a	-87 a
7	-35 a	-71 a	-68 a	-59 abc
8	-39 a	-50 abc	-100 a	-13 de
9	-100 a	-100 a	-97 a	-91 a
10	0 a	0 c	-67 a	0 e

* negative changes indicate a reduction in stems and values followed by the same letter in a column do not differ at P = 0.05

EFFECTS OF APPLICATION TIMING ON WOODY STEM CONTROL USING DICAMBA TANK MIXTURES. L.R. Nelson and A.W. Ezell. Clemson University, Clemson, SC; and Mississippi State University, Starkville.

ABSTACT

Herbicide treatments were installed during the 1998 growing season at two locations to evaluate effects of application timing on pine and hardwood control using dicamba (Vanquish®) mixed with either imazapyr (Arsenal Applicators Concentrate®), glyphosate (Accord®) or triclopyr (Garlon 4®). Study sites included a piedmont site near Starr, SC and an upper coastal plain site near Starkville, MS. Treatments included dicamba @ 2 qt + glyphosate @ 3 qt product/ac, dicamba @ 2 qt + triclopyr @ 2 qt product/ac and dicamba @ 2 qt + imazapyr @ 16 oz product/ac. Treatments were applied with a CO_2 pole sprayer in mid-June, mid-July and mid-August in South Carolina and at the same times plus a mid-September application in Mississippi. A complete randomized design with three replications was used at both sites. Dominant hardwood species were black cherry, red oak spp. and sweetgum in South Carolina and red maple, red oak spp., swamp chestnut oak and winged sumac in Mississippi. Evaluations were conducted 12 MAT. Reduction of the number of woody stems/ac by species was used as a measure of control.

Significant herbicide treatment and timing effects occurred on hardwoods in South Carolina. Vanquish @ 2 qt + Arsenal @ 16 oz resulted in a 55 % stem reduction of sweetgum compared to a 10 and –18 % reduction with Vanquish @ 2 qt + Accord @ 3 qt and Vanquish @ 2 qt + Garlon 4 @ 2 qt/ac, respectively. July and August applications resulted in approximately 30 % stem reduction of red oak species compared to 1 % with June applications. Effects on other species were not significant.

In Mississippi both treatment and timing effects were significant. Vanquish @ 2 qt + Garlon 4 @ 2 qt provided a 73 % stem reduction of loblolly pine compared to 19 and 21 % for the Arsenal and Accord mixtures, respectively. The Vanquish + Arsenal tank mixture provided 92 % stem reduction of red maple compared to 58 and 47 % for Vanquish mixed with either Accord or Garlon 4, respectively. Both the Arsenal and Accord mixtures provided better than 75 % control of red oak spp. compared to 33 % with the Garlon 4 mixture. Optimum application timing varied by species. June and August applications on loblolly pine were significantly better than July or September applications. June, August and September applications resulted in approximately 80% control of red maple compared to 57% with the July application. June and July applications resulted in 50 to 60 % control of red oaks while stem numbers increased following August and September applications.

A COMPARISON OF BASAL BARK TREATMENTS USING GLYPHOSATE AND MON 59120. J.L. Yeiser, Stephen F. Austin State University, Nacogdoches, TX 75962; L.R. Nelson, Clemson University, Clemson, S.C. 29634-1003; and A.W. Ezell, Mississippi State University, Mississippi State, MS39762.

ABSTRACT

Monsanto 59120 is a proprietary surfactant potentially providing the water solubility and bark penetration needed by Accord during low-volume, basal bark applications. Dormant and growing season, low-volume basal bark applications of Monsanto 59120+Accord were applied to a height of 14 in. without runoff and assessed for crown reduction of selected woody species in Arkansas, Mississippi, and South Carolina. After two growing seasons, crown reduction was greater for mixtures of Monsanto 59120+Accord than Accord alone. Monsanto 59120+Accord in a 50:50 mixture provided growing season control of pine and sweetgum comparable to the industry check, Garlon 4+vegetable oil (20%+80%). However, Garlon 4+vegetable oil (20%+80%) provided best overall dormant and growing season control across all test species.

INTRODUCTION

Basal bark applications have long been a part of controlling unwanted woody species along utility rights-of-ways (1). Although tree injection has been the preferred individual stem treatment in forestry, basal treatments are used (2). Originally, basal applications were high volume. The lower 18 in. to 24 in. of bark on the unwanted tree was soaked with the herbicide mixture. Puddling around the base of the tree was a common feature of this method (1) and thought necessary for control of sprouts (3). Basal applications were labor intensive, costly and limited by tree size, terrain, brush and access (1).

For over 25 years prior to its suspension by the EPA in 1979, 2,4,5-T was the principle herbicide in basal treatments (4). About 1980, triclopyr was introduced (5). Since then, the Garlon 4E formulation of triclopyr has provided excellent control of numerous hardwood species (6,7,8,9,10). Basal treatments in forestry are used for pine release from hardwoods (6,7,8,10) and to a lesser extent for pine control (11,12).

The high volume of mixture used during basal applications greatly restricted the practical use of this technology. Studies were initiated to reduce the volume of mixture delivered to the unwanted tree. One new method was called low volume basal application. This technique was intended for stems too small to inject but too tall for foliar application with a hand-held sprayer. Low volume basal involves treating the lower 14 in. of trees less than 3 in. at dbh until bark is saturated but without puddling around the root collar (13). Another method was called "streamline" basal bark application (13). For this technique, a 2- to 4-in. band of mixture (10% Cide-Kick, 20% Garlon 4 and 70% diesel) was applied to one or two sides of unwanted stems (13,15). Applicators target the smooth bark of juvenile stems less than 2 in. in ground line diameter (13,15). Studies investigating equipment, timing of application, size of stems and different carriers have been completed (1,7,13,14,15).

Basal bark treatments have traditionally used diesel or kerosene as a carrier of herbicide through the bark to vascular tissues (3,4,7,8,16,17). Impurities, benzene and polycyclic aromatic hydrocarbons, sometimes found in diesel and kerosene have been linked to carcinogenicity in some studies. Concerns for applicator safety partly justified an investigation of prospective, high-quality oil carriers such as those used during food and medicinal preparation (16,17,18). Today, commercially available vegetable oil, an alternative to diesel and kerosene, provides comparable control and enhanced safety during basal applications for woody stem control (16,18,19).

Accord is a water-soluble formulation of glyphosate. Accord is currently not used in basal applications for control of woody plants, presumably due to poor bark penetration. Monsanto 59120 is a new, proprietary surfactant providing water solubility and penetration. Thus, mixtures of Monsanto 59120+Accord have potential for low-volume basal bark treatment of unwanted woody stems in southern forests and right-of-ways.

OBJECTIVE

The objective of this study was to evaluate dormant and growing season basal bark applications of Accord and Monsanto 59120 combinations for crown reduction of unwanted woody stems occupying southern forests and utility right-of-ways.

METHODS

A site in each of Arkansas, Mississippi and South Carolina was selected for testing. In Arkansas, test species were distributed along the margin of an even-aged stand of loblolly pine (*Pinus taeda* L.) in the Upper Coastal Plain near Monticello. Test species included sweetgum (*Liquidambar styraciflua* L.) and natural loblolly pine reproduction. A similar number of test stems was selected from the one-, two- and three-in. dbh classes for each species and treatment combination. The second test area was a bottomland creek terrace near Starkville Mississippi that supported mixed pine-hardwoods. Species selected for testing were mixed red oak (*Quercus nigra* L., *Q. phellos* L., *Q. falcata* Michx.), and hickory (*Carya* spp.). Test stems were predominantly in the two- and three-in. dbh classes. The third study area was an Upland Piedmont site near Pendleton, South Carolina. Sweetgum and water oak were the test species bordering a right-of-way and a mature hardwood stand. In South Carolina, 90% of the test stems were less than 1.5 in. in dbh. Treated stems were seemingly healthy and injury free. All stems in a rootstock were treated and only the dominant stem evaluated for crown reduction. Test trees ranged from about 8 ft. to 28 ft. in height.

Test treatments and season of applications are presented in Table 1. A CO_2 backpack sprayer and an adjustable cone jet nozzle (5500-X3) were used to apply treatments. Herbicide was applied with a smooth, continuous motion starting at the root collar and proceeding up the stem to a height of 14 in. Herbicide was applied until the bark was saturated but not to the point of runoff. Dormant and growing season applications of herbicides were applied in Arkansas, Mississippi, and South Carolina on February 13 and June 21, February 20 and May 19, and February 28 and June 6, respectively. Garlon 4 mixed with a generic, commercially available vegetable oil was the check.

For all three test sites, temperatures were near normal and soils were near field capacity at the time dormant season treatments were applied. Throughout the first growing season temperatures were generally above normal and soils droughty. Drought conditions occurred in Arkansas throughout the second growing season as well.

At all three test sites, treatments were randomly assigned to plots in each of three replications. Each plot contained 10 stems per test species. Treated stems were visually evaluated in10% intervals for crown reduction. Dormant and growing season evaluations were taken in Arkansas, Mississippi, and South Carolina on August 10, July 24 and and *****, respectively.

Data were analyzed using a completely randomized design with three replications. An analysis of variance and Duncan's New Multiple Range test was used to conduct statistical tests at the p=0.05 level.

RESULTS

After two growing seasons, best and similar pine crown reduction in Arkansas were achieved with basal treatments of Garlon 4+vegetable oil (20%+80%) applied during growing and dormant seasons and Monsanto 59120+Accord (75%+25%, 50%+50%) applied in the growing season. Managers seeking the flexibility of growing or dormant seasons applications should select the Garlon 4 treatment instead of the Accord treatments. Managers interested in growing season treatments may select either the Garlon 4 or Monsanto 59120+Accord (75%+25%, 50%+50%) mixtures for pine control. Sweetgum in Arkansas was controlled best and similarly with Garlon 4+vegetable oil (20%+80%) applied during growing and dormant seasons and Monsanto 59120+Accord (50%+50%) applied in the growing season. Large red oaks (commonly 2-in. and 3-in. dbh) in Mississippi were similarly and best controlled with dormant season treatments of Garlon 4+oil (20%+80%) or the 50:50 and 25:75 mixtures of Monsanto 59120+Accord. Garlon 4+oil (20%+80%) remains the treatment of choice for dormant and growing season basal treatments of hickory in Mississippi. Small (90% < 1.5-in. dbh) oaks in South Carolina were controlled best and similarly with growing and dormant season treatments of Garlon 4+oil (20%+80%) or dormant season treatments the 50:50 and 75:25 mixtures of Monsanto 59120+Accord. South Carolina sweetgums were best and similarly controlled with Garlon 4+vegetable oil (20%+80%) applied during growing and dormant seasons and Monsanto 59120+Accord (50%+50%, 25%+75%) applied in the growing season.

When compared, sweetgum data from South Carolina and Arkansas suggested a rate effect exists. In South Carolina and Arkansas, increased in penetrant was associated with increased sweetgum control that peaked with the 50:50 mixture and then decreased for the 75:25 (Monsanto 59120+Accord) mixture. The general magnitude of sweetgum control in Arkansas was lower than in South Carolina probably due to larger test-stems in Arkansas. When oak results were compared, we noted that the same growing season treatments providing best control of large red oaks in Mississippi also provided best growing season control of small oaks in South Carolina.

Previously reported first-year trends were similar to those reported here (12). Probably the largest difference in first- and second-growing season results existed in the excellent growing season control of pine in Arkansas by Monsanto 59120+Accord (75%+25%, 50%+50%). This was not observed by the end of the first-growing season.

CONCLUSION

In conclusion, Garlon 4+vegetable oil (20%+80%) remains the best option for the dormant and growing season control across all test species. Monsanto 59120+Accord significantly increase basal control over that of Accord alone. Monsanto 59120+Accord in a 50:50 mixture provided growing season control of pine and sweetgum comparable to the industry check, Garlon 4+vegetable oil (20%+80%), and warrants further testing.

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Table 1. Mean percent crown reduction after two growing seasons for dormant and growing season basal bark applications.

Treatment[1]	Application	Arkansas[2]		Mississippi[2]		S. Carolina[2]	
		Pine	Sweetgum	Red Oak	Hickory	Oak	Sweetgum
G4 + VEG (20% + 80%)	Dormant[3]	90ab	89ab	72a	95a	90ab	100a
59120 + AC (25% + 75%)	Dormant	57de	28f	63b	26c	64bc	44cd
59120 + AC (50% + 50%)	Dormant	68cd	37ef	67ab	41bc	80ab	35d
59120 + AC (75% + 25%)	Dormant	16f	21f	72a	44bc	92ab	35d
AC (100%)	Dormant	8f	36ef	48c	25c	18de	29de
G4 + VEG (20% + 80%)	Growing[4]	95a	100a	54b	97a	100a	100a
59120 + AC (25% + 75%)	Growing	99a	51de	57b	31c	4e	65bc
59120 + AC (50% + 50%)	Growing	95a	80abc	58b	48b	36cd	94ab
59120 + AC (75% + 25%)	Growing	74bc	74bc	50bc	50b	42cd	84ab
AC (100%)	Growing	43e	62cd	40c	52b	22de	34d

[1] Treatments are: G4=Garlon 4E, VEG=Generic commercial grade of vegetable oil, AC=Accord, 59120=Monsanto 59120.
[2] Season of application by treatment means within a column sharing the same letter are not significantly different. (Duncan's New Multiple Range Test, p=0.05)
[3] Dormant season treatments were applied on February 13, February 20 and February 28, 1998 in Arkansas, Mississippi and South Carolina, respectively.
[4] Growing season treatments were applied on June 21 in Arkansas, on May 19 in Mississippi and June 6, 1998 in South Carolina. Uncommonly high temperatures and below average rainfall provided a south wide drought during most of the first growing season and again in Arkansas during the second growing-seasons.

COMPARING HEXAZINONE FORMULATIONS FOR SITE PREPARATION. J.L. Yeiser, Stephen F. Austin State University, Nacogdoches, TX 75962 and A.W. Ezell, Mississippi State University, Mississippi State, MS39762.

ABSTRACT

Site preparation rates of Velpar L and the new Velpar DF alone and in combination with Garlon 4 were assessed for the brownout of grass, broadleaf and woody plant groups. In Texas, Velpar L+Accord and Krenite S+Arsenal AC were also tested. The Texas site was treated on June 1 and the Mississippi site on June 5. Both sites were evaluated on July 30, 1999, approximately eight weeks after treatment, for brownout. In Mississippi and Texas, brownout by the new Velpar DF was commonly as good or better than that by Velpar L for the grass, broadleaf and woody species tested. When tolerant species, such as American beautyberry were assessed in Texas, mixtures of hexazinone+Garlon 4 and hexazinone+Accord provided better brownout than hexazinone alone or Krenite S+Arsenal AC. Mangers should consider hexazinone tank mixtures as an option when site preparing with herbicides followed by burning.

INTRODUCTION

Numerous studies have documented the benefits of site preparation prior to planting (1,2,3,4) and consequently, the number of acres managers chemically prepare for planting increases annually (5). Products used during chemical site preparation include, but are not limited to, Arsenal AC, Accord, Garlon 4, Velpar L and Krenite S. DuPont has developed a new formulation of hexazinone and its potential contribution for grass, broadleaf and hardwood control during the preparation of pine sites is unknown. The objectives of this study were to compare the brownout and stem reduction resulting from site preparation applications of Velpar L and The new Velpar DF, a new extruded formulation of hexazinone, alone and in combination with Garlon 4 for the control of unwanted woody species occupying pine sites.

METHODS

A site in Texas and Mississippi were selected for testing. The Texas test site was in the Upper Coastal Plain near Diboll (Angelina County). The soil was a moderately well drained sandy loam with a top 6-in. pH of 4.5. This site supported a mixed pine hardwood stand prior to clearcutting in the fall of 1998. Yaupon (*Ilex vomitoria* Ait.), sweetgum (*Liquidambar styraciflua* L.) and mixed red oak (*Quercus falcata* Michx. and *Q. nigra* L.) were the dominant species occupying the site. Sweetgum and oak were very uniform in height and commonly 3-ft. tall. Yaupon was somewhat less uniform in height and varied from 1.5- to 4-ft. in height. Minor components of green ash (*Fraxinus pennsylvanica* Marsh.), hickory (*Carya tomentosa* (Poir.) Nutt), honeylocust (*Gleditsia triacanthos* L.) and fringetree (*Chionanthus virginicus* L.) were present in too few plots or occurred too infrequently to justify an individual species assessment. These species were also commonly 3-ft. tall when herbicides were applied. At treatment time, light grass (*Dichanthelium* spp) and light broadleaf (*Callicarpa americana* L.) communities were present, perhaps due to the heavy litter layer. Soil moisture was good. Plots were geo-referenced to facilitate plot assessment over time. Loblolly pine (*Pinus taeda* L.) seedlings will be planted in research plots this dormant season.

The Mississippi site was in the Upper Coastal Plain approximately 5 miles west of Ackerman, MS. The soil was a clay loam with a pH of 5.6. The site supported a mixed pine-hardwood stand prior to clearcutting in October 1998. The major undesired woody species occupying the site were sweetgum, mixed red oaks (*Quercus phellos* L., *Q. nigra* L., *Q. falcata* Michx. and *Q. pagoda* Raf.), and red maple (*Acer rubrum* L.). Lesser amounts of post oak (*Q. stellata* Wangenh.) and black cherry *Prunus serotina* Ehrh.) were scattered across plots. At the time of treatment, moderate grass (panicgrasses *Dichanthelium* spp, and sedges *Carex* spp) and broadleaf communities (ragweed (*Ambrosia artemisiifolia* L.), goldenrod (*Solidago odora* Ait.), dock (*Rumex* spp), dogfennel (*Eupatorium capillifolium* (Lam.) Small) and mares-tail (*Conyza canadensis* (L)) existed. Soil moisture was moderate.

A backpack aerial simulator was used to apply broadcast tank mixtures in Texas on June 1 and in Mississippi on June 5. The sprayer boom supported a single, KLC9 flood nozzle 12 ft. above the ground. Tank mixtures were applied with a single pass across treatment plots. Treatment plots were 100' X 30' with an internal measurement plot of 80' X 10'. The test treatments are listed in Table 1. All test treatments at both sties contained 2.5% Timberland 90 surfactant.

Vegetation cover was evaluated 8 weeks after treatment (WAT) on July 30 in Texas and in Mississippi. Vegetation was categorized as grass, broadleaf or hardwood and visually evaluated in each plot for percent brownout relative to untreated checks. These classes are consistent for species across plots. In Texas, overall assessment of brownout was also assigned for non-grass species in each plot regardless of composition. Estimates of brownout ranged from 0% to 100% such that 0% indicated no browning and 100% total browning. Since brownout may or may not indicate total vegetation control, total stem counts for each species and measurement plot were also tallied for determination of stem reduction 16 months following treatment. Only brownout data is available at this time.

Seven treatments in Texas and five treatments in Mississippi were established in each of three blocks according to a randomized complete block design. Texas data were adjusted for brownout in the untreated check plot prior to analysis and are not presented. Data were analyzed according to an analysis of variance and the GLM procedure of SAS (6). Means were separated using Duncan's New Multiple Range test. All tests were conducted at the p=0.05 level.

RESULTS

In Texas, grasses were browned similarly by all treatments. The broadleaf, American beautyberry, was browned neither by the current nor by the new hexazinone formulation. When Accord and Garlon 4 were tank partners with hexazinone, brownout of American beautyberry increased significantly. Krenite S+Arsenal AC provided similar brownout as did hexazinone mixtures of American beautyberry. Brownout of woody species by hexazinone+Garlon 4 was uniquely visible one WAT. Brownout continued to increase on these plots and, in addition to Velpar L+Accord, provided best brownout eight WAT. Overall best brownout of all woody and broadleaf species (non-grasses) was achieved with treatments containing hexazinone mixed with Garlon 4 or Accord. Brownout recorded for overall species was lower than that recorded for woody and broadleaf species. This is due to the inclusion of minor species in the overall assessment of brownout.

In Mississippi, similar brownout of grass, broadleaf and woody species was observed for new or current formulations of hexazinone. Best brownout of grass, broadleaf and woody species was achieved with hexazinone+Garlon 4 mixtures. The new Velpar DF alone provided similar broadleaf and Velpar L similar woody brownout as hexazinone+Garlon 4 combinations.

CONCLUSION

In conclusion, current and new formulations of hexazinone provided similar brownout of the grass, broadleaf and woody species tested in Mississippi and Texas. When tolerant species, such as American beautyberry were assessed in Texas, mixtures of hexazinone+Garlon 4 and hexazinone+Accord provided better brownout than hexazinone alone or Krenite S+Arsenal AC. Mangers should consider hexazinone tank mixtures as a spring option when site preparing with herbicides followed by burning. These results are preliminary. Counts of surviving stems will be assessed in the fall of 2000.

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Table 1. Mean brownout (%) of species groups eight weeks after treatment on June 1 in Texas and June 5 in Mississippi with site preparation rates of hexazinone formulations.

HERBICIDES[1]	RATE (Product per acre)	GRASS	BROADLEAF[2]	WOODY[3]	OVERALL[4]
Mississippi					
Velpar L+Garlon 4	8 qt.+2 qt.	93a	95a	83a	-
New Velpar DF+Garlon 4	5.3 lb.+2 qt.	95a	93a	87a	-
Velpar L	8 qt.	73c	83b	87a	-
New Velpar DF	5.3 lb.	82b	92a	72b	-
Check		3d	5c	0c	-
Texas					
Velpar L+Garlon 4	6 qt.+2 qt.	100a	69a	90a	78a
New Velpar DF+Garlon 4	4 lb.+2 qt.	100a	59a	90a	78a
Velpar L	6 qt.	100a	4b	76b	50b
Velpar DF	4 lb.	100a	0b	81ab	50b
Velpar L+Accord	6 qt.+2 qt.	100a	66a	79b	68a
Krenite S+Arsenal AC	4 qt.+16 oz.	100a	53a	42c	39b

[1] Treatment means within a column sharing the same letter are not significantly different (Duncan's New Multiple Range Test, p=0.05).

[2] In Texas, American beautyberry only. In Mississippi, ragweed, goldenrod, dock, dogfennel and mare's tail.

[3] The average of red oak, red maple and sweetgum in Mississippi and red oak, sweetgum and yaupon in Texas.

[4] No assessment made in Mississippi. In Texas, all non-grass species in the plots were included in the assessment.

FIRST-YEAR BROWNOUT OF VEGETATION USING TANK MIXTURES OF FOSAMINE, IMAZAPYR, GLYPHOSATE AND METSULFURON. L.R. Nelson and A.W. Ezell. Clemson University, Clemson, SC and Mississippi State University, Starkville.

ABSTRACT

Herbicide treatments were installed during the 1999 growing season at two locations to evaluate the performance of fosamine tank mixtures for forest site preparation. Study sites included a piedmont site near Abbeville, SC and an upper coastal plain site near Louisville, MS. Dominant hardwood species were sweetgum, water oak and winged elm in SC and sweetgum, red maple, red oak spp. and winged elm in MS. Herbicide treatments included fosamine @ 4 lb ai/ac + imazapyr (Chopper®) @ 6 oz ai/ac + surfactant (Dynamic®) @ .25 % v/v, fosimine @ 4 lb ai/ac + imazapyr (Chopper) @ 6 oz ai/ac + metsulfuron @ .9 oz ai/ac + surfactant (Dynamic) @ .25 % v/v, fosamine @ 4 lb ai/ac + imazapyr (Chopper) @ 6 oz ai/ac + glyphosate (Accord®) @ 1.5 lb ai/ac + MON 59120 @ .25 % v/v and fosamine @ 4 lb ai/ac + imazapyr (Arsenal Applicators Concentrate®) @ 6 oz ai/ac + surfactant (dynamic) @ .25 % v/v. Treatments were applied with a CO_2 backpack-pole sprayer in mid-August. A randomized complete block experimental design was used at both locations. Plots were 100 ft x 25 ft with 3 replicates. Evaluations were conducted 8 WAT. Measurements included ocular estimates of percent foliar brownout of hardwoods and understory grasses and forbs. Foliar brownout of hardwoods was measured on a per species basis in SC.

All treatments provided effective brownout of grasses. Fosimine + imazaypr (Chopper) + Glyphosate + surfactant resulted in 95 % brownout at both locations. Brownout with the other treatments ranged from 63 to 88 %. All treatments were significantly different than the check plots which were rated at 5 and 0 % in MS and SC, respectively.

Herbicide treatments did not differ statistically with respect to percent brownout of broadleaf forbs. Percent brownout ranged from 83 to 100 %. All treatments differed from check plots which were rated at 7 and 0 % in MS and SC, respectively.

Herbicide treatments did not differ statistically with respect to overall percent brownout of hardwood species. Foliar brownout ranged from 70 to 95 %. All treatments differed from the check plots which were rated at 0 % at both locations. Herbicide treatments were particularly effective on sweetgum in SC. Brownout ranged from 95 to 100 %. Low levels of brownout occurred on water oak with a range of 23 to 42 %. Two treatments were effective on winged elm. Applications of Fosamine + imazapyr (Chopper) + metsulfuron and Fosamine + imazapyr (Chopper) + glyphosate resulted in 100 and 95 % brownout, respectively. Remaining treatments provided less than 50 % brownout.

STEM REDUCTION ON PINE SITES FOLLOWING HIGH RATES OF GLYPHOSATE. A.W. Ezell, L.R. Nelson, and J.L. Yeiser, Mississippi State University, Starkville, Clemson University, Clemson, S.C., and Stephen F. Austin State University, Nacogdoches, TX.

ABSTRACT

A total of eleven herbicide treatments were applied to recently cutover sites to evaluate the efficacy of the materials for site preparation. Brownout at 6 WAT was generally excellent and burning would be facilitated by use of these treatments. Generally, the higher rates of glyphosate alone or mixed with imazapyr gave best total control. MON 59120 mixed well with Accord, and MON 78300 performed very well alone at the 6 and 8-quart rates.

INTRODUCTION

MON 78300 has demonstrated excellent brownout results and competition control in forestry site prep applications. This study was installed to evaluate the efficacy of MON 78300 alone and in tank mixtures for site prep hardwood and natural pine control and to evaluate MON 59120 as a surfactant for use with Accord.

METHODS

A total of 11 herbicide treatments were applied and an untreated check area was included for basis of comparison (Table 1). Each treatment was replicated three times on linear plots 25 ft. x 100 ft. All spray applications were completed with a CO2-powered backpack sprayer with a pole extension and KLC9 nozzle. Spray volume was 10 gpa.

The treatments were applied to recently harvested clear-cut areas in South Carolina, Arkansas, and Mississippi in August 1998. Treatment assignment followed a completely randomized design in plots, which were marked with metal rebar at the center of each end of the plot and nylon string stretched between the metal stakes. The string provided the basis for direction during spray application and stem count evaluations.

Woody stems were tallied prior to spray application in a 10 ft. x 80 ft. evaluation area centered with the spray treatment plot. Stems were tallied by species and height class. Principal species occurring on the study areas included white oak, loblolly pine, green ash, mockernut hickory, red maple, black cherry and red oaks.

At 6 WAT, all plots were evaluated with an ocular estimation of percent brownout for different vegetation classes. Final stem counts were completed in October 1999, and observations were recorded by species and height class. Results were analyzed to evaluate any statistical differences among the treatments with Duncan's New Multiple Range Test used for specific comparisons and separation.

RESULTS

The brownout response in the study was reported previously, but to review, the treatments with 6 or 8 quarts of glyphosate generally gave a better brownout than those with 4 quarts. Brownout did vary slightly by location, but overall, response would have been adequate for burning if desired.

Woody stem control for the individual study sites are presented in Tables 2, 3, and 4. Two of the study areas had substantial amounts of loblolly pine present with densities of 2000-3000 stems/acre in many areas. Only six of the treatments resulted in consistently good control of the pine. Generally, these are the treatments which had 6 or 8 quarts of glyphosate (Table 2 and 3).

Green ash, sweetgum, white oak, and black cherry were all controlled by the treatments in the study. Exceptions would be Treatments 4 and 8 on black cherry. Hickory control did not follow a straight-line response, but generally, the mixtures with imazapyr (Trts. 2, 3, 4, and 11) gave better control. Waxmyrtle was difficult to control but six of the treatments did result in 80% or greater control (Table 2).
Overall, treatment response can be grouped into three categories. Best control was from Treatments 3, 4, 7, and 11. Good control was obtained from Treatments 2, 6, 9, 10, and 12. Finally, Treatments 5 and 8 performed well but perhaps not at the level required for most site prep operations.

SUMMARY

The research sites in this study carried a spectrum of woody species which ranged from highly susceptible to resistant to glyphosate. It therefore provided a tough yet representative test of field applications of these products and mixtures across the South. Brownout was excellent and prescribed burning would be facilitated by use of these treatments, especially the ones with higher rates (6 or 8 qts.) of glyphosate.

Overall, control of woody species ranged from good to excellent. Generally, higher rates (6 or 8 qts.) of glyphosate alone or mixed with imazapyr resulted in the best total control. Given the proper species mix MON 78300 can be used effectively alone. MON 59120 worked well with Accord and resulted in comparable control to MON 78300 at the 6 and 8 qt. rate.

Table 1. List of treatments in 1998 Monsanto field trials.

Treatment No.	Products – Rate/Acre
1	Untreated Check
2	MON 78300 + Arsenal AC – (6 qts. + 2 oz)
3	MON 78300 + Arsenal AC – (6 qts. + 4 oz)
4	MON 78300 + Arsenal AC – (6 qts. + 6 oz)
5	MON 78300 – (4 qts.)
6	MON 78300 – (6 qts.)
7	MON 78300 – (8 qts.)
8	Accord + MON 59120 – (4 qts. +2.5%)
9	Accord + MON 59120 – (6 qts. + 2.5%
10	Accord + MON 59120 – (8 qts. + 2.5%)
11	MON 78300 + Arsenal AC – (4 qts. + 12 oz)
12	MON 78300 + Escort – (4 qts. + 1 oz)

Table 2. Woody stem control (percent change) in 1998 Monsanto site preparation study – AR

	Species			
Treatment	Pine	S. Gum	Waxmyrtle	Total
	---------------------------- percent ----------------------------			
Untreated	+120 c	+123 b	+118 c	+120 c
M 7 + AR (6+2)	- 70 a [1]	- 100 a	- 94 a	- 88 a
M 7 + AR (6+4)	- 77 a	- 96 a	- 55 ab	- 76 a
M 7 + AR (6+6)	- 92 a	- 100 a	- 88 a	- 93 a
M 7 (4)	- 75 a	- 100 a	- 65 ab	- 80 a
M 7 (6)	- 77 a	- 97 a	- 75 ab	- 83 a
M 7 (8)	- 87 a	- 96 a	- 81 ab	- 88 a
AC + M 5 (4+2.5)	- 38 b	- 83 a	- 47 b	- 56 b
AC + M 5 (6+2.5)	- 89 a	- 83 a	- 56 ab	- 76 a
AC + M 5 (8+2.5)	- 86 a	- 100 a	- 65 ab	- 84 a
M 7 + AR (4+12)	- 80 a	- 92 a	- 57 ab	- 76 a
M 7 + ES (4+1)	- 76 a	- 98 a	- 58 ab	- 78 a

[1]Negative values indicate a decrease in stems and values followed by the same letter in a column do not differ at $p = 0.05$

Table 3. Woody stem control (percent change) in 1998 Monsanto site preparation study – MS.

	Species[1]				
Treatment	SCO/WHO	LLP	GRA	HIC	Total
	------------------------------ percent ------------------------------				
Untreated	0 a	+133 e	- 85 b	- 14 e	+87 c
M 7 + AR (6+2)	-100 a[2]	- 86 a	-100 a	-100 a	- 96 a
M 7 + AR (6+4)	-100 a	- 84 a	- 90 a	- 67 c	- 91 a
M 7 + AR (6+6)	-100 a	- 85 a	- 90 a	- 80 b	- 92 a
M 7 (4)	-100 a	- 52 c	- 93 a	- 67 c	- 83 a
M 7 (6)	-100 a	- 73 ab	- 50 c	- 46 d	- 85 a
M 7 (8)	-100 a	- 86 a	-100 a	- 75 b	- 94 a
AC + M 5 (4+2.5)	-100 a	- 52 c	-100 a	- 55 cd	- 71 ab
AC + M 5 (6+2.5)	-100 a	- 73 ab	- 95 a	- 47 d	- 86 a
AC + M 5 (8+2.5)	-100 a	- 81 a	-100 a	- 71 bc	- 89 a
M 7 + AR (4+12)	-100 a	- 80 a	- 88 ab	- 93 a	- 89 a
M 7 + ES (4+1)	-100 a	- 41 cd	-100 a	- 75 b	- 81 a

[1] SCO/WHO = Swamp chestnut and white oak, LLP = loblolly pine, GRA = green ash, HIC = hickory

[2] negative values indicate a decrease in stems and values followed by the same letter in a column do not differ at $p = 0.05$

Table 4. Woody stem control (percent change) in 1998 Monsanto site preparation study – SC.

Treatment	Species: Black Cherry	Red Oaks	Total
	------------------- percent -------------------		
Untreated	- 40 ab	0 d	0 d
M 7 + AR (6+2)	-100 a[1]	-83 ab	-91 ab
M 7 + AR (6+4)	-100 a	-95 a	-91 ab
M 7 +AR (6+6)	- 58 ab	-92 ab	-96 a
M 7 (4)	-100 a	-55 abc	-70 b
M 7 (6)	-100 a	0 d	-98 a
M 7 (8)	-100 a	-83 ab	-90 ab
AC + M 5 (4+2.5)	- 7 b	- 8 cd	-52 c
AC + M 5 (6+2.5)	- 58 ab	-45 bcd	-75 abc
AC + M 5 (8+2.5)	- 92 ab	-75 ab	-90 ab
M 7 + AR (4+12)	- 93 ab	-80 ab	-89 ab
M 7 + ES (4+1)	-100 a	-49 abc	-93 ab

[1] Negative values indicate a decrease in stems and values followed by the same letter in a column do not differ at P = 0.05

ADDITION OF SULFOMETURON METHYL TO FALL SITE PREP APPLICATIONS INCREASES HERBACEOUS WEED CONTROL DURING THE FOLLOWING GROWING SEASON. A.W. Ezell, Mississippi State University, Starkville.

ABSTRACT

A total of 12 herbicide treatments were applied to a recently cutover site to evaluate their efficacy for site preparation. In four of the treatments, Oust ® was added to evaluate the ability to control herbaceous vegetation the following growing season. Ten of the twelve treatments resulted in very good control of the woody species on the study site. The addition of Oust gave excellent herbaceous weed control during the following growing season, with control evident 11.5 months following application.

INTRODUCTION

For years, sulfometuron methyl has been a principal product for herbaceous weed control in pines or hardwoods. The vast majority of this work has been done as a post-plant application, and took the form of a release operation. However, interest in adding Oust ® to the site preparation treatment has increased in recent years.

OBJECTIVE

The objective of this study was to evaluate the efficacy of (1) fall Oust ® applications during site prep in control of herbaceous competition the following growing season and (2) woody stem control, by the tank mixes utilized.

METHODS

A total of 13 treatments (Table 1) were utilized in the study with three replications of each treatment. Plot installation was in a CRD layout. Each plot consisted of a 25 ft. x 100 ft. rectangular spray area marked with metal rebar center posts and nylon string stretched between the rebar. The sample area of 10 ft. x 80 ft. was centered in the treatment plot

The study was installed on land owned by The Timber Company in Noxubee Co., Mississippi. The soils were Wilcox-Faulkner silty clay loam with pH=5.7. The site had been harvested in December 1997, and the treatments were applied early September 1998.

All woody stems in the sample area were tallied by species and height class prior to spray application. Plots were evaluated ocularly for percent brownout by vegetation class at 6 WAT. Woody stems were tallied again in November 1999 to assess control and herbaceous vegetation coverage was evaluated ocularly in June, July, and August 1999.

RESULTS

The addition of Oust to the treatments resulted in excellent herbaceous control during the following growing season (Table 2). By June 1999, the site had been invaded and colonized by fireweed (*Erechtites heiracifolia*) and a number of lesser species scattered across the area. *Panicum* spp. were also present in the area. The treatments which contained Oust generally had 50-60% more clear ground than the other treatments. This effect continued through July, and even though control was breaking down by mid-August, three of the four Oust treatments still had 40% clear ground.

In woody species, red maple, sweetgum, red oaks, and persimmon were all present in sufficient numbers for statistical comparison (Table 3). Nine of the 12 treatments gave good control of red maple with only the Krenite/Escort combinations and one Chopper/Accord mix having less than 80% control. For sweetgum, only the Krenite/Escort combinations failed to give excellent control. The red oaks (water, cherrybark, and Shumard) were controlled very well by all treatments.

In summary, the addition of Oust in fall site prep applications can be very effective for herbaceous weed control 9-11 months later. The woody species in this study were controlled by all treatments except the Krenite/Escort combinations.

Table 1. List of treatments in 1998 DuPont site prep study – Mississippi

Treatment No.	Amount of Product per Acre
1	4 qts. Krenite + 20 oz Chopper + 1 qt. TL 90
2	4 qts. Krenite + 24 oz Chopper + 1 qt. TL 90
3	4 qts. Krenite + 32 oz Chopper + 1 qt. TL 90
4	4 qts. Krenite + 20 oz Chopper + 3 oz Oust + 1 qt. TL 90
5	4 qts. Krenite + 1.5 oz Escort + 1 qt. TL 90
6	4 qts. Krenite + 1.5 oz Escort + 3 oz Oust + 1 qt. TL 90
7	1 oz Escort + 24 oz Chopper + 1 qt. Accord + 1 qt. TL 90
8	1 oz Escort + 40 oz Chopper + 1 qt. TL 90
9	48 oz Chopper + 1 qt. Accord + 1 qt. TL 90
10	48 oz Chopper + 1 qt. Accord + 3 oz Oust + 1 qt. TL 90
11	16 oz Chopper + 5 qt. Accord + 1 qt. TL 90
12	16 oz Chopper + 5 qt. Accord + 3 oz Oust + 1 qt. TL 90
13	Untreated Check

Table 2. Herbaceous coverage in 1998 DuPont site preparation study

	1999 Observations		
Trt. No.	June	July	August
	------------------------ percent ------------------------		
1	76.7	80.0	80.0
2	83.3	86.7	90.0
3	70.0	75.0	86.7
4 *	21.7 **	26.7	56.7
5	68.3	73.3	83.3
6 *	18.3	26.7	70.0
7	78.3	80.0	86.7
8	70.0	76.7	86.7
9	78.3	83.3	91.7
10 *	16.7	20.0	56.7
11	78.3	83.3	91.7
12 *	11.6	18.3	53.3
13	91.7	98.3	100.0

* Treatments with Oust
** One replication invaded by *Sereca lezpedeza*

Table 3. Woody stem control (percent reduction) in 1998 DuPont site preparation study – MS

Treatment	Species				
	R. Map.	S. Gum	R. Oaks	Per	Total
	-----------	-----------	percent	-----------	-----------
K + C (4+20)	-100 a [1]	- 94 a [2]	-100 a	- 87 ab	- 91 a
K + C (4+24)	-100 a	-100 a	-100 a	- 95 a	- 94 a
K + C (4+32)	-100 a	-100 a	-100 a	-100 a	-100 a
K + C + O (4+20+3)	- 91 a	-100 a	-100 a	-100 a	- 97 a
K + E (4+1.5)	- 67 c	- 55 b	- 88 a	- 23 d	- 65 b
K + E + O (4+1.5+3)	- 56 c	- 20 c	-100 a	- 50 c	- 74 b
K + C + A (1+24+1)	- 94 a	-100 a	-100 a	-100 a	- 95 a
E + C (1+32)	- 80 b	- 88 a	-100 a	-100 a	- 91 a
C + A (48+1)	- 72 c	-100 a	-100 a	*	- 92 a
C + A + O (48+1+3)	-100 a	- 91 a	-100 a	*	- 95 a
C + A (16+5)	- 87 ab	-100 a	-100 a	- 87 ab	- 94 a
C + A + O (16+5+3)	- 80 b	- 93 a	- 87 a	- 83 b	- 89 a
Untreated	+ 60 d	+ 72 d	0 b	- 26 d	+ 57 c

K = Krenite (qts.), C = Chopper (oz), O = Oust (oz), E = Escort (oz), A = Accord (qts)
* insufficient stems for comparison
[1] Negative values indicate reduction in stems
[2] Values followed by the same letter in a column do not differ at P = 0.05

NEW FORMULATIONS OF OUST, VELPAR AND ESCORT FOR HERBACEOUS WEED CONTROL. J. Jones and J.L. Yeiser. Stephen F. Austin State University, Nacogdoches, TX 75962.

ABSTRACT

New extruded formulations of Oust, Velpar and Escort in selected combination and with Arsenal were tested in three studies for pine tolerance and weed control. When new formulations were tested alone and mixed with traditional tank partners, weed control and seedling performance were at least as good as that of conventional mixtures at comparable rates. Oustar, a new premix containing new Velpar DF and Oust XP, provided similar control as conventional formulations at comparable rates.

INTRODUCTION

Competing vegetation in newly planted loblolly pine (*Pinus taeda* L.) plantations has long been a concern of southern foresters. In studies where the effects of various components of competition (woody and herbaceous) have been examined, competition from herbaceous species has contributed more to lost pine growth through age three than woody species (1,2). Reducing competing vegetation positively impacts seedling survival and growth for a variety of species and growing conditions (1,2,3,4,5,6,7). Because of the number of studies documenting enhanced pine seedling performance, herbaceous vegetation control after planting has gained rapid acceptance as a means of increasing pine survival and growth.

Oust, Velpar, Escort and Arsenal are among the herbicides commonly used for control of early herbaceous competitors in pine plantations (8,9,10,11). Therefore, the objectives of this project were to compare the weed control and pine tolerance of (1) current and new extruded formulations of Oust, Velpar and Escort in selected combinations and with Arsenal AC and (2) a premix formulation of the new Velpar DF+Oust XP with the conventional Velpar L+Oust mixture.

METHODS

The site chosen for the study was a moderately well to well-drained sandy loam soil (12) in East Texas near Woden (Nacogdoches County). Previously, the site had supported a mixed pine-hardwood stand. This stand was clearcut in June 1997 and treated chemically on July 1, 1998 with 16 oz of Arsenal, 0.75 oz of Escort, and two qt of Accord. In late October, a fixed Piedmont plow was used to subsoil and bed the site. Genetically improved loblolly pine seedlings were hand planted on January 5, 1999 on an 8-ft by 10-ft spacing.

For all three studies, treatment plots consisting of 16-planted seedlings were staked with a plot marker. Each seedling in a plot was marked with a stake flag and the seedling measured for total height and ground line diameter prior to the application of herbicides. The internal 12 seedlings composed the measurement plot, leaving two seedlings on each end as buffers.

A CO_2 backpack sprayer connected to a "T" boom supporting four, 8002 nozzles was used to apply herbicides in a 6-ft. band centered over-the-top of seedlings. All treatments were early post-emergence when dominant species were less than 2-in. tall. The Oust treatments were applied on March 25 to 80% bare ground, the Velpar treatments on March 31 to 70% bare ground and the Escort treatments on April 6 to 60% bare ground. Primary competitors for all three studies were *Rubus* spp, ragweed (*Ambrosia artemisiifolia* L.), wooly croton (*Croton capititus* Michx.) and poorjoe (*Diodia teres*

Walt.). On application day, buds on planted pine seedlings in the Oust study were 12/16 unchanged and 4/16 elongated, in the Velpar study 3/16 unchanged, 6/16 elongated, and 7/16 flushed, and in the Escort study 1/16 unchanged, 10/16 elongated and 5/16 flushed.

Visual plot evaluations for competitor control in 10% intervals were made 30, 60, 90 and 120 days after treatment (DAT). In mid-October, after one growing season, seedlings were assessed for survival (%) and measured for total height (cm) and ground line diameter (mm). Seedling measurements were converted to inches for analysis. Volume was computed as height X ground line diameter^2.

Treatments in each of the three studies were installed in a randomized complete block design with four blocks. The Oust, Velpar and Escort studies had 12,12 and 14 treatments, respectively, in each block. Treatment effects were partitioned using the ANOVA procedure of SAS with means separated according to Duncan's New Multiple Range test. All tests were conducted at the p=0.05 level.

RESULTS AND DISSCUSSION

The test area received limited rainfall during July 1 (0.5 in.), August (0.2 in.) and three weeks in September (0.0 in.) at which time temperatures were commonly 97° to 103°. Consequently, herbicide efficacy changed little during evaluations at 90 and 120 DAT and will not be presented for all studies. Furthermore, the drought probably explains the poor survival and limited seedling growth.

Vegetation Control

Oust formulations provided excellent control (Table 1). No difference was observed among Oust formulations for all evaluations of poorjoe and ragweed control. At all evaluations, wooly croton control was best for Oust or Oust XP mixtures with Arsenal and Arsenal alone. Overall control was best and similar 30 DAT for most treatments. At 60 DAT, Oust and Oust XP mixtures with Arsenal and Velpar were best. By 90 DAT, Arsenal alone or in combination with Oust or Oust XP provided best overall competitor control.

All formulations of Velpar provided excellent control of poorjoe, ragweed, wooly croton and overall species (Table 2). Statistical differences were often among treatment extremes and considered minor. Oustar (12.7 oz) and Velpar L+Oust (1 qt+2 oz) contain comparable active ingredients and provided similar control of competitors. The only noticeable exception to the trend of excellent ragweed control was for Arsenal+Oust (4+2 oz), which provided excellent early control, decreasing 90 DAT.

Current and new formulations of Escort provided excellent control of herbaceous competitors (Table 3). Escort formulations alone and in mixture with tank partners Oust, Velpar and Arsenal provided best and similar control of poorjoe. More often, tank mixtures of Escort, either current or new formulations, provided similar and excellent control of poorjoe, ragweed, wooly croton and overall competitor control. Escort, both current and new formulations, provided least control of ragweed. Wooly croton control was least controlled with Escort and Oust. Overall control was least with Escort formulations.

Seedling Performance

Differences in seedling survival were detected among treatments in the studies of new Oust, Velpar and Escort formulations (Table 4). For all three studies, differences in seedling height were either not detected (Oust) or minor (Velpar and Escort) as were differences in ground line diameter and volume. Seedling performance for many treatments was similar to industry checks, like Velpar L+Oust (1 qt+2 oz) and Arsenal+Oust (4 or 6 oz+2 oz). Consequently, I conclude that (1) survival differences, like seedling growth, were strongly influenced by the 12-week drought frommid-June through late September and that (2) seedling performances for new formulations of Oust, Velpar and Escort were similar to current formulations.

In conclusion, seedling tolerance and weed control were similar or better for current and new formulations of Oust, Velpar and Escort. When new formulations were mixed with traditional tank partners, seedling performance and weed control were similar to that of conventional mixtures at comparable rates. Oustar, the premix formulation of the new Velpar DF and Oust XP, performed similarly as conventional Velpar L+Oust treatments at comparable rates.

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Table 1. Control (%) of herbaceous competition 30, 60 and 90[1] days after treatment (DAT) with Oust formulations and mixtures applied on March 25, 1999 to an 80%-bare, moderately well to well-drained sandy soil in East Texas near Woden (Nacogdoches County).

		DAT			DAT			DAT			DAT		
Treatment[2,3]	Rate[4]	30	60	90	30	60	90	30	60	90	30	60	90
		poorjoe			ragweed			wooly croton			overall		
Oust XP+Ar	2 oz + 4 oz	90a	97a	97a	97a	97a	97a	84a	92ab	92a	93a	92ab	33abcd
Oust+Ar	2 oz + 4 oz	90a	97a	97a	98a	98a	98a	91a	94a	92a	95a	94a	53a
Oust XP+Ar	2 oz + 6 oz	90a	98a	98a	94a	94ab	94a	92a	94a	96a	93a	90abc	35abc
Oust+Ar	2 oz + 6 oz	90a	95a	94a	95a	95ab	95a	90a	96a	92a	95a	94a	43ab
Oust XP	2 oz	90a	97a	97a	94a	92ab	92ab	35bc	56c	56bc	83a	76bc	11de
Oust	2 oz	90a	97a	97a	91a	90ab	90ab	35bc	60bc	49c	83a	74c	11de
Oust XP+Vel	2 oz + 1 qt	90a	97a	97a	94a	94ab	94a	79a	86abc	86a	93a	89abc	28bcd
Oust+Vel	2 oz + 1 qt	90a	97a	97a	94a	91ab	91ab	60ab	77abc	77ab	90a	81abc	20cde
Arsenal	4 oz	90a	95a	95a	65b	65c	65c	65ab	70abc	70abc	83a	76abc	23bcde
Arsenal	6 oz	90a	95a	94a	79ab	76bc	76bc	81a	79abc	79ab	89a	84abc	33abcd
Velpar L	1 qt	55b	58b	58b	35c	33d	33d	20c	23d	23d	48b	41d	5e

[1] Evaluations 120 DAT were completed but plots changed very little after the 90-day assessment probably due to drought.

[2] O=Oust; Ar=Arsenal; Vel=Velpar L

[3] Treatment means within a column sharing the same letter are not significantly different (Duncan's New Multiple Range test, p=0.05 level).

[4] Product per treated acre.

Table 2. Herbaceous competitor control (%) 30, 60 and 90[1] days after treatment (DAT) with Velpar formulations and mixtures applied on March 31, 1999 to a 70%-bare, moderately well to well-drained sandy soil in East Texas near Woden (Nacogdoches County).

		DAT			DAT			DAT			DAT		
Treatment[2,3]	Rate[4]	30	60	90	30	60	90	30	60	90	30	60	90
		poorjoe			ragweed			wooly croton			overall		
Arsenal+Oust	6 + 2 oz	99a	99a	96a	90a	92a	99a	96a	90a	92a	97ab	97ab	80a
Arsenal+Oust	4 + 2 oz	92ab	92ab	77bc	77cd	64c	72b	77bc	77cd	64c	95ab	89abc	48c
Oustar[5]	25.4 oz	99a	99a	89ab	89ab	87ab	100a	89ab	89ab	87ab	99a	99a	79a
Oustar	12.7 oz	96ab	96ab	75bc	79bc	70bc	98a	75bc	79bc	70bc	97ab	96ab	78a
Oustar	9.5 oz	80c	80c	68c	68d	65c	97a	68c	68d	65c	96ab	86bc	70ab
Velpar DF	16 oz	98a	98ab	84ab	84abc	81abc	98a	84ab	84abc	81abc	95ab	92abc	78a
New Velp DF	16 oz	96ab	96ab	80bc	81abc	78abc	98a	80bc	81abc	78abc	94ab	88abc	70ab
Velpar DF	10.7 oz	87bc	87bc	83ab	76cd	79abc	97a	83ab	76cd	79abc	94ab	90abc	70ab
New Velp DF	10.7 oz	98ab	98ab	78bc	76cd	70bc	95a	78bc	76cd	70bc	89b	83c	55bc
Velpar L	1 qt	95ab	95ab	85ab	80abc	82abc	96a	85ab	80abc	82abc	92ab	84c	68abc
Velp L+Oust	1 qt + 2 oz	98a	98ab	83ab	78cd	75abc	98a	83ab	78cd	75abc	97ab	93abc	63abc

[1] Evaluations 120 DAT were completed but plots changed very little after the 90-day assessment probably due to drought.

[2] Ar=Arsenal; Velp L=Velpar L

[3] Treatment means within a column sharing the same letter are not significantly different (Duncan's New Multiple Range test, p=0.05 level).

[4] Product per treated acre.

[5] Oustar is a premix formulation by DuPont consisting of the new Velpar DF and Oust XP (63%:12%).

Table 3. Control of herbaceous competitors 30 and 60[1] days after treatment (DAT) with new Escort formulations applied on April 4, 1999 to a 60%-bare, moderately well to well-drained sandy soil in East Texas near Woden (Nacogdoches County).

		DAT		DAT		DAT		DAT	
Treatment[2]	Rate[3]	30	60	30	60	30	60	30	60
		poorjoe		ragweed		wooly croton		Overall	
Escort+Oust	1 oz + 2 oz	99a	99a	98a	98a	79ab	79ab	94a	94a
New Escort+Oust	1 oz + 2 oz	97ab	97ab	96a	99a	78ab	78ab	92a	90a
Escort	1 oz	95ab	93ab	65b	65b	38c	50cd	65cd	50c
New Escort	1 oz	95ab	95ab	58b	58b	43c	50cd	60d	45c
Velpar L+Escort	1 qt + 1 oz	95ab	95ab	93a	93a	68b	68bc	90ab	90a
Velpar L+ New Escort	1 qt + 1 oz	93ab	93ab	98a	98a	75b	75ab	92a	90a
Arsenal+New Escort	6 oz +1 oz	94ab	94ab	97a	97a	95a	95a	94a	94a
Arsenal+Escort	6 oz + 1 oz	93ab	93ab	95a	95a	95a	95a	92a	90a
Arsenal	6 oz	91ab	91b	94a	94a	83ab	83ab	75bc	68b
Velpar+Oust	1 qt + 2 oz	93ab	93ab	98a	98a	80ab	80ab	85ab	85a
Arsenal+Oust	4 oz + 2 oz	90b	90b	95a	95a	78ab	78ab	88ab	83ab
Velpar L	1 qt	90b	90b	90a	90a	75b	75ab	88ab	83ab
Oust	2 oz	83c	83c	91a	91a	38c	38d	75bc	68b

[1] Evaluations 90 and 120 DAT were completed but plots changed very little after the 60-day assessment probably due to drought.

[2] Treatment means within a column sharing the same letter are not significantly different (Duncan's New Multiple Range test, p=0.05 level).

[3] Product per treated acre.

Table 4. Seedling survival (%), height (in.), ground line diameter (in.) and volume (in^3) after one growing season on a moderately-well to well-drained, sandy soil in East Texas near Woden (Nacogdoches County).

Treatment[1]	Rate[2]	Survival	Height	Ground Line Diameter	Volume
Oust formulations					
Oust XP	2 oz	63a	17.8a	0.32abc	2.0abc
Oust	2 oz	42bcd	18.7a	0.34abc	2.7abc
Oust XP+Arsenal	2 oz + 4 oz	61ab	18.3a	0.33abc	2.6abc
Oust+Arsenal	2 oz + 4 oz	58ab	18.0a	0.38a	3.2ab
Oust XP+Arsenal	2 oz + 6 oz	52abc	17.8a	0.35ab	2.4abc
Oust+Arsenal	2 oz + 6 oz	33cd	19.1a	0.36a	3.3a
Oust XP+Velpar L	2 oz + 1 qt	44abcd	19.0a	0.35ab	2.9abc
Oust+Velpar L	2 oz + 1 qt	44abcd	17.4a	0.33abc	2.3abc
Arsenal	4 oz	28d	18.0a	0.31abc	2.1abc
Arsenal	6 oz	42bcd	19.0a	0.35ab	3.0ab
Velpar L	1 qt	27d	18.1a	0.29bc	1.7bc
Check		28d	16.4a	0.28c	1.5c
Velpar formulations					
Arsenal+Oust	4 oz + 2 oz	64ab	18.7ab	0.35b	2.9bc
Arsenal+Oust	6 oz + 2 oz	68ab	18.6ab	0.35b	2.6bc
Oustar[3]	25.4 oz	66ab	19.6ab	0.40ab	4.1abc
Oustar	12.7 oz	61ab	21.5a	0.43a	4.8a
Oustar	9.5 oz	63ab	18.9ab	0.37ab	3.5abc
Velpar DF	16 oz	69ab	20.0ab	0.41ab	4.2abc
New Velpar DF	16 oz	70a	20.6ab	0.39ab	3.9abc
Velpar DF	10.7 oz	52ab	18.0b	0.34b	2.5c
New Velpar DF	10.7 oz	56ab	20.3ab	0.40ab	4.0abc
Velpar L	1 qt	63ab	19.4ab	0.39ab	3.8abc
Velpar L+Oust	1 qt+2 oz	53ab	20.9ab	0.43a	4.3ab
Check		50b	19.5ab	0.35b	3.6abc
Escort formulations					
New Escort+Oust	1 oz + 2 oz	83a	21.7a	0.45a	4.9abc
Escort+Oust	1 oz + 2 oz	75abc	21.5a	0.47a	6.0a
New Escort	1 oz	44de	20.4a	0.37b	3.2c
Escort	1 oz	64bc	20.1a	0.38b	3.5c
Velpar L+ New Escort	1 qt + 1 oz	67abc	20.0a	0.38b	3.3c
Velpar L+Escort	1 qt + 1 oz	58cd	19.0ab	0.38b	3.3c
Arsenal+New Escort	6 oz + 1 oz	64bc	21.5a	0.46a	5.2ab
Arsenal+Escort	6 oz + 1 oz	80ab	21.6a	0.47a	5.8a
Arsenal	6 oz	63bc	18.8ab	0.38b	3.3c
Velpar+Oust	1 qt + 2 oz	73abc	20.6a	0.39b	3.8bc
Arsenal+Oust	4 oz + 2 oz	73abc	21.1a	0.43ab	4.4abc
Velpar L	1 qt	61bcd	19.7ab	0.39b	3.7bc
Oust	2 oz	59cd	20.7a	0.39b	3.6bc
Check		33e	17.2b	0.29c	1.6d

[1] Treatment means within a column sharing the same letter are not significantly different (Duncan's New Multiple Range test, p=0.05 level).

[2] Product per treated acre.

[3] Oustar is a premix formulation by DuPont consisting of the new Velpar DF and Oust XP (63%:12%).

TWO-YEAR SLASH PINE *PINUS ELLIOTI* SEEDLING RESPONSE FOLLOWING HERBACEOUS WEED CONTROL WITH OUST, VELPAR, ARSENAL AC, AND DPX-R6447. W.D. Mixson, D.C. Sloan, Dupont Co. Pensacola, Fl and New Orleans, La.

ABSTRACT

Fifteen replicated herbicide treatments and two operational treatments were applied over the top of newly planted Slash pine seedlings. Included in the treatments were operational standards of Oust, Velpar, Arsenal AC, and various tank mixes of these products as well as DPX-R6447 (Azafenadin). The objective of this study was to assess the crop tolerance and growth response of the test treatments to A) operational standards B) untreated check C) total herbaceous control

The study was established on a flatwoods Coastal Plain site in Calhoun County Florida. The site was prepared for planting with a shear/chop pass followed by double bedding. Seedlings were 1.5 generation improved and planted on a 5 X 9.5-ft spacing.

Study layout consisted of 15 treatments and an untreated check and two operational areas. Each measurement strip had 3, 66 ft random strip plots within the treated areas. A CO2 hand held sprayer was used to apply the experimental treatments. A single nozzle skidder sprayer applied the operational treatments. A five ft band and 20 GPA solution was used for all treatments. Experimental treatments were made totally pre-emergent on March 6, 1998. The operational skidder treatment was made June 15, 1998 as a late post emergent application. Total control plots were kept weed free with an initial application of Oust at 4 oz, a mid-summer follow-up with Oust at 2 oz and directed sprays of Glyphosate as needed. In year two a combination of Hexazinone + Oust was applied in the spring with follow-up treatments of Glyphosate as needed.

Seedlings were assessed for survival and measured for total height and groundline diameter in year 1. After the second growing season height and diameter at 6 inches was measured. A seedling volume index of diameter X diameter X height was utilized to assess seedling response.

In Year 1 seven treatments outperformed the total control plots these included:

1.5 oz Oust + 10.67 oz Velpar DF
10.67 oz Velpar DF
½ oz Escort + 10 oz R6447
10.67 oz Velpar DF + 10 oz R6447
10.67 oz Velapr DF + 4 oz Arsenal AC
4 oz Oust + 16 oz Velpar DF
20 oz DPX-R6447 + 4 oz Arsenal AC

Several treatments ranked poor in terms of growth and included:

20 oz DPX-R6447
1.5 oz Oust + 10 oz DPX-R6447
1.5 oz Oust
1.5 oz Oust + 4 oz Arsenal AC
4 oz Arsenal AC
Untreated

Three treatments had outstanding weed control in March 1999 from applications in March 1998 and June 1998.

Total Control	95%
20 oz DPX-R6447 + 4 oz Arsenal AC	85%
2 oz Oust + 6 oz Arsenal AC (Operational)	75%

It is interesting to note that while the operational treatment resulted in excellent weed control its performance was only mediocre in terms of growth in year 1 and in year 2.

After two growing seasons only one treatment outperformed the total control in terms of volume index. This treatment was 20 oz DPX-R6447 + 4 oz Arsenal AC. 1.5 oz Oust + 10.67 oz Velpar DF was similar in volume production to the total control.

The combination of Velpar + Arsenal AC performed well and warrants further investigation as both products are currently registered but are not commonly tank mixed. Oust and oust tank mixes did not perform with the exception of the tank mix with Velpar. Arsenal alone was similar to the untreated check in year 1 but had caught up with the other poor performing treatments in year 2. DPX-R6447 did not perform well alone but was good in most tank mix combinations. 4 of the 5 best performing (volume index) treatments in YR 1 & 2 contained Velpar DF.

THE USE OF THE MICROPHOR SIDEWINDER® JR. ROADSIDE SPRAYER WITH PATCHEN WEEDSEEKER® TECHNOLOGY FOR ROADSIDE VEGETATION ENCROACHMENT CONTROL. D.P. Montgomery, L.M. Cargill, D.L. Martin, and R. Mayfield, Department of Horticulture and Landscape Architecture, Oklahoma State University, Stillwater, OK 74078 and Microphor Company, Willits, CA 95490.

ABSTRACT

During 1999 several demonstrations were conducted in Oklahoma using the Microphor SidewinderâJr. sprayer. This boom-type sprayer is unique as each spray tip is controlled by a Patchen Weedseekerâ unit. The Weedseeker uses both a visible and an infra-red light source, plus a light detector to measure the reflectance of the ground over which it travels. When the light source contacts a green plant a spray tip is triggered, however, surfaces such as asphalt, concrete, or bare soil will not trigger the spray tip. The interest in this technology will hopefully facilitate the roadside vegetation encroachment control efforts of Oklahoma Department of Transportation maintenance personnel while reducing the costs of expensive bareground treatments. The Sidewinderâ Jr. sprayer was used to apply the selected treatment of Roundup Pro at 2 % V/V plus Arsenal at 1% V/V in four demonstration sites. The four sites totaled approximately 50 lane miles of highway shoulder and treatments were applied during the last week of June 1999. All applications were made using a truck speed of 10 miles per hour. All targeted weeds were actively growing through asphalt shoulders or encroaching 1 to 2 feet over the edge of the shoulder. Weeds present in each of the demonstration areas included common bermudagrass, saltgrass, switchgrass, and large crabgrass.

The first observations were taken 40 days-after-treatment (DAT) at which time the average common bermudagrass control was 78%, saltgrass 25%, switchgrass 80%, and large crabgrass 98%. Observations were again made at 70 DAT at which time control had increased for some species but decreased for others. Common bermudagrass control had increased to 86% and saltgrass to 63%. However, switchgrass control had decreased to 68% while latter germinating large crabgrass was reinfesting many of the demonstration sites.

In summary the Sidewinderâ Jr. sprayer was very user friendly, however, the level of weed control was 10 to 15% lower than what is currently being achieved through conventional applications of the same herbicide treatment. It is suspected that the reduced levels of control may be a result of a low carrier rates (maximum SidewinderÒ carrier rates of 8 gallons per acre compared to traditional carrier rates of 20 to 40 gallons per acre) and lack of a longer residual herbicide effect. Future work with the Sidewinderâ Jr. sprayer will include changing the standard spray valve cartridge in the Patchen Weedseekerâ with a valve driver cartridge. This will allow the use of standard solenoids and nozzle assemblies that will allow for higher flow rates while still taking advantage of the sensing technology. This modification will also allow the use of dry herbicide formulations.

IMAZAPIC FOR TALL FESCUE (*FESTUCA ARUNDINACEA*) SEEDHEAD SUPPRESSION. F.H. Yelverton, J.D. Hinton, and T.W. Gannon. North Carolina State University, Raleigh, NC 27695.

ABSTRACT

Plant growth regulators (PGRs) are currently used on roadsides and other utility turfgrasses to manage seedheads of both turf-type and Kentucky 31 tall fescue. Experiments were therefore conducted to compare various products and rates of existing PGRs for seedhead suppression and quality reductions on both turf-type and Kentucky 31 tall fescue.

Experiments were initiated on April 13, 1998 and April 24,1998 at the NCSU Turf Field Lab and NC DOT in West Jefferson, respectively. The NCSU Turf Field Lab location consists of turf-type tall fescue while the West Jefferson location consists of Kentucky 31 tall fescue. Turf quality, seedhead suppression, and foliar height of turfgrass was taken throughout the trial period. Turf quality was rated on a 0 – 9 scale with 0 = desiccated turf and 9 = ideal turf. Seedhead suppression was rated by recording the number of seedheads per ft^2. Also, foliar height of turfgrass was measured in inches.

The tests aforementioned included the following treatments: Telar (0.125 oz/a) + Embark (0.5 pt/a), Plateau (1.0 oz/a) + X77 (0.25% v/v), Plateau (2.0 oz/a) + X77 (0.25% v/v), Plateau (3.0 oz/a) + X77 (0.25% v/v), and Plateau (4.0 oz/a) + X77 (0.25% v/v).

Results demonstrated that all rates of imazapic exceeding 1.0 oz/a provided great seedhead suppression thoughout the test period (21 WAT) on both turf-type and Kentucky 31 tall fescue. However, rates of imazapic exceeding 2.0 oz/a did result in unacceptable turf injury through 7 WAT in Kentucky 31 tall fescue and 9 WAT in turf-type tall fescue. From these tests, we observed that turf-type tall fescue was more sensitive to imazapic than was Kentucky 31 tall fescue. Telar + Embark, which is currently a treatment used by NC DOT also effectively controlled both turf-type and Kentucky 31 tall fescue seedheads with much less, if any quality reductions.

EVALUATION OF IMAZAPIC RATE AND TANK-MIXES FOR WEED CONTROL ON ROADSIDES. K. C. Hutto, G.E. Coats, and J.M. Taylor. Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Three studies were conducted to evaluate imazapic (Plateau[a]) rates and tank mixes for summer and winter weed control on bermudagrass roadsides in Mississippi. The first study, initiated in June 1999, involved tank mixing 0.063, 0.094, or 0.125 lb ai/A imazapic with 1, 2, or 3 lb ai/A MSMA. Imazapic at 0.125 lb/A controlled johnsongrass better than the lower rates of imazapic. Tank-mixing MSMA with any rate of imazapic did not improve control of johnsongrass. Tank mixing 0.125 or 0.094 lb/A imazapic with 3 lb/A MSMA significantly increased bahiagrass control 8 weeks after treatment (WAT) or tall fescue control at 12 WAT compared to MSMA alone. Bermudagrass injury had a tendency to decrease as the rate of MSMA increased when tank mixed with imazapic.

The second experiment, initiated in June 1998, involved tank mixing 0.375 or 0.5 lb ai/A glyphosate (Roundup Pro[a]) or 3.3 lb/A MSMA with 0.063 to 0.125 lb/A imazapic on a bermudagrass roadside. Tank mixing 0.375 lb/A glyphosate with 0.094 or 0.125 lb/A imazapic increased the control of knotroot foxtail 8 WAT compared to glyphosate alone (45 to 50% compared to 13%). Tank mixing both rates of glyphosate with all rates of imazapic controlled both johnsongrass and crabgrass better at 8 WAT compared to glyphosate alone. The injury of bermudagrass tended to increase with both rates of glyphosate when tank-mixed with imazapic 4 WAT compared to imazapic alone (23% to 35% compared to 13% to 25%). However, the turf showed no signs of injury 8 WAT. Tank mixing 0.063 to 0.125 lb/A imazapic with 3.3 lb/A MSMA significantly decreased bermudagrass injury compared to imazapic alone. Imazapic at 0.125 lb/A resulted in 25% injury while the tank-mix of 0.125 lb/A imazapic plus 3.3 lb/A MSMA resulted in 15% injury.

The final study, initiated in February 1999, involved evaluating 0.063 or 0.125 lb/A imazapic combined with various herbicides. The addition of 0.063 lb/A imazapic to 0.5 lb/A glyphosate, 0.25 lb ai/A dicamba (Vanquish[a]) + 0.475 lb ae/A 2,4 D amine, or 0.023 lb ai/A sulfometuron (Oust[a]) significantly increased the control of Carolina geranium 2 months after treatment (MAT) compared to these herbicides alone. Tank mixing 0.063 lb/A imazapic with 0.5 lb/A glyphosate or 0.5 lb/A dicamba increased the control of wild carrot 3 MAT. Adding 0.063 lb/A imazapic to 0.475 lb/A 2,4-D amine significantly increased the control of hop clover 3 MAT compared to 2,4 D amine alone. The addition of 0.063 lb/A imazapic to 0.71 + 0.56 lb/A glyphosate + 2,4-D amine (Campaign[a]), 0.5 lb/A glyphosate, or 0.023 lb/A sulfometuron significantly increased the control of tall fescue 3 MAT compared to these herbicides alone. All herbicides tank mixed with 0.125 lb/A imazapic provided good control of wild chervil, Italian ryegrass, sixweeks fescue, and common vetch. Bermuda turf density increased as the rate of imazapic increased when tank mixed with glyphosate + 2,4 D amine, glyphosate, 2,4 D amine, or dicamba+2,4-D amine compared to these herbicides alone.

REFINING RATES AND TREATMENT SEQUENCES FOR COGONGRASS (*IMPERATA CYLINDRICA*) CONTROL WITH IMAZAPYR AND GLYPHOSATE. J.H. Miller, USDA Forest Service, Southern Research Station, Auburn University, AL 36830.

ABSTRACT

Cogongrass (*Imperata cylindrica* (L.) Palisot) is an aggressive invasive plant on all continents and has been spreading northward in the Southeast's Gulf Coastal Plain and into Florida for 80 years. It spreads by prolific windblown seeds and with movement of infested soils while infestations increase in size and become more dense by rhizome spread. Much research has been reported worldwide on cogongrass control, while especially crucial in our region has been that performed by the team led by Dr. Donn Shilling at the University of Florida. The research by Schilling's team has found that the most effective forestry herbicides for cogongrass control are Accord (glyphosate) and Arsenal (imazapyr); the most effective application times for both herbicides are in late summer; and that the total application volume is best at 5 gallons per acre (gpa) for Accord and 25 gpa for Arsenal. All research has shown that repeated applications are needed for eradication.

To further refine treatment effectiveness, the objectives of the current research were to (1) test a range of rates for Accord and Arsenal so as to define the dose-response curves, (2) refine late-summer timing by testing both September and October applications, and (3) in an adjunct study, test a mixture of Accord and Arsenal using three different spray volumes. The research was performed at two sites: infestations under a 50-year old longleaf pine (*Pinus palustris* Miller) plantation (old patch) and in a 2-year-old loblolly pine (*P. taeda* L.) plantation (new patch). The treatments were tested using three replications in blocks at each site. Plots were 12 x 24 feet, split to 6 x 24 feet for retreatments one year after the initial treatments. Applications used a CO_2 sprayer with two 9502E nozzles and 20 psi. Accord was tested at 0, 2, 4, 8, and 16 quarts per acre and Arsenal was tested 0, 8, 16, 32, and 64 ounces per acre. Accord was applied at 10 gpa and Arsenal was applied at 25 gpa total volume. The trial on the mixture of the two herbicides tested 10, 25, and 40 gpa of spray volume. To assess control, I performed ocular estimates of volume reduction relative to non-treated check plots at 1 and 2 years after treatment (YAT) and then at 1 and 2 years after retreatment (YART). ANOVA's were calculated along with contrasts, and percents were transformed using arcsine square root.

This research found that Arsenal was significantly more effective than Accord at the rates tested for 1 YAT and 1 YART. The differences were non-significant for most second year responses. September applications were significantly more

effective than October treatments and retreatments, especially with Accord. Control 1 YAT and 1 YART increased with increasing rates with both herbicides, especially at lower rates, and then became more level with less increase between the higher rates (diminishing returns). Maximum rates of Arsenal and Accord resulted in greater than 90 percent and 74 percent control, respectively, 1 YAT and 1 YART. Recovery between 1 and 2 YAT on the old patch was 10 to 40 percent loss in control and on the new patch it was 20 to 80 percent loss in control. Excavation of areas within plots found that regrowth originated from recovering plants on lower rates and from partially-controlled rhizomes on higher rate plots. Results from applying the mixture of Arsenal and Accord found that the volume of spray solution did not significantly influence control.

The best current recommendations for cogongrass control using registered forestry herbicides is Arsenal at 32 ounces per acre at 25 gpa volume, Accord at 4 quarts per acre at 5 to 10 gpa volume, or a mixture of Accord at 4 quarts + Arsenal 16 ounces per acre at 10 to 40 gpa volume. These applications are best in September. It is assumed that pines can be planted on treated sites and oversprayed with lower rates during establishment in an attempt to shorten the reclamation process, which is the approach being pursued in tropical countries with cogongrass.

DEVELOPMENT OF AN INTEGRATED METHOD OF SWITCHGRASS (*Panicum virgatum* L.) CONTROL USING MOWING AND ROPEWICK APPLIED GLYPHOSATE ON BERMUDAGRASS ROADSIDES. L.M. Cargill, D.L. Martin and D.P. Montgomery; Department of Horticulture and Landscape Architecture, Oklahoma State University, Stillwater OK 74078.

ABSTRACT

Switchgrass (*Panicum virgatum* L.) is a native, warm-season, sod-forming tall grass that has become a major weed problem in selected areas in Oklahoma. Switchgrass' tall, upright growth habit enables it to successfully compete with the desirable bermudagrass in the clear zone along highway roadsides. Previous research conducted at Oklahoma State University on broadcast applications of commercially available and experimental herbicides alone has found no single treatment that provides satisfactory switchgrass control without substantial or unacceptable injury to desirable roadside bermudagrass.

A field study was initiated during 1996 and retreated during 1997 and 1998 to (1) evaluate the performance of Roundup Pro, applied at a 33% solution (2 parts water plus 1 part herbicide) through a pipewick applicator for the selective control of switchgrass along a bermudagrass roadside after being treated for three consecutive years; (2) to evaluate and compare the effects of wiping in one direction versus wiping in two directions (second application is in opposite direction of the first); and (3) to evaluate the effects of one or two timely mowing cycles, alone, or in combination with Roundup Pro. A total of nine treatments were applied with herbicide applications being made with a pipewick applicator, 4.5 feet in length, mounted on a bicycle sprayer at approximately 10-11 inches from the ground. Ground speed was 2 MPH. Mowing treatments were conducted just prior to emergence of flowers from the boot and were performed using a sicklebar mower set to cut at 5 inches. Treatments were arranged in a randomized complete block design with three replications of plots measuring 5 by 20 feet. Visual observations were made for percent bermudagrass phytotoxicity, percent bermudagrass cover and percent switchgrass control.

Due to the large amount of data generated from these experiments, the focus of this abstract is the 3 month after treatment (MAT) evaluations conducted during 1998. These evaluations represent treatment success achieved after three consecutive years of treatment.

All plots were observed to have an overall increase in percent bermudagrass ground cover, with one exception. There was an overall decrease in percent bermudagrass cover in the untreated, unmowed check plots from 22% observed beginning in June 1996 with only 10% recorded during September 1998, representing an overall 52% decrease. This supports the concept that, if given sufficient time, switchgrass can compete very effectively with bermudagrass. If left untreated, unmowed or virtually undisturbed, it can eventually overcome the once established bermudagrass roadsides and establish itself as the predominant vegetation type in that particular area. Plots which had been wiped with Roundup Pro and mowed 0, 1 or 2 times annually, had an average overall increase of 80% to 136% in percent bermudagrass cover after being treated for three consecutive years. The untreated check plots, which had received 1 or 2 timely mowing cycles per year for three consecutive years, had an average increase of only 40% to 64% in the amount of bermudagrass cover. No bermudagrass phytotoxicity was observed from any treatment when evaluations were recorded.

No significant differences in percent switchgrass control was observed among plots which were treated with Roundup Pro, wiped in 1 or 2 directions and mowed either 0, 1 or 2 times annually. These same treatments, however, provided significantly better switchgrass control than all non-herbicide treated check plots which had received 0, 1 or 2 annual mowing cycles. Percent switchgrass control in the Roundup Pro treated plots ranged from92% to 99% and 65% to 67% in the untreated check plots which had been mowed once or twice annually, respectively.

REVIEW OF SULFOSULFURON RESEARCH IN MISSISSIPPI. G.E. Coats and J.M. Taylor. Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Johnsongrass is a common weed found along roadsides in Mississippi. Typically, johnsongrass growth is sufficient to warrant mowing by late May or early June. Experiments were conducted in 1998 and 1999 to evaluate sulfosulfuron (Outrider[a]) as a management tool for johnsongrass control in common bermudagrass and bahiagrass roadsides. A second major objective in these studies was to determine the impact of mowing on efficacy. Plots were treated, mowed 14 to 15 days later or plots were mowed, the johnsongrass allowed to regrow to the 6- to 8-leaf stage, then treated. If efficacious in either or both mowing regimes, brown-out could potentially be reduced. Sulfosulfuron, sulfometuron (Oust[a]), or imazapic (Plateau[a]) were applied alone or tank-mixed with MSMA or glyphosate (Roundup Pro[a]) in common bermudagrass. In studies in bahiagrass, sulfosulfuron, sulfometuron, and imazapic were evaluated.

Sulfosulfuron at 0.06 lb ai/A controlled johnsongrass equal to or better than other herbicides. The addition of 0.4 lb ai/A glyphosate or 3.3 lb ai/A MSMA did not increase johnsongrass control. Sulfosulfuron was equally efficacious applied prior to or after mowing. Bermudagrass density in plots treated with sulfosulfuron was equal to or greater than untreated plots through 8 weeks after treatment and density was frequently significantly higher than sulfometuron or imazapic treated plots, especially at 4 weeks after treatment.

No injury was observed in bahiagrass treated with 1.33 oz/A sulfosulfuron while 3 fl oz/A imazapic or 0.5 oz/A sulfometuron caused approximately 25% injury at 4 weeks after treatment, but the bahiagrass turf had recovered by 8 weeks after treatment. At these rates sulfosulfuron tank-mixed with sulfometuron or imazapic provided 80% or better bahiagrass seedhead suppression through 8 weeks after treatment.

SCREENING KROVAR IDF, R6447 (AZAFENIDIN) AND KRENITE S FOR WILDING PINE CONTROL. J.L. Yeiser, Stephen F. Austin State University, Nacogdoches, TX 75962.

ABSTRACT

Pines in neighboring stands may seed a prepared and newly planted site producing overstocked stands composed of unimproved “wildling” and genetically improved pine seedlings. Managers need a treatment that controls unwanted wildling pine seed, germinants and seedlings while releasing without injury, genetically improved pine seedlings. The objectives of this study were to determine the efficacy of different rates of Krovar IDF, Krenite S, and R6447 on (1) herbaceous competitors of newly planted pines, (2) unwanted pine germinants, and (3) the growth response of planted loblolly pine seedlings. Directed and over-the-top treatments of Krovar IDF (20 oz and 40 oz) damaged planted seedlings and failed to provide more weed or germinant control than Oust (3 oz). R6447 did not damage planted pines but failed to provide germinant control above that of Oust (3 oz). Germinant control with Krenite S was confounded with drought and undetermined. The use of directed and over-the-top treatments of Krovar IDF and R6447 for wildling pine seed and germinant control is not recommended. The long germination window for pine seeds suggests their control with a single application is unlikely. Additional research is needed.

INTRODUCTION

Herbicide and fire are commonly used during site preparation to control unwanted pine seed, germinants and seedlings. Pines in neighboring stands may seed the prepared area and when planted, produce overstocked stands composed of unimproved “wildling” and genetically improved pine seedlings. With time, genetically improved and wildling seedlings become indistinguishable. Mechanical and chemical treatments imposed at that time to reduce stocking could remove genetically improved pines fromthe stand. If overstocking is not addressed during early stand development, crop tree growth can be reduced.

Krovar IDF is a dispersible granule used predominantly in citrus and utility markets and not presently registered for forestry (1). Leaves and roots absorb bromacil and diuron, the active ingredients in Krovar IDF. Krenite S is labeled for woody plant control in many southern states and used during forest site preparation and utility operations (2). Fosomine is the active ingredient in Krenite. It is absorbed through plant foliage with local translocation. Azafenidin, the active ingredient in R6447, was recently labeled as Milestone and is used in citrus (4,5). R6447 is being investigated for potential use in forestry for pre-emergent control of herbaceous weed in pine and hardwood plantations (3). Pine seeds can be controlled with R6447 and Krovar IDF. Both Krenite S and Krovar IDF control pine germinants and seedlings (1,2). DuPont manufactures Krovar IDF, Krenite S and Milestone.

Forest managers need a treatment that controls unwanted wildling pine seed, germinants and seedlings and releases genetically improved, newly planted pine seedlings without injury. A single treatment of Krovar IDF, Krenite S or R6447, with appropriate application methods, may control wildlings without injury and growth loss to planted pines. The objectives of this study were to determine the efficacy of different rates of Krovar IDF, Krenite S, and R6447 on (1) herbaceous competitors of newly planted pines, (2) unwanted pine (*Pinus taeda* L.) germinants, and (3) the growth response of planted loblolly pine (*Pinus taeda* L.) seedlings.

METHODS

The study was established on a fine sandy loam soil (6) in East Texas near Woden (Nacogdoches County). The site previously supported a mixed pine-hardwood stand that was clearcut in June 1997 and treated aerially on July 1, 1998 with 16 oz of Arsenal, 0.75 oz of Escort, and two qt of Accord. In late October 1998, a fixed Piedmont plow was used to subsoil and bed the site. Genetically improved loblolly pine seedlings were hand planted on January 5, 1999 on an 8-ft by 10-ft spacing.

Treatment plots consisting of 16-planted seedlings were staked with a plot marker and a treatment-bearing aluminum tag on March 3, 1999. Each seedling in a plot was marked with a stake flag and the seedling measured for total height and ground line diameter. The internal 12 seedlings comprised the measurement plot, leaving two seedlings on each end as buffers. Table 1 lists the herbicides, rates, and application methods tested.

Treatments of R6447 and Krovar IDF were applied over-the-top of seedlings on March 15, 1999. A CO_2 backpack sprayer and a “T” boom supporting four, 8002 nozzles were used to apply herbicides in a six-foot band. All above ground seedling parts were sprayed with herbicide. Plots designated to receive the Krenite S treatment were first treated with Oust (3 oz) on March 15 and Escort (0.75 oz) on June 21 to fully expose germinants for the directed Krenite S treatment on August 2. Directed treatments were applied with a hand-held “T” boom containing two, K1.5 nozzles. The boom was centered over-the-top of seedlings and held approximately 21 in. above the ground. Herbicides were directed away from planted seedling terminal buds while covering a six-foot swath that included tips of planted seedling branches.

On March 15, 1999 there was 95% bare ground. *Rubus* spp. were less than 1-in. tall and were the dominant competitors occupying plots. Physiological activity of planted seedlings was minimal with 14/16 buds swollen and 2/16 unchanged. Dominant species invading plots were low panicgrasses (*Dichanthelium scoparium* (Lam.) Gould and *D. acuminatum* (Sw.) Gould & C.A. Clark), poorjoe (*Diodia teres* Walt.) and wooly croton (*Croton capititus* Michx.).

Immediately following herbicide application (March 15,1999), 1.25 pounds (10,000 seeds per pound) of stratified, genetically improved loblolly pine seeds were applied to study plots. Two seeds were placed at one-ft intervals along the center of the bed at the rate of 12,500 seeds per acre. A heavy rain (1.4 in. < 1.5 hrs) fell four days after sowing, moving some sown seeds from their original placement to low spots often outside the treatment swath.

Plot evaluations of herbaceous control were made 30, 60, 90 and 120 days after treatment (DAT). Plots were visually evaluated and control expressed in 10% intervals. Germinants within a 2-ft swath on bed crowns were staked weekly with colored stake flags and their fate followed until October 2. Germination data were grouped in 30-day intervals from 30 through 200 DAT for analysis. Planted pine seedlings were evaluated for survival and the number of new terminal and lateral flushes at 30 DAT. After 120 DAT and again on October 8, 1999, after one growing season, seedlings were measured for total height (cm) and ground line diameter (mm). Seedling measurements were converted to inches for analysis. Volume was computed as height X ground line diameter^2.

The study was installed as a randomized complete block design with four blocks. Each block contained 14 single-row treatment plots. Treatment effects in the ANOVA were partitioned using the GLM procedure of SAS and means separated using Duncan’s New Multiple Range test. All tests were conducted at the p=0.05 level.

RESULTS AND DISCUSSION

For panicgrasses and poorjoe, Krovar IDF (20 oz; 40 oz) and R6447 (5 oz; 10 oz) provided control comparable to the Check and Oust (3 oz) in the O/E/Krenite S sequence (Table 1). For wooly croton, Krovar IDF showed better early control than the check and Oust (3 oz) per the O/E/Krenite S sequence (Table 2). At 30, 60, and 90 days after treatment, the Check (Oust 3 oz) and Oust/Escort/Krenite S plots (which had been treated with Oust (3 oz) for this period) provided the best overall control of herbaceous competitors (Table 2). Escort (0.75 oz), the second herbicide in this sequence (O/E/Krenite), was applied about two weeks prior to the 120 DAT assessment with no efficacy visible at the 120-day assessment. Data suggests R6447 and Krovar IDF offered more wooly croton control, but little additional competitor control beyond that currently achieved with conventional herbaceous weed control treatments, such as Oust (3 oz). The June 21 application of Escort (3/4 oz) gave excellent control of <u>Rubus</u> spp and wooly croton (100%, 45 DAT), providing full exposure of germinants to the August 2 application of Krenite S.

Of the 12,500 seeds sown, 1,639 germinated within the middle 2 ft of beds with 56% (918), 19% (311), 15% (246), 10% (164), 1% (16) and 1% (16) recorded during the first (30 DAT), second (60 DAT), third (90 DAT), fourth (120 DAT), fifth (170 DAT), and sixth (200 DAT) evaluation periods (Table 3). The poor germination was partly expected and probably due to a lack of moisture (7). Covering the seeds may have increased their germination but may also have altered the efficacy of R6447, which penetrates little into the soil (4). Although the likelihood of unwanted natural seed at this site was thought to be low, wild seed germinated in the untreated (not sown) check post site-preparation (October through mid-March) and continued sporadically throughout the study. Sown seeds germinated throughout the evaluation period of mid-March through October 2. Given the half-life of the herbicides tested and of forestry herbicides in use today, it is unlikely a single herbicide treatment will provide adequate germinant control.

For seeds germinating within the first 30 DAT, statistical differences in seed control were detected 30 DAT and continued through 90 DAT (Table 3). Best germinant control was achieved with high rates of Krovar IDF (20 oz or 40 oz), R6447 (5.0 oz or 10 oz), Krenite S (which in this sequence had received Oust (3 oz) only) and the Check (Oust 3 oz). Because Oust treatments have been used operationally for many years with little visible impact on pine germinants, test treatments offering similar control seem to be of little value. Herbicides were not effective at controlling germinants that emerged 30 or more days after sowing. These late germinants contributed little to final wildling levels with no differences detected among treatments. Perhaps this is partly due to a severe drought for July 1 (0.5 in.), August (0.2 in.) and three weeks in September (0.0 in.), a period during which many young germinants died. The efficacy of Krenite S treatments (170 and 200 DAT) on germinants was confounded with drought effects and undetermined.

Reduced survival and flushes were apparent 30 DAT for seedlings treated with Krovar IDF (40 oz OTT and DIR and 20 oz OTT) (Table 4). Seedling mortality increased throughout the growing season. By year's end, highest survival and seedling volume resulted from a treatment of Oust/Escort/Krenite S or the high rate of R6447. Some of the lowest survival and growth resulted from Krovar IDF treatments, low rates of R6447 or check seedlings. Because the check seedlings received a treatment of Oust (3 oz) as did the Krenite S treated seedlings, it seems the intermediate treatment of Escort (3/4 oz), which provided excellent control of Rubus spp and wooly croton, resulted in additional seedling growth. This increase was three- to four-times that of check seedlings and was probably accentuated by drought.

CONCLUSIONS

In conclusion, Krovar IDF treatments (20 oz and 40 oz) compared to a conventional weed control treatment of Oust (3 oz) (1) provided little additional weed control, (2) damaged planted pine seedlings, and (3) gave similar control of pine germinants. R6447 (azafenidin 10 oz) provided similar weed control, seedling performance and germinant control as a conventional treatment of Oust (3 oz). With major risk of damage to planted pine seedlings by directed and over-the-top treatments of Krovar IDF (20 oz and 40 oz) and the lack of enhanced pine seed control by R6447, the use of directed and over-the-top treatments of these products for pine seed and wildling control is not recommended. The long germination window for pine seeds relative to the half-life of release herbicides suggests germinant control with a single application is unlikely. Additional research is needed.

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Table 1. Control (%) of herbaceous competitors in a newly planted loblolly pine plantation in East Texas (Nacogdoches County) with pre-emergent herbicide treatments applied on March 15, 1999.

TREATMENTS[1]	RATE[2] AND METHOD		Days After Treatment 60	90	20	60	90	120
			panicgrasses			poorjoe		
O/E/Krenite S[4]	0.5%	DIR	97a	97a	95ab	90ab	90abcd	90abc
O/E/Krenite S[4]	1.0%	DIR	97a	95a	95ab	93ab	93abcd	93abc
O/E/Krenite S[4]	1.5%	DIR	97a	97a	97a	95ab	95ab	93abc
Krovar IDF	10 oz	OTT	95a	95a	95ab	86ab	86abcd	86abc
Krovar IDF	10 oz	DIR	91a	89b	84c	82b	79d	65d
Krovar IDF	20 oz	OTT	97a	97a	94ab	92ab	92abcd	92abc
Krovar IDF	20 oz	DIR	91a	89b	87bc	83b	80cd	80c
Krovar IDF	40 oz	OTT	97a	97a	93ab	97a	97a	95a
Krovar IDF	40 oz	DIR	97a	97a	97a	97a	97a	97a
R6447	2.5 oz	OTT	82b	83c	80c	82b	82bcd	82bc
R6447	5.0 oz	OTT	95a	92a	94ab	92ab	92abcd	89abc
R6447	10 oz	OTT	97a	97a	97a	94ab	94abc	91abc
Check-Oust[5]	3 oz	OTT	97a	97a	95ab	93ab	93abcd	93abc

[1] Treatment means within a column sharing the same letter are not significantly different (Duncan's New Multiple Range test, p=0.05 level).
[2] Product per acre. DIR=directed and OTT=over-the-top.
[3] Not emerged sufficiently at 30 DAT for an evaluation.
[4] These plots received a treatment of Oust (3 oz) on March 15, Escort (¾ oz) on June 25 followed by Krenite S on August 2.
[5]One seeded and one unseeded check plot were treated with Oust (3 oz) and the competitor control averaged for the reported values.

Table 2. Control (%) of herbaceous competitors in a newly planted loblolly pine plantation in East Texas (Nacogdoches County) with a March 15, 1999 pre-emergent herbicide treatment.

TREATMENTS[1]	RATE[2] AND METHOD		DAYS AFTER TREATMENT 60	90	120	30	60	90	120
			wooly croton[3]			overall herbaceous control			
Krovar IDF	40 oz	OTT	80a	75a	65ab	73ab	73abc	30bc	18cd
Krovar IDF	40 oz	DIR	75ab	75a	70a	61b	51c	33bc	33c
Krovar IDF	20 oz	OTT	63ab	59ab	58abc	58b	54c	21bc	10d
Krovar IDF	20 oz	DIR	58abc	58ab	57abc	65ab	63bc	16c	11d
R6447	10 oz	OTT	68ab	64ab	55abc	66ab	66abc	38b	20cd
R6447	5.0 oz	OTT	63ab	56ab	54abc	69ab	66abc	34bc	22cd
Krovar IDF	10 oz	OTT	48bcd	48abc	45abcd	68ab	65abc	21bc	15cd
O/E/Krenite S[4]	1.5%	DIR	39cd	34bcde	34cdef	90a	90ab	83a	83a
O/E/Krenite S[4]	0.5%	DIR	39cd	36bcd	36bcde	71ab	71abc	65a	63b
Krovar IDF	10 oz	DIR	23de	23cde	23def	51b	49c	20bc	12d
R6447	2.5 oz	OTT	18de	15de	15ef	49b	46c	21bc	13d
O/E/Krenite S[4]	1.0%	DIR	8e	8e	5f	92a	92a	79a	79ab
Check-Oust[5]	3 oz	OTT	35cd	34bcde	35bcde	90a	90ab	80a	80a

[1] Treatment means within a column sharing the same letter are not significantly different (Duncan's New Multiple Range test, p=0.05 level).
[2] Product per acre. DIR=directed and OTT=over-the-top.
[3] Not emerged sufficiently at 30 DAT for an evaluation.
[4] These plots received a treatment of Oust (3 oz) on March 15, Escort (¾ oz) on June 25 followed by Krenite S on August 2.
[5] Seeded and unseeded check plots were treated with Oust (3 oz) and averaged for the control reported here.

Table 3. Unwanted pine seed potential germination (POT), actual germination (ACT) and germinant survival (%) 30- through 200-days following treatment of a newly planted loblolly pine plantation in East Texas (Nacogdoches County)

TREATMENT[1]	RATE[2] AND METHOD		GERMINANTS[3]		DAYS AFTER TREATMENT (DAT)					
			POT	ACT	30	60	90	120	170	200
Germinated During First 30 DAT (April 15)										
Krovar IDF	10 oz	DIR	672	32	3.6a	3.0a	3.0a	2.0a	0.3a	0.2a
Krovar IDF	20 oz	DIR	632	23	3.1ab	3.0a	2.4ab	2.3a	0.2a	0.2a
Krovar IDF	20 oz	OTT	1060	27	2.4abc	1.8ab	1.8abc	1.9a	0.0a	0.0a
Krovar IDF	10 oz	OTT	972	23	2.0bc	1.8ab	1.8abc	1.7a	0.3a	0.3a
R6447	2.5 oz	OTT	1096	19	1.6c	1.6ab	1.6abc	1.6a	0.3a	0.3a
R6447	5.0 oz	OTT	932	12	1.4c	1.4ab	1.2bc	1.2a	0.0a	0.0a
R6447	10 oz	OTT	1016	9	0.9c	0.9b	0.8c	0.8a	0.0a	0.0a
O/E/Krenite S[4]	0.5%	DIR	960	14	1.2c	1.2b	0.9bc	0.9a	0.5a	0.5a
O/E/Krenite S[4]	1.0%	DIR	1024	13	1.4c	1.3b	1.3bc	1.2a	0.3a	0.2a
O/E/Krenite S[4]	1.5%	DIR	924	15	1.4c	1.4b	1.3bc	1.2a	0.3a	0.3a
Krovar IDF	40 oz	OTT	1104	13	1.0c	0.4b	0.4c	0.4a	0.0a	0.0a
Krovar IDF	40 oz	DIR	740	25	1.3c	0.5b	0.3c	0.3a	0.0a	0.0a
Check-Seeded[5]	3 oz	OTT	908	7	0.8c	0.8b	0.6c	0.6a	0.1a	0.1a

[1] Treatment means within a column sharing the same letter are not significantly different (Duncan's New Multiple Range test, p=0.05 level).
[2] Product per acre. DIR=directed and OTT=over-the-top.
[3] Mean number of pre-test germinants per treatment was 4.
[4] These plots were treated with Oust (3 oz) on March 15, Escort (¾ oz) on June 25 followed by Krenite S on August 2.
[5] Over-the-top treatment of Oust (3 oz) on March 15, 1999.

Table 4. Survival (%, S_30) and flush counts (F_30) 30 days after treatment (DAT), plus survival (S_120) and volume (in.^{3}, V_120) 120 DAT and after one growing season (S_1YR, V_1YR) for loblolly pine seedlings in East Texas treated on March 15, 1999 for control of unwanted wildling pine germinants.

Treatment[1]	Rate and Method[2]		S_30	F_30	S_120	V_120	S_1YR	V_1YR
Krovar IDF	10 oz	OTT	100a	3.8cd	90a	1.0d	48bcd	0.9c
R6447	10 oz	OTT	100a	5.0ab	96a	1.8bc	61abc	2.2bc
O/E/Krenite S[3]	1.5%	DIR	96ab	4.2abcd	95a	2.6a	66a	3.9a
O/E/Krenite S[3]	0.5%	DIR	96ab	5.1a	96a	2.1ab	78a	3.4ab
O/E/Krenite S[3]	1.0%	DIR	96ab	4.3abcd	89a	2.2ab	81a	3.3ab
Check-Oust[4]	3 oz	OTT	96ab	3.3d	91a	1.0d	41cd	1.0c
Krovar IDF	20 oz	DIR	95ab	4.2abcd	95a	0.9d	38de	1.1c
R6447	2.5 oz	OTT	95ab	5.0abc	93a	1.2cd	55bcd	1.8c
Krovar IDF	10 oz	DIR	94ab	3.3de	85a	1.0d	50bcd	1.2c
R6447	5.0 oz	OTT	93ab	4.0bcd	91a	1.1d	74ab	1.3c
Krovar IDF	40 oz	DIR	85bc	3.8cd	83a	1.1d	46bcd	1.9c
Krovar IDF	20 oz	OTT	78c	2.3ef	64b	1.2cd	48bcd	1.5c
Krovar IDF	40 oz	OTT	64d	2.0f	52b	0.8d	21e	1.1c

[1] Treatment means within a column sharing the same letter are not significantly different (Duncan's New Multiple Range test, p=0.05 level).
[2] Product per acre. OTT=over the top; DIR=directed spray.
[3] These plots received a treatment of Oust (3 oz) on March 15, Escort (¾ oz) on June 25 followed by Krenite S on August 2.
[4] One seeded and one unseeded check plot were treated with Oust (3 oz) and the growth averaged for the reported values.

VEGETATION DYNAMICS FOLLOWING CONTROL OF KUDZU WITH HERBICIDES AND FIRE[1]. T.B. Harrington and L.T. Rader, School of Forest Resources, University of Georgia, Athens, GA 30602-2152.

ABSTRACT

Abundance of kudzu (*Pueraria lobata*), blackberry (*Rubus* spp.), herbaceous species, and planted loblolly pines (*Pinus taeda*) were compared for three years following five herbicide treatments (clopyralid, metsulfuron, picloram+2,4-D, tebuthiuron, and triclopyr) and an untreated check. The study was conducted on four sites at the Savannah River Site, a National Environmental Research Park near New Ellenton, SC. Initial herbicide treatments were applied July 1997 to 0.2- to 0.3-acre plots located at each site, and each site was broadcast burned December 1997. Seedlings of loblolly pine were planted January 1998 within split plots at densities of 0, 1, or 4 pines m^{-2} to induce competitive pressure and potentially exclude recovering kudzu. Spot treatments of each herbicide were applied to recovering kudzu in July 1998 and June 1999. Vegetation abundance, measured as crown cover (%) within three 1-m^2 quadrats per split plot, was assessed immediately before and 8 weeks after each herbicide application. Analysis of variance for a split-plot experimental design was conducted on each set of vegetation data, and multiple comparisons of treatment means were performed with Tukey's test.

Four distinct plant communities resulted from the herbicide treatments. Kudzu continued to dominate the untreated check, despite a one-year reduction in its cover as a result of the broadcast burn. Clopyralid reduced the abundance of kudzu and some of the herbaceous vegetation, allowing blackberry to dominate the community. Herbaceous species dominated each of the metsulfuron, picloram+2,4-D, and triclopyr treatments because these herbicides were effective in controlling kudzu, blackberry, and other woody or semi-woody species. A very sparsely populated community resulted from the tebuthiuron treatment because the herbicide controlled all species, including the planted pines. At the end of the third year of the study (1999), kudzu cover was less than 1% in each of the herbicide treatments, while it was 94% in the untreated check. Blackberry cover was 44% in the clopyralid treatment, 10% in the untreated check, and 1-7% in the remaining treatments. Cover of herbaceous vegetation averaged 74% in the metsulfuron, picloram+2,4-D, and triclopyr plots, while it averaged 17% in the clopyralid, tebuthiuron, and untreated check plots. Cover of planted pines was 6-10% in the clopyralid, metsulfuron, picloram+2,4-D, and triclopyr plots, while it was less than 1% in the tebuthiuron and untreated check plots.

To summarize, each herbicide treatment was effective at controlling kudzu and most of the treatments resulted in large increases in cover of herbaceous vegetation. Blackberry was found to be tolerant of clopyralid and now dominates this treatment. Planted pines have become successfully established in each treatment except tebuthiuron and the untreated check, where most of the seedlings have now died. Absence of kudzu in the herbicide plots has precluded the testing of effects of induced competition from the high-density plantings of pine. Vegetation dynamics will continue to be monitored for two more years in the absence of additional herbicide treatments to quantify rates of kudzu recovery and effects of induced competition from loblolly pine.

1999 MISSISSIPPI KUDZU DEMONSTRATION UPDATE. J.W. Barnett, Jr., J.D. Byrd, Jr., D.B. Mask. Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

After kudzu (*Pueraria montana*) was added to the Federal noxious weed list in 1997, Mississippi was selected for a management demonstration site. In August of 1998, field studies were initiated in Lafayette and Marshall counties to evaluate the efficacy of selected herbicides on kudzu and to monitor the regrowth of other weed species in these areas. Eleven herbicides or combination of herbicides were applied on the Lafayette county site at 80 gallons per acre (GPA). These treatments were Transline at 22 fl oz/A, Transline + Garlon 4EC at 22 fl oz/A + 32 fl oz/A, Tordon 101M at 128 fl oz/A, Tordon 2K at 64 fl oz/A, Vanquish + Escort at 64 fl oz/A + 3 oz/A, Vanquish + Transline at 64 fl oz/A + 11 fl oz/A, Vanquish at 128 fl oz/A, Roundup Pro + Escort at 128 fl oz/A + 2 oz/A, Roundup Pro at 128 fl oz/A, Escort at 4 oz/A, and Garlon 4EC at 96 fl oz/A. At the Marshall county site, eight herbicide treatments were applied at 20 GPA. These treatments included Transline at 22 fl oz/A, Transline + Garlon 4EC at 22 fl oz/A + 32 fl oz/A, Tordon 101 at 256 fl oz/A, Tordon 2K at 64 fl oz/A, Vanquish + Escort at 64 fl oz/A + 3 oz/A, Vanquish + Transline at 64 fl oz/A + 11 fl oz/A, Escort at 4 oz/A, and Transline + Escort at 16 fl oz/A + 3 oz/A. In both Lafayette and Marshall counties, all treatments were applied with Timberland 90 surfactant at 64 fl oz/A. Each plot was approximately one acre. All treatments except Escort caused foliar desiccation one month after treatment (MAT) and at 2 MAT plots were completely defoliated and vines desiccated. When plots were evaluated at 9 MAT, Escort provided the best results with 80% control. Roundup at 128 fl oz/A and Roundup + Escort also provided 75% control. Tordon K and Tordon 101 provided only 50 and 60% control, respectively, but epinastic leaf symptoms were still visible on kudzu foliage 9 MAT indicating residual soil activity. Overall, herbicide activity at the Marshall county site was less effective than at the Lafayette county site. Lower ratings could be due to the fact that these plots were clipped in early May which could have

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stimulated new growth. However, Vanquish + Escort, Vanquish + Transline, and Tordon K gave 90% control of kudzu at 9 MAT. Plots in Lafayette and Marshall counties were retreated in September of 1999 and will be retreated yearly. Both sites had good regrowth of alternative vegetation in plots where control was above 75%. Vegetation reemerging at the Lafayette county site included Japanese honeysuckle, elderberry, giant foxtail, common pokeweed, common and giant ragweed, crabgrass, yellow woodsorrel, Pennsylvania and ladysthumb smartweed, blackberry, and southern dewberry. Reemerging vegetation in Marshall county included bermudagrass, horsenettle, blackberry, horseweed, goldenrod, and dogfennel. This diversity and abundance of different plant species should increase with time.

AN EVALUATION OF MECHANICAL AND CHEMICAL TREATMENTS TO ENHANCE HABITAT FOR NORTHERN BOBWHITE. J.R. Welch, Warnell School of Forest Resources, The University of Georgia, Athens, GA 30602; K.V. Miller, Warnell School of Forest Resources, The University of Georgia, Athens, GA 30602; and W.E. Palmer, Tall Timbers Research Station, 13093 Henry Beadel Drive, Tallahassee, FL 32312.

ABSTRACT

We assessed potential use of imazapyr (Arsenal), mowing, chopping, and burning alone and in combination to control hardwood understory in pine stands managed for Northern Bobwhite quail in the Red Hills Region of south Georgia and north Florida. Two independent sites and study designs were used to evaluate treatment responses.

On Tall Timbers Research Station, we used a blocked design with 3 blocks and each of 7 possible treatment plots (0.75 ha/plot) replicated once per block (burn, herbicide and burn, herbicide, mow, mow and burn, chop, and chop and burn). On Foshalee Plantation, 14 plots, varying in size from 2 – 8 ha were selected at random within a ca. 200 ha treatment area. Half of the plots (n=7) were located on areas that were 1 year post-burn, and 7 were located on areas that were 2 years post-burn. All treatments were applied during October 1997. Herbicide application occurred on 21 October and consisted of 24 oz. Arsenal/acre + 64 oz /acre of Timberland surfactant, applied via skidder-mounted BoomBuster nozzle.

We sampled woody and herbaceous vegetation systematically pre- and post-treatment during the summers of 1997 and 1998 on both areas. On the Tall Timbers study area, hardwood stem density was significantly reduced on both the herbicide and the herbicide and burn plots. In contrast, stem density tended to increase on the other treatment plots. Similarly, forb cover increased dramatically on the herbicide-treated plots, but remained unchanged on the other treatments. Some important quail foodplants such as ragweed (*Ambrosia artemisiifolia*) were most abundant on the chemically-treated areas. On the Foshalle Plantation study area, hardwood stem density and stem height similarly were reduced one year post-treatment, and forb cover increased on both the 1 and 2 year post-burn treatment plots.

Traditional methods to control hardwood on these quail plantations (mowing or chopping in combination with prescribed fire) do not control invading hardwoods and inhibit pine regeneration. The one-time application of Arsenal can dramatically reduce hardwood stem density and enhance growth of herbaceous species. Following treatments, annual or biennial prescribed fire can be used to deter hardwood invasion and stimulate herbaceous species. However, we caution against use of chemical treatments over broad areas within a single growing season due to potential elimination of escape and nesting cover. Habitat renovation should be a gradual process that considers habitat requirements for quail throughout the year.

Acknowledgements: Funding for this research was provided by American Cyanamid Company

FOREST PLANTS OF THE SOUTHEAST AND THEIR WILDLIFE USES--A PLANT MANUAL FOR FORESTRY, RIGHT-OF-WAY, AND RANGE RESEARCHERS AND MANAGERS. J.H. Miller, USDA Forest Service, Auburn University, AL 36849, and K.V. Miller, School of Forest Resources, University of Georgia, Athens, 30602.

ABSTRACT

Vegetation management and research in the Southeast is hindered by the lack of adequate plant identification resources for non-crop lands. The Southern Weed Science Society has recently published a field manual for plants common in the region. This 454-page, field-durable manual describes 330 species of forbs, grasses-grasslikes, shrubs, semiwoody plants and woody vines, ferns, palms, cactus, and ground lichens. There are 644 images to illustrate the plants and their identifying features. Species common to forests, right-of-ways, pastures, and natural areas are the focus. Many non-native invasive species are included as well as wetland plants. The important wildlife uses are summarized for each plant genus to the extent reported in research literature. Instructors may want to consider this manual for use as a supplemental or required text. A CD version with full-screen, high resolution images will be released early next year, which can also be useful for instruction.

The book sells for $36 (includes shipping and handling). The book can be ordered by making checks payable to *The Southern Weed Science Society*, include your name and address, and send these to Robert Schmidt, Society Business

Manager, 1508 W. University Ave., Champaign, IL 61821-3135 or phone (217)-352-4212, fax 217-352-4241, or email: raschwssa@aol.com.

The authors would gratefully acknowledge the contribution of the following individuals and companies. The planning and layout of the book was assisted by the members of the Society's Forest Plant ID Guide Subcommittee over the past six years. The book features photography by Ted Bodner. The photography was funded by grants from the Society, American Cyanamid, Dow, DuPont, and Monsanto. Critical botanical reviews and guidance have been provided by Alvin Diamond (Troy State University), David Bourgeois (Westvaco Corporation), Harold Grelen (retired US Forest Service), and for selected sections by Suzanne Oberholster (formerly US Forest Service). Initial botanical guidance and plant identifications were by the late John Freeman (Auburn University). Overall reviews of descriptions have been contributed by John Everest (Auburn University) and Timothy Harrington (University of Georgia), and selected sections by Fred Fallis (Weyerhaeuser) and Jim McIlwain (retired US Forest Service).

WILDFLOWER ESTABLISHMENT USING PREEMERGENCE HERBICIDES. J.M. Taylor and G.E. Coats. Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Studies were conducted at the Plant Science Research Center near Starkville, MS, to evaluate preemergence or delayed preemergence herbicides for weed control in three wildflower species. Wildflowers were planted on March 10, 1999, with a drop spreader on the surface of a seedbed that had previously been tilled, smoothed, and then rolled to create a firm surface. Preemergence herbicides were applied immediately after planting while delayed applications were made when wildflowers were in the 2- to 3-leaf growth stage. Lanceleaf coreopsis (*Coreopsis lanceolata*) did not flower during the growing season and quality ratings were based on foliage mass. Sulfur cosmos (*Cosmos sulphureus*) and black-eyed Susan (*Rudbeckia hirta*) quality ratings were based on visual display of flowers. Knotroot foxtail and prostrate spurge control was generally better when 1 or 2 lb ai/A pendimethalin, 0.38 or 0.5 lb ai/A prodiamine, or 2 or 3 lb ai/A metolachlor were applied PRE than when application was delayed. Conversely, control of these weeds with 0.063 or 0.094 lb ai/A imazapic was better when applications were delayed. Quality of lanceleaf coreopsis, sulfur cosmos and black-eyed Susan at 4 months after planting were rated at 2 to 3 on a 10 point scale (10 equal best) in the untreated plots. Wildflower quality (4 to 7) generally increased with PRE applications of pendimethalin and prodiamine at the lower rates. Wildflower quality did not consistently increase when the high rates of pendimethalin or prodiamine were used.

WEED SPECIES AND POPULATION SHIFTS WITH LONG TERM WEED CONTROL AND TILLAGE SYSTEMS. N.W. Buehring and G. Nice, Mississippi State University, North Mississippi Research and Extension Center, Verona MS 38879.

ABSTRACT

Weed species seedbank changes from 1994 to 1997 were evaluated in a long-term (1990-97) tillage-postemergence herbicide combination study. Tillage systems were: 1) conventional tillage [CT, fall chisel followed by spring disk twice followed by doall twice prior to planting]; 2) minimum tillage (MT, fall chisel followed by early spring field cultivate) and no-tillage early burndown (NT-EB); and 3) no-tillage with a burndown at planting (NT-LB). Pendimethalin was applied preemergence each year after planting to the entire study. Bentazon + aciflurofen treatments applied postemergence to each tillage system were: 1) ½-x rate (bentazon + aciflurofen at 0.38 + 0.19 lb ai/ac) applied once at 15 days after planting (DAP); 2) split application of ½-x rate applied 15 DAP and repeated 30 DAP; 3) 1-x rate applied 30 DAP; and 4) check (no postemergence herbicide).

Weed species identification and population measurements were made annually about 15 DAP, prior to any postemergence herbicide applications. Weed species present, but in insufficient populations for analysis were: redroot pigweed (*Amaranthus retroflexus*), hopphorn copperleaf (*Acalypha ostryifolia*), sicklepod (*Cassia obtusifolia*), johnsongrass (*Sorghum halepense*), and barnyardgrass (*Echinochola crus-galli*). The species present in sufficient quantity for analysis were: cocklebur (*Xanthium pensylvanicum*), spotted spurge (*Euphorbia maculata*), prickly sida (*Sida spinosa*), and morningglory [pitted (*Ipomoea lacunosa*) and entire leaf (*Inpomoea hederacea*)]. These species increased especially in 1996 and 1997 and they did not respond similarly across tillage - herbicide systems.

No-tillage (NT-EB and NT-LB) checks across years had no increase in the cocklebur population, the larger weed seed. These treatments, however, across years had increased populations of the smaller seed species of weeds, morningglory, prickly sida and spotted spurge. Compared to both no-tillage checks, the CT and MT checks had higher cocklebur populations, and lower populations of spotted spurge, morningglory, and prickly sida. Excluding both MT and CT checks, all tillage-herbicide treatment combinations across all years maintained very low cocklebur populations while populations of prickly sida, morningglory, and spotted spurge increased. Across tillage systems, years and weed species, the split herbicide application (½-x rate applied twice) had populations equal or lower than the 1-x rate, especially in MT and CT; however, in the CT-check, prickly sida and spotted spurge populations were as low or lower than all other

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tillage-herbicide combinations. NT-LB with all herbicide treatments generally had higher populations of morningglory than NT-EB, MT, and CT.

REDVINE (*BRUNNICHIA OVATA*) AND TRUMPETCREEPER (*CAMPSIS RADICANS*) LEAF SURFACE CHARACTERISTICS. D. Chachalis and K.N. Reddy, USDA-ARS, Southern Weed Science Research Unit, P.O. Box 350, Stoneville, MS.

ABSTRACT

Redvine and trumpetcreeper are common perennial vines and among the ten most troublesome weeds in cotton and soybean in the Mississippi Delta. Laboratory studies were conducted to characterize leaf surface structure and wax composition of these species. Leaves were collected from viny plants (approximately 3 months old) from field naturally infested with these species. From each plant, young (1st or 2nd leaf from the growing end) and old (5th to 7th leaf from the growing end) leaves were collected. Leaf surface was examined under Scanning Electron Microscope. Contact angle of the herbicide droplet on the adaxial surface of old leaves was measured. Epicuticular waxes were extracted by dipping leaves in chloroform for 10 sec at room temperature and concentrated in a rotary evaporator. Wax sample (approximately 100 *m*g) was analyzed by GC-MS.

Microroughness in trumpetcreeper adaxial leaf surface was greater due to the presence of trichomes (6 mm^{-2}) and glands (3.5 mm^{-2}) than redvine leaf (no trichomes or glands). No stomata and crystal wax deposition on the adaxial leaf surface was observed in either species. Glufosinate and glyphosate spray solutions had similar contact angle in both species.

In both species, the amount of wax per unit area was similar (from 22 to 37 *m*g cm^{-2}). Epicuticular wax consisted of hydrocarbons, alcohols, acids, and triterpenes with a clear distinction between species in the wax composition. Redvine wax consisted more of alcohols and acids than trumpetcreeper wax. However, there was a clear distinction of the major components in wax between species. Redvine young leaves wax had major components of more hydrophilic nature that totally changed to hydrophobic as leaf aged. In contrast, major components in trumpetcreeper young leaves wax tend to be hydrophobic whereas in old leaves the major components of wax were both hydrophilic and hydrophobic. Since both herbicides are hydrophilic, it appears that the higher herbicide efficacy was related to the more hydrophilic nature of trumpetcreeper epicuticular waxes than that of redvine.

PLANT GROWTH AND NITROGENASE ACTIVITY OF GLYPHOSATE-TOLERANT SOYBEAN IN RESPONSE TO FOLIAR GLYPHOSATE APPLICATIONS. C.A. King and L.C. Purcell, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville; E.D. Vories, University of Arkansas Northeast Research and Extension Center, Keiser.

ABSTRACT

Glyphosate [N-(phosphonomethyl)glycine] inhibits 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS), thus blocking aromatic amino acid synthesis. While glyphosate-tolerant (GT) soybean (*Glycine max* [L.] Merr.) contains resistant EPSPS, *Bradyrhizobium japonicum* grown in culture is sensitive to glyphosate. Experiments were conducted to evaluate nitrogen fixation, growth, and yield of GT soybean treated with glyphosate. Early application of glyphosate generally delayed nitrogen fixation and reduced biomass and nitrogen accumulation in the cultivar TV5866RR 19 days after emergence. Glyphosate changed the nodulating pattern to more nodules with smaller individual nodule mass on plants harvested 40 days after emergence. Biomass and nitrogen content of GT soybean were also reduced by glyphosate in plants grown with soil nitrogen. In growth chamber studies, nitrogen fixation was delayed and was more sensitive to water deficits in glyphosate-treated plants. In field studies glyphosate tended to decrease biomass and seed yields of GT soybean when soil water was limited during reproductive growth.

EFFECT OF LOW CONCENTRATIONS OF GROWTH REGULATORS ON GLYPHOSATE EFFICACY. S.A. Payne, N.R. Burgos, and L.R. Oliver, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR 72701.

ABSTRACT

Studies were conducted to examine the effects of the addition of low concentrations of growth regulator-type herbicides on glyphosate efficacy and soybean (*Glycine max*) injury. A field study consisted of glyphosate applied alone at 0.56 or 1.12 kg ai/ha or glyphosate applied at 0.56 kg/ha with a growth regulator herbicide applied at 1/10 its labeled rate. Labeled rates were 2,4-D, 1.12 kg/ha; dicamba, 0.56 kg/ha; and quinclorac or triclopyr, 0.28 kg/ha. Entireleaf morningglory (*Ipomoea hederacea* var. *integriuscula*), hemp sesbania (*Sesbania exaltata*), velvetleaf (*Abutilon theophrasti*), and prickly sida (*Sida spinosa*) were visually rated for percent control at 4 WAT.

The addition of dicamba, quinclorac, and 2,4-D to 0.56 kg/ha glyphosate improved glyphosate activity on entireleaf morningglory. Such combinations resulted in morningglory control equal to or greater than control with 1.12 kg/ha

glyphosate applied alone (86%). Hemp sesbania control by glyphosate was improved by the addition of 2,4-D or dicamba from 80 to 97% and 94%, respectively. Only dicamba as an additive improved control of velvetleaf and prickly sida over that by glyphosate alone.

A greenhouse study was conducted using a factorial arrangement of treatments that included a growth regulator herbicide at 1/10 or 1/100 the labeled rate applied alone or with 0.56 kg/ha glyphosate. Growth regulators and their respective labeled rates included 2,4-DB (0.035 kg/ha) and clopyralid (0.21 kg/ha) in addition to those used in the field study. Soybean 'Asgrow 5601 RR' and weed species previously mentioned were grown in 10-cm pots and were harvested for dry weight at 2 WAT.

The addition of dicamba to glyphosate resulted in 33% soybean dry weight reduction, but 2,4-DB or quinclorac plus glyphosate had no effect. Biomass reduction of entireleaf morningglory by glyphosate + 2,4-D at either rate or by quinclorac or triclopyr at 1/10 the label rate increased control over that by glyphosate alone (about 70% as compared to 55%). Clopyralid or quinclorac at 1/10 the labeled rate plus glyphosate produced among the highest hemp sesbania dry weight reduction at 72 and 57%, respectively. No growth regulator plus glyphosate combination caused greater dry weight reduction of velvetleaf or prickly sida as compared to glyphosate alone.

EFFECTS OF LATE-SEASON HERBICIDE APPLICATIONS ON COMMON COCKLEBUR SEED PRODUCTION AND VIABILITY. L.A. Schmidt, R.E. Talbert, and L.R. Oliver, Department of Crop, Soil, and Environmental Science, University of Arkansas, Fayetteville, AR 72704.

ABSTRACT

An experiment was conducted in 1998 and 1999 at University of Arkansas Research and Extension Center in Fayetteville to evaluate the effects of late-season applications of glyphosate, glufosinate, and paraquat on common cocklebur (*Xanthium strumarium*) seed production, viability, and control. Plots were 6 by 12 foot and established in an area infested with common cocklebur. The plot area was tilled each year in May and allowed develop without a crop being present. The experiment was designed as randomized complete block with treatments arranged as a 3 by 5 by 2 factorial (three herbicides, five rates, and two application timings) with four replications. Glyphosate, glufosinate, and paraquat were applied at 1X (labeled rate), 0.5X, 0.25X, 0.125, and 0X at early-bloom (early staminal flower development) and late-bloom (fully developed staminal and pistillate flower or 10 to 14 days after early-bloom). Labeled rates of glyphosate, glufosinate, and paraquat were 1 lb ai/A, 0.75 lb ai/A, and 0.94 lb ai/A; respectively. Applications were applied with a CO2 backpack sprayer at a carrier volume of 20 GPA. Plots were shielded on all four sides at application to prevent drift to adjacent plots. Seed production was evaluated as the number of bur produced per 20 plants per plot and viability was determined by treating 50 bur halves from each plot sample with a 0.3% solution of 2,3,5 tetrazolium chloride. Visual ratings for common cocklebur control were taken at 28 days after treatment (DAT).

Glyphosate and paraquat at the 0.5 and 1X rate and both application timings controlled common cocklebur >80% at 28 DAT. Glufosinate at the 1X rate provided 87% and 88% control of common cocklebur 28 DAT for the early-bloom and late-bloom application timings, respectively.

Common cocklebur seed production was not effected by year; therefore, means were averaged across years. All rates and timings resulted in reduction of common cocklebur seed production. Glyphosate and paraquat reduced seed production >80% regardless of timing at the 0.5 and 1X rates. Glufosinate at the early-bloom timing reduced seed production >80% at the 0.5 and 1X rates, but was less effective at the late-bloom timing. In general, the early-bloom timing of application reduced common cocklebur seed production more than the late-bloom timing.

Viability of common cocklebur seed was not affected by time of application; therefore, means were averaged across timings. Glyphosate was the only herbicide to reduce seed viability >80% at the 0.5 and 1X rates in both years. The labeled rate (1X) of glufosinate and paraquat in both years averaged less than 62% viability reduction.

ABSORPTION AND TRANSLOCATION OF DIFLUFENZOPYR AND DICAMBA IN VELVETLEAF (*Abutilon theophrasti*). A.S. Sciumbato, S.A. Senseman and R.W. Bovey. Texas Agricultural Experiment Station and Texas A&M University, College Station.

ABSTRACT

Diflufenzopyr has been combined with dicamba because of the effective weed control that the association provides. Diflufenzopyr has been shown to increase the effectiveness of dicamba by inhibiting auxin transport thus allowing an accumulation of auxins and auxin-like herbicides in the meristematic regions of plants. In 1999, velvetleaf (*Abutilon theophrasti*) was used as the test species in a study conducted at Texas A&M University to determine the effects that dicamba and diflufenzopyr have on each other in both absorption after application and translocation within the plant. Preliminary results of this study are summarized here.

Dicamba absorption was numerically higher when applied with diflufenzopyr, but no statistical differences between the absorption of dicamba applied alone and dicamba applied with diflufenzopyr were detected. An obvious trend of dicamba absorption continuing through 96 hours after treatment could be observed. Diflufenzopyr absorption did not continue beyond 48 hours after treatment. Dicamba accumulated in plant meristems by 24 hours after treatment with seemingly more dicamba being translocated when diflufenzopyr was present. Although there were no statistical differences in this preliminary data between dicamba meristem concentration when applied by itself and when applied with diflufenzopyr, the concentration of dicamba applied with diflufenzopyr was numerically higher.

ABSORPTION AND TRANSLOCATION OF HALOSULFURON BY SORGHUM. A.C. Carpenter, S.A. Senseman, and H.T. Cralle, Texas A&M Agric. Exp. Stn., College Station.

ABSTRACT

Halosulfuron is a relatively new sulfonylurea herbicide used for broadleaf weed control in sorghum. Stunting of sorghum has been exhibited following treatment with halosulfuron. While numerous studies have investigated the uptake, translocation, and metabolism of various sulfonylurea herbicides in weed and crop species, no studies have been published regarding the activity of this herbicide in sorghum. The objectives of this study were to determine the rate of halosulfuron uptake by sorghum, and the pattern of halosulfuron translocation in sorghum. The experiment was conducted in a growth chamber. Sorghum variety 'RTX-430' was treated at the 3-leaf, 5-leaf, or 7-leaf stages. Treatment consisted of application of a 1x field rate of analytical-grade halosulfuron in a spray chamber, followed by application of ^{14}C-halosulfuron to the middle leaf of each plant. Plants were harvested at 0, 4, 12, 24, 48, 72, or 240 hat. At harvest, plant heights were recorded, and plants were separated into treated leaf, plant mass above the treated leaf, plant mass below the treated leaf, and roots. Treated leaves were washed and the leaf wash was analyzed by liquid scintillation spectroscopy for absorption determination. Sub-samples of each plant part were analyzed with a biological oxidizer. In addition, visual injury ratings were made just prior to harvest in the plants harvested 240 hat. Uptake of halosulfuron was 75% of that applied. Uptake was complete for all treatments by 240 hat. Plants which were treated at the 3-leaf and 5-leaf stages exhibited stunting, with 25% and 19% height reductions, respectively. No stunting occurred in plants treated at the 7-leaf stage. Translocation of halosulfuron from the treated leaf was complete by 72 hat. Greater than 98% of the absorbed halosulfuron remained in the treated leaf 240 hat. No statistical differences were found in the translocation of halosulfuron from the treated leaf to other plant parts. There was no translocation of the herbicide into the roots.

INFLUENCE OF PALMER AMARANTH ON GRAIN SORGHUM YIELDS. J.W. Moore and D.S. Murray, Department of Plant and Soil Sciences, Oklahoma State University, Stillwater, OK 74078.

ABSTRACT

In 1999, a field experiment was conducted at the South Central Research Station near Chickasha, OK to evaluate the competitive and the noncompetitive effects of Palmer amaranth (*Amaranthus palmeri S. Wats*) on grain sorghum. The experimental design was a randomized complete block with four replications and a plot size of four rows that were 0.76 m wide by 15 m long. The eight weed densities used in this experiment were 0, 1, 2, 4, 6, 9, 12 and 18 weeds per 15 m of row. To measure the full-season competitive effects of Palmer amaranth, the weeds were planted beside the rows of grain sorghum at the desired densities and they remained there for the entire season. The noncompetitive component of this experiment was measured by allowing the grain sorghum to grow weed-free until maturity then Palmer amaranth were placed in holders beside the rows of grain sorghum at harvest to measure variables associated with grain yield, such as grain moisture and foreign material.

The Palmer amaranth plants used in the competitive component of this research were planted into peat pellets on the same day the grain sorghum was planted in the field. The Palmer amaranth plants were grown in the green house until the plants reached a size of about five to six true leaf then transplanted into the field at the desired densities beside rows 2, 3 and 4 of the grain sorghum. A field adjacent to this experiment was used to collect the Palmer amaranth needed for the noncompetitive component of this experiment. All Palmer amaranth used in this experiment were measured and cut at approximately 1.8 m tall. The plants were then brought to the experiment and placed into a weed holding apparatus that fit between the two center rows of grain sorghum and positioned the Palmer amaranth adjacent to the grain sorghum.

The weed holding apparatus used in this experiment was composed of three segments which were built with 10.2 cm (4 inch) PVC pipe, tees and 90° elbows to form a rectangle that fit between two grain sorghum rows. When the segments were put together, the apparatus was 0.56 m wide and 15 m long. Each segment was constructed with six tees spaced 0.8 m apart that were positioned to hold the Palmer amaranth adjacent to the grain sorghum. Two 90° elbows were used on both end segments and were connected with a short joint of PVC pipe for support and transporting. For additional support, tees were randomly placed along the sides and positioned parallel to the ground and connected with a short joint of PVC pipe.

The center two rows were harvested for data collection for the competitive component and the noncompetitive component. For the competitive component, moisture and weights were taken for each grain sample before and after

cleaning. Prior to harvesting the competitive plots, the Palmer amaranth were removed from rows 2 and 3 of the grain sorghum and weighed. Grain yields were regressed against the weed densities and the weed weights. Grain yields decreased 97 kg/ha for each increase of one Palmer amaranth plant per 15 m of row and decreased 392 kg/ha for each increase of one kilogram of Palmer amaranth per 15 m of row. Grain yield, as a percent of the check, reduced 2% for each increase of one Palmer amaranth plant per 15 m of row. For the noncompetitive component, moisture and weights were taken for each grain sample after harvest. Grain samples were then cleaned from low weed density to high weed density to remove foreign material, which were the differences in grain weights of before and after cleaning. After all samples were cleaned, moisture and weights were taken again for each sample. No differences in grain yields were found before or after cleaning. Grain moisture and foreign material were regressed against the weed densities. Before cleaning and after cleaning, grain moisture increased 0.7% and 0.2% for each increase of one Palmer amaranth plant per 15 m of row, respectively. Foreign material increased 67 kg/ha for each increase of one Palmer amaranth plant per 15 m of row.

EFFICACY ENHANCEMENT OF GLYPHOSATE BY ADJUVANTS AND N-FERTILIZERS. S.D. Sharma and M. Singh. University of Florida, Citrus Research and Education Center, Lake Alfred, Florida.

ABSTRACT

Enhancement of glyphosate phytotoxicity with various adjuvant types varied greatly in the literature. Therefore, experiments were designed to determine the relative influence of various adjuvants and nitrogen fertilizers on the efficacy of glyphosate. The test weeds black nightshade, wild mustard, barnyard grass and large crabgrass, were selected based on their surface smoothness and wax content of their leaves. The plants were grown under controlled greenhouse environment for 4 weeks to develop sufficient foliage for spray contact.

Glyphosate as Touchdown formulation was applied at 0.25, 0.375 and 0.5 kg a.i./ha. Adjuvant X-77, Kinetic, Dyne-Amic at 0.25%; L-77 at 0.1%; methylated seed oil, Agri-dex at 1% and VOLT at 2.5% (V/V), Ammonium sulfate (AS), ammonium nitrate (AN), calcium nitrate (CN) and urea (all analytical grade) at 1% (w/v), were formulated with glyphosate. These adjuvants were individually added with 0.25 kg a.i./ha glyphosate and their effects were compared with only glyphosate @ 0.25 and 0.50 kg a.i./ha treatments. The influence of AS on X-77, L-77, Kinetic and MSO added to glyphosate, was also examined to study the added effects of AS. All the treatments were applied using a Chamber Track Sprayer fitted with flat fan nozzle delivering 189 L/ha of water at 20-psi pressure. Shoot fresh weight and visual rating were determined 14 days after treatment.

Glyphosate phytotoxicity at 0.25, 0.375, 0.5 kg a.i./ha and glyphosate at 0.25 kg a.i./ha + adjuvants / nitrogen fertilizers was investigated. The addition of either L-77 or AS or X-77 to glyphosate, significantly reduced the fresh weight in black nightshade, and that with the addition of AS or X-77 or Agri-Dex or Volt in wild mustard. Addition of either Kinetic, X-77, Dyne-Amic, Volt, Urea, MSO or AS significantly increased the percent reduction in the fresh weight of large crabgrass. In barnyard grass the reduction was significantly higher with Volt, MSO, Urea and Dyne-Amic than glyphosate alone. But the effect of glyphosate (± adjuvants) on barnyard grass was lower than large crabgrass. Tank mixing of AS (+ X-77 / Kinetic / MSO) in glyphosate, further reduced the fresh weight of black nightshade and wild mustard. In barnyard grass, it was observed that addition of L-77 (± AS) to glyphosate showed some antagonistic effect, as shown by the higher fresh weight over the control due to extra growth of lateral shoots. In large crabgrass, the addition of AS (+ X-77 / MSO) in glyphosate recorded further reduction in the fresh weight and in barnyard grass with AS + MSO in glyphosate. But visual observations indicated significantly higher percent control of barnyard grass with the tank mixing of AS to Kinetic and MSO. In general, the percent fresh weight reduction of all the test weed species obtained from glyphosate (+ adjuvants) was at par with that obtained by the application of glyphosate @ 0.50 kg a.i./ha alone and hence a significant saving of glyphosate active ingredient.

^{14}C GLYPHOSATE ABSORPTION AS AFFECTED BY APPLICATION POSITION ON ROUNDUP READY COTTON. R.H. Blackley, Jr., D.B. Reynolds, S.L. File, and C.D. Rowland, Jr. Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Research has shown that topical applications of Roundup (glyphosate) on Roundup Ready cotton (*Gossypium hirsutum* L.) after the 4-leaf stage may affect reproductive development. Current label restrictions require applications made after the 4-leaf stage to be post-directed. In 1999 field grown plants were utilized at the Plant Science Research Center near Starkville, MS to compare the uptake and translocation of glyphosate in Roundup Ready cotton, when applied topically versus when applied post-directed.

^{14}C-glyphosate (99% radiochemical purity; specific activity = 2.04 Gbq/mmol) prepared in formulation blank was applied to various stem and leaf segments of cotton plants at the 6th leaf growth stage to simulate post-directed applications. Treatments included applying ^{14}C-glyphosate to: the base of the plant near the soil level up to the 1st leaf; the base of the plant up to the 3rd leaf; the base of the plant to the 5th leaf; and a topical application only to the third leaf. When applied

to simulate a post-directed application, the ^{14}C-glyphosate was evenly distributed among stem and leaf segments with the stem and leaf sections receiving equal amounts of radioactivity.

Absorption was defined as the amount of ^{14}C-glyphosate remaining in leaf, stem, or root tissue after rinsing twice with deionized water. Radioactivity was measured by liquid scintillation spectrometry (LCS). Leaf and stem rinses were determined by direct counting, while radioactivity in plant tissue was determined by combustion followed by LCS.

Total ^{14}C-glyphosate recovery fromleafand stemrinses and combustion ofleaves, stems, and roots ranged from70-85%, but did not vary among treatments. Total absorption did not differ among treatments, regardless of application location or method. Acropetal and basipetal translocation did not differ among post-directed treatments. Of the absorbed ^{14}C-glyphosate, 25-31% was partitioned in the roots of all treatments. Partitioning into stem tissue ranged from 17-24% for post-directed treatments and was significantly greater than the 9% for the topical application. Absorption was not increased by post-directed applications that equally contacted leaf and stem tissue, compared to topical applications. The rate of absorption did not differ when ^{14}C-glyphosate was applied post-directed at varying heights above the soil.

Post-directedtreatments inwhichequalconcentrations contact theleaves andstemresultedinabsorptionrates equivalent to topical applications and thus do not appear to impart safety based upon rate of absorption. Although the rate of absorption was the same between topical and post-directed treatments, the theoretical target area is much larger for topical applications and thus would probably result in greater overall loading. It is expected that reduction in reproductiveeffects associatedwithpost-directed sprays are due to reduction intotalherbicideloadinginthecottonplant and not due to differences in absorption between leaf and stem.

THE EFFECTS OF GLYPHOSATE AND SULFOSATE ON ROUNDUP-READY® COTTON. G.E. MacDonald, J.A. Tredaway and M. Gallo-Meagher. Agronomy Department, University of Florida, Gainesville, FL 32611.

ABSTRACT

Field and greenhouse studies were initiated to investigate the effects of glyphosate and sulfosate on Roundup-Ready (RR) cotton. Sulfosate is not registered for use on RR cotton and previous observations indicate moderate to severe injury when sulfosate is applied to RR cotton. Observations made during field studies in 1999 also showed severe damage, but with dissimilar symptomology to glyphosate and sulfosate on non-transgenic crops. Sulfosate and glyphosate were applied at 0.0, 0.38, 0.75 and 1.5 lbs-ai/A to cotton in the 1st true, 4th true leaf and 1st square stage of development. Sulfosate caused leaf chlorosis and necrosis and severe stunting within 5 to 7 days, while normal symptoms of glyphosate injury are not generally visible until 10 days after application. The commercial formulation of glyphosate (Roundup Ultra) did not cause visible injury to RR cotton at any rate or time of application. Rates of photosynthesis (µmoles/cm^2/min)were measured two days after herbicide application. The commercial formulation of sulfosate caused over an 80% reduction in the photosynthetic rates of both conventional (Stoneville 454) and RR cotton (DeltaPine 655) when applied at the 4th leaf stage of cotton. Rates were also reduced from applications made on the 1st square stage but to a lesser extent. Glyphosate reduced photosynthetic rates in conventional cotton but did not effect the RRvariety. Further studies under greenhouse conditions investigated the effect of several formulations of glyphosate including isopropylamine salt, trimesium salt, sesquesodium salt, ammonium salt and technical acid applied at 0.0, 0.38, 0.75 and 1.5 lbs-ae/A to cotton at the 4th leaf stage. In addition, trimesium iodide alone and in combination with technical acid and ammonium sulfate were applied at the same rates found in the previously listed formulations. The commercial formulation of trimesium glyphosate, the trimesium iodide alone and in combination with technical glyphosate acid caused a significant reduction in the photosynthetic rates of RR cotton; and similar symptomology to that observed under field conditions. These studies indicate there is an alternate mode of action of sulfosate in RR cotton and that the trimesiumsalt itself is phytotoxic to cotton. The symptomology and rapid reduction in photosynthesis rates further suggest that the salt may be a photosynthetically active compound.

CHARACTERIZATION OF HERBICIDE METABOLISM BY HETEROLOGOUSLY EXPRESSED CYTOCHROME P450s FROM CORN. J.L. Ralston, S. Avdiushko, A. Freytag, E. Ward, S. Potter, and M. Barrett University of Kentucky, Lexington, 40546 and Novartis Agribusiness Biotechnology Research, Inc., Research Triangle Park, NC 27709.

ABSTRACT

Cytochromes P450 mediate the metabolism of a range of herbicides and other xenobiotics in plants. Since corn microsomes contain many P450s, it is difficult to assign the metabolismofa herbicide to a particular P450. To overcome this limitation, we tested the herbicide metabolism capabilities of two different corn P450s (CYP72A5 and CYPX) and a Jerusalem artichoke P450 (CYP73A1, a cinnamate hydroxylase) heterologously expressed in engineered yeast strains. Microsomes were prepared from the three yeast strains expressing P450s and a fourth strain transformed with a blank plasmid. These microsomes were assayed for the metabolism of six different ^{14}C-labeled substrates. The substrates tested were: bentazon, chlorimuron, chlortoluron, clomazone, imazethapyr, and malathion.

CYPX showed high levels of bentazon metabolism (116 pmol/mg protein/min) and lower levels of chlortoluron (36 pmol/mg protein/min) and malathion (13 pmol/mg protein/min) metabolism. CYP72A5 demonstrated low levels of clomazone and malathion metabolism, with 2 and 6 pmol/mg protein/min, respectively. The cinnamate hydroxylase (CYP73A1) did not appear to metabolize any of the substrates tested. There was no evidence of chlorimuron or imazethapyr metabolism in any of the transformed yeast strains.

These data demonstrate that a single corn P450 (CYPX) has the ability to metabolize multiple substrates. These results also show that P450s may be somewhat substrate specific, since CYP73A1, which had the highest microsomal P450 concentration, did not metabolize any of the six substrates tested. Imazethapyr and chlorimuron were not metabolized by either of the corn P450s, which suggests that there are other herbicide metabolizing P450s in corn, since they were previously shown to be metabolized by corn microsomes.

GROWTH AND YIELD OF TRANSGENIC COTTON (GOSSYPIUM HIRSUTUM L.) UNDER VARIOUS WEED MANAGEMENT PROGRAMS. M.L. Mobley, N.R. Burgos, and M.R. McClelland, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR 72704.

ABSTRACT

Herbicide-resistant cotton and ultra narrow spacing are emerging technologies that could potentially improve weed management and profitability of cotton production. Growing cotton in ultra narrow rows changes the plant structure and imposes greater stress on the plant. A field study was conducted to compare development of transgenic cotton in conventional and ultra narrow rows and to determine whether a soil-applied herbicide is needed in weed management programs for transgenic varieties. Plant height and canopy width were measured at 30, 45, 60, and 75 days after planting (DAP). COTMAP, a boll mapping technique, was used at harvest to determine variations of fruiting patterns and growth among treatments. For conventional row spacing, bolls were hand-harvested from two rows per plot, 6.6 ft. long. An equivalent area was harvested for ultra narrow row plots. Studies were conducted in Fayetteville and Little Rock, AR in 1999.

The study was done as a randomized complete block design in Little Rock with 13 treatments using four varieties, PM1220, BXN47, SG125, and DP450. Narrow rows were spaced 7.5 to 10 inches and conventional rows 30 inches apart. Herbicide treatments consisted of a total postemergence program and a preemergence followed by a postemergence program.

In Fayetteville, the design was a split factorial. The study contained eight treatments using two varieties, PM1220 and BXN47, two herbicide programs and two row spacings. The cotton was planted in 7.5- and 40-inch row spacing. The herbicides programs were the same as those of Little Rock. A ninth treatment was added using PM1220 with standard cotton herbicides and no glyphosate.

In Little Rock under conventional row spacing without a soil-applied herbicide, BXN47 was shorter and had narrower canopy than SG125, PM1220, and DP450 at any period. Plants grown in conventional row spacing were larger than those in ultra narrow rows regardless of variety. Plants in conventional rows also had a higher first fruiting node, more bolls retained at second position, and more sympodia first position bolls. In ultra narrow row spacing, there was no difference in total bolls between PM1220 and BXN47, but in conventional row spacing PM1220 had more total bolls than BXN47. In general, treatments with a preemergence herbicide followed by a postemergence had higher yields. Row spacing did not influence yield.

In Fayetteville, canopy height and width measurements were larger for PM1220 at 45 and 60 DAP compared to BXN47. At 75 DAP, there was no difference in plant height regardless of variety, row spacing, and herbicide program. In conventional row spacing, more first and second sympodia bolls were produced as well as more total bolls. PM1220 had higher first and second position boll retention than BXN47. PM1220 also had more total bolls than BXN47 in both row spacings. Plants in conventional row spacing had higher yields than those in ultra narrow rows. In general PM1220 produced higher yields than BXN47.

UPTAKE AND TRANSLOCATION OF ^{14}C-GLYPHOSATE IN GLYPHOSATE-RESISTANT COTTON. H.M. Harris and W.K. Vencill, University of Georgia, Athens.

ABSTRACT

Glyphosate uptake was similar between stages of growth when a directed base application was made. However, when glyphosate was applied 33% up the stem or applied broadcast to the whole plant either as a single or sequential application, glyphosate uptake at the square stage of growth was approximately twice that of glyphosate applied at the white-flower stage. Less than 3% of absorbed glyphosate was translocated to the root, stem, or terminal of cotton with any glyphosate application method at both growth stages. When glyphosate was applied to the base of two-leaf cotton, there was an even distribution of glyphosate amongst vegetative and reproductive tissue. However, when glyphosate was applied to the base of cotton at the square stage, approximately 70% was translocated to vegetative tissue.

Applications of a single or sequential application of glyphosate broadcast or a single application 33% up the stem resulted in greater than 70% translocation of glyphosate to vegetative tissue at both stages of cotton growth. These data indicate that substantial levels of glyphosate are translocated to the reproductive tissues of cotton regardless of application type.

TROPIC CROTON (*Croton glandulosus* var. *septentrionalis*) INTERFERENCE IN COTTON (*Gossypium hirsutum*) AND PEANUT (*Arachis hypogaea*). S.D. Askew, J.W. Wilcut, G.H. Scott, and J.D. Hinton; North Carolina State University, Raleigh, NC 27695.

ABSTRACT

Tropic croton ranks as one of the 10 most troublesome weeds of cotton and/or peanut in Alabama, Georgia, North Carolina, South Carolina, and Virginia. The amount of cotton-producing area infested with tropic croton has steadily increased from 66,400 ha in 1990 to 194,000 ha in 1998. Likely reasons for the increase in tropic croton infestations include an increase in cotton production in the states most commonly infested, lack of tropic croton control with many soil-applied herbicides, and increased use of postemergence herbicides in peanut that do not control tropic croton. Although lack of herbicidal control has been documented, no data has been published on tropic croton competitive relationships with cotton or peanut. Therefore, studies were conducted to evaluate density-dependent effects of tropic croton on yield and growth of cotton and peanut and dry weight and height of tropic croton.

In the cotton study, tropic croton was planted 15 cm from the crop row at 0, 1, 2, 4, 8, 16, and 32 plants per 9.1 m of row. Undesirable weeds were removed throughout the season. Height of four cotton and tropic croton plants were measured bi-weekly throughout the season. All weeds were carefully removed prior to harvest and fresh and dry weights of four weeds were obtained. Cotton was then harvested with a spindle picker. Where significant tropic croton density effects were observed on plant heights, weed dry weight, and yield loss, appropriate regressions were performed. Nonlinear models were used if ANOVA indicated higher-order polynomial effects of tropic croton density were more significant than linear or quadratic effects. In the peanut study, tropic croton was planted 15 cm from the crop row at 0, 1, 2, 4, 8, 12, 16, and 32 plants per 6.1 m of row. Undesirable weeds were removed throughout the season. Diameter of four peanut canopies and height of four tropic croton plants were measured bi-weekly throughout the season. Weeds were removed prior to peanut harvest. Data analysis was similar to the cotton study.

In cotton, tropic croton density did not influence tropic croton height, however, late-season cotton height decreased 0.42 cm with each increasing tropic croton plant per 9.1 m of row. Weed biomass also had an inverse linear relationship to weed density. Tropic croton dry weight decreased 1.59 g as density increased. When cotton lint yield was regressed by total tropic croton biomass per 9.1 m of row, yield was shown to decrease 220 kg/ha with each kg increase in tropic croton biomass. Percent cotton yield loss was best explained by the Gompertz equation in lieu of the rectangular hyperbola. The hyperbola tended to over estimate the asymptote variable and resulted in a higher residual mean square compared to the Gompertz equation. Predicted cotton yield loss from season-long interference of one tropic croton per 9.1 m of row is 1.65%. This yield loss indicates that tropic croton is less competitive than many weeds of cotton and similar in competitiveness to prickly sida (*Sida spinosa).*

In peanut, tropic croton density did not affect peanut canopy diameters or tropic croton height at any measuring time. Tropic croton dry weight decreased 1.4 g with each increase in plant density. Trends in peanut yield followed an inverse quadratic relationship of decreasing yield to increasing tropic croton density for each of the three years of the study. One tropic croton plant per 6.1 m of row caused 3, 2, and 2% yield loss in 1988, 1989, and 1998, respectively. Although less competitive in cotton and peanut than many other weeds, tropic croton can cause substantial yield losses. The limited control options in peanut and non-transgenic cotton coupled with the ability to compete in the sandy soils common to these crops in North Carolina will likely promote the already growing tropic croton infestations.

ALLELOPATHIC INTERFERENCE OF HONEYSUCKLE (*LONICERA JAPONICA* THUNB.) TO PINE REGENERATION. B.W. Skulman, J.D. Mattice, and M.D. Cain. Crop, Soil and Environmental Sciences Department, University of Arkansas, Fayetteville, AR 72704 and USDA Forest Service, SRS, P.O. Box 3516, Monticello, AR 71656-3516.

ABSTRACT

The potential for honeysuckle allelopathic interference to the regeneration of loblolly and shortleaf pines (*Pinus taeda* L. and *P. echinata* Mill.), has been investigated with a greenhouse hydroponic system, amended soils in pots and extracts of honeysuckle leaf tissue. Hydroponic bench studies were conducted with honeysuckle and pine seedlings grown in separate pots attached to a common recirculating water reservoir. Results show that loblolly (*Pinus taeda* L.) pine seedlings had reduced growth compared to the control hydroponic bench where all pots were planted to pine. Shortleaf *(P. echinata* Mill.) did not show any differences. Aqueous extracts of honeysuckle leaf tissue were found to produce growth inhibition in an allelopathic bioassay using *Lemna minor* at rates of 0.125 g/100 mL or greater. Experience has shown that any rate less than 1 g/100 mL is not due to physiological effects.

Pine seed germination was examined with aqueous extracts of honeysuckle on both filter paper in petri plates and as an extract/agar bioassay in test tubes. In these studies seed germination tended to be erratic and inconsistent with no demonstrable difference between the treatments and controls.

Studies using soils amended with honeysuckle leaf tissue or peatmoss (control) in pots were examined for effects on germination and growth in height for both pine species. Each treatment was replicated 10 times. The treatments were applied as either incorporated tissue that was throughly mixed with the soil at a rate of 2 g tissue/100 g soil or as a surface dressing on a weighed amount of soil in each pot. The pots received 25 pine seed each and were monitored for germination and measured for plant height from the soil surface. No significant effect was found for the honeysuckle treatment on germination. However, there was a significant effect on germination by surface dressed material over incorporated regardless of which material was present.

When pine growth was measured over time a significant reduction in height was observed for both pine species in the incorporated treatments. Loblolly height was reduced by 20% while shortleaf height was reduced by 60% after 184 days after planting (DAP). The effect on growth was noted as early as 128 DAP. In the surface dressed experiment loblolly and shortleaf showed a 55% and 41% reduction in height respectively after 184 DAP. Yellowing was observed in the seedlings that received the honeysuckle treatments when compared to the controls.

Ethyl acetate partitions of aqueous leaf extracts were derivatized with trimethylchlorosilane (TMS) and subjected to gas chromatography mass spectroscopy (GCMS). Four compounds previously identified as allelopathic substances by other researchers were identified. These compounds were 2-hydroxycinnamic acid, 4-hydroxycinnamic acid, 3,4-dihydroxycinnamic acid and 3,4-dihydroxybenzoic acid.

These results suggest that honeysuckle can have a negative impact on pine seedling growth by allelopathic and competitive interference. Germination of pine seedlings was not shown to be affected by honeysuckle leaf tissue. However, the presence of surface litter did have a negative effect on germination.

Work will continue to examine interactive effects of pH and tissue amendment on pine growth, to determine the quantities of potential allelochemicals present in honeysuckle leaf tissue and to test for the effects of these potential allelochemicals on pine growth at concentrations equivalent to those observed from tissue.

Acknowledgments: USDA Forest Service, SRS

USING HPLC TO PREDICT WHICH ACCESSIONS OF RICE WILL INTERFERE WITH GROWTH OF BARNYARDGRASS. J.D. Mattice, R.H. Dilday, E.E. Gbur, and B.W. Skulman, Crop, Soil and Environmental Sciences Department, University of Arkansas, Fayetteville, AR 72704 and USDA-ARS, Dale Bumpers National Rice Research Center, Stuttgart, AR 72160.

ABSTRACT

Methanol extracts of rice leaf tissue from 40 accessions were prepared by cutting rice leaves into approximately 1 cm lengths, adding methanol at a ratio of 1 ml methanol to 10 mg fresh tissue, and refrigerating the samples overnight. The following morning the extracts were diluted 1/1 with deionized water and analyzed by HPLC. A 25 cm x 4.6 mm C18 column was used with an acetonitrile/1% acetic acid in water gradient from 10% acetonitrile for 3 min and then increased linearly over 27 min to 50% acetonitrile. The flow was 1.5 ml/min and analysis was at 320 nm.

There was a visual difference between chromatograms of those accessions that have shown barnyardgrass (BYG) inhibition and those that do not. There are 4-6 peaks that are either much larger or present only in the chromatograms of accessions showing weed control. A cluster analysis using the K-means procedure of Hand (1) was performed using 20 peaks from the chromatograms. The optimum number of clusters was three with one of the clusters, cluster 3, distinctly removed from the other two.

Bioassays were performed by growing four BYG plants with 15 rice plants in cups in the greenhouse. There were 10 reps per accession. BYG heights were recorded 12-14 days after emergence and expressed as a percent of the height of BYG grown with Rexmont, a commercial variety that does not inhibit BYG growth. Of the 28 accessions for which bioassay data is available, 8 have consistently shown significant inhibition of BYG growth relative to Rexmont with plant height being 65-80% of the height of BYG grown with Rexmont. All eight of these accessions fall into the cluster 3 that is distinctly separated from the other two clusters. Another accession that falls in this cluster shows inconsistent bioassay results with inhibition of BYG growth being intermediate to strong. The accessions that do not show inhibition of growth fall in clusters 1 and 2. None of them are in cluster 3.

These results indicate that an HPLC analyses of a methanolic extract from leaf tissue of a 10 day old rice plants can be used to predict if that accession will inhibit BYG growth.

Work is underway to determine if the HPLC assay can be used to determine which individual progeny of crosses between accessions of rice showing weed control activity and commercial varieties will contain the BYG control property.

(1) J. D. Hand, Discrimination and classification. 1981, New York: John Wiley and Sons. P 174.

Acknowledgments: Arkansas Rice Research and Promotion Board and United States Department of Agriculture.

INTERFERENCE BETWEEN RED RICE AND RICE IN A TWO-YEAR REPLACEMENT SERIES STUDY.
L.E. Estorninos, Jr. and R.E. Talbert, Department of Crop, Soil, and Environmental Science, University of Arkansas, Fayetteville, AR. , and D.R. Gealy, USDA-ARS, Dale Bumpers National Rice Research Center, Stuttgart, AR.

ABSTRACT

Kaybonnet rice(medium-tall, popular rice cultivar in Arkansas) was found to be less competitive than PI 312777 (semi-dwarf and possible allelopathic rice) against red rice under field conditions. A replacement series study was conducted in the greenhouse in 1998 and 1999 to evaluate the growth response of rice cultivars Kaybonnet and PI312777 when grown together with Katy red rice (presumed cross between Katy rice and a strawhull red rice) and LA3 red rice (from Louisiana). The replacement series also included monoculture of the two red rice ecotypes and two rice cultivars. The proportions were 3:0, 2:1, 1:2, and 0:3 (rice:red rice) plants per pot. Plant heights and leaf areas of both rice and red rice were measured 28, 49, and 70 days after emergence (DAE), and dry weights of plant leaves, stems, and roots were determined. Relative yield for each species at each mixture proportion was calculated and expressed as the shoot dry weight/pot of the species in mixture divided by the shoot dry weight/pot of the species in monoculture. The data presented were the averages of two years.

Leaf area index of Kaybonnet and PI 312777 rice at 70 days after emergence decreased as their density in the mixture proportions decreased. Leaf area index of Kaybonnet was lower than that of PI 312777 at all planting mixture proportions. Heights of Kaybonnet and PI 312777 were not different when grown with KatyRR and LA3 until harvest (70 DAE). At 70 DAE, height of KatyRR was reduced when planted with PI 312777 at 2:1 rice,red rice proportions compared to that with other mixtures. LA3 was not affected by the rice cultivars and mixture proportions.

Relative yield for dry weight of above ground parts of Kaybonnet was lower than that from KatyRR or LA3 which suggests that Kaybonnet was less competitive than KatyRR and LA3. In the PI 312777 and KatyRR mixture, the relative yield for dry weight of PI 312777 comparable to that of KatyRR and LA3. The trend was the same on the relative yield of the combined weights of the roots, stems and leaves. These greenhouse results appeared to be in contrast with the field research results which showed KatyRR to be a poor competitor among the two ecotypes against Kaybonnet and PI 312777 in 1997 and 1998. These results also indicate that Kaybonnet was less competitive than PI 312777 against KatyRR and LA3 red rice ecotypes.

COMPARATIVE N UPTAKE BETWEEN RED RICE AND RICE. N.R. Burgos, R.J. Norman, and D.R. Gealy, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR 72701.

ABSTRACT

Previous studies have shown that one red rice plant m^2 can cause between 180 and 270 kg ha^{-1} yield loss in rice. The competitive edge of red rice lies mainly in its capability to grow taller than rice, produce more tillers, and essentially produce more biomass. The amount of nitrogen red rice takes away fromrice to produce so much biomass is not known. A study was conducted at the Rice Research and Extension Center (RREC), Stuttgart, Arkansas in, 1999 to (1) compare nitrogen uptake between red rice and rice and (2) to determine the proportion of soil-applied nitrogen taken up by red rice. Stuttgart strawhull red rice and Drew rice cultivar were seeded at 90 kg ha^{-1} in alternate rows spaced 19 cm apart, at eight rows per plot. Two weeks after emergence, red rice plants were thinned 1:3 red rice to rice population ratio. Before permanent flood, two metal squares 76 by 76 by 31 cm were placed in the middle of each plot. Each square enclosed two rice and two red rice rows. Pelletized ^{15}N urea fertilizer was applied at 0, 50.4, 100.8, 151.2, and 201.6 kg ha^{-1} in the square. Regular urea fertilizer was broadcasted outside the squares at 100.8 kg N ha^{-1}. Weeds were controlled using propanil (3.36 kg/ha), thiobencarb (2.24 kg/ha), and quinclorac (0.56 kg/ha). The experiment was conducted in a randomized complete block design with four replications. Above-ground biomass was harvested from one square of each plot at panicle initiation and two weeks after heading. Biomass was separated into top and bottom leaves, sheath, and panicle. Tissues were processed for total N and ^{15}N analysis.

Shoot biomass production of red rice and rice were similar at panicle initiation. At two weeks after heading, biomass of red rice (828 g m^2)was greater than that of rice (468 g m^2) at 0 N rate. The difference in biomass production increased with N rates. At 151 kg N ha^{-1}, red rice produced 1,737 g m^2 biomass which was 2.5 times higher than that of rice. The total N uptake at panicle initiation was similar between red rice and rice at low N rates. N uptake by red rice continued at higher N rates but that of rice leveled off. At two weeks after heading, total N uptake by red rice was greater than rice especially at higher N rates. At 151 kg N ha^{-1}, red rice had 18.3 g m^2 while rice had 9.7 g m^2 total N

in shoot tissue two weeks after heading. At this time, N content in the bottom leaves was similar for rice and red rice, but red rice had more total N in the top leaf, sheath, and panicle than rice. The majority (50 to 55%) of N in both species was found in the top leaf at panicle initiation. At two weeks after heading, % of total N was lowest in the flag leaf, indicating translocation of N to panicle. The percentage of N in the flag leaf was higher in red rice than in rice. The percentage of N in the sheath was higher in rice than in red rice. Our results indicated that red rice was more efficient in taking up and utilizing nitrogen than rice.

DNA FINGERPRINTING OF RED RICE (*Oryza sativa*) ECOTYPES IN RELATION TO HERBICIDE AND DISEASE TOLERANCE. D.R. Gealy and T.H. Tai, USDA-ARS, Dale Bumpers National Rice Research Center, Stuttgart, AR, and F.N. Lee, University of Arkansas Rice Research and Extension Center, Stuttgart, AR.

ABSTRACT

Red rice is one of the most troublesome weeds of rice (Oryza sativa) in the southern United States. It is a crop mimic and is the same species as commercial rice cultivars. Numerous types of this weed species are known to exist in farmers' fields and intercrossing between commercial cultivars and red rice can occur, further increasing the complexity of control strategies. However, this close genetic relationship presents a valuable opportunity to exploit red rice as a potential source of desirable genes for commercial rice cultivars. In these studies, we evaluated the genetic relationships among numerous types of red rice (including know crosses with rice) from the southern USA using 10 'simple sequence repeat' ('SSR') (also called 'microsatellite') DNA markers. We related the resulting DNA types to tolerances to the herbicides glufosinate, glyphosate, imazethapyr, and molinate, and to rice blast (*Pyricularia grisea*) (races IC-17, IB-49, IH-1, IG- 1, and IE-1K), the most severe rice pathogen in US rice. Red rice types exhibited a wide range of tolerance to the herbicides and to blast. Low to moderate levels of herbicide tolerance were observed in only a few instances. Only one of 150 red rice types (1995-14) was rated resistant to all 5 races of blast suggesting that this type might be a useful source of blast resistance genes. Highest tolerances to herbicides and blast generally occurred in awned, 'black' hulled red rice. Multidimensional scaling (MDS) analysis and cluster analysis of SSR results indicated clear genetic differences among several groupings of types (e.g. red rice vs. rice vs. red rice-rice crosses; awned vs non awned types; and 'straw' colored vs. 'black' colored hulls). Genetic groupings for several of the red rice types suggest that these types had previously hybridized with cultivated rice.

WATER USE BY WATERMELON AND SELECTED WEEDS. M. Biernacki, W. Roberts, J. Shrefler, J. Duthie, J. Edelson and M. Taylor. Lane Agricultural Center, Oklahoma State University - Wes Watkins Agric. Res. and Ext. Center, Lane, OK 74555-0128.

ABSTRACT

Watermelon prefers well-drained soils but also needs sufficient supply of water. Water shortage may result in plant wilting and severe injuries to vegetative structures and damage to fruit. Irrigation of watermelon crops may increase yields of marketable fruits and their quality. However, in field production systems watermelon often has to compete for soil moisture with associated weeds. Despite its importance there is little information available about quantitative and temporal patterns of water needs of watermelon and weeds associated with this crop. Present study was design to identify quantitatively water needs of watermelon and its weeds. Also, effects of selected factors affecting plant water management were evaluated. Watermelon (*Citrullus lanatus*, Cucurbitaceae cultivars "Sugar Baby" and "Sangria"), tumble pigweed (*Amaranthus albus,* Amaranthaceae), redroot pigweed (*Amaranthus retroflexus,* Amaranthaceae), and large crabgrass (*Digitaria sanguinalis*, Poaceae) were grown individually in 19 L containers or in mixtures of plants to evaluate their water use over that growing season. Water inputs and drainage from containers, as well as moisture evaporation from soil were measured every 2 to 3 days over 14 weeks of study.

Study was replicated 3 times with 50 replicates of each treatment. Nondestructive data (leaf number, leaf surface area, shoot number, fruit number and size) for each plant were collected every 2-3 days. Destructive data on biomass of plant parts and surface area of roots was collected weekly for each treatment. Data was analyzed using linear and nonlinear regression models and analyses of covariance. Prior to analyses data was transformed to comply with assumption of analytical procedures. Watermelon water needs increased from seed germination until fruits matured and later decrease sharply at plants senescence. The greatest relative increase in water uptake by watermelon was observed over period of intensive vegetative growth and before flower production. However, maximum water needs were recorded within 2 - 3 weeks before fruit matured. At this time watermelon plants were able to use 1 to 3 L of water per day. Regression analyses indicated a significant correlation between leaf surface area per plant and volume of used water. It indicates that water uptake by plant was related to transpiration by leaves. Overall leaf surface area accounted for 92% to 97% of variation in water use. Fruit mass at maximum accounted for less than 5% of variation in water use by watermelon. Over the growing period watermelon crop required from 30 L to 50 L of water per each kg (in fresh weight) of fruit. Air temperature significantly affect plant water needs and watermelon grown at 35 C could require twice as much water per unit mass as plants grown at 20 C. Pigweed and crabgrass had much lower water needs compare to watermelon. Water uptake of these weeds at maximum was 6 to 10 times lower per plant compare to watermelon. The greatest relative increase in water consumption by weeds was also observed as plants developed vegetatively before production of reproductive structures. In contrast to watermelon water needs of weeds did not approach any maximum but increased persistently over the study period proportionally to changes in plant size. Variation in weed water use was in over 90%

associated with changes in surface area of leaves. If grown together, watermelon and weeds compete for water with each other. With increased weeds density watermelon water uptake decreased more rapidly than water uptake by pigweed or crabgrass. Root surface area of watermelon plants decreased rapidly if grown together with weeds and just addition of 2 to 3 pigweed plants to pot with watermelon cased 50% decrease in water uptake by watermelon. Addition of a single pigweed or crabgrass plant to pot could decrease water uptake by watermelon to 77% of control with no weeds. Also other factors affecting root growth and surface area may have effects on water uptake by watermelon. Root diseases and/or mechanical damage to roots may have significant effects on plant water management. Transplanted plants generally suffer damage to a taproot and do not develop deep root systems as compare to directly seeded plants. Pests like a squash bug (*Anasa tristis*) that feed on cucurbit plants may also interrupt normal functions of plant vascular system and decrease water uptake. Water uptake by plants with 2 to 4 squash bugs may decrease from 86% to 49% of control plants without insects. Generally, watermelon is a poor competitor for water as compare to weeds. Decrease in water availability cased by various factor may affect plant reproductive potential and decrease production of marketable fruits.

GIANT SALVINIA (*SALVINIA MOLESTA)* CONTROL IN TOLEDO BEND RESERVOIR. D.E. Sanders , R.E. Strahan, J.D. Hyde, H.E. Temple and C.E. Dugas. Louisiana State University Agricultural Center, Baton Rouge, LA 70803, Sabine River Authority, Many, LA 71449 and Louisiana Department of Wildlife and Fisheries, Opelousas, LA 70049.

ABSTRACT

Giant salvinia (*Salvinia molesta)* was first identified in Toledo Bend Reservoir in the summer of 1998. Giant salvinia is native to South America where it is a serious pest in aquatic habitats including rice fields. Its introduction has caused severe economic and ecological problems in many countries including New Zealand, Australia and South Africa. Trials were conducted in 1999 to determine the most effective herbicide control. Trials consisted of stocking 2 meter diameter floating rings with giant salvinia collected near the trial site. The rings containing the giant salvinia were then treated with either a boom sprayer or a high pressure sprayer (depending on trial) from a boat. Twenty-four hours after treatment the giant salvinia plants were harvested from the rings and transferred to partially submerged stationary wire mesh cages. Control ratings were taken at 1 and 3 week periods. A total of 4 trials were conducted between May 5 and August 15, 1999. All trials were conducted using a Randomized Complete Block design with 3 replications.

The first trial was a comparison of: 1) Reward at 2.0 lb.; 2) Renovate at 1.5 lb.; 3) Rodeo at 4.0 lb.; 4) Arsenal at 1.5 lb.; 5) Liberty at 0.75 lb.; 6) Weedar 64 at 4.0 lb. The second trial was a comparison of 1) Reward at 0.5, 1.0 and 2.0 lb. and Nautique at 4.55 and 9.10 lb. The third trial was a comparison of 1) Reward at 2.0 lb.; 2) Reward at 2.0 lb. plus Sonar at 0.5 lb.; 3) Arsenal at 1.5 lb.; 4) Liberty at 0.75 lb. and Londax at 0.06 lb. The fourth trial was a comparison of spray volumes comparing a 15 gal/A boom application vs. a 150 gal/A high volume spray using 1) Reward at 1.5 lb. and Reward at 1.5 lb. plus Clearigate at 4.0 lb. All applications included Agridex Spray Adjuvant at 1.0% v/v.

In the first trial only a 7 DAT rating was taken with Reward providing 80 % control followed by Liberty at 65% control. All other treatments provided less than 50% control. In the second trial a rate comparison indicated that at 28 DAT Reward at 0.5 lb. provided 33% control > by Reward at 1.0 lb. with 50% control > Reward at 2.0 lb. with 90% control. Nautique at 9.10 lb. provided only 60% control. In the third trial at 18 DAT Reward at 2.0 lb provide 97% control > Liberty at 0.75 lb. 93% control > Reward at 2.0 lb. + Sonar at 0.5 lb. 83% control > Arsenal at 1.0 lb. 67 % control > Londax at 0.06 lb. 0% control. In the fourth trial there was no significant difference in control between a boom application and a high volume spray. There was no significant difference between 1) Reward at 1.5 lb. and 2) Reward at 1.5 lb. plus Clearigate at 4.0 lb. with all treatments providing between 90-95% control.

The Louisiana Dept. of Wildlife and Fisheries began treating all know infestations of giant salvinia in July with Reward at 2.0 lb./A. Monitoring of these sights through Sept. of 1999 indicated better than 95% control.

Giant salvinia will not be easily eradicated from Toledo Bend Reservoir due to its growth habits and the inability to treat all infested areas. However, it does appear that herbicide applications can be effective and will hopefully keep the pest in check.

COOPERATIVE INTRODUCTION OF *ACERIA MALHERBAE* FOR BIOLOGICAL CONTROL OF FIELD BINDWEED (*CONVOLVULUS ARVENSIS*). K.A. Hollon, T.F. Peeper, T.A. Royer, K.L. Giles, and G. Micheals. Oklahoma State University, Stillwater, and Texas Agriculture Experiment Station, Bushland.

ABSTRACT

On May 14, 1999 field bindweed foliage infested with *Aceria malherbae* was hand collected and placed into sealed plastic bags at the Texas Agricultural Experiment Station in Bushland, TX. The bags were maintained at 21 C° +/- 5 C° until distribution. The following day the samples were distributed to 125 interested Oklahoma wheat producers. The producers were instructed to release the *A. malherbae* samples in growing field bindweed the same day and flag the release site. Each release site was visited prior to 1999-wheat harvest and mapped and recorded using a handheld GPS unit. During October and November 1999, prior to killing frost, all mapped sites were revisited to determine whether

field bindweed at the site was exhibiting symptoms of damage inflicted by *A. malherbae*. Of 115 mapped release sites throughout western Oklahoma, two sites had noticeable damage due to feeding *A. malherbae*. During spring and summer 2000 efforts will be made to identify factors contributing to the successful introduction and efficacy of this biological control agent.

SMOLDER™: A BIOHERBICIDE FOR SUPPRESSION OF DODDER (*CUSCUTA* SPP.). T.A. Bewick, J.C. Porter and R.C. Ostrowski. University of Massachusetts Cranberry Experiment Station, East Wareham and United Agri Products, Greeley, CO.

ABSTRACT

In 1984, an *Alternaria* species was found infecting swamp dodder in an uncultivated marsh in Wisconsin. The use of the fungus as a bioherbicide was patented in 1990 and the fungus was named *Alternaria destruens* by Emmory Simmons in 1998. United Agri Products obtained development rights in 1995. In 1997, United Agri Products teamed with Sylvan, Inc., to produce the active ingredient of the commercial product. In 1998, field experiments were conducted in cranberry in Massachusetts (2 sites) and carrot in Wisconsin (1 site) to determine the dose of inoculum needed to provide commercially acceptable postemergence control of dodder in these crops. Conidia for these experiments was produced by Sylvan. The conidia were suspended in water to which emulsifiers and surfactants were added. The mixture was applied to dodder actively growing in the field at the rate of 195 l/ha. The plots in cranberry were 1 m^2 with four replications per treatment. The plots in carrot were 1 bed wide and 6 m long with four replications per treatment. A disease progress curve was generated for each dose of conidia applied. The doses used per ha were: 0.0, 2.2 x 10^{10}, 2.2 x 10^{9}, 2.2 x 10^{8}, and 2.2 x 10^{7}. Carrot roots were harvested immediately prior to commercial harvest and fresh weight determined. Results were analyzed by ANOVA and means separated by LSD (p = 0.05). All doses of the bioherbicide controlled dodder compared to the untreated control. However, 2.2 x 10^{10} conidia provided rapid, commercially acceptable control and, in carrot, increased crop yield.

In 1999, 2 formulations were compared for their ability to control dodder preemergence. Experiments in Massachusetts were done in containers placed outdoors, while experiments in Wisconsin were done in the field. In both experiments, the bioherbicide was applied in a starch matrix at the rate of 66 kg of product/ha and a cellulose matrix at the rate of 66 and 132 kg of product/ha. Field plots were 7 beds wide and 7 m long. All experiments had four replications. The bioherbicide did not prevent the emergence of dodder in either experiment. In the container study, fewer dodder seedlings infected hosts when the bioherbicide was applied compared to the untreated control. In the field study, both formulations of the bioherbicide reduced dodder growth compared to the untreated control. The cellulose matrix, applied at 132 kg of product/ha, caused disease of the dodder stems and resulted in commercially acceptable season long dodder control.

Also in 1999, a demonstration of the postemergence product was conducted in a Massachusetts cranberry bog. A dose of 2.2 x 10^{10} conidia/ha was applied to approximately 0.4 ha heavily infected with dodder. Results were compared to an area 1.4 miles away that was also heavily infected with dodder but that was left untreated. By 14 days after treatment, over 90 % of the dodder had died. The untreated area showed no signs of natural senescence for over 30 days after the treated dodder was completely dead. This result indicated that the commercial product for postemergence control of dodder produces excellent control of dodder under conditions faced by growers. Based on these and previous results, a Section 3 registration is being sought this year.

VARIATION IN PEANUT HERB RECOMMENDATIONS BASED ON SCOUTING TECHNIQUES IN NORTH CAROLINA. D.L. Jordan, G.G. Wilkerson, H.D. Coble, J.W. Wilcut, and D.W. Krueger, Crop Science Department, North Carolina State University, Raleigh, NC 27695.

ABSTRACT

Variation in predicted yield loss and predicted income from applying postemergence herbicides based on average weed density of the field (referred to as field average recommendation) versus the sum of site-specific weed densities within a field (referred to as site-specific recommendation) were compared in five peanut fields in North Carolina using Peanut HERB yield loss predictions and herbicide recommendations. Site-specific recommendations were based on grids within each field that were approximately one acre in size. Weeds were counted by species in a 100 square foot section within each grid and used to determine the most appropriate herbicide option based on a 3,700 pound per acre yield at a selling price of $550 per ton farmer stock peanuts. These fields were randomly selected from a data set containing approximately 40 fields ranging in size from 3 to 35 acres. Predicted yield loss was 20, 25, 2, 1, and 10% higher when based on field average recommendations rather than site-specific recommendations in the five fields. Starfire (paraquat) and non-Starfire herbicide recommendations were included. Peanut HERB recommended Starfire options more often than other herbicides in virtually all situations. Many growers in the Virginia-Carolina production region are reluctant to apply Starfire for fear of crop injury and potential delays in pod maturity. Predicted income for entire fields based on the sum of site-specific recommendations exceeded that of field average recommendations. Although applying herbicides based on site-specific recommendations using a 1-acre grid size is not practical, this does represent a theoretical best herbicide recommendation for the entire field. Predicted income using field average recommendations

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rather than site-specific recommendations was $135 lower for the entire set of five fields when Starfire options were included (approximately 53 acres for an average of $2.50 per acre). When non-Starfire options were used, predicted income was $894 lower for the five fields when using field average recommendations (average of $16.90 per acre). Predicted yield loss and predicted income were also compared when estimates were based on all grid samples (1-acre grids), half of the grids, and when only a few samples were taken on the edge of the field (represents a real world situation when only a limited amount of resources can be assigned to weed scouting). In many situations, decreasing the number of sites within a field decreased predicted yield loss and decreased the magnitude of difference between field average and site-specific recommendations. Considerable variation was noted when comparing the primary herbicide recommendation based on field averages with the recommendation for the 1-acre grids. In only one of 5 fields did the most cost effective herbicide option based on field average recommendations match the primary herbicide option for at least 50% of the grids within a field.

ADAPTATION OF A COMPUTER DECISION SUPPORT SYSTEM (DSS) TO OKLAHOMA PEANUT PRODUCTION. S.W. Murdock and D.S. Murray, Department of Plant and Soil Science, Oklahoma State University, Stillwater, OK 74078.

ABSTRACT

In 1999 a computer decision support system (HADSS) was adapted to Oklahoma agriculture crop production. HADSS was modified from HERB, a DSS that was developed at North Carolina State University in the early 1980's. HADSS database was changed to reflect agricultural production and environmental conditions for peanut production in Oklahoma.

A field study was conducted in 1999 near Ft. Cobb, Oklahoma to validate the Oklahoma adapted version of HADSS. The study was performed on a sandy loam soil (OM 0.7% and pH 7.5). The plots were four rows, 36 inches wide by 50 feet long. The experimental design was a RCBD replicated four times. There were ten treatments in the study; five treatments received a PPI application of Sonalan HFP at 0.75 lbs/ac, while five treatments did not receive a preventive weed control herbicide. HADSS was used three times during the growing season to recommend postemergent weed control in four treatments, two PPI and two postemergent only (POST) treatments; likewise a "human recommendation" was made for four treatments. The two remaining treatments were an untreated weedy check and a check where cost was ignored to obtain maximum weed control.

There are a number of input variables that must be entered before HADSS can give effective or profitable recommendations. One important input variable is the number of weed species/100 ft^2. Weed counts were made at 10, 22, and 45 days after planting. Weed populations were both estimated and counted by three individuals at each date. The estimations were made in species/100 ft^2, while counts were made with grids and adjusted to the same format. Estimations varied between individuals, especially when weeds were small and numerous. When weeds were larger and the populations less dense, variation between individual estimations were small. There were also significant differences between the estimations and the weed counts.

Weed control, yield, and profit were similar between HADSS treatments and human treatments. The only statistical difference in yield was between one HADSS POST and one Human PPI treatment. In this case, the yield from the human recommended treatment was higher than the yield from the HADSS recommended treatment. All other human and HADSS treatments were equivalent. With a return ratio of $18.82 one human PPI treatment returned more than one HADSS POST, one human POST, and one HADSS PPI treatment, $15.75, $12.97, and $12.03 respectively. The return ratios for the other HADSS and human treatments were comparable to the human PPI treatment that had the return ratio of $18.82. Due to some differences, the database was slightly edited in anticipation for next years studies.

EFFECT OF INPUT VARIABLES ON RECOMMENDATIONS USING A COMPUTER DECISION SUPPORT SYSTEM. C.J. Gray, S.W. Murdock, and D.S. Murray, Department of Plant and Soil Sciences, Oklahoma State University, Stillwater, OK 74078.

ABSTRACT

With the use and availability of computers in today's world, computer programs have been developed to aid producers in making decisions of herbicide applications. Computer decision support systems give recommendations of postemergence herbicides based on crop value and yield, weed densities, estimated yield loss, expected net gain, and cost of herbicide application. One such computer decision support system is Herbicide Application Decision Support System (HADSS) developed by North Carolina State University. Currently, Oklahoma State University is attempting to adapt HADSS to Oklahoma crops, weeds, and environmental conditions. The objective of this research was to determine the estimate accuracy needed for proper herbicide recommendations using Oklahoma's HADSS.

The crop selected for this research was peanuts (*Arachis hypogaea* L.). Hypothetical input variables were placed in HADSS for the following weeds: common cocklebur (*Xanthium strumarium* L.), Palmer amaranth (*Amaranthus palmeri* S. Wats.), and prickly sida (*Sida spinosa* L.). The competitive indices of common cocklebur, Palmer amaranth, and

prickly sida were 10.0, 3.5, and 1.2 respectively. Hypothetical target populations were used which could simulate the actual population found in a producer's field. The weed estimations were allowed to vary within 10% of the hypothetical target populations. Variable weed sizes used included small, medium, and large which were < 2", 2-4", and >4", respectively. The results concluded that higher degrees of accuracy for weed estimations are necessary with weeds that have higher competitive indices. Weeds with low competitive indices do not require high degrees of accuracy in order to obtain profitable yields. Weed size estimations are critical for proper herbicide recommendations.

VALIDATION OF HADSS COMPUTERIZED DECISION AID IN LOUISIANA SOYBEANS. J.H. Pankey, J.L. Griffin, J.M. Ellis, G.G. Wilkerson, and A.C. Bennett. Louisiana State University Agricultural Center, Baton Rouge, LA; and North Carolina State University, Raleigh, NC.

ABSTRACT

Experiments were conducted at the Ben Hur Research Farm, near Baton Rouge, LA in 1999 to evaluate use of the HADSS (Herbicide Application Decision Support System) computer program for herbicide recommendations in conventional and Roundup Ready soybean systems. Three experiments were conducted as part of this study and all were planted May 17, 1999. The soybean variety 'Asgrow 5901 RR' (Roundup Ready) was used in experiment 1 and 'D&PL 5644 RR' in experiment 2. For each experiment either Squadron (0.88 lb ai/A) was applied preemergence (PRE) or no PRE herbicide was used. At 14, 21, and 28 days after emergence (DAE), weed counts were made in each plot. Numbers of each weed per 100 ft^2 were entered into HADSS to obtain a herbicide recommendation for each system. The recommended herbicide treatments were applied with a CO_2 backpack sprayer (15 gallons water/A) on the same day the counts were made. Weed size 14 DAE was 2 to 5 inches, 21 DAE 4 to 11 inches, and 28 DAE 2 to 20 inches. Plot size was 4 rows (30 inch spacing) x 20 feet.

For experiments 1 and 2, a postemergence (POST) application was necessary whether or not Squadron was applied. Based on expected yield and soybean price, a POST treatment was not recommended at 21 and 28 DAE for the conventional system. Application of Squadron in a Roundup program increased yield compared with Roundup alone. Weed control increased yield 76% and 92% in experiments 1 and 2, respectively, compared with a nontreated control. The Roundup system resulted in greater yield than the conventional system at all application timings whether or not Squadron was used.

A third experiment compared weed control and crop response using the HADSS recommendation and a selected grower standard for both conventional and Roundup Ready systems using Asgrow '5901RR' soybean. A PRE herbicide was not applied and weed counts were made 21 and 28 DAE. Weed size 21 DAE was 2 to 7 inches and 3 to 16 inches 28 DAE. Plot size and herbicide application were as described for experiments 1 and 2. Both the conventional and Roundup systems provided excellent weed control. The HADSS weed control program was as effective as the grower standard. For both application timings, the Roundup system resulted in greater yield compared with the conventional system. Weed control increased yield 53% compared with a nontreated control.

In summary, use of herbicides recommended by HADSS resulted in excellent weed control, comparable to the grower standard. Weeds present in these experiments included barnyardgrass (*Echinochloa crus-galli* (L.) Beauv.), hemp sesbania (*Sesbania exaltata* (Raf.) Rydb. Ex A. W. Hill), pitted and entireleaf morningglory (*Ipomoea lacunosa* L. and *Ipomoea hederacea* var. *integriuscula* Gray), prickly sida (*Sida spinosa* L.), purple nutsedge (*Cyperus rotundus* L.), redweed (*Melochia corchorifolia* L.), sicklepod (*Senna obtusifolia* (L.) Irwin and Barnaby), and wild poinsettia (*Euphorbia heterophylla* L.). For each application timing, a control recommendation was made using HADSS in the Roundup system, but at 21 and 28 DAE in two of the three experiments, the HADSS recommendation for the conventional system was to not treat. Expected yield and soybean price requested by HADSS in order to make recommendations were extremely important in determining cost effectiveness of the herbicide treatment. This was even more apperant when the cost of individual herbicides was considered. The price of Roundup in relation to other herbicides was such that Roundup systems were always cost effective. Further research will evaluate HADSS under different weed spectrums throughout the state.

REGIONAL ADAPTATION AND VALIDATION OF HADSS. A.C. Bennett and G.G. Wilkerson, Crop Science Department, NC State University, Raleigh, NC 27695.

ABSTRACT

A USDA-funded regional project to validate and implement the use of HADSS (Herbicide Application Decision Support System) was initiated last year. HADSS is an economic threshold model, using weed populations, weed competitiveness, herbicide efficacy, and herbicide cost information to generate a list of appropriate herbicides or tank-mixtures. Treatments are initially sorted by net economic return, but they can also be sorted by optimum weed control, herbicide price, and several other factors. States with cooperating weed scientists include Alabama, Arkansas, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, and Texas. Several databases previously developed for soybean (Mississippi, North Carolina), peanut (Georgia), cotton (North Carolina), and corn (North Carolina) provided the initial databases for modification. Data summarized compares weed control, yields, and returns (when available)

obtained using the recommendations generated by HADSS, those of experts (weed scientists involved in validation), grower standards, or weed free controls. Comparisons of weed control ratings are from the season-ending rating of the respective study, and an individual comparison of weed control represents control of an individual weed species. Most studies had several comparisons, based on recommendations following different soil-applied herbicides, or different herbicide tolerant crop cultivars.

Alabama, Georgia, Oklahoma, South Carolina, and Tennessee compared HADSS recommendations for cotton to expert recommendations. Weed control following HADSS recommendations was equivalent or greater than when following the expert recommendations in 97 of 104 comparisons. Yields following HADSS recommendations were equivalent to those following expert recommendations in 28 of 31 comparisons. A preliminary analysis of returns was conducted using the Oklahoma data, and showed returns following HADSS recommendations were equivalent to those following expert recommendations in 14 of 16 comparisons. Cotton tests compared HADSS to a standard in North Carolina and in two Texas locations. Weed control following HADSS recommendations was equivalent to that obtained from the standard in 73 of 75 comparisons. Yields following HADSS recommendations were equivalent to those obtained from the standard in 24 of 24 comparisons. In North Carolina and one Texas location, net returns were determined. In these studies, net returns from HADSS recommendations were equivalent to those obtained from the standard in 13 of 15 comparisons. Tests in Mississippi compared HADSS recommendations with a weed-free. Weed control following HADSS recommendations was equivalent to the weed-free in 204 of 224 comparisons, and yields were equivalent in 43 of 44 comparisons.

Peanut studies were conducted in Oklahoma and North Carolina. In North Carolina, HADSS recommendations were compared to a grower standard. Weed control following HADSS recommendations was equivalent or greater than that obtained using the standard in 21 of 21 comparisons. Yield and net return following HADSS recommendations were greater in 9 of 28 comparisons, and equivalent in 19 of 28 comparisons to that obtained from the standard. Oklahoma peanut studies compared HADSS recommendations to those of an expert. Weed control following HADSS recommendations was equivalent or greater than that obtained by following expert recommendations in 12 of 16 comparisons. Yield and return following HADSS recommendations was equivalent or greater than that obtained by following the expert recommendations in 4 of 4 comparisons.

Mississippi soybean studies consisted of demonstration trials, as extensive validation work has been conducted in the past. Weed control was generally excellent in demonstration trials. In a Louisiana soybean trial, weed control and yield following HADSS recommendations were equivalent to those obtained using the grower standards.

Several problems were encountered during testing. HADSS does not track the total amount of a specific product that can be applied, so multiple applications that exceed the labeled maximum can occur. Several weeds were encountered that are not presently in the databases, so these will have to be added. Although the recommendations generally gave good weed control, several cooperators indicate a need for the program to mirror their top choices as closely as possible for the program to gain acceptance.

HADSS recommendations generally provided good weed control and protected yields effectively. Although limited, the return data available indicate HADSS is making reasonable economic choices in most cases. Several problems were encountered during testing, and modifications will be made to correct or limit the effect of these shortcomings.

TOMATO RESPONSE AND RESIDUE DETECTION FROM SIMULATED DRIFT RATES OF QUINCLORAC. M.L. Lovelace, R.E. Talbert, L.A. Schmidt, and E.F. Scherder. Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR 72701.

ABSTRACT

Quinclorac (Facet) drift has been speculated as causing injury to tomato crops throughout Northeast Arkansas. A study was conducted in Fayetteville, AR, in 1999 to determine the injury and residue level within tomatoes after treatment with simulated drift rates of quinclorac. The study was conducted as a randomized complete block with four replications. Treatment structure was a factorial arrangement consisting of number of applications (one, two, or three) and quinclorac rate (0.42, 4.2 and 42 g ai/ha) at weekly intervals beginning at first bloom. Quinclorac was also applied at 420 g/ha, which was representative to the 1X rate. All treatments were compared to an untreated check. Total plant biomass (1plant/treatment) was analyzed for quinclorac concentration using HPLC weekly for 6 weeks after initial treatment (WAT).

Injury increased as quinclorac rate increased. Injury ranged from 75 to 80% from 2 to 9 WAT of quinclorac at 420 g/ha. Injury ranged from 55 to 65% from 2 to 9 WAT with two and three applications of quinclorac at 42 g/ha. This was greater than one application, which ranged from 40 to 47% injury. Injury from multiple applications of quinclorac at 4.2 g/ha was 45 to 60%, which was greater than a single application. Injury was less than 18% when tomatoes were exposed to quinclorac at 0.42 g/ha, compared to no injury on untreated tomato plants.

Plant fresh weight was 1750 g/plant or less when exposed to 420 g/ha. Plant fresh weight was greater when exposed to a single quinclorac application at 42 g/ha (3,100 g/plant) compared to multiple applications (2,100 to 2,500 g/plant).

Tomatoes treated with either one or three applications of quinclorac at 4.2 g/ha resulted in a fresh weight of 5,000 g/plant by 9 WAT, which was greater than the fresh weight after two applications (3,900 g/plant). Quinclorac at 0.42 g/ha did not affect plant fresh weight compared to the untreated check.

Quinclorac residue in tomato tissue was initially 10,000 ppb in samples taken immediately after application when treated with 420 g/ha, and was 900 ppb by 4 WAT. Quinclorac concentrations were greater in tomatoes that received multiple applications of quinclorac over a single application. Concentrations spiked to approximately 1,000 and 100 ppb immediately after each application of quinclorac at 42 and 4.2 g/ha, respectively. Quinclorac residue could not be detected after 4 WAT in plants treated with 4.2 g/ha. Instrumentation could not detect levels of quinclorac in plants treated with 0.42 g/ha after initial quinclorac treatment.

Tomato fruit yield in untreated tomatoes was not different than tomatoes treated one or two times with quinclorac at 0.42 g/ha. Fruit yield ranged from 25 to 29 kg/10-m row when treated with quinclorac at 0.42 g/ha. As quinclorac rate increase, fruit yield decreased. Yield ranged from 10 to 12 kg/10-m row when treated with 4.2 kg/ha and 3 to 5 kg/10-m row when treated with 42 kg/ha. Tomato fruit yield was approximately 0.1 kg/10-m row when treated with quinclorac at 420 kg/ha.

USE OF REMOTE SENSING FOR QUANTIFICATION OF HERBICIDE INJURY. A.E. Stone, T.F. Peeper, J.B. Solie, and M.L. Stone. Oklahoma State University, Stillwater, OK, 74078.

ABSTRACT

On October 9, 1998, an experiment was begun to explore the potential of detecting and quantifying herbicide injury with the use of remote sensing. Hard red winter wheat cultivar ‘Jagger’ was planted into 5 x 25 foot plots with four replications. On November 11, 1998 six herbicide treatments were applied using a three nozzle boom and CO^2 backpack. Two, seven, fourteen, and twenty-one days after treatment reflectance was determined in six randomly chosen sites per plot. Reflectance was determined using a dual channel Ocean Optics 2000 spectrometer recording wavelengths from 200 to 1200 nm. From the sampled data, NDVI (normalized difference vegetation index) were calculated for each sampled site. NDVI is defined as reflectance at by 780nm minus 670nm divided by 780nm plus 670nm. This index estimates the extent to which chlorophyll in a given area is using red light. NDVI data was compared to visual estimates of crop injury. Herbicide injury could be detected with the spectrometer one week after treatments were applied. In addition, NDVI measurements differentiated among treatments better than visual ratings.

DEVELOPMENT OF 3-D ANIMATIONS AND VIRTUAL REALITY ENVIRONMENTS FOR TEACHING IN WEED SCIENCE AND AGRICULTURAL PEST MANAGEMENT. P.M. Sforza and K.K. Hatzios, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061-0331.

ABSTRACT

Three-dimensional (3-D) animations were developed as visual teaching aids for selected concepts in weed science and agricultural pest management. Visualization may enhance a viewer’s perception and retention of information presented. This may be particularly important in teaching scientific or technical material containing complex concepts and a highly specialized vocabulary. Models and animations were created on a desktop computer using 3D Studio Max software from Kinetix. Animations can be delivered to the student in various formats including streaming video and VRML (Virtual Reality Modeling Language). VRML is the standard for interactive 3-D objects on the internet. In addition, the CAVE™ (Cave Automated Virtual Environment) technology at Virginia Tech provides an immersive and interactive environment for visualization of virtual environments. An electromagnetic sensor updates the scene on rear-projected walls according to the position and actions of the user with various control devices including a wand controller, gloves, and LCD stereo glasses. Current and future advances in information technology provide unique opportunities for innovative teaching approaches in weed science and agricultural pest management.

WEED MANAGEMENT IN PEANUTS: A SUMMARY OF COMMERCIAL PRACTICES AND HERBICIDE USE. D.T. Smith, Department of Soil and Crop Sciences, Texas Agricultural Experiment Station, College Station, TX 77843-2474; and W.J. Grichar, Texas Agricultural Experiment Station, Yoakum, TX 77995.

ABSTRACT

A direct mail survey was conducted to document chemical and non-chemical weed control practices and decision-making processes of peanut growers in 1997. Over 21% of the peanut acreage in Texas was represented in the responses. Runner peanuts represented 70% of the production and 84% of the crop was grown under irrigation. Growers reported that 86% of the acreage was scouted for weeds, at an average cost (paid for scouting all pests) of $5.30 per acre. Most weed scouting was conducted by farmers (70%) and general crop advisors. Non-chemical control measures were practiced by all growers but these tillage and rotational practices were not considered to substitute for herbicidal control methods. Over 90% of the crop was cultivated for weeds (an average of 1.8 times per season), 78% of the acreage was

hand-hoed, and 36% of all peanuts were in a crop rotation to help reduce weed problems. Weeds most commonly mentioned were pigweed, nutsedge, morningglories, johnsongrass, silverleaf and black nightshades, and other annuals. “Previous weed problems” was the most commonly mentioned reason for using soil-applied herbicides. Economic thresholds were considered by many growers before making an application. Growers cited four primary factors in their selection of a particular herbicide: past experience with the herbicide (mentioned by 57% of the growers), chemical cost (cited by 48%), future plans in crop rotation (cited 40% of the time), and herbicide efficacy (cited 30% of the time). Over 96% of the crop was treated with one or more herbicides. PPI herbicide use predominated and was used on 83% of the peanut acreage. Pendimethalin made up one-half of this use and trifluralin was applied on another 20% of the acreage. Methlachlor was applied PE on 19% of the crop. POST treatments were applied on over 50% of the crop. The three most predominate POST herbicides (and percent of acreage treated) were: 2,4-DB (13%), imazapic (18%), and imazethapyr (11%). Seven others accounted for 10% of the POST market. We determined that 326,000 pounds of herbicide (38% of all pesticide use) were applied on the 314,000 acres of peanut grown in Texas in 1997. Growers applied 71% of all herbicides and 95% was applied by ground sprayers. One-half of the growers reported using a computer in their peanut farming operations, mostly for financial record keeping (44% of the users), Internet use for market or weather news (24%), and pesticide record keeping (21%). The study was conducted in cooperation with the Texas Peanut Producers Board and numerous Extension Specialists, for subsequent use by state and federal decision makers and chemical registrants and additional use by industry leaders to document their responsible chemical and non-chemical methods of pest control. Similar results on pesticide use in Oklahoma and New Mexico were documented in a three-state report provided to USDA, US EPA, and others. Several staff in the Benefits and Economic Assessment Bureau (BEAD) of US EPA indicated that they use these types of findings on insecticide and fungicide (not reported herein) and herbicide use in their assessments of pesticide use patterns and economic importance in implementing the 1996 Food Quality Protection Act.

CONTROL/ERADICATION ACTIVITIES ON SEVERAL INVASIVE FEDERAL NOXIOUS WEEDS IN THE SOUTHEAST. T.J. English, USDA, APHIS, PPQ, Oxford, NC and A.E. Miller, Conyers, GA; W.K. Glenn, DPI, Clemson University; and D.T. Patterson, NCDA, PID, Raleigh, NC.

ABSTRACT

APHIS, Animal Plant Health Inspection Service, has been cooperatively involved with several state entities in eliminating or containing infestations of several invasive Federal Noxious Weeds. These species include [*Striga asiatica* (L.) Kuntz] (witchweed), *Orobanche minor* Smith (small broomrape), *Solanum viarum* Dunal (tropical soda apple), *[Imperata cylindrica* (L.) Beauv.] (cogongrass), and *Salvinia molesta* (giant salvinia).

Since 1995, the Plant Industry Division of the North Carolina Department of Agriculture and the Department of Plant Industry of Clemson University have administered the witchweed eradication program in North and South Carolina with APHIS, PPQ (Plant Protection and Quarantine) funding. Continuous eradication progress is being achieved with scheduled treatments designed to eliminate reproduction and induce suicidal germination of witchweed seed. Two new developments this past season in the witchweed program included the modification of an applicator that would provide a means of injecting ethylene gas in no-till small grain stubble, and finding a first year treatment (sethoxydim) to control witchweed host grasses in Paulownia. At the end of 1999, this project has eliminated witchweed (released from quarantine) from 430,314 (98.5%) of the 436,673 acres once infested.

Eradication activities are being conducted on tropical soda apple (TSA) sites in GA, NC, and SC through cooperative efforts. Control activities include everything from roguing to the application of systemic herbicides triclopyr or picloram + 2,4-D. In GA and SC tropical soda apple has been eliminated from of 13 sites. To aid in the elimination of TSA, GA and SC passed special regulations. In GA these regulations are entitled “Tropical Soda Apple Rules”, SC regulations are entitled “Tropical Soda Apple Quarantine”. Both regulations basically regulate infested property and commodities, prescribe treatments for infested property and articles, provide for compliance agreements with land owners, and define penalties for regulation violations.

In GA, cogongrass has been detected at five sites (in five different counties) since 1995. The types of infested sites included highway right-of-ways, abandoned produce stands and ornamental nurseries. Control efforts usually required three treatments of glyphosate per season and were applied either by the Department of Transportation, City Government, or PPQ. Control activities have resulted in the eradication of cogongrass from Brantly County and probably from at least two additional counties. The last remaining task is the reclamation of cogongrass lawns in Bainbridge, GA.

APHIS has participated in arresting small broomrape reproduction on infestations in GA, SC and VA. This has been accomplished by utilizing the appropriate labeled herbicide(s) preemergence to broomrape over-top of host plants (usually native weeds) on every infested site. Herbicides that have been identified as providing complete broomrape control include 2,4-D amine, dicamba, triclopyr, glyphosate, clopyralid, and sulfosate applied individually and as mixtures. Broomrape infested sites include pecan orchards, turf, ornamentals, idle fields, field borders, pastures, and highway right-of-ways. Goal of the control activity especially in GA is to prevent the expansion and movement of broomrape into central and northern sections of the state where forage legumes and other host crops are more common.

APHIS participated in the eradication of giant salvinia from a 0.5 ha private pond in Colleton County, SC during 1995. Since then surveys by PPQ and stakeholders have located Salvinia in botanical gardens, aquatic nurseries and other ponds in several states of the PPQ Eastern Region. Mechanical removal, treatments and cooperative agreements are being utilized to mitigate the survival and spread of this invasive weed. Infestations have most recently been detected in ponds in Gwinett and Lamar Counties, GA and were immediately treated by the GA Department of Natural Resources.

Progress toward eliminating Federal Noxious Weeds from threatened areas is being made on these and several other species that can not be covered due to time limitations. Successes are being achieved in spite of resource limitations through the collaboration of stakeholders.

VALOR™ HERBICIDE: A NEW HERBICIDE FOR WEED CONTROL IN COTTON, PEANUTS, SOYBEANS, AND SUGARCANE. J.R. Cranmer, Valent USA Corporation, Cary, NC; J.V. Altom, Valent USA Corporation, Gainesville, FL; J.C. Braun, Valent USA Corporation, Richardson, TX; and J.A. Pawlak, Valent USA Corporation, Lansing, MI.

ABSTRACT

VALOR™ Herbicide (flumioxazin), formerly known as V-53482, is a new herbicide being developed by Valent USA Corporation for broadleaf weed control in cotton, peanuts, soybeans, and sugarcane. Flumioxazin is a N-phenylphthalimide derivative, which is a new chemistry for cotton, peanuts, and sugarcane. The mode of action of this family is inhibition of protoporphyrinogen oxidase (PPO). Porphyrins accumulate in susceptible plants causing photosensitization, which leads to membrane lipid peroxidation. The peroxidation of membrane lipids leads to irreversible damage of membrane function and structure in susceptible plants.

VALOR is applied preemergence for control of susceptible weeds in peanuts, soybeans, and sugarcane. VALOR also provides postemergence control of susceptible weeds in sugarcane when applied post-directed or as a layby and in cotton when applied with hooded or shielded sprayers or as a layby.

VALOR degrades rapidly in water and soil. Dissipation occurs by a combination of hydrolysis and microbial oxidation. Although VALOR dissipates rapidly, discrete intermediates do not accumulate and the ultimate environmental products are incorporation into soil organic matter and carbon dioxide. Based on column leaching studies and the short aerobic soil half-life (11.9 to 17.5 days), the potential for VALOR or its degradation products to leach in field agricultural soils is low. The low use rate and rapid soil dissipation results in low carryover potential to rotational crops including field and sweet corn, cotton, rice, sorghum, sunflowers, tobacco, and small grains.

VALOR applied preemergence provides control of many important weeds, including common lambsquarters (*Chenopodium album* L.), eclipta [*Eclipta alba* (L.) Hassk.], Florida pusley (*Richardia scabra* L.), black nightshade (*Solanum nigrum* L.), eastern black nightshade (*Solanum ptycanthum* Dun.), carpetweed (*Mollugo verticillata* L.), Palmer amaranth (*Amaranthus palmeri* S. Wats), redroot pigweed (*Amaranthus retroflexus* L.), smooth pigweed (*Amaranthus hybridus* L.), spiny amaranth (*Amaranthus spinosus* L.), tumble pigweed (*Amaranthus albus* L.), prickly sida (*Sida spinosa* L.), spotted spurge (*Euphorbia maculata* L.), Florida beggarweed [*Desmodium tortuosum* (Sw.) DC.], hairy indigo (*Indigofera hirsuta* Harvey), smallflower morningglory [*Jacquemontia tamnifolia* (L.) Griseb], common purslane (*Portulaca oleracea* L.), Venice mallow (*Hibiscus trionum* L.), coffee senna (*Cassia occidentalis* L.), common ragweed (*Ambrosia artemisiifolia* L.), hemp sesbania [*Sesbania exaltata* (Raf.) Rydb. ex A. W. Hill], jimsonweed (*Datura stramonium* L.), ivyleaf morningglory [*Ipomoea herderacea* (L.) Jacq.], tall morningglory [*Ipomoea purpurea* (L.) Roth], entireleaf morningglory (*Ipomoea herderacea* var. *integriuscula* Gray), tropic croton (*Croton glandulosus* var. septentrionalis Muell.-Arg.), common waterhemp (*Amaranthus rudis* Sauer), tall waterhemp [*Amaranthus tuberculatus* (Moq.) J. D. Sauer], velvetleaf (*Abutilon theophrasti* Medicus), and wild poinsettia (*Euphorbia heterophylla* L.). VALOR applied postemergence provides control of all previously mentioned weeds plus field bindweed (*Convolvulus arvensis* L.), common chickweed [*Stellaria media* (L.) Vill.], common cocklebur (*Xanthium strumarium* L.), giant ragweed (*Ambrosia trifida* L.), ladysthumb (*Polygonum persicaria* L.), Pennsylvania smartweed (*Polygonum pensylvanicum* L.), pitted morningglory (*Ipomoea lacunosa* L.), purple nutsedge (*Cyperus rotundus* L.), red morningglory (*Ipomoea coccinea* L.), rice flatsedge (*Cyperus iria* L.), sicklepod (*Cassia obtusifolia* L.), and yellow nutsedge (*Cyperus esculentus* L.). Based on field evaluations to date, VALOR will be an excellent new tool for weed control in soybeans, peanuts, cotton, and sugarbeets once registered.

VALOR™ HERBICIDE: A NEW PREEMERGENCE HERBICIDE IN PEANUTS. J.C. Braun, J.R. Cranmer, J.V. Altom; Valent USA Corporation, Richardson, TX; Cary, NC; Gainesville, FL.

ABSTRACT

VALOR™ä HERBICIDE (flumioxazin) is a new low rate herbicide being developed by Valent USA Corp. for broadleaf weed control in peanuts. VALOR, a PPO inhibitor, offers a different mode of action from other commonly used peanut herbicides that will help in resistance management and crop rotation. Preemerge applications of VALOR provide control of many tough to control weeds across the peanut growing areas of the U.S., like golden crownbeard (*Verbesina*

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VALOR™ HERBICIDE: A NEW HERBICIDE FOR WEED CONTROL IN COTTON, PEANUTS, SOYBEANS, AND SUGARCANE. J.R. Cranmer, Valent USA Corporation, Cary, NC; J.V. Altom, Valent USA Corporation, Gainesville, FL; J.C. Braun, Valent USA Corporation, Richardson, TX; and J.A. Pawlak, Valent USA Corporation, Lansing, MI.

ABSTRACT

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VALOR™ HERBICIDE: A NEW PREEMERGENCE HERBICIDE IN PEANUTS. J.C. Braun, J.R. Cranmer, J.V. Altom; Valent USA Corporation, Richardson, TX; Cary, NC; Gainesville, FL.

ABSTRACT

VALOR™ä HERBICIDE (flumioxazin) is a new low rate herbicide being developed by Valent USA Corp. for broadleaf weed control in peanuts. VALOR, a PPO inhibitor, offers a different mode of action from other commonly used peanut herbicides that will help in resistance management and crop rotation. Preemerge applications of VALOR provide control of many tough to control weeds across the peanut growing areas of the U.S., like golden crownbeard (*Verbesina*

encelioides), hophornbean copperleaf (*Acalypha ostryaefolia* Ridd.), eclipta (*Eclipta prostrata*), Florida beggarweed (*Desmodium tortuosum*), pigweeds (*Amaranthus* sp.), and morningglories (*Ipomea* sp.). Growers will benefit from VALOR's rotational flexibility that will allow them to follow peanuts with cotton and/or corn and other grains which is not possible with other commonly used products. VALOR has shown good crop safety across the peanut growing areas and is expected to be available for sale for the 2001 growing season.

VALOR™ HERBICIDE – THE NEW STANDARD FOR LAYBY APPLICATIONS IN COTTON. J.V. Altom, J. R. Cranmer, and J.A. Pawlak, Valent USA Corporation, Gainesville, FL, Cary, NC, and Lansing, MI.

ABSTRACT

Valor™ Herbicide, with the active ingredient flumioxazin, is a low use rate herbicide being developed by Valent USA Corporation in peanuts, soybeans, sugarcane, cotton, grapes, and almonds. Flumioxazin is an N-phenylphthalimide herbicide. The mode of action is inhibition of protoporphyrinogen oxidase, which leads to a disruption of the cell membrane. Flumioxazin rapidly degrades in water and soil, therefore leaching potential to groundwater is low and carryover potential to rotational crops is minimal. Because some weed species have developed resistance to several classes of herbicides, VALOR will offer growers a resistance management tool by controlling a broad spectrum of weeds, including ALS and triazine resistant weeds. VALOR also has demonstrated excellent soil and foliar activity.

Research over the past couple of years has demonstrated an excellent biological fit for VALOR as a late season post-directed or layby application in cotton. With the uncertainty of cyanazine, weed scientists have been searching for alternatives to use for late season weed management in cotton. VALOR appears to be a herbicide to meet the requirements for late season weed control in cotton due to consistent postemergent weed control along with residual activity.

Crop injury is a major concern when applying post-directed or layby herbicides. VALOR has demonstrated excellent crop safety when applied to cotton at least 12 inches in height and applied on the bark layer. A misapplication of VALOR (i.e. broadcast over-the-top, small cotton with green stems, or eight inches up on a ten inch cotton plant) can cause severe cotton injury. Therefore, timing and correct method of application is critical.

VALOR applied at 2 oz. pr./A (0.063 lbai/A) tankmixed with Roundup Ultra or MSMA has proven to be an excellent broad spectrum treatment controlling grasses, nutsedges, and broadleaves. These tankmixes are equal to and usually superior to the cyanazine + MSMA tankmix. A brief list of some broadleaf weeds that are controlled include: sicklepod, morningglory species, pigweed species, hophornbeam copperleaf, smellmelon, cutleaf groundcherry, purple moonflower, common ragweed, common lambsquarters, black nightshade, Florida pusley, prickly sida, spotted spurge, wild poinsettia, common cocklebur, Florida beggarweed, tropic croton, devil's claw, spurred anoda, wrights groundcherry, velvetleaf, and hemp sesbania. Some of the grasses controlled include: johnsongrass, bermudagrass, browntop millet, large crabgrass, broadleaf signalgrass, goosegrass, smooth crabgrass, and Texas panicum. Both yellow and purple nutsedge are effectively controlled.

Therefore, the tankmixes with Roundup Ultra or MSMA offer broad spectrum weed control and residual activity on a number of key weeds in cotton. VALOR + Roundup Ultra or MSMA effectively controls most of the weeds that are listed as the most common and most troublesome weeds in cotton as published in the 1998 Proceedings, Southern Weed Science Society. Because of the quick weed control, effectiveness on a number of key weeds, excellent crop rotational profile, low use rate, and effective residual control, VALOR will offer cotton growers a valuable tool to manage late season weeds.

VALOR™:-A NEW WEED MANAGEMENT OPTION FOR COTTON. J.W. Wilcut, S.D. Askew, A.J. Price, G.H. Scott, and J. Cranmer. Crop Science Department, North Carolina State University, Raleigh, NC 27695-7620, and Valent USA Corporation, Cary, NC 27511.

ABSTRACT

Research was conducted from 1996 through 1999 to evaluate flumioxazin, proposed tradename Valor, for use as a preplant herbicide in stale seedbed cotton and for use post-directed early season (PDS) on 6 inch tall cotton or late season as a LAYBY post-directed treatment on cotton at least 12 inches tall.

In post-directed research at two locations with Suregrow 125 and Deltapine 51 cotton, Valor at 0.063 lb or 0.094 lb ai/ac alone or tank mixed with MSMA at 2.0 lb ai/ac did not injure cotton any more (5% or less) than Cotoran plus MSMA on 6 inch tall (PDS) cotton or Bladex plus MSMA on 12 inch cotton (LAYBY). All Valor treatments were applied with a nonionic surfactant (NIS) at 0.25% (v/v). Herbicide treatments did not influence the yields of cotton grown in a weed free environment. In weed management studies, Valor provided excellent burndown and good residual control of common lambsquarters (*Chenopodium album*), common ragweed (*Ambrosia artemisifolia*), annual *Ipomoea* morningglories, redroot pigweed (*Amaranthus retroflexus*), smooth pigweed (*Amarnthus hybridus*), and Palmer amaranth (*Amaranthus palmeri*).

Cotton injury is more likely to occur with use of a crop oil concentrate than with a NIS when Valor is applied PDS or LAYBY. Severe cotton injury has been seen in the field where heavy rainfall immediately after application resulted in treated sandy loam soil bouncing up (bounced up 6 inches on the cotton plants) and coming into contact with cotton foliage. Further research was conducted applying Valor at LAYBY (12 to 14 inches tall) immediately before and after irrigation (1 inch with a lateral move irrigation system) and in conditions of high temperature and humidity. The lack of cotton injury in this trial would appear to indicate that Valor does not volatilize or co-distillate. Cotton tolerance to Valor at LAYBY with a NIS is excellent provided Valor application is restricted to the bark.

Preliminary research investigating the absorption and translocation of C_{14}-Valor in cotton has been initiated. The C_{14}-Valor was applied with a NIS (Induce) at 0.25% (v/v). Averaged over 3, 24, 48, and 72 hours after treatment (HAT) on 4L and 8Lcotton; 46% and 53% of the applied C_{14} Valor was recovered in the leaf wash, respectively. Averaged over harvest times, 42%, 3%, 2%, 3%, and 4% of the applied C_{14}-Valorwas found in the treated stem (area immediately above the soil level extending approximately 2 inches up the stem, not woody tissue), the rest of the stem, roots, fully expanded leaves, and emerging leaves and other tissues and plant organs of the apical meristem of 4L cotton, respectively. For 8L cotton averaged over all harvest intervals, 37%, 4%, 4%, 6%, and 2% of the applied C_{14}-Valor was recovered in the treated stem area (very little woody tissue), the rest of the stem, roots, fully expanded leaves, and emerging leaves and other tissues and plant organs of the apical meristem, respectively. Plant samples for 12L cotton have not been oxidized at the time of this report. Application of C_{14}-Valorto nonwoody stem tissue did result in significant stem tissue damage. Metabolism experiments have been initiated.

ZA1296 USE IN CORN WEED CONTROL SYSTEMS. S.M. Schraer, K.D. Melton, J.D. Smith, and B.D. Black. Zeneca Ag Products, Richmond, CA.

ABSTRACT

ZA1296 (2-[4-methylsulfonyl-2-nitrobenzoyl]-1,3-cyclohexanedione) is a new herbicide being developed by ZENECA Ag Products for broadleaf weed control in corn (*Zea mays* L.). The proposed common name for ZA1296 is mesotrione. ZA1296 formulations under development include a 4.0 lb ai/gal soluble concentrate for postemergence broadleaf weed control and a 3.5 lb ai/gal premix of ZA1296 and acetochlor (1:11) for preemergence weed control. Use rates for the ZA1296 and the ZA1296/acetochlor premix are 0.063-0.125 and 1.75-2.40 lb ai/A, respectively.

The ZA1296/acetochlor premix has been evaluated for several years in conventional, reduced tillage, and no-till fields with excellent results. ZA1296/acetochlor provides broad spectrum control of many important weeds, including velvetleaf (*Abutilon theophrasti* Medicus), pigweeds and waterhemps (*Amaranthus* sp.), common lambsquarters (*Chenopodium album* L.), common ragweed (*Ambrosia artemisiifolia* L.), jimsonweed (*Datura stramonium* L.), nightshade (*Solanum* sp.), smartweed (*Polygonum* sp.), giant foxtail (*Setaria faberi* Herrm.), green foxtail [*Setaria viridis* (L.)Beauv.], yellow foxtail [*Setaria glauca* (L.)Beauv.], barnyardgrass [*Echinochloa crus-galli* (L.)Beauv.], large crabgrass [*Digitaria sanguinalis* (L.)Scop.], fall panicum (*Panicum dichotomiflorum* Michx.), and several other species. Corn exhibits excellent tolerance to the ZA1296/acetochlor premix.

ZA1296 has been extensively tested alone and with other postemergence corn herbicides. For optimum herbicide performance, the addition of crop oil concentrate, alone or with UAN fertilizer, is recommended. ZA1296 controls velvetleaf, common cocklebur (*Xanthium strumarium* L.), pigweeds and waterhemps, common lambsquarters, jimsonweed, nightshade, smartweed, and several other common broadleaf weeds. The addition of a very low rate (0.25 lb ai/A) atrazine is an excellent tank-mix partner for ZA1296 on species such as common ragweed and morningglories (*Ipomoea* sp.) that are difficult to control with ZA1296 alone. Broad spectrum grass and broadleaf weed control can be attained by preemergence applications of acetochlor or other grass herbicides followed by ZA1296 applied postemergence, or by a postemergence tank-mix of ZA1296 with a postemergence grass herbicide. Corn has exhibited excellent tolerance to postemergence applications of ZA1296.

FLUFENACET & METRIBUZIN & ATRAZINE: A NEW BROAD SPECTRUM SOIL-APPLIED HERBICIDE FOR CORN. A.T. Palrang, W.D. Rogers, J.A. Hopkins, F.S. Donaldson, J.E. Cagle, L.K. Almand, A.C. Scoggan, R.D. Rudolph, and J.R. Bloomberg. Bayer Corporation, Kansas City, MO 64120.

ABSTRACT

FLUFENACET & Metribuzin & Atrazine is a new combination herbicide that Bayer Corporation is developing for corn. It is composed of three active ingredients, flufenacet, metribuzin and atrazine. Flufenacet is from the newer class of chemistry called the oxyacetamides, and has been developed by Bayer under the code name FOE 5043. Metribuzin is the active ingredient in the herbicide Sencor. This new combination product contains 19.6% flufenacet, 4.9% metribuzin and 5.5% atrazine, and is formulated as a 75% dry flowable. The trade name will be AXIOM ATÔ.

AXIOM ATÔ will offer broad-spectrum control of annual grasses and dicots. It will have flexible application timing and tank mix recommendations. It can be applied early pre-plant, pre-plant surface, pre-plant incorporated, or pre-emergence. AXIOM ATÔ will control ALS resistant weeds and will offer burndown weed control. AXIOM ATÔ is

compatible with a broad range of tillage systems, from conventional to no-till, and has demonstrated season-long soil residual activity for most of the weeds on its label. The acute toxicity values for AXIOM ATÔ are relatively safe and it will carry a CAUTION signal word in the label. AXIOM ATÔ has two distinct modes of action; flufenacet is a protein synthesis inhibitor, while metribuzin and atrazine are photosynthesis inhibitors. This will be an important Resistance Management feature of AXIOM ATÔ.

Efficacy on broadleaf signalgrass, barnyardgrass, large crabgrass, giant foxtail, green foxtail, yellow foxtail, and fall panicum has been very good to excellent with AXIOM ATÔ at rates between 1.3-3.0 kg A.I./H. Activity against Texas panicum has been good to very good, depending on geographic region. AXIOM ATÔ also has activity against a wide range of dicot species, including velvetleaf, pigweeds, tall waterhemp, common sunflower, common ragweed, lambsquarters, morningglorys, smartweeds, and common cocklebur. The efficacy of AXIOM ATÔ against these weed species has been comparable to, or better than, that of metolachlor & atrazine or acetochlor & atrazine in direct (within) trial comparisons. Corn tolerance to AXIOM ATÔ has been very good over a wide range of soil types and moisture conditions.

FLUFENACET & METRIBUZIN—EARLY SEASON WEED CONTROL IN SOYBEANS. L.K. Almand, J.A. Hopkins, D.M. Hunt, F.S. Donaldson, W.D. Rogers, D.A. Komm, R.D. Rudolph and J.R. Bloomberg, Bayer Corporation, Kansas City, MO.

ABSTRACT

Domain is a new broad spectrum herbicide from Bayer Corporation for control of early season grass and broadleaf weeds in a planned post emergence program for soybeans. Domain consists of a 1:1.5 ratio of flufenacet and metribuzin in a 60DF formulation. A broad spectrum preemergence application in front of a planned post application has the advantages of reducing/eliminating early weed competition, there are fewer weed numbers at the time of the post application, there is better spray coverage of the weeds post, better weed size uniformity, the post application can oftentimes be delayed and there is better flexibility in the post application window. Data are presented on the control of AMASS, BRAPP, CASSS, DIGSA, ECHCG, IPOSS, SIDSP, SEBEX AND XANST. The use rate is 0.38-0.67 kg ai/ha. Label information listing the weeds controlled is shown. Commercial launch is in 2000.

RYGRASS CONTROL IN WINTER WHEAT WITH FLUFENACET & METRIBUZIN. J.A. Hopkins, J.E. Cagle, A.T. Palrang, L.K. Almand, D.M. Hunt, F.S. Donaldson, and H.J. Santel. Bayer Corporation, Kansas City, MO 64120.

ABSTRACT

AXIOMÔ 68 DF is a product containing 54.4% flufenacet & 13.6% metribuzin. AXIOM was registered for use in soybean and field corn in 1998. Bayer Corporation has continued the development of AXIOM for control of ryegrass (*Lolium* species) and other important weed species in winter wheat. Registration of AXIOM in winter wheat is pending with the U.S. Environmental Protection Agency.

When left uncontrolled, ryegrass can result in significant yield loss in winter wheat. The concern for effective ryegrass control in the U.S. has increased with the discovery of herbicide-resistant ryegrass biotypes. Resistance of Italian ryegrass (LOLMU) to diclofop-ethyl (HoelonÒ) was first reported in the U.S. in 1987. Hoelon-resistant biotypes have since been discovered in other states including several in the southern U.S.

AXIOM has been tested across the U.S. for control of several weeds of winter wheat including Hoelon-susceptible and Hoelon-resistant ryegrass. Based on the results of these studies, Bayer Corporation has proposed to register AXIOM for use on winter wheat for control of ryegrass and several other important grass and broadleaf weeds. Data reported from 27 trials conducted by university, and Bayer Corporation researchers from 1994 to 1999 have been summarized and reported herein.

Winter wheat has demonstrated good to excellent crop tolerance in efficacy trials and in trials designed to evaluate tolerance across several wheat cultivars. Data from fifteen efficacy trials where preemergence or delayed preemergence applications were evaluated indicate an average of 8% phytotoxicity at 4- to 6- weeks after application. However, it is important to note that AXIOM resulted in excessive wheat injury in only two of the fifteen trials, both of which were on soils with high sand content. Other observations, indicate the risk of injury increases with preemergence applications, especially if significant rainfall occurs following application. Therefore, Bayer Corporation has decided not to pursue preemergence applications in winter wheat and will also not recommend use on sandy soils. AXIOM applied early postemergence, while winter wheat is in the spiking to 3-leaf stage affords the best timing to avoid wheat injury. This timing also allows applications to target ryegrass preemergence to the 1-leaf stage which is the optimum timing for AXIOM performance.

AXIOM applied early postemergence in winter wheat provides good to excellent control of ryegrass. Where AXIOM was compared to Hoelon for control of Hoelon-susceptible ryegrass, similar control (81 to 83%, respectively) was

observed at the final spring evaluation. As expected, AXIOM was much more effective than Hoelon on ryegrass biotypes resistant to Hoelon.

SULFENTRAZONE PERFORMANCE IN PEANUTS. H.G. Hancock, FMC AgProducts Group, Hamilton, GA 31811.

ABSTRACT

Field testing of sulfentrazone (F6285), a PPO inhibitor in the aryltriazolinone family, continues in peanuts (*Arachis hypogaea* L.). In the generally coarse, low organic matter soils of peanuts, a strategy of reducing sulfentrazone soil application rates was further defined in 1999. The current research definitively established a highly efficacious range of 0.05 to 0.25 lb ai/a against the majority of broadleaf weeds affecting peanuts in the southeast and southwest.

Two principal protocols were established in 1999 in university and in-house field programs. The first examined soil applications (PPI or PRE) of sulfentrazone alone at rates of 0.05, 0.1, 0.15, 0.2 and 0.25 lb ai/a. The second protocol evaluated sulfentrazone, at the same rates and application methods, in combination with pendimethalin, ethalfluralin, or metolachlor. These same combinations were also followed with post-emergent applications of chlorimuron, 2,4 DB, or paraquat to simulate typical ‘peanut herbicide programs’. All protocols included comparisons to imazapic (0.063 lb ai/a, POST), flumioxazin (0.079 lb ai/a, PRE) and diclosulam (0.023 lb ai/a, PPI).

Control of *Amaranthus* spp. was excellent (85 to 100%) with rates as low as 0.1 lb ai/a for redroot pigweed (*A. retroflexus* L.), spleen amaranth (*A. rudis* L.), palmer amaranth (*A. palmeri* S. Wats.), and waterhemp (*A. rudis* L.). Efficacy among the morningglories was excellent (88 to 100%) over the range of 0.1 to 0.15 lb ai/a for ivyleaf (*Ipomoea hederacea* (L.) Jacq.), entireleaf (*I. hederacea* var. *integriuscaula*), pitted (*I. lacunosa* L.) and *scarlet (I. coccinea* L.) morningglories. Florida beggarweed (*Desmodium tortuosum* (Swartz) DC), prickly sida (*Sida spinosa* L.), cocklebur (*Xanthium strumarium* L.) and yellow nutsedge (*Cyperus esculentus* L.) were controlled (85 to 99%) with a minimum rate of 0.25 lb ai/a. Excellent (88 to 100%) control of common lambsquarters (*Chenopodium album* L.), tropic croton (*Croton glandulosus* var. *septentrionalis* Muell. Arg.), eclipta (*Eclipta prostrata* L.), prostrate spurge (*Euphorbia humistrata* L.), golden crownbeard (*Verbesina encelioides* (Cav.) Benth. & Hook f. ex. Gray) and hophornbeam copperleaf (*Acalypha ostryifolia* Riddell) was observed with rates of 0.05 to 0.15 lb ai/a.

These results, combined with excellent yield response, will allow sulfentrazone use in peanuts predicated on weed spectrum. The flexibility in soil application methods will also allow growers to adapt sulfentrazone use to their cultural practice.

UTILIZATION OF CLOMAZONE AND SULFENTRAZONE IN SUGARCANE. H.R. Mitchell, FMC Corporation. Louisville, MS.

ABSTRACT

Clomazone and sulfentrazone have been evaluated as potential new herbicides in sugarcane for several years. Clomazone has demonstrated excellent control of several important grass weed of sugarcane including itchgrass, broadleaf signalgrass, johnsongrass, Texas panicum and crab grass species. Sulfentrazone has shown to provide good control of several broadleaf weeds of sugarcane including morningglory species, palmer amaranth and yellow nutsedge as well as annual grass suppression.

During 1998 and 1999, several replicated field trials were conducted in sugarcane by both university researchers and FMC personnel. Clomazone at 1.25 lb ai/A and sulfentrazone at 0.375 lb ai/A were applied alone and in combination and evaluated against clomazone at 1.25 lb ai/A plus atrazine at 2.0 lb ai/A, metribuzin at 1.0 lb ai/A, and diuron at 2.0 lb ai/A. Applications were made either early post to sugarcane 10 to 20 inches tall and prior to weed emergence or as a lay-by.

Clomazone applied early post at 1.25 lb ai/A resulted in 23-30 % chlorosis at 20 days after treatment. However, by 40 days after treatment, chlorosis was less than 10% indicating rapid recovery of sugarcane to initial clomazone symptoms. No significant stand reduction or stunting between treatments and the untreated check were observed. Less chlorosis occurred to sugarcane when clomazone was applied as a lay-by than early post. Clomazone applied at 1.25 lb ai/A lay-by resulted in 10-15% chlorosis at 15 days after treatment and dropped to less than 8% by 30 days after treatment with no stand reduction or stunting observed. Sulfentrazone applied either early post or as a lay-by at 0.375 lb ai/A resulted in less than 10% discoloration (necrosis) at 15-20 days after treatment and 6% discoloration at 30-40 days after treatment again with not significant stand reduction or stunting observed.

Clomazone provided excellent control (88-95%) of itchgrass (*Rottboellia exaltata*), broadleaf signalgrass (*Brachiaria phatyphylla*), Texas panicum (*Panicum texanum*) and johnsongrass (*Sorghum halapense*) at approximately 50 to 60 days after treatment. Clomazone also provided suppression (59-68%) of pitted morningglory (*Ipomoea lacunosa*), scarlet morningglory (*Ipomoea coccinea*), palmer amaranth (*Amaranthus palmeri*) and cutleaf eveningprimrose (*Oenothera*

laciniata). Sulfentrazone provided control (86-98%) of pitted and scarlet morningglory, palmer amaranth and cutleaf eveningprimrose and suppression (53-85%) of itchgrass, broadleaf signalgrass, Texas panicum and johnsongrass at 50-60 days after treatment. Sulfentrazone also demonstrated yellow nutsedge (*Cyperus esculentus*) control in the range of 77-83% at the same evaluation timing. The tank-mix of clomazone + sulfentrazone at 1.25 + 0.375 lb ai/A, respectively, increased control of both grass and broadleaf weeds evaluated by 5-10% over either herbicide alone.

These data support acceptable sugarcane tolerance to both clomazone and sulfentrazone when applied early post or lay-by. Clomazone continues to show promise as an effective grass herbicide with some broadleaf activity. Sulfentrazone shows promise as an effective broadleaf herbicide with some grass activity. Further, field trials indicate tank mixtures of clomazone and sulfentrazone will provide excellent control of the major grass and broadleaf weeds in sugarcane and an excellent fit in a total sugarcane herbicide program.

CGA-362622: A NEW HERBICIDE FOR WEED CONTROL IN SUGARCANE. E.K. Rawls, J.W. Wells, M. Hudetz, R. Jain, and M.F. Ulloa, Novartis Crop Protection, Vero Beach, FL., Greensboro NC., Basle, Switzerland and Sugar Farms Cooperative, Loxahatchee, FL.

ABSTRACT

CGA-362622 [N-(4,6-Dimethoxy-2-pyrimidinyl)carbamoyl)-3-(2,2,2-trifluoroethoxy)-pyridin-2-sulfonamide sodium salt]is a new broad-spectrum, post-emergence herbicide that Novartis Crop Protection is developing for use in sugarcane and cotton. It has been field tested as a 75% water dispersible granule for the past several years in North America, South America, Africa, and Asia under the code name CGA-362622. The proposed common name is trifloxysulfuron sodium.

CGA-362622 will offer control of dicotyledonous and monocotyledonous weeds and sedges. It is highly active on several important weeds in sugarcane, including yellow nutsedge (*Cyperus esculentus*), purple nutsedge (*Cyperus rotundus*), pigweed species (*Amaranthus* spp.), horse purslane (*Trianthema portulacastrum*), morningglory species (*Ipomea* spp.), cocklebur (*Xanthium* sp.), spurges (*Euphorbia* spp.), alexandergrass and signalgrass species (*Brachiaria* spp.), and panicum species (*Panicum* spp.). In sugarcane (plant and ratoon cane) up to 30 g ai/ha of CGA-362622 can be applied Post-over-the-top, depending on location and clutivar without negative effects on crop tolerance. For optimum post-emergence activity, the addition of NIS is recommended at 0.25% v/v. The very low use rate of 15 to 30 g ai/ha together with its favorable toxicological, ecotoxicological and environmental properties make CGA-362622 an excellent tool for sugarcane farmers. CGA-362622 is readily absorbed by shoots and roots and is readily translocated in weeds. Susceptible weeds are inhibited following an application of CGA-362622 with complete death occurring within 1 to 2 weeks after application.

CGA-362622 is compatible with other herbicides including AAtrex and Evik. The combination of CGA-362622 and AAtrex can be used to increase the weed spectrum and length of control. CGA-362622 can be applied in combination with Evik, post-directed only, to increase speed of activity and weed spectrum, especially the grasses. Crop tolerance to Post applied CGA-362622 is generally excellent, but there is some variation in tolerance among varieties.

CGA 362622, A NEW LOW RATE NOVARTIS POST-EMERGENT HERBICIDE FOR COTTON AND SUGARCANE. M. Hudetz, W. Foery, Novartis Crop Protection AG, CH-4002 Basel; J. Wells, Novartis Crop Protection, Inc. Greensboro USA; J. E. Soares, Novartis Biociencias S.A. Brazil.

ABSTRACT

CGA 362622 is a new Novartis sulfonylurea herbicide for post-emergence over the top weed control in cotton and sugarcane. It controls a wide spectrum of important dicotyledonous, monocotyledonous weeds and sedges. The product is formulated as a water dispersible granule, containing 75% active ingredient. The use rates of CGA 362622 are extremely low and vary between 5 - 15 g ai/ha in cotton and 15-50 g ai/ha in sugarcane. CGA 362622 has a favorable environmental and toxicological profile and crop rotation flexibility.

INTRODUCTION

Purple nutsedge (*Cyperus rotundus*), an economically important perennial weed, is classified as the world's worst weed due to its distribution and competitiveness (1). A 1995 US weed survey on the 10 most troublesome cotton weeds of increasing importance (2) includes Morningglories (*Ipomoea spp.*), Nutsedges (*Cyperus spp.*), Pigweeds (*Amaranthus spp.*), Common Cocklebur (*Xanthium strumarium*), Sicklepod (*Senna obtusifolia*), Spurges (*Euphorbia spp.*) and Johnsongrass (*Sorghum halpense*).
CGA 362622 is a new post-emergent sulfonylurea herbicide for use in cotton and sugarcane discovered and being developed by Novartis Crop Protection AG. This new herbicide provides broad spectrum weed control including important weeds in these crops as mentioned above. It's very low use rate together with favorable toxicological, ecotoxicological and environmental properties make CGA 362622 an excellent tool for cotton and sugarcane farmers.

CHEMICAL AND PHYSICAL PROPERTIES

Structure:

Common Name: trifloxysulfuron sodium(ISO proposed)

Chemical Name:	N-[4,6-Dimethoxy-2-pyrimidinyl)carbamoyl]-3-(2,2,2-trifluoroethoxy)-pyridin-2-sulfonamide sodium salt
Empirical Formula:	$C_{14}H_{13}F_3N_5O_6SNa$
Molecular Weight:	459.34
Appearance:	solid, colorless, odorless
Melting Point:	173-175/C
Dissociation:	pKa 4.81
Water Solubility at 25/C:	pH 5 63 mg/l pH 7 5016 mg/l

Octanol/Water Partition Coefficient (logP): logP = 1.4 (pH5)
logP = -0.43 (pH7)

Vapor Pressure at 25/C: $< 1 \times 10^{-7}$ Pa.

FORMULATION

CGA 362622 is formulated as a water dispersible granule (WG) containing 750 g/kg of the active ingredient.

TOXICOLOGICAL AND ENVIRONMENTAL SAFETY

Acute oral LD_{50} (rat)	> 5000 mg/kg bw
Acute dermal LD_{50} (rat)	> 2000 mg/kg bw
Acute inhalation LD_{50} (rat)	> 5.03 mg/l
Non irritant to the skin	(93/21 EEC)
Non irritant to the eye	(93/21 EEC)

Non sensitizing
Non mutagenic
Non teratogenic
Repeated dose studies show that all species tested tolerate high levels of CGA 362622 for prolonged periods of time with few signs of toxicity.

Ecotoxicology

Fish (96h):	$LC_{50} > 103$ mg/l
Daphnia (48h):	$EC_{50} > 108$ mg/l
Eastern Oyster (96h):	$EC_{50} > 103$ mg/l
Mysid Shrimp (96h):	$LC_{50} = 60$ mg/l
Bobwhite Quail:	$LD_{50} > 2000$ mg/kg bw
Mallard Duck:	$LD_{50} > 2000$ mg/kg bw
Earthworm:	$LC_{50} > 1000$ mg/kg soil

FATE IN THE ENVIRONMENT

CGA 362622 degrades in soil mainly by chemical hydrolysis. Degradation of CGA 362622 in soil is temperature dependent with a DT_{50} of 52 days at 20/C, decreasing to a DT_{50} of 22 days at 30/C and 75% field capacity.
Chemical hydrolysis of CGA 362622 in soil is observed over a wide pH range. It is less stable under acid pH and therefore more rapid degradation can occur in acid soils as compared to alkaline soils. Laboratory studies using water/buffer solutions at 25/C show a DT_{50} of 6 days at pH 5, a DT_{50} of 20 days at pH 7 and 21 days at pH 9.
Degradation products of CGA 362622 in soil have been identified and are not herbicidal active.
Soil mobility is pH dependent with a K_d of 0.4-8.6 ml/g.
CGA 362622 has not shown carry over the following year at recommended use rates and double rates in cotton in the US Midsouth and Southeast, Brazil and Argentina.

BIOLOGICAL EFFICACY

Mode of action
CGA 362622 is readily taken up by shoots and roots and is well translocated in weeds. Growth of susceptible weeds is inhibited following an application of CGA 362622, the leaves turn yellow or red after a few days, followed by complete

death of the plant within 1-2 weeks. CGA 362622, like other sulfonylureas, inhibits the enzyme acetolactate synthase (ALS).

Spectrum of herbicidal activity, crop tolerance cotton

The CGA 362622 weed spectrum in cotton has been evaluated over several years in field trials in North America, South America and Asia. It is a highly active herbicide with excellent timing flexibility on a broad spectrum of important weeds in cotton (Tab. 1). It is effective on the key US cotton weeds *Cyperus esculentus, Cyperus rotundus, Ipomoea spp., Senna spp., and Xanthium strumarium* and on the important South American cotton weeds *Acanthospermum hispidum, Bidens pilosa and Euphorbia heterophylla*. A sequence of 7.5 g ai/ha post over the top followed by 15 g ai/ha post/late post directed additionally improves the activity on grasses, *Cyperus spp*. and dicot weeds. CGA 362622 is tolerated up to 7.5 g ai/ha post over the top in cotton and up to 30 g ai/ha post directed. Over the top applications occasionally result in chlorosis and less often stunting, but cotton recovers quickly and yield is not affected.

Spectrum of herbicidal activity, crop tolerance sugarcane

In addition to the weeds controlled in cotton, troublesome weeds like *Brachiaria spp*. and *Rottboellia exaltata* are controlled in sugarcane at higher rates of 25 to 50 g ai/ha (Tab.2). In sugarcane (plant and ratoon cane) up to 50 g ai/ha can be applied post over top, depending on location and cultivar without negative effects on crop tolerance and yield.

Tab. 1: Weed spectrum of CGA 362622 in cotton at 7.5 g ai/ha applied early post/post over the top and 15 g ai/ha post/late post directed (USA, Brazil and Argentina field trials 1996-1999, 20-40 days after application). E = excellent (>90% weed control), G = good (75-90% control), - = less than 75% control, NT = not tested

Weed	**7.5g ai/ha**	**15g ai/ha**
	early post/post over top	post/late post directed
Acanthospermum hispidum	E	E
Ageratum conyzoides	G	E
Amaranthus hybridus	G	G
Amaranthus palmeri	G	G
Amaranthus retroflexus	E	E
Ambrosia artemisiifolia	E	E
Bidens pilosa	E	E
Chenopodium album	E	G
Cyperus esculentus	G	G
Cyperus rotundus	G	-
Desmodium tortuosum	E	E
Euphorbia heterophylla	E	E
Ipomoea grandifolia	E	E
Ipomoea hederacea	E	G
Ipomoea lacunosa	G	G
Ipomoea nil	G	E
Ipomoea pupurea	E	NT
Senna obtusifolia	E	E
Senna occidentalis	E	NT
Sesbania exaltata	G	G
Sorghum halepense (seedl.)	G	G
Sorghum halepense (Rhizom)	-	G
Trianthema portulacastrum	E	G
Xanthium strumarium	E	E
Xanthium cavalinesii	E	NT

Tab. 2: Weed spectrum of CGA 362622 in sugarcane at 25 and 50g ai/ha applied post over the top. USA, Mexico, Colombia, Brazil and Indonesia field trials 1996-1999, 20-60 days after application. E = excellent (>90% weed control), G = good (75-90% control), - = less than 75% control

Weed	25g ai/ha	50g ai/ha
Brachiaria adspersa	-	G
Brachiaria decumbens	-	G
Cyperus odoratus	E	E
Cyperus rotundus	-	G
Croton lobadus	G	G
Digitaria horizontalis	-	G
Fimbristylis miliacea	E	E
Rottboellia exaltata	E	E

CONCLUSIONS

CGA 362622 is a new, highly effective herbicide for the control of troublesome weeds such as *Cyperus spp., Euphorbia spp., Ipomoea spp., Senna spp., Xanthium spp. Brachiaria spp.* and *Rottboellia exaltata* post emergence at low rates in cotton and sugarcane. Many of these weeds are difficult to control with the current pre - and post emergent herbicides. Use rates of 5 - 15 g ai/ha in cotton and 15-50 g ai/ha in sugarcane are extremely low. Available data suggest favorable toxicological, ecotoxicological and environmental properties.

ACKNOWLEDGEMENT

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CGA 362622 PERFORMANCE IN US COTTON. J.W. Wells, J.C. Holloway, Jr., M. Hudetz, W.W. Bachman, G.L. Cloud, J. Driver, B.W. Minton, S. Moore, D. Porterfield, E.K. Rawls, M.G. Schnappinger, H.R. Smith, and J.J. Grow, Novartis Crop Protection, Inc., Greensboro, NC.

ABSTRACT

CGA 362622 is a new broadspectrum postemergence herbicide for use in cotton and sugarcane. Weed control is achieved with rates from 2 to 6 g ai/acre in cotton. The addition of 0.25% v/v nonionic surfactant (NIS) improves weed control. CGA 362622 can be applied safely to cotton from early post over the top through layby.

Small plot replicated trials applied with backpack sprayers or tractor mounted small plot sprayers have been conducted with a 75 WDG formulation since 1997. Results indicate that CGA 362622 applied early post over the top of 3 to 4 inch tall cotton at 2 g ai/acre with 0.25% NIS provides control of sicklepod (*Senna obtusifolia)*, ivyleaf morningglory (*Ipomoea hederacea)*, pitted morningglory (*Ipomoea lacunosa*, yellow nutsedge (*Cyperus esculentus*) and common cocklebur (*Xanthium strumarium)*. The same weeds are controlled with a directed application at a mid-post timing (5 to 6 inch tall cotton) with 3 g ai/ha with 0.25% NIS. Some transient yellowing of cotton leaves and less often stunting can occur from over the top applications but the response dissipates quickly and does not affect cotton yield. Results also indicate that CGA 362622 is more effective on large weeds including sicklepod, yellow nutsedge, and morningglory than Staple or Roundup Ultra.

WEED MANAGEMENT IN COTTON WITH CGA-362622, FLUOMETURON, AND PROMETRYN. D. Porterfield, J.W. Wilcut, and S.D. Askew. Novartis Crop Protection, Cary, North Carolina and North Carolina State University, Raleigh.

ABSTRACT

Field studies were conducted at five locations in North Carolina in 1998 and 1999 to evaluate weed control and cotton response to CGA-362622 in systems with the commercial standards. CGA-362622 at 3 g ai/a was applied early postemergence, postemergence, or as a sequential application with 1.5 g ai/a applied early postemergence and followed

by 1.5 g ai/a postemergence. Pyrithiobac at 1 oz ai/a was included as a postemergence standard. Both CGA-362622 and Pyrithiobac were evaluated in programs with fluometuron 1.2 lbs ai/a applied preemergence and prometryn 1.2 lbs ai/a + MSMA 2.0 lbs ai/a applied at layby.

CGA-362622 at all application timings gave control of common ragweed (*Ambrosia artemisiifolia*), sicklepod (*Senna obtusifolia*), ivyleaf morningglory (*Ipomoea hederacea*), entireleaf morningglory (*Ipomoea hederacea* var. *integriuscula*), tall morningglory (*Ipomoea purpurea*), pitted morningglory (*Ipomoea lacunosa*), and yellow nutsedge (*Cyperus esculentus*) at 2 to 3 weeks after application. CGA-362622 gave significantly better control of sicklepod, common ragweed, and tall morningglory than pyrithiobac. Pyrithiobac gave significantly better control prickly sida (*Sida spinosa*). CGA-362622 applied postemergence in programs with fluometuron applied preemergence and prometryn + MSMA applied at layby resulted in overall better weed control late season where additional flushes of weeds emerged after the post applications.

Early season crop injury averaged less than 10% with CGA-362622 3 g ai/a on all cotton varieties. Injury was transient with no negative impact on yields.

CGA-362622 in programs with fluometuron preemergence and prometryn + MSMA layby provided season long control of all weed species evaluated resulting in the highest yields.

AURA: A NEW POSTEMERGENCE GRAMINICDE FOR RICE FROM BASF. J.B. Guice, P.H. Bruno, J.S. Harden, and W.W. Stewart, BASF Corporation, Research Triangle Park, NC, 27709.

ABSTRACT

Aura (BAS 625 00H) is a new, postemerge, cyclohexanone herbicide for the control of annual grasses in dry and water seeded rice. Field trials were conducted to evaluate annual grass control and crop tolerance of Aura alone, in tankmixes, and in sequential herbicide programs. The predominant grass species in these trials were barnyardgrass (Echinochloa crus-galli), broadleaf signalgrass (Brachiaria platyphylla), and sprangletop (Leptochloa species). Aura rates and application timings were: 0.075 kg ai/ha (0.067 lb ai/A) applied to 1 – 3 leaf grass; and 0.10 kg ai/ha (0.094 lb ai/A) applied to 4-6 leaf grass. Crop oil concentrate was included with all Aura applications at 1.0% volume/volume.

In university and BASF trials, good to excellent barnyardgrass, broadleaf signalgrass, and sprangletop control was observed when Aura was applied at 0.075 kg ai/ha, early postemergence, and 0.10 kg ai/ha mid – late postemergence. In the sequential herbicide trials, Aura at 0.075 kg ai/ha increased broadleaf signalgrass control 24, 22, and 55% above that obtained with Facet (quinclorac at1/2 X rate), Command (clomazone at 1 X rate), and Prowl (pendimethalin at 1.121 kg ai/ha), respectively. Aura increased barnyardgrass control 24, 13, and 29% above that obtained with Facet, Command, and Prowl, respectively. In 1999, no antagonism was observed with Aura + Londax (bensulfuron), whereas a 2-18% decrease in barnyardgrass control occurred when Aura was tankmixed with either Permit (halosulfuron) or Aim (carfentrazone-ethyl).

BAY MKH 6561 - A NEW SELECTIVE HERBICIDE FOR GRASS CONTROL IN WHEAT. H.J. Santel[1], A.C. Scoggan[1], J.D. Wollam[1], D. Feucht[2] and K.H. Mueller[2], [1]Bayer Corp., Kansas City, MO 64120 and [2]Bayer AG, 51368 Leverkusen, Germany.

ABSTRACT

BAY MKH 6561 is a new sulfonyl-amino-carbonyl-triazolinone herbicide discovered and being developed by Bayer. The product acts as an inhibitor of the enzyme acetolactate synthase (ALS). It provides excellent activity against grasses and several important broadleaf weeds when applied postemergence to wheat. In field experiments conducted between 1993 and 1999 in Europe and North America, the product has demonstrated strong and consistent activity against important grass weeds like cheatgrass, downy brome, wild oat, canarygrass, blackgrass, wind grass and the perennial grass, quackgrass. At the suggested use rates of 30 - 60 g ai/ha weeds were selectively controlled in wheat.

Very low toxicity of BAY MKH 6561, tested as pure active ingredient and 70 DF formulation, was observed when the product was administered orally, as dermal treatment or by inhalation to male and female rats. Dermal applications to rabbits or guinea pigs did not result in irritation or sensitization. Only slight to moderate eye irritation was observed in the respective test with rabbits. Chronic studies showed no evidence of any neurotoxic, genotoxic, teratogenic or carcinogenic potential or reproductive toxicity. No residues of toxicological significance were detected in plants or animals and dietary exposure calculations resulted with reasonable certainty, that no harm to humans will result from the use of BAY MKH 6561. The overall classification of BAY MKH 6561 technical falls in Toxicity Category III; Signal Word: CAUTION.

On the soil surface, BAY MKH 6561 is stable to photodegradation. The major routes of degradation in soil are abiotic processes and microbial breakdown to the final mineralization product, carbondioxide. In field dissipation studies the product was well to moderately fast degradable depending on soil type. No BAY MKH 6561degradates were found in

any soil layers below 6 inch depth. On the basis of a series of studies and modelling, BAYMKH 6561 does not represent a risk to groundwater BAY MKH 6561 indicated a low potential to bioaccumulate and insignificant concentrations in drinking water were estimated from model calculations.

BAY MKH 6561 showed little toxicity for birds, fish, green algae, daphnia, honeybees and earthworms. The use of the product will result in a minimal risk for fish, birds, aquatic and terrestrial invertebrates and algae.

BAY MKH6561 –WINTER WHEAT FIELD TRIAL PERFORMANCE IN THE SOUTHERN UNITED STATES. J.E. Cagle, J.A. Hopkins, A.T. Palrang, R.D. Rudolph, H.J.Santel and A.C. Scoggan; Bayer Corporation, Kansas City, MO 64120.

ABSTRACT

BAYMKH 6561 a new herbicide that Bayer Corporation is developing has been tested in field experiments in the United States since 1993. The product has demonstrated strong and consistent activity against important grass weeds like cheat,downy brome and Japanese brome at the suggested use rates of 30-45 g ai/ha (0.6-0.9 oz product/acre). Cheat control was excellent from single postemergence applications of 30g ai/ha early in the fall through applications in the spring. Consistent control of downy brome required the application of 45 g ai/ha rate in the fall or spring with the fall applications offering the highest levels of control.

Bromus control also was excellent when the product was applied to grazed wheat in the fall or spring after removal of the cattle. The wide application window of BAY MKH 6561 will allow growers to protect their wheat crop from grass competition in the spring if economics favor grain production.

BAY MKH6561 gave economic control of wild oats in a fall application of 45g ai/ha in the southern wild oat area.

Crop rotation choices with BAYMKH 6561 should be flexible with grain sorghum showing good tolerance in field trials.

Efficacy of BAY MKH6561 was not limited to grasses but also covers certain broad leaf weeds such as mustards.
Fall applications of BAY MKH6561 were superior to spring applications and offered early and extended protection of the crop from weed competition.

AN INTRODUCTION TO CLEARFIELD WHEAT™. C.D. Youmans and F. Taylor, American Cyanamid Co., Dyersburg, TN and Princeton, NJ.

ABSTRACT

At the beginning of the 1990's Cyanamid developed imidazolinone tolerant wheat (*Triticum aestivum*) via whole plant selection. The initial experiments were performed on a soft red winter wheat and lead to the discovery of wheat plants exhibiting tolerance to imidazolinone herbicides. The tolerance is based on a single gene point mutation that results in a change in amino acids. The currently used trait is referred to as FS4.
The CLEARFIELD winter wheat variety used in efficacy trials to date and for fall 1999 is experimental material derived from the original selection and is designated CLEARFIELD Wheat variety CV9804. Since not fully adapted to US environmental conditions, the variety CV9804 will not be a commercial product in the US, but the trait FS4 will be introduced by crossing into high quality US varieties.

Southern U.S. winter wheat should be commercially introduced by 2004. Imazamox is expected to be registered for CLEARFIELD Wheat in the fall of 2001. The anticipated use rates should be .032 to .047 lb ai/a. Imazamoxhas contact and residual activity, excellent grass and broadleaf weed control, uses low rates, has a broad rotation crop profile, and has a benign toxicological and environmental profile.

Imazamox applied at .032 to .047 lb ai/a in the fall postemergence controlled diclofop resistant Italian ryegrass (*Lolium multiflorium*) and diclofop susceptible Italian ryegrass similar. Researchers have seen excellent grass weed control including downy and rescue brome (*Bromus* spp.), Italian ryegrass, annual bluegrass (*Poa annua*), jointed goatgrass (*Aegilops cylindrica*), volunteer rye (*Secale cereale*), and cheat (*Bromus secalinus*).

CARFENTRAZONE-ETHYL FOR CONTROL OF BROADLEAF WEEDS IN SOUTHERN RICE. H.R. Mitchell and E.V. Gage, FMC Corporation. Louisville, MS and Carlisle, AR.

ABSTRACT

Carfentrazone-ethyl (AIM 40DF) is a new herbicide discovered and in development by FMC Corporation for post emergent broadleaf weed control in rice. It is an aryltriazolinone that acts by inhibiting protoporphyrinogen oxidase in the chlorophyll pathway, resulting in rapid disruption of the cell membrane. Susceptible species fail to metabolize the

molecule and the foliage shows signs of desiccation within a few hours after application with death of the weed in subsequent days. Carfentrazone-ethyl has demonstrated minimal soil activity at the common use rate of 0.025 lb ai/A in rice and has a short soil half-life. Under FQPA's new ruling, carfentrazone-ethyl is the first new chemistry to be classified as a low risk compound.

Carfentrazone-ethyl has been evaluated in private and university rice weed management research programs during the past five years for its potential fit as a broadleaf weed control herbicide in rice. Results presented herein are a compilation of experiments conducted between 1997 and 1999 by private and university personnel with carfentrazone-ethyl 40 DF applied early-post (EPOST) at a rate of 0.025 lb ai/A in tank-mix with a nonionic surfactant (NIS) at 0.25% v/v for crop tolerance, weed efficacy and subsequent effects on yield. Herbicide standards that were compared against carfentrazone-ethyl included propanil at 4.0 lb ai/A, quinclorac at 0.38 lb ai/A + crop oil concentrate at 1 qt/A and triclopyr at 0.25 lb ai/A + NIS at 0.25% v/v, all applied EPOST. Grass control was uniformly maintained across all treatments in order to concentrate specifically on broadleaf efficacy and its impact on yield.

Excellent rice tolerance was observed with carfentrazone-ethyl. Rice injury in the form of stand reduction or stunting was not observed with carfentrazone-ethyl. At 7 days after treatment (DAT), carfentrazone-ethyl treated rice resulted in only 3-8% discoloration / necrosis and recovered from the initial discoloration by 30 DAT.

Carfentrazone-ethyl provided excellent control (> 88% at 15-21 DAT) of entireleaf and ivyleaf (*Ipomoea hederacea*), palmleaf (*Ipomoea wrightii*) and pitted (*Ipomoea lacunosa*) morningglory, hemp sesbania (*Sesbania exaltata*), Pennsylvania smartweed (*Polygonum pensylvanicum*), hedge hyssop (*Bacopa rotundifolia*), spreading dayflower (*Commeline diffusa*), texasweed (*Caperonia palustris*) and redweed (*Melochia corchorifolia)* at a rate of 0.025 lb ai/A. No significant grass activity was observed in these studies.

Excellent weed control resulted in comparable yields when carfentrazone-ethyl was evaluated against the standard broadleaf herbicides of rice. Carfentrazone-ethyl at 0.02 lb ai/A EPOST provided a yield of 125 Bu/A compared to propanil at 4.0 lb ai/A EPOST of 127 Bu/A in 17 replicated trials. At the same rate and application method, carfentrazone-ethyl also provided 124 and 106 Bu/A in 13 and 6 replicated trials, respectively, compared to quinclorac at 0.38 lb ai/A and triclopyr at 0.25 lb ai/A of 128 and 103 Bu/A, respectively.

These data support acceptable rice tolerance to carfentrazone-ethyl applied early- post at 0.025 lb ai/A. At this rate and application method, carfentrazone-ethyl should prove to be a valuable new weed control tool in rice through its novel mode of action, low use rate technology, rapid activity and excellent broadleaf weed efficacy.

CYHALOFOP, A NEW POSTEMERGENCE GRAMINICIDE IN RICE. R.K. Mann, R.B. Lassiter, D.M. Simpson, D.L. Grant, J.S. Richburg, and V.B. Langston, Dow AgroSciences LLC, Indianapolis, IN; Little Rock, AR; Wayside, MS; Hernando, MS; Indianapolis, IN; and The Woodlands, TX.

ABSTRACT

Cyhalofop-butyl (DE-537, 2-[4-(4-cyano-2-fluorophenoxy)phenoxy] propanoic acid, butyl ester, (R); tradename Clincher*EC) is a new aryloxyphenoxy propionate herbicide being developed by Dow AgroSciences LLC for postemergence control of grass weeds in water- and dry-seeded rice in the southern U.S. As a postemergence, preflood application in drill seeded rice, cyhalofop-butyl at 210 g ai/ha will be labeled to provide control of up to 4 leaf barnyardgrass, junglerice, sprangletop, broadleaf signalgrass, large crabgrass, and seedling johnsongrass. Cyhalofop-butyl will also be labeled at 280 to 310 g ai/ha to control up to 6 leaf grasses prior to tillering. Rates from 280 to 310 g ai/ha may be applied as a salvage application. Rice has excellent tolerance to cyhalofop-butyl at any time of application, with no injury (<5%) or negative effect on yield seen at the highest rate tested of 1120 g ai/ha.

Cyhalofop-butyl is a phloem mobile, systemic herbicide that inhibits the enzyme Acetyl-CoA carboxylase (ACC'ase). In susceptible grasses, cyhalofop-butyl efficacy is due to metabolismto the herbicidally active monoacid metabolite. In tolerant plants such as rice, cyhalofop-butyl is quickly metabolized to the inactive diacid. Broadleaf plants are completely tolerant to cyhalofop-butyl, thus cyhalofop-butyl is very safe to neighboring broadleaf crops.

Microbial degradation is the primary degradation pathway for cyhalofop-butyl in the environment. The degradation half-life for cyhalofop-butyl in aerobic soil is approximately 0.1 to 0.4 days, in aerobic water/soil systems approximately 0.1 day, and in anaerobic water/soil systems from 0.2 to 1 day. Photolysis is not a major pathway of degradation. In the absence of microbes the photolytic half-life has been experimentally determined to be about 1 month. Due to rapid soil microbial degradation, sorption coefficients were determined using sterilized soil, with calculated Kd values from 45 to 77 l/kg, and Koc values from 2000 to 9600 l/kg. Thus cyhalofop-butyl is quickly degraded, strongly adsorbed to soil, and has very low mobility, with no soil residual herbicidal activity or rotational crop issues.

The risk for ground water contamination from cyhalofop-butyl is negligible, due to rapid degradation in the environment, high soil adsorption, and low use rates. Cyhalofop-butyl has low acute toxicity, with oral and dermal LD50's > 5,000 mg/kg. Animals rapidly metabolize and excrete metabolites of cyhalofop-butyl, resulting in low potential for bioaccumulation in aquatic or terrestrial animals. Cyhalofop-butyl is not mutagenic, teratogenic, neurotoxic,

carcinogenic, or a reproductive hazard. The planned commercial formulation is a 285 g ai/liter EC formulation (2.38 lb ai/gal).

* Trademark of Dow AgroSciences LLC

EFFICACY AND CROP TOLERANCE OF CYHALOFOP POST-APPLIED IN DIRECT SEEDED RICE. R.B. Lassiter, D.M. Simpson, D.L. Grant, J.S. Richburg, V.B. Langston, and R.K. Mann; Dow AgroSciences, Little Rock, AR, Wayside, MS, Hernando, MS, Indianapolis, IN, and The Woodlands, TX.

ABSTRACT

Cyhalofop-butyl is currently under development by Dow AgroSciences as a postemergence graminicide for use in rice in the U.S., and will be marketed under the tradename of Clincher EC. It is a member of the class of chemistry known as aryloxyphenoxy propionates, and works by inhibition of the Acetyl CoA carboxylase enzyme (ACCase). Currently cyhalofop-butyl is registered and sold in over 20 rice growing countries around the world.

This paper is a summary of thirty small-plot research trials conducted by Dow AgroSciences Development Biologists or contracted researchers from 1997 to 1999 across the rice growing areas of the U. S. Delta to evaluate cyhalofop-butyl as a preflood, postemergence graminicide for use in drill-seeded rice. The research objectives were to: 1) determine rate(s) of cyhalofop required to control key annual grasses such as barnyardgrass, sprangletop species, broadleaf signalgrass, and large crabgrass at various growth stages, and 2) evaluate rice tolerance to cyhalofop at various growth stages.

Cyhalofop-butyl was evaluated in in-crop studies at 70 to 560 g ai/ha applied postemergence on 1-3 leaf or 4-6 leaf barnyardgrass, sprangletop species, broadleaf signalgrass, and large crabgrass, and compared to standard use rates of quinclorac, propanil, and/or fenoxaprop. Percent weed control and crop injury were assessed at 1-3 weeks and 1, 2-3, and 6-8 weeks after application respectively. In addition, weed free yield studies were also conducted to determine if cyhalofop-butyl applied postemergence at three development stages of the rice (2-3 leaf, 4-6 leaf, or 7 days post-panicle initiation) would impact rice yield.

Results of the efficacy studies suggest that cyhalofop-butyl at rates of 210 g ai/ha provide 91 to 98% control of 1-3 leaf grasses (barnyardgrass, sprangletop species, broadleaf signalgrass, and large crabgrass), and control was equal to or better than quinclorac, propanil, and fenoxaprop.

Cyhalofop-butyl applied to 4-6 leaf barnyardgrass and sprangletop species at 210 g ai/ha provided an average of 81 to 88% control which was superior to quinclorac, propanil, and fenoxaprop. Increasing the rate of cyhalofop-butyl to 280 g ai/ha improved control of these larger grasses to 89 to 92% control.

Rice treated with cyhalofop-butyl exhibited excellent crop tolerance in all studies. Visual crop injury averaged less than 2% at rates up to and including 560 g ai/ha of cyhalofop-butyl regardless of the rice stage of development at application. No yield reductions were observed from cyhalofop-butyl at rates up to 1120 g ai/ha, independent of the development stage of the rice at application.

These data support cyhalofop-butyl's excellent activity on a key annual grasses found in the U. S. Delta rice growing region, and confirms the exceptional crop safety across a range of rice development stages.

STAM WEED CONTROL PROGRAMS FOLLOWING CLOMAZONE TREATED RICE FIELDS. L.C. Walton and J.W. McGee, Rohm and Haas Company, Philadelphia, PA., 19106-2399.

ABSTRACT

Stam, common name "Propanil" marketed by Rohm and Haas Company has been the foundation of rice weed control program for over 39 years. Stam is used as a postemergence treatment for the control of many annual grasses and broadleaf weeds that compete with rice production and reduce yields.

Command 3ME herbicide, common name "Clomazone" has been under development by the FMC Corporation for weed control in rice as a preemergence surface applied broadcast application. At the current time, Command has not been granted a Section 3 registration by the EPA, however Section 18 registrations were issued for Command 3ME in the major rice producing states in 1999 at use rates of 0.40 to 0.60 lb ai/a, with use rate dependent upon soil texture.

A major objective of Rohm and Haas Company was to determine a fit for STAM into a weed control program when Clomazone was utilized as a preemergence surface broadcast application in rice. Field experiments were established at Proctor, Arkansas and Metcalfe, Mississippi in 1998 and 1999. At both locations, factorial design was a randomized complete block with 4 replications. Plot size was 6 feet wide by 20 feet in length. Prior to seeding rice, experiments were overseeded with barnyardgrass (***Echinochloa crus-galli***) and hemp sesbania (***Sesbania exaltata***). In 1998 a natural

population of amazon sprangletop (***Leptochloa panicoides***) was evaluated, however lower population levels prevented evaluations in 1999.

In 1998, Clomazone was applied as a preemergence surface applied broadcast at a rate of 0.50 lb ai/a. Postemergence sequential herbicide overlays following Clomazone applied preemergence included: None at 0.0 lb ai/a; Stam at 3.0 lbs ai/a; and Stam + Facet tank-mix at 3.0 + 0.25 lb ai/a respectively. Postemergence treatment applications were made with weeds in the 1 to 3 leaf stage. In 1999, in order to gain a better understanding of crop response the Clomazone rate was increased to 0.60 lb ai/a and applied at preemergence surface applied broadcast timing. Sequential postemergence overlays to Clomazone applied at preemergence timing were: None at 0.0 lb ai/a; Stam at 4.0 lbs ai/a; and Stam + Facet tank-mix at 4.0 + 0.25 lb ai/a respectively.

Results from these experiments indicate that Clomazone applied at preemergence timing at either 0.50 or 0.60 lb ai/a was highly ineffective for hemp sesbania control. The 0.50 lb ai/a rate did not provide season long control of either barnyardgrass or amazon sprangletop. With the rate increased to 0.60 lb ai/a, barnyardgrass control was obtained. Stam or Stam + Facet combination applied sequentially at early post timing following an application of Clomazone at preemergence timing provided highly effective season long control of annual grasses and hemp sesbania in rice. Clomazone applied at preemergence timing resulted in the bleaching of rice seedlings, however rice seedlings outgrew this initial response. No increased response to rice plants was apparent when applying Stam or Stam + Facet tank-mixes sequentially at early post timing.

A DEVELOPMENTAL SUMMARY OF RICE WEED CONTROL WITH REGIMENT (BISPYRIBAC-SODIUM). V.F.Carey; G.R. Rich; and W.C. Odle.

ABSTRACT

Regiment™ Herbicide is being developed by Valent USA for weed control in California and southern rice. The common name for Regiment is bispyribac-sodium. It controls selected weeds by inhibition of the acetolactate synthase (ALS) enzyme thus blocking branched chain amino acid biosynthesis. Regiment is a contact herbicide with no soil residual activity. It is sold internationally under the trade name Nominee[7] by Kumia Ihara, Intl.

Regiment has been under development by Valent in the United States since 1995. A summary of results indicate that weeds controlled in southern rice include barnyardgrass (including propanil-resistant barnyardgrass), junglerice, johnsongrass, alligatorweed, hemp sesbania, northern and Indian jointvetch, ducksalad and rice flatsedge. Significant activity (suppression) has been observed on mexicanweed, eclipta, and purple ammannia. Control of these weeds can be obtained from a single application of Regiment at the rate of 22 grams ai per hectare (9 grams ai per acre). Regiment can be used in both water-seeded and dry-seeded rice culture as a pre-flood or post-flood application. Regiment can control barnyardgrass that is up to 4-tillers in size.

In research trials, Regiment has been applied in a weed control program with either Prowl, Bolero, Facet, or Command applied as a pre-emergence or delayed pre-emergence application. In these trials, complete broad spectrum weed control was acheived and Regiment could effectively replace Arrosolo or Stam in these programs. Regiment was also applied in a total post-emergence program in combination with Bolero. This treatment included an early application of Stam + Bolero at the 2-leaf barnyardgrass stage of growth followed by an application of Regiment + Bolero pre-flood. This treatment also provided complete broad spectrum weed control combined with some residual control of aquatic weeds from the Bolero.

Regiment Herbicide can be tank mixed with almost all herbicides approved for use in rice. The most notable exception would be any propanil containing herbicide. Valent does not recommend mixing Regiment with other ALS-inhibiting herbicides such as Londax. All applications of Regiment Herbicide should include an approved non-ionic silicone based surfactant at a rate of 0.125 to 0.25 %v/v.

EVALUATION OF A UNIQUE NOZZLE-ADJUVANT SYSTEM FOR FORESTRY SITE PREPARATION. P.M. McMullan, L. Rhodes, and F. Sexton, Agrobiology Research, Inc., Memphis, TN 38120, Helena Chemical Co., Aiken, SC, and Exacto, Inc., Richmond, IL.

ABSTRACT

Removal of undesired vegetation is key to the establishment of a newly planted forest. Two techniques are currently used for forest site preparation, chemical site preparation and mechanical site preparation. Chemical site preparation involves aerial application of herbicide(s) followed by burning. It is recommended that the burning be as complete as possible. The greater the "brownup" on existing vegetation, the better the burn. The typical spray volume for chemical site preparation is 10 gallons/acre. This high gallonage can limit the number of acres that can be applied per tankload. Reducing spray volume would help but there is increased potential for off-target drift as the spray volume decreases. A new nozzle-adjuvant system has been developed with a very narrow droplet size range and very minimal "fine"

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droplets. This allows the applicator to use a spray volume of 5 gallons/acre. The adjuvant system forms an invert emulsion for the proper formation of spray droplets.

Four commonly used herbicide mixtures were evaluated. The following herbicides were used in the study: Chopper at 1.5 qt/ac, Chopper at 20 oz/ac + Garlon at 1 qt/ac, Chopper at 20 oz/ac + Accord at 5 qt/ac, Chopper at 20 oz/ac + Krenite at 5 qt/ac, and Choipper at 20 oz/ac + Krenite at 5 qt/ac. AccuFlo nozzles were used at 10 gallons per acre for conventional treatments. Invert nozzles were used at 5 gallons per acre spray volume. Quest at 3.2 oz/ac + Optima at 6.4 oz/ac were added to the Chopper+Accord treatment for the AccuFlo nozzles and Dyne-Amic at 6.4 oz/ac were added to the Chopper+Krenite treatment for the AccuFlo nozzles. Plot size was 135 feet (3 passes of a GPS equipped helicopter) by approximately 450 feet in length. Treatments were applied on Sept. 1, 1999 and plots were evaluated for percent brownup approximately 6 weeks after treatment. Individual species were grouped into one of five classes: grass, broadleaf, sedge, fern, and hardwood.

Brownup was more rapid when Chopper, Chopper + Garlon, or Chopper + Krenite were applied using the invert emulsion system at 5 gallons/acre compared to the AccuFlo system at 10 gallons/acre. Brownup was at least similar when Chopper + Accord was applied using the invert emulsion system at 5 gallons/acre compared to when applied through the Accuflo system at 10 gallons/acre. Averaged over all of the herbicides, percent brownup was at least 10 percentage units greater when the herbicides were applied using the invert system nozzle than when applied using the AccuFlo nozzle.

COMPARISON OF APPLICATION TECHNIQUES FOR SPARTAN IN TOBACCO. D.T. Gooden and E.C. Murdock, Clemson University, Florence, SC 29506 and W.D. Martin, FMC Corporation, Halifax, VA 24558.

ABSTRACT

Sulfentrazone (Spartan) has been used for effective control of nutsedge and morningglory in flue-cured tobacco. In the last three years, producers have associated sulfentrazone application with crop damage such as early-season leaf flecking and stunting. Though injury symptoms are temporary, concern for the problem still exists. Previous research has shown injury symptoms most often in sandy fields with low organic matter content. The recommended sulfentrazone rate is directly related to soil type and percent organic matter of the targeted area. Incorporation that concentrates Spartan in the root zone is most likely to cause tobacco injury.

In 1999, a flourescent dye-black light incorporation study using popular herbicide incorporation tools for tobacco was conducted. Several application methods were compared. This study was followed by Spartan application using the same tools and application methods. Applications included five methods for incorporation prior to bedding: 1) spray - bed (Spartan 1X), 2) spray - bed (Spartan 2X), 3) spray - double disc - bed, 4) spray - field cultivator - bed, 5) spray - Perfecta - bed. Five treatments were utilized where bedding was performed first: 6) bed - spray - PTO rotary hoe, 7) bed - knock-off bed - spray PRE, 8) bed - knock-off bed - directed spray PRE, 9) bed - knock-off bed - spray - PTO rotary hoe, 10) bed - knock-off bed - no chemical. All treatments received .25 lb ai/A Spartan except #2 which received .5 lb ai/A Spartan. Results with Spartan closely resembled anticipated results with the flourescent dye and black light. Treatments that concentrated Spartan in the root zone (#1 and #2) showed the greatest injury. Only treatment #6 (bed - spray - PTO rotary hoe) and #8 (bed - knock-off bed - directed spray PRE) provided inadequate yellow nutsedge control. Yields were similar for all treatments, but the treatment with greatest injury (#2) resulted in the greatest yield. There was a positive correlation between crop injury and delayed flowering. This study again illustrates that early season stunting resulting from Spartan is not reflected in tobacco yield reduction, but may delay flowering. Injury can be minimized by applying Spartan PRE or by uniform incorporation of PPI application of Spartan.

EVALUATION OF THE EFFICACY OF CAPSTAN SYNCHRO SPRAY SYSTEM IN COTTON AND SOYBEAN USING GLYPHOSATE. C.D. Elmore, L.A. Smith, and J. Mulrooney, USDA, ARS, Stoneville, MS.

ABSTRACT

A test was conducted on the research farm at Stoneville, MS of the efficacy of glyphosate from various test conditions and nozzle arrangements on five weed species in cotton and soybean. A total of 12 nozzle arrangements with and without the Capstan Synchro Spray system were compared with the conventional XR11002VS tip @6mph and 10gpa applied with a hooded boom. All treatments except the hooded boom were applied with a Tyler Patriot fitted with TT11008vp, TT11003vp, TT11004vp, Hardi Injet 03, or Hardi Injet 04 tips. The TT11008vp tips were applied with the Aim Command System activated. The hooded boom arrangement results in a spray particle size of 220 mm., which is smaller than the other tips which have a particle size of 425 or greater. The purpose of the larger spray particles and of the Capstan Synchro system is to produce larger particles for the express purpose of reducing drift potential. The test weed species were morningglory species (*Ipomoea* spp.), prickly sida (*Sida spinosa* L.), barnyardgrass (*Echinochloa crus-galli* (L.) Beauv.), johnsongrass (*Sorghum halepense* (L.) Pers.), and common cocklebur (*Xanthium strumarium* L.). The test was conducted twice in a strip block design with six replications. In test 1 the crops were at the correct stage, but the morningglory had grown beyond the preferred label size for control. All other weeds were in the label size range. In

test 2 glyphosate was used at ½ label rate and a susceptible crop added. These were done to check the suspected on-off effect of the Aim Command system.

The hooded boom was equal or better for weed control than all other treatments. In the second test when the rate of glyphosate was reduced a better discrimination of efficacy effects were noted.. A number of treatments were worse than the hooded boom standard, and not all were related to the Aim Command feature. It should be noted that the weather was extremely dry for this second test and volunteer cocklebur was not consistently available for evaluation.

The results suggest that the hooded boom is the superior system for glyphosate application, but other systems are equally as good, as long as the rate of glyphosate is not reduced.

EVALUATION OF A UNIQUE NOZZLE-ADJUVANT SYSTEM FOR USE IN AGRICULTURAL CROP PRODUCTION SYSTEMS. P.M. McMullan, J. Thomas, and F. Sexton, Agrobiology Research, Inc., Memphis, TN 38120, Helena Chemical Co., Memphis, TN 38120, and Exacto, Inc., Richmond, IL.

ABSTRACT

Producers want to decrease spray volume to increase spray efficiency. In addition, the efficacy of many herbicides has been shown to increaseas spray volume is decreased. However, reducing spray volume as increases spray drift potential. A new nozzle-adjuvant system has been developed with a very narrow droplet size range and very minimal “fine” droplets. The adjuvant system forms a thin invert emulsion and is required for the proper formation of spray droplets. This research was conducted to evaluate the efficacy of Roundup Ultra (glyphosate) and Liberty (glufosinate) and various cotton defoliants when applied through the invert nozzle system at various spray volumes compared to application through flat-fan nozzles.

Roundup Ultra and Liberty were applied at label rates. Ammonium sulphate at 3 pounds per acre was tank-mixed with Liberty. Conventional flat-fan treatments were applied at 10 gallons/acre (Roundup) or 15 gallons/acre (Liberty) using XR11002 nozzles. Invert nozzles were used at either 20 inch or 40 inch spacing and the following spray volumes were used: 5, 2.5, and 1.25 gallons/acre. Weed control was evaluated visually 21 days after treatment for the Roundup trial and 14 days after treatment for the Liberty trial. For the cotton defoliation trials, cotton defoliant products were used at labeled rates and were applied at 10 gallons/acre using flat-fan nozzles and 5 gallons/acre using invert system nozzles. Percent defoliation was evaluated visually at 1, 2, 3, 4, 5, 6, 7, 10, and 14 days after treatment. Percent stuck leaves were evaluated at 14 days after treatment.

For the Roundup trial, corn (*Zea mays*), redroot pigweed (*Amaranthus retroflexus*), velvetleaf (*Abutilon theophrasti*), and johnsongrass (*Sorghum halepense*) was similar when Roundup was applied at 10 gallons/acre via flat-fan nozzles or at 2.5 or 5 gallons/acre via the invert nozzles. For Liberty, control of redroot pigweed, velvetleaf, and johnsongrass was similar when Liberty was applied at 15 gallons/acre via flat-fan nozzles or at 1.25, 2.5, or 5 gallons/acre using the invert nozzles. Cotton defoliation was similar when the defoliation treatments were applied at 10 gallons/acre using flat-fan nozzles or at 5 gallons/acre using the invert nozzles.

CARRIER VOLUME AFFECTS HERBICIDE ACTIVITY IN SIMULATED SPRAY DRIFT STUDIES. P.A. Banks, MARATHON-Agricultural & Environmental Consulting, Las Cruces, NM; and J. Schroeder, New Mexico State Univ., Las Cruces, NM 88005.

ABSTRACT

Occasionally, herbicides physically drift onto non-target vegetation during application and may cause significant injury and affect crop yield. Researchers have conducted studies to determine the susceptibility of a variety of crops to newly developed as well as to commonly used herbicides in order to determine precautions needed during application. Mostly these have consisted of dose-response studies where carrier volume remained constant.

In this work, dose-response studies with 2,4-D on cotton and glyphosate on sweet corn were conducted to determine if varying carrier volume proportionally with the dosage would change crop response compared to maintaining a constant carrier volume with varying dosages. For both herbicides, the dosages used were 0.37, 0.185, 0.092, and 0.046 kg ai/ha. The constant water carrier volume was 281 L/ha. Variable carrier volumes were 94, 47, 24, and 12 L/ha, respectively, for the declining rates. Applications were made to 25 cm tall sweet corn and pre-blooming cotton. Treatments were compared to non-treated and a full rate of each herbicide (1.12 kg/ha) applied with 281 L/ha of carrier. Visual injury, plant fresh weight, and final crop yield were obtained.

For both crops, the variable carrier volume increased visual injury and reduced crop yield compared to when the carrier volume was constant. Crop fresh weight response was variable and differed due to carrier volume only at the higher dosages. This work suggests that when determining non-target crop response to drift amounts of a herbicide, the amount of carrier used for each dosage should be in the same proportion as the full dosage that would have been applied to the target field.

EVALUATION OF SPRAY DRIFT FROM CAPSTAN SYNCRO BLENDED PULSE SPRAY CONTROL SYSTEM. L.A. Smith, J.E. Mulrooney, C.D. Elmore, and M. Steele; USDA-ARS, Application and Production Technology, Stoneville, MS 38776 and Professor, Department of Physical Science, Delta State University, Cleveland, MS 38732.

ABSTRACT

The SYNCRO Blended Pulse Spray Control (SBPSC) allows the use of a single nozzle for a wide range of application rates while maintaining a constant pressure on the spray boom. The SBPSC breaks the link between pressure and flowrate. An applicator can tailor the application by selecting the nozzle and pressure for the desired droplet size. The application rate can then be set to achieve the desired delivery of active chemical. Pressure and application-rate adjustments can be conveniently made ‘on the go’ from the cab of the sprayer. Nozzle selection should be based on droplet size needed and the highest speed and application rate anticipated. Flowrate is controlled by cycling the nozzles on and off at a rate of 10 Hz. The controller adjusts the ‘on time’ relative to the ‘off time’ within the 0.1 s cycle to achieve the required application rate.

The SBPSC system was retrofitted on a Tyler Patriot Wide-Trax sprayer with a 75’ open-boom and compared to conventional (continuous spray) technology on both open-boom and hooded-boom sprayers. Selected combinations of speed (6, 10,14,16, 18 mile/h), application rate (5, 10, 15, 18 gal/acre), and nozzle tip (TT11008, TT11004, TT11003, XR11002, Hardi Injet 04, Hardi Injet 03) were compared for a total of 17 treatments in four randomized replications. Conventional open-boom treatments were applied with the Tyler Patriot with a continuous spray setup. The conventional hooded-boom treatments were applied with a three-point-hitch mounted RedBall© sprayer with a 13.3’ boom.

The field layout for the test consisted of a 73’ swath, 400’ long oriented perpendicular to the prevailing wind direction. Each treatment run consisted of applying the experimental treatment and a ‘standard’ treatment. Two spray passes were made for each treatment run with the ‘standard’ sprayer following closely behind the treatment sprayer during each pass. The ‘standard’ spray was applied with a 4-row JD 6000 Hi Cycle at the same rate and speed (10 gal/acre, 6.5 mile/h) throughout the entire test. The ‘standard’ spray contained a Rubidium (Rb) tracer, and the treatment spray contained a Cesium (Cs) tracer. Drift of the Rb spray among runs was influenced by the variations in environment among runs; therefore, Rb data were used as a covariant to account for the variability in Cs data due to environment. A sampler line was established at the midpoint of the spray swath on the downwind edge and extended for 223’ downwind from and perpendicular to the swath. Each of ten sampler stations (0’, 6.6’, 13’, 20’, 26’, 39’, 66’, 118’, 171, 223’) held three collectors: 1) a 5”x5” mylar fallout sheet, 2) a 5.2” x 0.25”d soda straw with its longitudinal axis perpendicular to the wind direction, and 3) a 3”x2” water sensitive spray card. The test was conducted in an open-canopy cotton crop approximately 10” high that was planted in 40” rows. Samplers were supported in the horizontal plane at the height of the crop canopy. Wind speed recorded for each spray pass averaged 7.0 mile/h and ranged from 4.5 mile/h to 9.8 mile/h. Testing was interrupted if the wind died or if winds came from the wrong direction. Ambient air temperature ranged from 85 to 93 degrees Fahrenheit during the test. Sample collection and processing for analysis were accomplished without allowing the collectors (mylar and straw) to touch any surface that was not washed with a dilute nitric acid solution to recover the rare-earth tracers.

Versatility of the SBPSC was demonstrated by using a single nozzle-pressure combination to make 5, 10, 15, and 18 gal/acre applications at 10 mile/h. This same setting was also used to apply 10 gal/acre at 6, 10, 14, 16, and 18 mile/hr. Conventional sprayers with TT11003 and TT11004 nozzles had significantly higher drift than the SBPSC system using TT11008 nozzles except at the lowest application rate and lowest speed. Drift from conventional systems with the Hardi Injet nozzles was slightly less than but statistically similar to drift from the SBPSC for speeds and application rates tested. Drift from a hooded boom sprayer with XR11002 nozzles was statistically similar to that from the SBPSC at a 6 mile/h speed.

METHOD FOR EVALUATING SPRAY DRIFT USING ATOMIC ABSORPTION SPECTROMETRY. C.D. Elmore, J. Mulrooney, L.A. Smith, and M. Steele. USDA ARS, Stoneville, MS and Dep. Physical Sci., Delta State Univ., Cleveland, MS.

ABSTRACT

Determining spray drift requires a sensitive technique for evaluation. Graphite furnace technology on an atomic absorption spectrometer provides the required level of sensitivity when using the rare earth elements Rubidium and Cesium. These are detectable in the low picogram range (5 and 10 mg/L). Mylar sheets (5 by 5 in) and soda straws were positioned down wind in a holder at canopy height at various distances from the spray swath. The wind speed and direction were monitored at the time of each spray run. The spray solution contained either 200 g CsCl in 400 gal. or 25 g RbCl in 70 gal. The mylar sheets were collected and placed in a ziploc bag and the tracer solutes were eluted by washing with a dilute nitric acid solution. The soda straws were collected in screw cap vials and similarly eluted. The eluted solutions were run on a Perkin Elmer Atomic Absorption Spectrometer equipped with a Graphite Furnace. The sensitivity was good enough to detect drift of Rb and Cs at a distance of 50 m in high drift situations. Not all spray

efforts have drift of this magnitude. This is presented as a method of measuring drift in situations where environmentally benign substances are required for testing.

IMAGE-BASED REMOTE SENSING SYSTEM FOR AGRICULTURAL AIRCRAFT USING GEO-REFERENCED DIGITAL VIDEO

S.J. Thomson, J.E. Hanks, USDA-ARS-APTRU, Stoneville, MS 38776.

ABSTRACT

Reliable geo-referencing becomes particularly important when attempting to locate field sections for precision application at very low altitudes. A study was conducted to evaluate the accuracy of a GPS-based geo-referencing system for remote sensing from agricultural aircraft. The remote sensing system used a digital video camera connected to a differential GPS. The GPS was connected to a device that recorded data to the audio track of videotape. A study was conducted to evaluate positioning accuracy of a chosen GPS configuration at an altitude of 21-m (70-ft). Ground points for comparison were taken with a portable GPS that implements the Precise Positioning Service (PPS) used by the US military. After images were obtained, the tape was indexed for geo-referencing of images. Differences in position between the aircraft and ground GPS units ranged from +38.6 m to -66 m over four field sections flown.

INTRODUCTION

Reliable geo-referencing becomes particularly important when attempting to locate field sections at very low altitudes for precision application. Boundaries and landmarks are not visible over many parts of large field areas, making association of key images with their respective locations difficult. For this reason, a method of providing real-time geo-referencing of images was sought that could be used with a spray plane-based video imaging system under development. It was desired that the system, including the GPS, be completely portable.

We developed a remote sensing system that uses a digital video camera mounted in a spray plane. A video mapping system (VMS) (Red Hen Systems, 1999) was incorporated along with a differential GPS (Starlink, 1999) to provide continuous GPS-based geo-referencing of images. The VMS works with software that allows indexing of the tape for association of GPS-derived time, location, altitude, and aircraft speed data with images captured from moving video.

Many investigations have used video systems on aircraft for detection and mapping of weeds. Everitt et al. (1995a) described an aerial video imaging system that used three analog video cameras fitted with narrow-band image filters. This system used a Trimble Transpack II GPS receiver, computer-based image capture, and a SuperVHS recorder. The analog VHS recorder served as a backup for possible computer malfunction. An interphaser was used to superimpose GPS information onto a portion of video going to both the computer and VHS. Variations on the camera/GPS configuration have been used successfully to map leafy spurge (*Euphorbia esula)* (Everitt et al., 1995b) and Chinese Tamarisk (*Tamarix chinensis*) infestations (Everitt et al., 1996). Carson et al. (1995) and Lass et al. (1996) utilized data from an airborne data acquisition and registration system (ADAR), which consisted of four sensors of 1024 lines by 1500 pixels resolution. Coordinates of the images were registered to match ground coordinates gathered with a GPS at field-placed control markers.

For the study described herein, GPS data were digitally coded onto continuous video, allowing for easy transfer of data and the potential for rapidly pinpointing areas for precision management. A previous study by Thomson et al. (1999) used several GPS configurations on the airplane to evaluate quality of signals and accuracy of the GPS in obtaining a position fix. The objective of this study was to evaluate the accuracy of a chosen GPS/VMS configuration in obtaining position fixes at low altitudes. Positions recorded by the system were compared to those recorded on the ground using a precise positioning GPS.

MATERIALS AND METHODS

An aerial video/GPS system was installed on an Air Tractor AT-402 spray plane. The system consisted of a Starlink 210S differential GPS (Starlink, 1999) connected to the microphone input of a Sony model TRV-103 Digital8 video camera via VMS-200 video mapping hardware (Red Hen Systems, 1999). The Starlink GPS unit was configured in parallel with the aircraft's differential GPS (Satloc, 1995). Both GPS units use the OmniSTAR satellite-broadcast correction signal. As the video camera was operated, the VMS-200 received data from the GPS, processed the data, and recorded it to the audio track of the videotape every second. The plane's Satloc GPS output data to a flash memory card that was later uploaded to a lab computer. Files from the flash card were converted from binary to ASCII for export to a spreadsheet. Time references between the two files types were synchronized so positioning and other flight data could be compared between the Starlink and Satloc units.

The north section of a research field containing soybeans and planted weed populations was geo-referenced using a Rockwell Collins Precision Lightweight GPS Receiver (PLGR). This unit uses the Precise Positioning Service (PPS) - the same service employed by the U.S. military. Use of PPS avoids selective availability (SA) and resulting position accuracy degradation (Sidle, 1999). The PLGR could resolve a ground position to 0.3-m (one-foot) and was useful in precisely dimensioning the field and locating the ground points. Ground points were located at three positions in four adjacent field sections along a northerly direction, for a total of twelve GPS ground points. The spray plane with the Starlink/VMS apparatus flew north at an altitude of 21-m (70-ft) over each field section.

After data were taken, the tape was indexed using the VMS-200 software. Video was monitored simultaneously using Sony DVvideo software so locations corresponding to ground-referenced points could be spotted. When a ground point was located, the tape was paused, and position data was recorded at that location. For consistency, video was paused when ground-referenced field locations were observed at the midpoint of the pop-up video monitor on the computer screen. Points on the VMS tracking map corresponding to ground-referenced points were marked so they could be located later.

RESULTS AND DISCUSSION

Table 1 illustrates differences in readings between the PLGR (ground), Starlink/VMS, and Satloc GPS units for the study flown at 21-m altitude over four field sections. (Where subtracted GPS readings were north of the first GPS readings, negative numbers are shown). In all cases comparing output fromGPS units, easting position values were very close to each other. The route over this field was due north with a maximum deviation of 1.2 degrees. All significant position changes were, therefore, in the northing components. Column 3 of Table 1 illustrates differences between PLGR (ground) and Starlink-registered positions at the 21-m (70-ft) altitude. Differences were fairly consistent, except over the first field section. Positions registered by the Starlink lagged the Satloc consistently, as illustrated in column 4. Greater differences were seen between many positions registered by the PLGR and Satloc than between the PLGR and Starlink. Column 3 indicates differences ranged from +38.6 m to -66 m. Differences in column 5 are simply the sum of data from columns 3 and 4, the latter indicating position differences between the Starlink and Satloc units. Position differences between the PLGR and Satloc ranged from -14.1 m to -125.4 m.

Using the differential GPS, we noticed that, in many cases, position fixes were not far off even when signal conditions were poor for proper differential correction. It is the authors' opinions that a simple non-differential GPS unit coupled with the VMS-200 unit may provide acceptable accuracy under many conditions, especially at higher altitudes. Inconsistencies between GPS differences across field sections (Table 1, columns 3 and 5) were largely due to the method used to record data from the Starlink GPS unit using the VMS-200 software and real-time video capture. As has been stated, Starlink GPS data were obtained when resulting video was stopped over a field location of interest. In some cases, the actual GPS location chosen could be either of two points if a GPS position was about to change, close to the marked location. Since the GPS updated every second and the airplane was traveling 65 m/s, the difference between any two consecutive locations would be about 65 m.

The system described herein should provide improved and highly usable information on field position associated with remotely-sensed images. A system like this should find its greatest utility where field areas cannot be geo-referenced using landmarks or other reference points, as would be the case for low altitude remote sensing over large field areas. Use of the system described herein for remote sensing studies will be documented in future work.

DISCLAIMER

Mention of a trade name, proprietary product, or specific equipment does not constitute a guarantee or warranty by the U.S. Department of Agriculture and does not imply approval of the product to the exclusion of others that may be available.

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Table 1. Position differences between GPS configurations at three locations per field section. (Column numbers are listed in top row)

1	2	3	4	5	6	7	8	9	10	11
Field Section	Field Location	PLGR - Starlink (Northing) (m)	Starlink - Satloc (Northing) (m)	PLGR - Satloc (Northing) (m)	PLGR - Starlink (Easting) (m)	Starlink - Satloc (Easting) (m)	PLGR - Satloc (Easting) (m)	Satellites in View (Starlink)	HDOP (Starlink)	True Heading, degrees (Starlink)
C1	1	38.1	-65.92	-27.83	-2.40	-1.51	-3.90	6	2	359.6
	2	-20.02	-52.72	-72.74	-3.65	-0.97	-4.63	6	2	360
	3	38.6	-52.72	-14.13	-1.49	-0.97	-2.46	6	2	360
C2	1	-52.71	-54.58	-107.29	-0.31	-0.52	-0.83	4	2.8	359.9
	2	-45.93	-54.49	-100.43	-3.14	-0.66	-3.80	4	2.8	0.1
	3	-51.51	-54.43	-105.93	-1.50	-0.71	-2.21	4	2.8	360
C3	1	-17.78	-54.70	-72.48	-1.47	-2.19	-3.66	4	2.9	359
	2	-11.31	-54.35	-65.67	-3.90	-1.40	-5.30	4	2.9	359.9
	3	-9.14	-54.75	-63.89	-4.63	-1.72	-6.35	4	2.9	359.8
C4	1	-66.02	-54.46	-120.48	0.27	-0.18	0.08	5	2	0.3
	2	-59.69	-54.71	-114.40	-4.02	-0.55	-4.57	5	2	359.7
	3	-58.50	-66.93	-125.43	-2.33	-1.88	-4.22	5	2	358.8

Ground speed:64.4 m/s (144 mph)

REMOTE SENSING OF COTTON INJURY AND GROWTH WITH VARIABLE HERBICIDES AND TILLAGE. C.S. Bray, D. R. Shaw, J.A. Mills, and C.T. Leon, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762; and Monsanto Agricultural Products Co., Collierville, TN 38017.

ABSTRACT

Images acquired by remote sensing, either multispectral or hyperspectral, have proven to be beneficial in evaluation of the development and stage of a crop including the stress levels in a crop canopy. Remote sensing data uses bands that are narrowed to a range of wavelengths in the visible and near infrared spectrum. These images capture the reflectance of a given area of a specified field. The reflectance of the crop canopy can reveal the health of the plants using NDVI (Normalized Difference Vegetation Index). The NDVI is a format that uses a ratio between red and near infrared wavelengths that allow the range of –1 to 1. This range allows the reflectance to be categorized by a value close to 1 being a healthy plant and a value closer to 0 being a stressed plant. Plants are stressed to some degree by most standard agronomic practices used today. Many tillage practices and herbicide applications, either directed spray or post-directed can place some degree of stress to the crop. Data values of plant responses are needed to determine if imaging systems can detect levels of stress induced by these practices.

An experiment was designed to evaluate multispectral images of a cotton canopy using various tillage and herbicide treatments. Tillage treatments evaluated in the study were till and no-till, and cultivation and no-cultivation. The sprayed trial was a comparison of glyphosate and conventional herbicide system in a glyphosate-resistant cotton cultivar. The tillage treatment consisted of field and bed preparation in the spring followed by a row conditioner prior to planting, planting the cotton cultivar, with two additional cultivations in season. The no-till treatments used no tillage only 0.84 kg ai/ha glyphosate pre-plant burndown, rates of, 0.84 kg/ha glyphosate postemergence over the top, and 0.84 kg/ha glyphosate broadcast with wheeled unit. The cultivation trial consisted of spring bed preparation, pre-plant burndown of 0.70 kg/ha glyphosate plus 0.70 kg ai/ha 2,4-D, bed conditioning, and either two cultivations plus one application of 0.56 kg/ha glyphosate, plus a layby application of 2.2 kg ai/ha cyanazine plus 0.63 kg ai/ha MSMA, or three sequential applications of 0.84 kg/ha glyphosate. The glyphosate treatment consisted of applications of 0.84 kg/ha glyphosate at pre-plant burndown, 0.84 kg/ha glyphosate at planting, two broadcast applications of 0.84 kg/ha glyphosate, a banded application of 0.56 kg/ha glyphosate, and a layby application 1.1 kg/ha cyanazine plus 0.63 kg/ha MSMA. The conventional treatment consisted of pre-plant burndown of 0.84 kg/ha glyphosate, 0.75 kg ai/ha flometuron plus 0.61 kg ai/ha metolachlor preemergence, postemergence broadcast application 0.84 kg/ha glyphosate, 0.0052 kg ai/ha pyrithiobac postemergence, spot spray of 0.14 kg/ha clethodim, 0.28 kg ai/ha prometryn plus 0.63 kg/ha MSMA as a

post-directed spray, and a layby application 1.1 kg/ha cyanazine plus 0.63 kg/ha MSMA. Images were acquired using a 4 CCD array camera (1320 by 1035 pixel array) with sensor ranging from 540 nm (green) to 840 nm (near infrared). All images are 8 bit image pixels. ITD Spectral Visions, Bay ST. Louis, MS, provided multispectral images on a weekly basis. Images were acquired at approximately 12,000 ft. with a 2-meter resolution. Areas of interest were chosen at random for each trial to detect stress individually by tillage or herbicide application.

In the till vs. no-till trial, NDVI values differed between treatments, but variability was high, thus correlations were poor. In cultivation vs. no-cultivation, a difference was observed between areas of interest, but variability was also high. In glyphosate vs. conventional herbicides a difference was observed in areas of interest once again given to the high variability of the reflectance responses. The NDVI images could not specify exact locations of treatments in an area or field by spectral correlation of pixel values for the visual observation. The values indicated illustrate the variance of reflectance responses of plants in an area or field from various practices.

ACTIVITY OF IMAZETHAPYR ON RICE WEEDS AT DIFFERENT SOIL MOISTURES. W. Zhang and E.P. Webster, Louisiana State University Agricultural Center, Baton Rouge, LA70803.

ABSTRACT

The recent development of imidazolinone-tolerant rice provides the possibility of using imazethapyr for weed control in rice. A greenhouse study was conducted in 1998 to evaluate the effect of soil moisture on weed control with imazethapyr. Soil was a Crowley silt loam with 1.4% organic matter, pH 5.5, and 1.37 g/cm^3 bulk density. The experimental design was a randomized complete block with a 3-factor factorial arrangement of treatments with four replications. Factor A was imazethapyr application method: preplant incorporated (PPI) or postemergence (POST), factor B was imazethapyr rate of 35 and 53 g/ha, and factor C was soil moisture content at 50, 25, 19 and 13% (w/w). A nontreated control was included as comparison for each soil moisture under each herbicide application method. Control of barnyardgrass [*Echinochloa crus-galli* (L.) Beauv.], red rice (*Oryza sativa* L.), and hemp sesbania [*Sesbania exaltata* (Raf.) Rydb. Ex A.W. Hill] were evaluated at 2 and 3 weeks after treatment (WAT). Plant height was determined at 2 WAT and plant dry weight at 3 WAT.

Response of barnyardgrass and red rice to imazethapyr PPI was affected by soil moisture. At 2 WAT, 53 g/ha imazethapyr PPI controlled barnyardgrass 35% at 50% soil moisture, compared with 79% control at 19% soil moisture. Barnyardgrass height was reduced as soil moisture increased from 19 to 50%. At 3 WAT, barnyardgrass control and dry weight decreased with the increase of soil moisture from 19 to 50%. Red rice control, height, and dry weight were reduced at 50% soil moisture compared with other moisture regimes. Imazethapyr PPI had little activity on hemp sesbania. Activity of imazethapyr on all three weeds was increased when applied POST compared with PPI. Activity of imazethapyr POST on barnyardgrass and red rice was not affected by soil moisture or application rates; however, red rice dry weight was reduced with both rates of imazethapyr at 13% soil moisture at 3 WAT. Hemp sesbania control was higher with 19 and 25% soil moisture; however, control was less than 45% for all rates and soil moistures.

These results suggest that saturated field conditions should be avoided in order to increase the activity of soil-applied imazethapyr on barnyardgrass and red rice. Better control of barnyardgrass, red rice, and hemp sesbania can be obtained through POST application of imazethapyr. Dry soil conditions may reduce efficacy of imazethapyr POST on red rice. Control of hemp sesbania with imazethapyr POST can be improved when plants are not under drought or waterlogged stress. To maximize the activity of imazethapyr for weed control in the imidazolinone-tolerant rice production system, soil moisture should be considered as an important factor, especially when imazethapyr is soil applied.

INTERACTION OF PALMER AMARANTH AND SUMMER SQUASH. K.D. Starke, D.W. Monks and R.J. Mills. North Carolina State University, Raleigh.

ABSTRACT

Studies having plant-back and removal treatments were conducted at the Horticultural Crops Research Station, Clinton, NC to evaluate interaction of Palmer amaranth and summer squash (Multipik) in 1998 and 1999.

In five plant-back treatments, Palmer amaranth at the cotyledon stage was transplanted into squash for five consecutive weeks beginning one week after squash planting. Spacing between squash and Palmer amaranth transplants was 0.61 m. Weedy and weed-free checks were included for comparison. Palmer amaranth transplanted one and two weeks after squash establishment reduced total marketable yield 58 and 60 %, respectively. Compared to the weed-free check, total marketable squash yield was not reduced when Palmer amaranth was transplanted at three, four or five weeks after squash establishment. In 1999, differences among plant-back treatments were not statistically significant.

In five removal treatments, Palmer amaranth was removed for five consecutive weeks. Weekly removals began one week after squash planting. Plot size and plant spacing was identical to the plant-back study. Data for removal studies was not statistically significant in either 1998 or 1999.

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Greenhouse studies were conducted at the Horticulture Field Lab, Raleigh, NC to evaluate preemergence control of Palmer amaranth using bensulide (Prefar 4E) and ethalfluralin (Curbit EC) in 1999. Bensulide was applied PRE at 2.8, 4.2, 5.6, 7.0, and 8.4 kg ai/ha. Ethalfluralin was applied PRE at 0.56, 0.84, 1.1, 1.4 and 1.7 kg ai/ha. A non-treated was included for comparison purposes. Palmer amaranth control was 68 and 64 %, respectively, when bensulide was applied at 5.6 and 8.4 kg ai/ha. Control of Palmer amaranth was 99 % when ethalfluralin was applied at 1.1 or 1.7 kg ai/ha.

CORRELATION OF SOIL FACTORS ON PERENNIAL WEED OCCURRENCE IN NO-TILL FIELDS. C.L. Brommer and W.W. Witt. University of Kentucky, Lexington, KY 40546.

ABSTRACT

Conservation tillage practices have increased in row crops across the United States and no-till agriculture makes up 50% of the total row crop acreage in Kentucky. These tillage practices have many benefits to producers over the use of traditional tillage practices. There are problems associated with no-till fields in Kentucky and one of these is higher relative populations of perennial weeds. The perennial weed population establishes primarily because of the lack of preplant tillage to disrupt the taproots of many broadleaf perennial weeds. Extension personnel and producers alike have noticed that perennial weed communities establish in similar areas in many different fields. These areas may include low or bottomportions of fields and in places where water would be more available. With these observations in mind, a study was established to try and correlate the terrain attributes of no-till fields with occurrence of perennial weed populations.

One of the University of Kentucky's agricultural research farms, located in Woodford Co., was used as the initial site for these studies. A field was selected which had been in no-till production for several years and was currently planted in corn. Populations of Canada thistle and hedge bindweed were located and their position documented with a Starlink GPS backpack unit. Digital elevation maps were used in conjunction with regression modeling to monitor the correlation between terrain factors and perennial weed population. Terrain factors included slope gradient, specific catchment area, profile curvature, plan curvature, and upslope length.

A correlation was drawn between the location of Canada thistle (*Cirsium arvense* L. Scop.) and with the catchment area (0.31) and the slope index (0.41). Hedge bindweed (*Calystegia sepium* (L.) R. Br.) with the catchment area (0.38) and the slope index (0.40). All correlation values were at the 0.01 level. Both of these values are indicators of run off and topography in a field. These correlations indicate that these weeds would be found in areas that are prone to run off and water collection areas in a Maury soil with similar topographical characteristics.

ANNUAL BLUEGRASS (*POA ANNUA*) CONTROL USING DMI FUNGICIDES. F.C. Waltz Jr., L.B. McCarty, and J.K. Higingbottom. Clemson University, Clemson, SC 29634.

ABSTRACT

Annual bluegrass (*Poa annua*) is a problem in bermudagrass (*Cynodon sp.*) fairways. It reduces aesthetic quality and when seedheads are present, can affect play of the golf course. Fungicide use is common practice on golf courses and these fungicides may have multiple uses. The demethylation-inhibiting (DMI) compounds are common fungicide chemistries, but DMI's are not new to weed control. Rubigan (fenarimol) has become the standard for annual bluegrass control in overseeded bermudagrass in the southeast. Also, annual bluegrass control has been observed with Turf Enhancer (paclobutrazol), a turfgrass growth regulator and DMI. Research objectives were to determine the efficacy of labeled turfgrass DMI fungicides for preemergence bluegrass control and post control using these in combination with a growth regulator.

In the fall 1998 a field study was established on a non-overseeded bermudagrass driving range. Plots were maintained by the staff at Southern Oaks Golf Club in Easley, South Carolina. Plots were 3 m x 3 m in a randomized complete block design with 8 replications. Using a CO_2 backpack sprayer set to deliver 187 l ha^{-1}, preemergence treatments were applied in August, September, and December. Treatments included Rubigan (2.3, 1.1, and 1.5 kg ai ha^{-1} respectfully), Eagle (myclobutanil) (2.2, 1.1, and 1.5 kg ai ha^{-1}), Sentinel (cyproconazole) (1.2, 0.6, and 0.8 kg ai ha^{-1}), and Banner (propiconazole) (2.5, 1.3, and 1.7 kg ai ha^{-1}). Postemergence treatments were applied in November, December, and February, the same rates were used for all three applications. Treatments included Rubigan + Turf Enhancer (TE) (1.1 + 0.3 kg ai ha^{-1}), Eagle + TE (1.1 + 0.3 kg ai ha^{-1}), Sentinel + TE (0.6 + 0.3 kg ai ha^{-1}), and Banner + TE (1.3 + 0.3 kg ai ha^{-1}). Relative to the untreated, visual annual bluegrass control ratings were made on a 0% to 100% scale, 0%= no control, and 100%= complete control or no annual bluegrass.

No preemergence treatment provided acceptable (³ 70%) annual bluegrass control at any time. The greatest control (15% to 25%) was observed with Rubigan, Eagle, Sentinel, and Banner at a February rating date. All preemergence treatments declined (£ 11%) by the last rating in April.

Marginal control (³ 77%), was observed in February with Eagle + TE, Sentinel + TE, and Banner + TE, while Rubigan + TE was less (59%). These observations were made prior to the third application. In April, after all three applications,

the trend was similar to the February rating with Eagle + TE, Sentinel + TE, and Banner + TE providing 63% to 71% control and Rubigan + TE with less control at 56%.

From this study it appears for control of annual bluegrass, late season (November and December) applications of DMI fungicides mixed with Turf Enhancer is best and the February application did not improve control, but may have extended the duration of annual bluegrass suppression. This study should be repeated and performed in an overseeded condition to determine the affect of these DMI's at these rates on perennial ryegrass (*Lolium perenne*) or rough bluegrass (*Poa trivialis*). Also, these fungicides are labeled for use on bentgrass (*Agrostis palustris*) greens, although at lower rates, and should be investigated for annual bluegrass control.

ANNUAL BLUEGRASS CONTROL ON ROUGH BLUEGRASS OVERSEEDED BERMUDAGRASS GREENS.
M.R. Toubakaris, J.K. Higingbottom, and L.B. McCarty. Clemson University, Department of Horticulture, Clemson, SC 29634-0375.

ABSTRACT

Annual bluegrass (*Poa annua*) control in overseeded golf greens is difficult since both species are cool-season grasses. *Poa annua*'s unattractive color and ability to produce noxious seedheads at close mowing heights reduce the overall quality of golf greens. The objective of this research was to provide selective control of *Poa annua* using a variety of pesticide applications at various rates while allowing establishment of overseeded grass to an acceptable level.

A field study was conducted in 1998-1999 in the midland area of SC on overseeded 'Tifdwarf' bermudagrass (*Cynodon dactylon x c. transvaalensis 'Tifdwarf'*) golf greens. The study determined the efficacy of pre and postemergence applications for *Poa annua* control, establishment of rough bluegrass (*Poa trivialis*), and injury to bermudagrass entering dormancy. The 22-treatment study included various rates, timings, and combinations of Kerb 50 WP (pronamide), Rubigan 1 AS and Patchwork .008 G (fenarimol), Ronstar 2 G (oxadiazon), Turf Enhancer 2 SC (paclobutrozol), Prograss 1.5 EC (ethofumesate), Dimension 1 EC (dithiopyr), Eagle 40 WP (myclobutanil), Sentinel 40 WG (cyproconazole), Banner 1.1 EC (propiconazole), and Primer, a commercial wetting agent reported in industry to have some selective *Poa annua* control.

Visual ratings were taken in early and late December and monthly, thereafter. *Poa annua* control and *Poa trivialis* cover was rated on a 0-100% scale with 0%=worst and 100%=best. Visual ratings were also taken on Bermudagrass injury prior to overseeding with maximum acceptable injury at 30%.

Best (>90%) long-term *Poa annua* control through May followed Dimension (0.5 lb ai/A) applied 30 DBO (Days Before Overseeding) and repeated in February. Sentinel also provided >90% control with applications 45, 30 DBO (1.0 oz/1000 ft^2) plus December (0.33 oz/1000 ft^2). No significant (>30%) turf injury followed any of the 22 treatments.

Acceptable (>70%) *Poa trivialis* cover followed Ronstar (2.0 lb ai/A) applied 60 DBO, Dimension (0.25 lb ai/A) 30 DBO plus February and Dimension (0.5 lb ai/A) 30 DBO plus February, Patchwork (218 lb ai/A) 45, 30 DBO plus December and February (87 lb ai/A) and Patchwork (218 lb /A) 45, 30 DBO plus December (87 lb ai/A), and Eagle (1.8 oz/1000 ft^2) 45, 30 DBO plus December (1.2 oz/1000 ft^2). Remaining treatments provided unacceptable *Poa trivialis* cover, and no differences were seen in *Poa trivialis* germination for any treatments.

Sentinel (1.0 oz/1000 ft^2) at 45 and 30 DBO, Eagle (1.8 oz/1000 ft^2) 45 and 30 DBO, and Banner (6.0 oz/1000 ft^2) 45 and 30 DBO did show minimal (<30%), short-term (14 days) bermudagrass injury, but recovered, thereafter.

Due to the undesirability and expense to control *Poa annua* on overseeded golf greens, research will continue to evaluate these and other potential treatments. *Poa trivialis* seeding rates and dates following certain treatments to improve overall quality.

ARSENAL MOVEMENT IN AN UPPER-COASTAL PLAIN SOIL AND WATERSHED.
T.B. Wiley[1], P.B. Bush, Y.C. Berisford, and J.F. Dowd, University of Georgia, Athens, GA 30602; J.W. Taylor, USDA-Forest Service, Atlanta, GA 30607.

ABSTRACT

Application of Arsenal as part of a regeneration effort was monitored for imazapyr movement in surface water and to groundwater. No detectable imazapyr residues were observed in runoff from a subunit (5.4 ac) watershed, in surface

[1]The authors wish to thank Tom Blalock, Rodney Kellum and International Paper, formerly Union Camp Corporation, for assistance and technical support. This work was supported by the National Agricultural Pesticide Impact Assessment Program, USDA and administered by Forest Health Protection, USDA-Forest Service, Atlanta, GA.

water downstream of the application area, or in groundwater approximately 2 yr following application. Imazapyr residues were periodically detected (<10 ppb) in lysimeters (unsaturated soil solution) for 1 yr following application. A field sampling design, based on the hypothesis that lateral flow occurs along a subsurface indurated layer, showed no indication of subsurface lateral flow.

Laboratory experiments were conducted on the intact sand layer, transition layer and indurated layer cores collected from the study site. Hydraulic conductivities based on Br^- (bromide) velocity were determined to be 0.78 to 1.6 x 10^{-4} cm/sec, 2.4 to 6.9 x 10^{-5} cm/sec, and 1.0 to 1.4 x 10^{-5} cm/sec, respectively. Since these hydraulic conductivities do not differ by more than an order of magnitude, it is unlikely that ponding at the interface of the transition and indurated layers occurs. Modeling Br^- tracer flow showed that hydrologic flow through the sand and transition cores is best described by a one-region flow model. However, flow through the indurated cores is best described by a two-region flow model, indicating the presence of an inactive flow domain.

The intact core experiments suggest that the indurated layer does not impede vertical water flow and that two-region flow occurs in the indurated layer. Through alternating cycles of soil wetting and drying, herbicide in the water will be drawn into micropores by capillary action during a dry cycle. The herbicide will be sequestered in these pores and slowly released by diffusion when the preferential pathways are activated again during a wet cycle. Herbicide released by diffusion would be slow and it is unlikely that detectable concentrations would reach the water table.

INTRODUCTION

To meet the increased demand for wood products, many forests in the Southeastern U.S. must be intensively managed to maximize fiber production. This management includes extensive site preparation, vegetation management, insect control and fertilization.

Assessment of the potential environmental impacts of a herbicide application to a forested watershed requires an understanding of the fate and movement of herbicides which are governed by a complex interaction of physical, chemical, biological, and hydrologic processes. These factors include herbicide characteristics, meteorologic and hydrologic conditions, soil and microbiological processes, vegetation response, and application conditions. Some of the important application conditions include rate, application system, and timing. Rainfall, temperature, sunlight, and evapotranspiration are key meteorologic factors.

Water movement has a significant impact on herbicide movement in a forested watershed. Three hydrologic flow paths are significant: 1) overland flow, 2) subsurface saturated and unsaturated laminar flow (Darcy flow), and 3) subsurface turbulent flow in macropores. Harvest operations can result in significant reapportionment of a plantation's water budget. Reduced evapotranspiration apportions greater volumes of water to leaching and runoff, and so watershed yields increased. Computer simulations of herbicide applications to a Georgia Piedmont site indicated that a half-life ($t_{1/2}$) of 50 or more days and a pesticide distribution coefficient (K_d) value of <10 are required to produce potential herbicide movement to groundwater (Dowd *et al,* 1993). Site preparation herbicides hexazinone, triclopyr, picloram, imazapyr and sulfometuron methyl meet these requirements, thus showing a potential to leach if applied to clear-cut land. Since the potential for contamination of the shallow groundwater in the Coastal Plain is greater than in the Piedmont, it is important to monitor herbicide movement and to develop a comprehensive understanding of edaphic factors that control or modify pesticide movement in the Coastal Plain.

Coastal Plain lithology units consist of sub-horizontal unconsolidated sand, silt and clay formations (layer cake geology). These alternating layers form a regional groundwater system consisting of aquifers and their confining/semi-confining units. Coastal Plain aquifers are usually comprised of highly permeable formations, whereas the confining units are formations of low permeability, primarily silts and clays, and thus form separate hydrostratigraphic units. These hydrostratigraphic units are regional in extent, with localized areas of recharge. Aquifer recharge is dependent upon the hydrologic characteristics of the hydrostratigraphic units (permeability and hydraulic conductivity). Therefore, the transport of organic compounds such as pesticides becomes dependent upon the hydrostratigraphic characteristics and their continuity.

A Coastal Plain herbicide dissipation study indicated that the magnitude of herbicide residue and rate of dissipation were affected by site slope (Bush *et al*, 1995). Significant lateral downslope movement of picloram and hexazinone was observed under saturated hydrologic conditions when slopes exceeded 2% (Bush *et al*, 1995). Imazapyr showed limited potential for lateral movement or vertical movement to an 8 ft perched water table, and was not as mobile or persistent in shallow wells as were hexazinone or picloram. Previous computer modeling has shown that by reducing the evapotranspiration component of the water budget by clear-cutting, the increased volume of water leaching below the root zone results in increased potential for groundwater contamination (Dowd *et al*, 1993). Further studies are needed to better understand factors affecting pesticide fate and movement in Coastal Plain soils.

In 1995, a NAPIAP-funded environmental-fate study was established in the Georgia Upper-Coastal Plain to determine the movement and dissipation of the insecticide imidacloprid in soil and pine needle tissue. As part of the intensive pine management practices used for this study site, herbaceous and woody weed competition was controlled by an application of Arsenal and Oust. Since this site was already instrumented with H-flumes to measure and sample surface runoff, lysimeters to collect near subsurface soil water, and groundwater monitoring wells, an opportunity existed to collect additional data on the movement and dissipation of imazapyr in Coastal Plain soils under operational conditions and at minimal environmental and monetary costs.

METHODS AND MATERIALS

Site Description: The study area is located in the Georgia Upper-Coastal Plain near Downs, GA. Historically, the area was a natural forest to which pesticides had not been applied for at least 40 yr prior to 1995. The site is surrounded by mature mixed hardwood and loblolly pine forests. A stream borders the site on the southwestern side. The stream flows from the northwest to the southeast and has a width of approximately 15 ft and depth of 2-4 ft (Figure 1).

The soil is predominately Orangeburg series with small areas of Ochlocknee series in the draws. The upland flats have three distinct soil layers based on split spoon samples taken during well installation. The upper layer is approximately 3-4 ft thick and has a sandy to loamy sand texture. Underlying this sand layer is a CRISL (clay-enriched indurated soil layer) consisting of red, dense sandy clay to sandy clay loam that is approximately 15-17 ft thick (mechanical analysis: 70-75% sand, 8-10% silt, 10-20% clay). Beneath the CRISL are coarse sand layers that extend to the water table. Erosion has exposed the CRISL at certain areas within the site. The CRISL slopes toward the center of the watershed and has erosional features hidden by overlying sand. A 5.4 ac watershed within the treated area was chosen to monitor the movement and dissipation of imazapyr. A small ephemeral stream forms within the watershed and drains the bottom of the Arsenal treatment area during large rainfall events (Figure 1).

Based on well borings, adjacent road cut evaluation, soil borings, and small core experiments, it was postulated that precipitation infiltrates the ground surface and percolates through the sandy loam layer until it reaches the CRISL. Vertical flow is impeded at the CRISL, causing the water to pond. Due to the slight slope of the layer (3-7%) the water travels laterally until the CRISL becomes discontinuous. Based on GPR (ground penetrating radar) site evaluation, the CRISL becomes discontinuous in the ephemeral stream bed. It is likely that the stream eroded the CRISL at the bottom of the stream channel. At the gap in the CRISL, the water resumes a vertical flowpath through the underlying sand and towards the water table (Figure 4 A).

Site Preparation: Trees on the site were harvested during August, 1994. Site and regeneration activities included spot raking (June 2, 1995), chopping using a drum roller (June 30, 1995), burning (July 14, 1995) and harrowing (September 12, 1995). On November 7, 1995, loblolly pine (*Pinus taeda* L.) seedlings were planted with a mechanical planter along the contour of the watershed in a 6 ft by 12 ft spacing (600 trees/ac). Imidacloprid was applied on February 26, 1996, followed by VelparL/Oust herbicide applications on April 1, 1996 and Arsenal application on September 24, 1996. Arsenal was applied again on June 22, 1997.

Watershed Instrumentation: The following were installed in the watershed:
A weather station equipped with a pyranometer, an anemometer, a weather vane, a relative humidity gauge, an internal and external temperature gauge, a barometer, a tipping-bucket rain gauge, a standard rain gauge and an evaporation pan.

Three 2-in diameter PVC wells were installed to sample groundwater and to monitor fluctuations in the depth to water in the wells. Wells were 39.5 ft (Well C1), 72.5 ft (Well C2), and 77 ft (Well C3) deep. Average depths to groundwater were 32, 52 and 70 ft, respectively. The water table fluctuated <1 ft over the study period.
A 1.5 ft H-flume, equipped with a Coshocton wheel discrete interval sampler and an FW-1 stage-height recorder for determining runoff volumes and durations, was installed across the ephemeral stream.
Thirty-six 1-bar high-flow porous ceramic cup lysimeters were installed approximately 30 ft apart in a 6 x 6 grid (Figure 1). Each lysimeter was installed at or within 6 in of the interface between the upper sandy layer and the CRISL. Based on field observations and measurements, it was theorized that water would tend to pond at this interface; hence greater volumes of water would be available for uptake into the lysimeters at this depth. Lysimeter depths ranged from 12-43 in.

Arsenal Application: Arsenal Applicator Concentrate (43.3% imazapyr) was aerially applied by helicopter at the operational rate of 5.12 oz formulation/ac (= 2.22 oz imazapyr ai/ac) on September 24, 1996 and June 22, 1997 by a Hiller-Soloy helicopter. Application solution contained Bullseye dye (0.5% of application solution volume). Dye was added as an aid to measure helicopter swath width. Pine Belt, Inc. (Monticello, AR) applied Arsenal to the site. "Crophawk" software was used to calibrate the spray rig to deliver 10 gal application solution/ac. The rig had a 90 gal spray tank and D6,46 plate raindrop nozzles that were spaced 6 in apart on a 30-ft boom. The helicopter flew at a speed of approximately 54 mph and approximately 50 ft above the field. The ground deposition of imazapyr was calculated from residues that were intercepted on 9.0 cm diameter glass fiber disks.

Analytical Technique for the Detection of Residues: Standard immunoassay kits (EnviroGard™ Imazapyr Plate Kit) provided by EnSys, Inc. (P.O. Box 14063, Research Triangle Park, NC 27709) together with standard reference material were used to determine imazapyr levels in water samples, trip blanks, and fortified samples. The imazapyr kit allowed quantitation of imazapyr residues between 2.5 and 30 ppb in undiluted water samples. Formulation and residue levels on deposition disks were determined by HPLC.

Variability in test kits due to natural water interferences was overcome by applying a sample in each of 2-3 adjacent cells of the immunoassay plate. A "duplicate run", then was a "sample run" that was duplicated somewhere else in the plate;

thus the same sample was applied to a total of either 4 or 6 cells in the plate. Given the attainment of acceptable standard curves (r^2 >0.95) in all kits and the reproducibility within the 2-3 cells/sample (cv<15), the results are within an acceptable range.

Intact Core Tracer Experiments: To better characterize water movement through the unsaturated zone and the soil profile, intact cores from three different lithologies were collected from the study site (as described by Tindall *et al*, 1992) and used to conduct unsaturated laboratory tracer studies according to the method of Baldwin (1997, thesis). Cores representative of the upper sand layer, the transition layer and the CRISL were collected from the study site, mounted on one-bar porous ceramic pressure plates, and instrumented with lysimeters and tensiometers. Aqueous tracer cocktails of Br^- and Oust or Arsenal were applied at a uniform rate (Table 1). The application produced unsaturated hydrologic conditions that did not reach equilibrium. Accurate and temporally real-time measurements of soil tension and tracer concentration were determined and recorded. Vacuum pumps pulled sample water from the lysimeters into sample traps. A peristaltic pump then routed the samples to a fraction collector. The samples were capped, removed from the fraction collector and refrigerated. They were analyzed for Br^- using a Dionex DX – 100 Ion Chromatograph and for imazapyr using HPLC.

Tracer experiments were conducted on three intact soil cores. Each core represented a distinct lithology from an Upper-Coastal Plain watershed. Tracers consisted of Br^- and either Arsenal or Oust herbicide. The tracer was continuously applied as an aqueous solution to the top of the core and then followed by a flush water solution.

Solute was sampled and soil tension was measured at multiple locations, which allowed for construction of breakthrough curves (BTC) for up to three different depths for each core. The breakthrough curves were then used to calculate advective pore water velocities. The velocity measurements were also used to calculate retardation factors and distribution coefficients. The soil tension measurements were used to calculate hydraulic gradients and to determine the moisture conditions within the cores. The hydraulic gradients were used with the velocities to calculate K (unsaturated hydraulic conductivity) values for different locations within the cores.

RESULTS AND DISCUSSION

Flume water samples were collected following each storm generating stormflow through the flume. From the 11 storm events between September 24, 1996 and May 9, 1997, only two runoff samples contained imazapyr residues (trace levels of 2.5-5.0 ppb). All other samples contained non-detectable residues (<2.5 ppb). Due to vegetative growth and increased evapotranspiration, only one rain event produced runoff in 1998, and it contained approximately 7 ppb imazapyr.

Well water from wells C1, C2, and C3 was sampled prior to the first Arsenal application and approximately 0.5, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 14, 18, 20 and 36 mo following the initial application. (Actual sampling date varied by 1-2 wks, depending on work schedule.). No imazapyr residues were detectable in any of the well samples. Stream samples were collected before spray application, the day following application, and approximately 2 wks, and 1, 2, 4, 6, 7 and 10 mo post-application. All imazapyr residues were <5 ppb.

Lysimeters: Low level (<10 ppb) imazapyr residues were periodically detected in lysimeters following initial application (Figure 2). Few samples were obtained during the dry, summer months following the second Arsenal application. When the soil moisture increased in the fall and winter of 1997-1998, low level imazapyr residues were again detected in lysimeters.

Imazapyr residues occurred randomly with respect to slope position. There was no indication of lateral downslope movement at the sand/CRISL interface as had been initially postulated. This is further supported by a Br^- tracer study conducted by W.W. Johnson (2000, thesis), who found that incorporation of 25 lb of Br^- in a trench above the top row of lysimeters resulted in only trace quantities of Br^- in the lysimeters. Therefore, we questioned if the CRISL serves as a barrier to water movement to groundwater under field conditions or if the CRISL allows water to pass (Figure 4). To address this question, a series of intact soil cores was collected and tracer studies (Br^-, Oust and Arsenal) were conducted in the laboratory.

Summary of Results for Different Lithologies: *Sand Core:* The sand core had the highest hydraulic conductivity values, and the highest retardation factors and distribution coefficients for both Br^- and Oust®. All the locations within the cores had hydraulic conductivity values of 10^{-5} cm/sec order of magnitude except for the plate on the sand core, which was 10^{-4} cm/sec for Br^-.

Transition Core: The transition core hydraulic conductivity values were lower than the sand core values but slightly higher than the CRISL. This was also the case with the retardation factors and distribution coefficients.

CRISL Core #1: This CRISL core had lower hydraulic conductivity values than the upper lithology cores. It also had the lowest retardation factors and distribution coefficients. The retardation factors were < 1 and the distribution coefficients were negative values because the herbicide appeared to be traveling ahead of the Br^-.

CRISL Core #2: This CRISL core had the lowest hydraulic conductivity values of the four cores. The retardation factors and distribution coefficients were comparable to those of the transition core.

In all four cores, there was little evidence of herbicide sorption. The conservative tracer Br^- and the herbicides exhibited very similar behavior, with low retardation factors and distribution coefficients. A retardation factor of 1 indicates that no sorption is occurring. The imazapyr traveled with or slightly behind the Br^- tracer (retention value = 1.0-1.1). Oust tended to precede the Br^- through the CRISL (retention value 0.8). There was little absorption (low K_d) in the transition or CRISL. The similarity of hydraulic conductivities for all three lithologies does not support the premise that vertical flow is impeded at the CRISL, causing ponding and leading to horizontal flow along this layer until it becomes discontinuous (Figure 4 A) as postulated by Burkingstock (1997, thesis) and Field *et al* (1997).

Using the hydraulic conductivity calculated in Table 2, and assuming 50 in of rainfall (no evapotranspiration), the minimum travel time for Br^- to reach groundwater is >10 yr (>40 imazapyr half-lives; Ware, 1992) for areas with an intact CRISL. The travel time in areas with no CRISL is 1.5 yr (5 imazapyr half-lives; Ware, 1992). It is, therefore, unlikely that detectable residues will reach groundwater.

CXTFIT Simulations: A CXTFIT (Parker and van Genuchten, 1984) computer program was used to determine solute transport parameters from core breakthrough curves for the conventional single-region flow model and the two-region non-equilibrium flow-model concepts of van Genuchten and Wierenga (1976) (Figure 3). In the single-region model, all wetted pore space contributes to mobile flow. However, in the two-region model there is both an active and inactive flow domain. In the inactive flow domain there are stagnant regions of wetted pore space that do not contribute to mobile flow. A portion of solute can become immobilized in the stagnant regions, and slowly diffuse back out into mobile flow regions. The computer program uses the appropriate analytical solution to calculate the value of transport constants that produce the best fit of predicted concentrations to observed concentrations (Figure 3).

Flow through the sand and transition cores was best described by the one-region flow model. However, flow through the CRISL cores was equally well described by the one- or two-region flow model. Two-region flow indicates the presence of an inactive flow domain. The two-region flow in the CRISL gives it the ability to reduce the concentration of a pesticide passing through it by trapping some of the mass of the pesticide in stagnant regions of the flow domain. CXTFIT beta () values correspond to the percentage of the wetted pore space contributing to mobile flow. Beta values for CRISL Core #1 (Oust®) and CRISL Core #2 (Arsenal®) were 0.68 and 0.72, respectively. In CRISL Core #1, 32% of the flow domain was immobile, while in CRISL Core #2, 28% of the flow domain was immobile.

Calculation of the potential herbicide concentration in the immobile region produced concentrations given in Table 3. Since the maximum potential concentration of 16 ppm in the immobile phase water is well below the imazapyr solubility (11,000 ppm; Ware, 1992), the immobile phase in 1 ft of CRISL has the potential to sequester all the pesticide traveling through it. Repeated herbicide applications to the same area could result in eventual breakthrough. However, since the herbicide is only applied 1-3 times during a 15-20 yr pulpwood rotation, it is unlikely that herbicide breakthrough will occur.

Conclusions: Monitoring an operational application of Arsenal® to an Upper-Coastal Plain site revealed only trace residues in surface runoff or movement to adjacent surface water. No imazapyr residues were detected in groundwater.

Soil solution sampling at the surface sand/CRISL interface showed no spatial pattern indicative of a lateral downslope flow pattern along the sand/CRISL interface. Intact core experiments suggest that the CRISL does not impede vertical flow and that two-region flow occurs in the CRISL. It is likely that a potential contaminant can travel through the CRISL, but that over an annual cycle of wetting and drying of the soil any herbicide in the water will be drawn into the non-preferential flow paths (micropores) by capillary action during a dry cycle. The herbicide will be sequestered in these pores and will only be released by diffusion when the preferential pathways are activated again during a wet cycle. The amount of herbicide released by diffusion will be very small and it is unlikely that detectable concentrations will reach the water table.

The use of herbicides such as Arsenal® or Oust® in forestry practices is unlikely to result in groundwater contamination where the CRISL is present and the water table is an adequate distance from the surface. However, repeated intense applications over a long period of time, common in some forms of agriculture like orchards, could overwhelm the non-preferential flow paths (immobile regions) of the CRISL. It is unlikely that the two-region flow behavior of the CRISL is isolated to this site. This CRISL is part of the Tobacco Road formation that is commonly found in the Upper Coastal Plain.

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TABLES AND FIGURES

Table 1. Physical parameters for intact core Br^- and Oust herbicide tracer experiments.

Core Experiment physical paramters	Sand Core #1		Transition Core #1		CRISL Core #1	
Amount of tracer solution (L) (pore volumes)	18.7	1.63	19.1	1.94	18.5	2.8
Amount of flush solution (L) (pore volumes)	35.8	3.11	35.1	3.55	43.5	6.6
Total solution applied (in)	30.4		30.2		34.6	
Tracer application (days)	7		9.5		10	
Flush application (days)	16		17		19.3	
Total application (days)	23		26.5		29.3	
Application rate (L/day)	2.37		2.05		2.12	
Pore volume (L)	11.5		9.9		6.6	
Avg. tension (cm H_20)	9.1		7.3		6.8	

Table 2. Calculated hydrologic parameters for intact core tracer experiments. Oust® was applied to Sand Core #1, Transition Core #1, and CRISL Core #1. Arsenal® was applied to CRISL Core #2. A retardation factor of 1.0 indicates no sorption.

Core	Location	Hydraulic conductivity (cm/sec)		Herbicide Retardation Factor	Herbicide Distribution Coefficient (K_d) (g/cm^3)
		Br-	Herbicide		
	top lysimeter	$7.8 * 10^{-5}$	$3.5 * 10^{-5}$	2.2	0.28
Sand	Bottom	$8.0 * 10^{-5}$	$3.1 * 10^{-5}$	2.6	0.35
#1	Plate	$1.6 * 10^{-4}$	$6.7 * 10^{-5}$	2.3	0.31
	top lysimeter	$6.9 * 10^{-5}$	$6.1 * 10^{-5}$	1.1	0.03
Transition	Bottom	$2.4 * 10^{-5}$	$2.1 * 10^{-5}$	1.1	0.03
#1	Plate	$2.8 * 10^{-5}$	$2.4 * 10^{-5}$	1.2	0.04
CRISL #1	Lysimeter	$1.0 * 10^{-5}$	$1.6 * 10^{-5}$	0.7	-0.08
	Plate	$1.4 * 10^{-5}$	$1.7 * 10^{-5}$	0.8	-0.05
CRISL #2	Lysimeter	$4.4 * 10^{-6}$	$4.7 * 10^{-6}$	1.0	-0.01
Arsenal®	Plate	$5.6 * 10^{-6}$	$5.2 * 10^{-6}$	1.1	0.02

Table 3. Concentration of Arsenal in the CRISL of various thicknesses, corresponding to percentage of flow domain that is immobile. Site application rate is 2.2 oz ai/ac.

% Immobile region	**Concentration of Arsenal in CRISL of 1 ft thickness (ppm)**	**Concentration of Arsenal in CRISL of 8 ft thickness (ppm)**	**Concentration of Arsenal in CRISL of 16 ft thickness (ppm)**
50	0.33	0.041	0.021
25	0.66	0.082	0.041
5	3.3	0.411	0.206
1	16.4	2.055	1.028

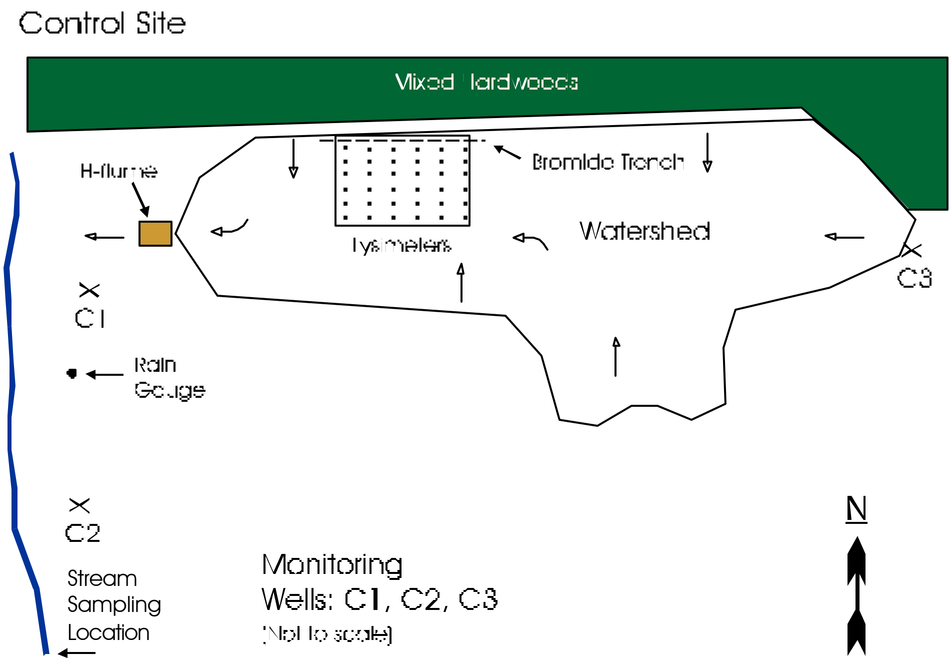

Figure 1. Diagrammatic presentation of Arsenal® study watershed showing location of sampling points. Stream is located ~ 2,000 ft southwest of treated watershed and ~500 ft from nearest Arsenal® treated area. Vegetated streamside buffer strip = 400 ft. Weather station is 1,400 ft due south of Arsenal® study plot. Hollow arrows indicate downslope

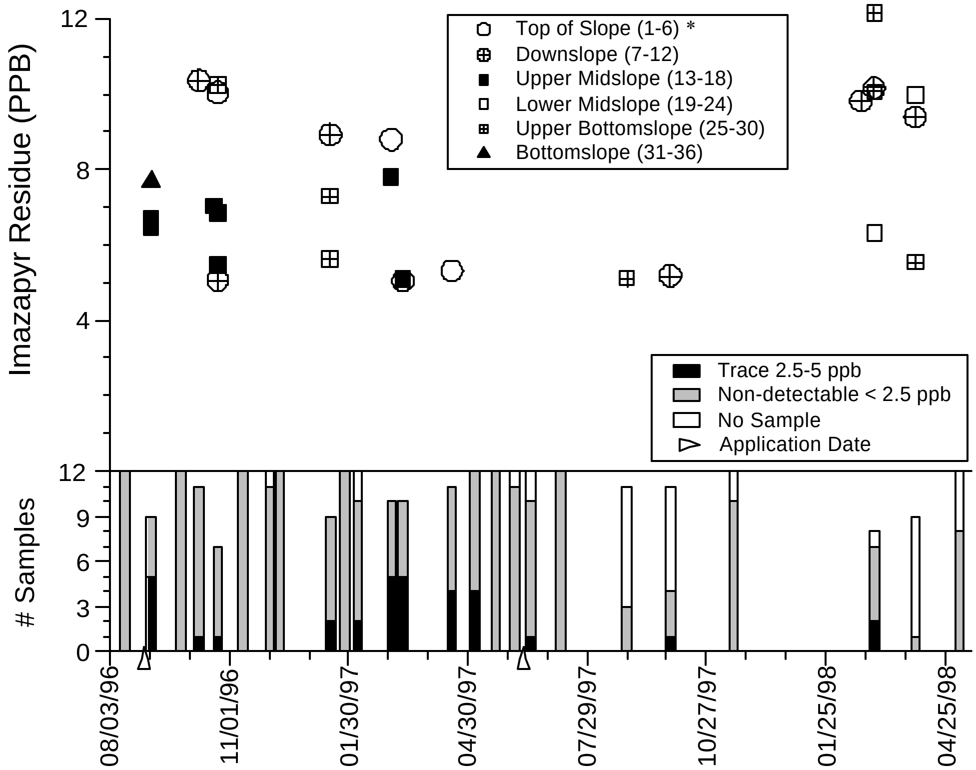

Figure 2. Imazapyr residue levels (ppb) in soil suction lysimeter samples collected for 2 yr after initial Arsenal® application. Lysimeter suction cups were installed at the sand/indurated layer interface (0.2-1.0 m depth) from the top to the bottom of the slope in five intermediate positions: 0.2, 0.4, 0.6, 0.8 and 1.0. Imazapyr levels >5.0 ppb are presented as individual values. Trace quantities and non-detectable residues are summarized at the bottom of the figure. *Numbers in parentheses refer to lysimeter groups.

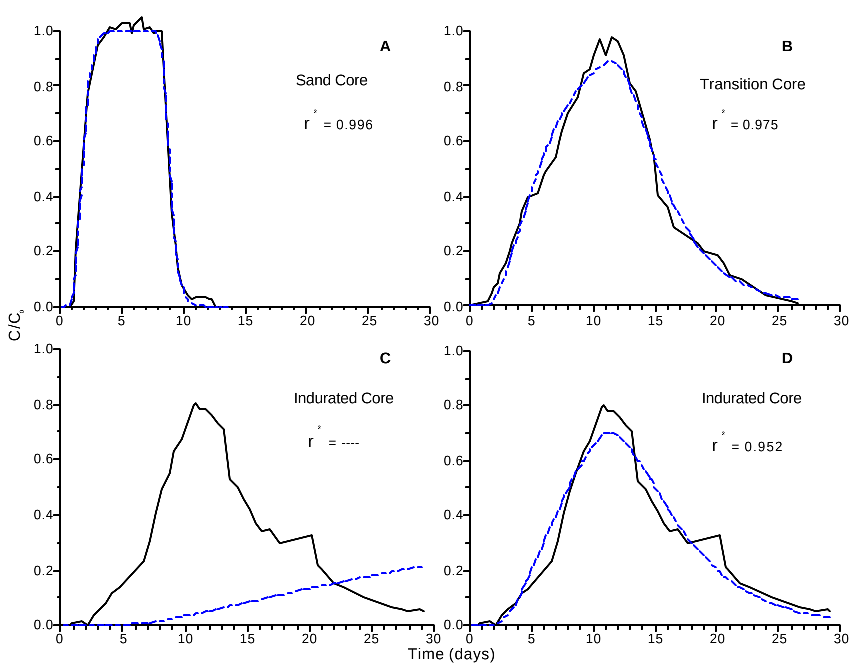

Figure 3. Comparison of measured bromide concentrations (¾) with CXTFIT simulated concentration (----) for: A: sand core + one-dimensional convection-dispersion equation solution; B: transition layer + one-dimensional convection-dispersion equation solution; C: indurated layer + one-dimensional convection-dispersion equation solution; D: indurated layer + two-dimensional convection-dispersion equation solution.

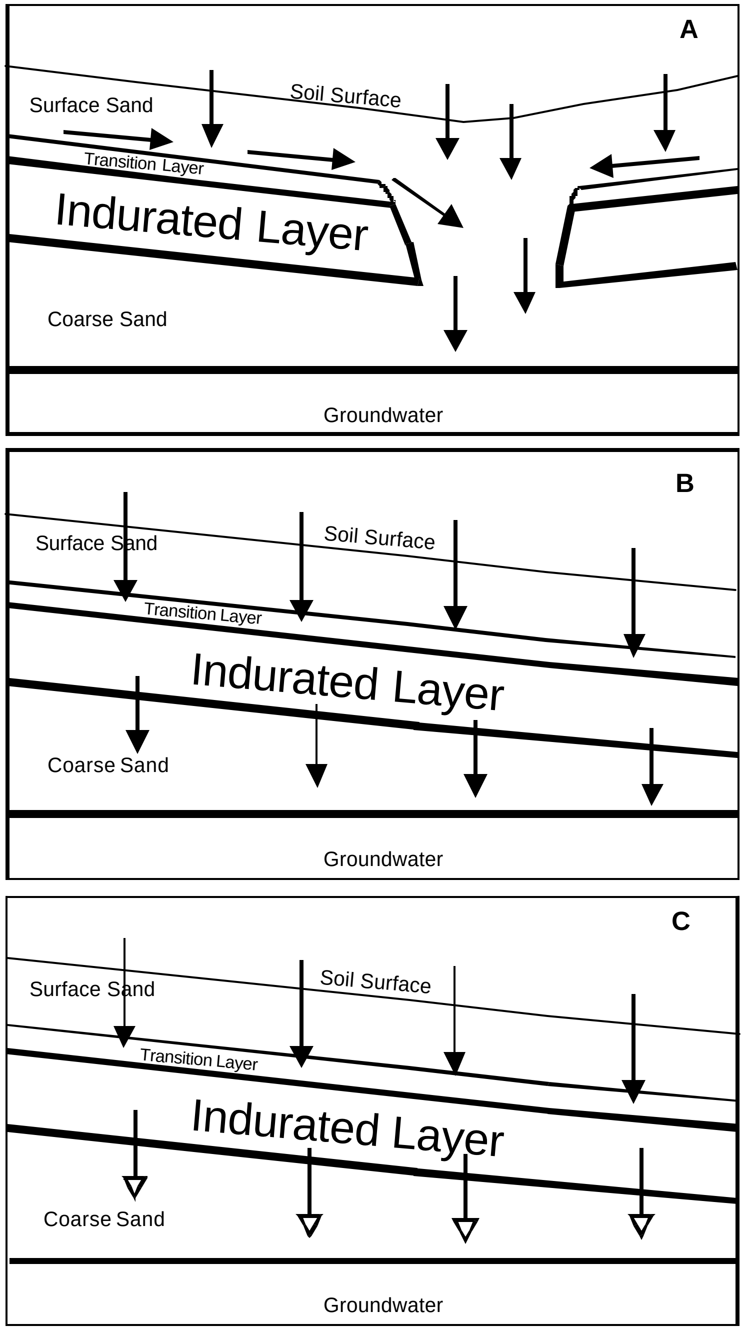

Figure 4. Diagrammatic presentation of possible flow paths.
A) Based on GPR data, water rapidly moves through the upper surface sand layer to the CRISL.The CRISL provides a barrier to vertical migration of recharge water and possible contaminants. With resulting periodic soil saturation and slope, it is thought that water and dissolved contaminants move laterally downslope along the CRISL surface to discontinuities at the bottom of the watershed. The absence of the CRISL in the area of the ephemeral stream provides a more direct pathway for groundwater recharge and transfer of possible contaminants.
B) In a second scenario, water and contaminants rapidly pass through all three layers to groundwater. Water and/or pesticides are not retained.
C) Water rapidly moves through the surface sand layer into the transition layer. Because of the large number of small pores in the transition layer due to clay and organic material leaching above, this layer holds water and appears moist. It is an area of heavy root infiltration for plant uptake. Since the hydraulic conductivities of the three layers are similar, water readily passes into the CRISL. During the repeated cycles of wetting and drying of the soil, herbicide solution is drawn into the micropores by capillary action during a dry cycle. The herbicide is sequestered in these pores and slowly released by diffusion when the preferential pathways are reactivated during a wet cycle

FFECTS OF OFF-TARGET DEPOSITION OF NON-SELECTIVE HERBICIDES IN NON-TRANSGENIC CROPS. C.D. Rowland, Jr., D.B. Reynolds, and R.H. Blackley, Jr., Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Herbicide spray drift is a major concern in the application of agricultural herbicides. In Mississippi, many corn, soybean, and cotton fields are located in close proximity, thus herbicides used in one crop may contact non-target crops by drift. The use of transgenic crops in agriculture has increased dramatically over the past few years. Transgenic crops are useful tools in weed management; however, problems may occur when transgenic crops are planted in close proximity to susceptible crops. Herbicides that can be applied over the top of resistant varieties may drift onto susceptible crops causing damage. These factors may further be complicated by aerial applications. Field studies were conducted in 1998 and 1999 at the Plant Science Research Center at Mississippi State University and at the Black Belt Experiment Station near Brooksville, MS, to evaluate the effects of sublethal concentrations of various herbicides on cotton (*Gossypium hirsutum* L.) and corn (*Zea mays* L.) growth, development and yield when applied at various growth stages. Treatments were arranged in a factorial arrangement in a randomized complete block design with four replications. Plots were 12 by 40 feet and all applications were applied at 15 gallons per acre. Factor A consisted of herbicide rates. Staple (pyrothiobac) rates used in corn were 0.5, 0.25, 0.125, 0.0625, and 0.0313 oz ai/A. Liberty (glufosinate) rates used in corn were 0.19, 0.0944, 0.0472, 0.0236, 0.0118 lb ai/A. Rates of Roundup (glyphosate) used in cotton were 0.375, 0.187, 0.093, 0.046, and 0.023 lb ai/A. Typical 1-x application rates for Staple, Liberty, and Roundup are 1.0 oz ai/A, 0.38 lb ai/A, and 0.75 lb ai/A, respectively. Factor B consisted of growth stages at time of application. Application timing in corn included 2-leaf, 6 to 8-leaf, and 12 to 15-leaf growth stages, and in cotton included cotyledon, pinhead square, and early bloom. Plant height and visual injury were determined 7, 14, and 28 days after each application timing, and machine harvested yield was determined to evaluate the effects of the herbicides. Corn plant height reduction was greater with 0.0944 lb ai/A and higher rates of Liberty applied at the 2 leaf and 6-8 leaf growth stage, and yield was reduced generally with the same rates of Liberty applied at the 2 leaf and 6-8 leaf growth stages. In general, as the rate of Liberty in corn increased, plant height and yield reductions increased. Corn plant height reduction was greater at the 2 leaf and 6 to 8 leaf growth stage for all rates of Staple applied. Corn plant height reductions for all rates of Staple ranged from 17 to 73% at both the 2 leaf and 6 to 8 leaf growth stages. In general, yield was reduced at the 2 leaf and 6 to 8 leaf growth stages with all Staple rates, and the 12 to 15 leaf growth stage with 0.125 oz ai/A and higher rates of Staple. Cotton plant height was reduced with 0.093 lb ai/A and higher rates of Roundup applied at the cotyledon growth stage. Cotton plant height was reduced 17% when 0.375 lb ai/A of Roundup was applied at the pinhead growth stage. Generally, yield was reduced with 0.187 lb ai/A and higher rates of Roundup were applied. In general, as the rate of Roundup in cotton increased, plant height and yield reductions increased.

COMPARISON OF SPRAY APPLICATION SYSTEMS ON THE EFFICACY OF ROUNDUP ULTRA® IN ROUNDUP READY® COTTON. W.H. Faircloth, M.G. Patterson, S.B. Belcher, and D.O. Stephenson, IV. Department of Agronomy and Soils, Auburn University, Auburn, AL 36849.

ABSTRACT

Field trials were initiated in 1998 to evaluate the effectiveness of Roundup Ultra® herbicide while using a low volume, air-assisted spray system. The Teemizer System[1] is an air-assisted system that uses air in addition to liquid as the carrier for pesticide solution. Air-assisted sprayers may allow reduced herbicide rates without sacrificing weed control. Two trials, one for pitted morningglory [*Ipomoea lacunosa* L.] and one for sicklepod [*Senna obtusifolia* (L.) Irwin & Barneby], were designed and replicated over two years. A factorial arrangement of Roundup Ultra® rate (0.14, 0.28, 0.56, and 1.12 kg ai/ha), weed growth stage at application (2-leaf and 4-leaf), and sprayer type (Teemizer system - 18.7 L/ha and conventional, hydraulic system - 93.5 L/ha) was implemented. Transgenic, glyphosate-tolerant cotton was grown on the Alabama Agricultural Experiment Station near Shorter, AL, using conventional growing practices. Appropriate weed seed was sown over one row of two row plots which were then treated according to the protocol. Data obtained included visual ratings of weed control and crop injury, weed biomass samples, and seed cotton yield.

Injury to cotton as a result of herbicide spray averaged less than 1% for both weed trials, and was therefore deemed insignificant. Visual weed control ratings suggested that pitted morningglory control was determined mainly by Roundup Ultra® rate, with 1.12 kg ai/ha providing 74% control, regardless of sprayer type used. Sicklepod control was affected similarly by Roundup Ultra® rate, but weed control at the 2-leaf stage was 25% greater than at the 4-leaf stage. The air-assisted sprayer provided equivalent control on 2 and 4 leaf weeds, respective of rate. However, weed control dropped significantly as applications were delayed from 2 to 4 leaves with the conventional sprayer. Weed biomass samples confirm visual ratings, showing a reduction in biomass for both weeds as rate increased. The air-assisted spray system provided numerically decreased pitted morningglory biomass production during both years and statistically better in 1998. Biomass ratings confirm that small differences in the spray systems exist. Seed cotton yield data were influenced solely by herbicide rate, with each increase in rate resulting in higher yields. Though a reduction in herbicide

[1]Developed by J.R. Williford and F.E. Fulgham, Field Crops Mechanization Unit, USDA-ARS, Stoneville, MS (not commercially available).

rate was not realized, these field experiments show that an air-assisted sprayer would be an effective alternative to the conventional hydraulic sprayer for Roundup Ultra® application.

GLYPHOSATE APPLICATION TIMING BASED ON WEED CANOPY LAI VALUES IN SOYBEAN. K.D. Walsh and L.R. Oliver, Department of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville, AR 72701.

ABSTRACT

The objective of this study is to determine, by total weed leaf area index (LAI), the most effective timing for the first application of glyphosate in narrow- and wide-row soybean production systems.

A field study was conducted during the summers of 1998 and 1999 at the University of Arkansas Main Agricultural Experiment Station in Fayetteville, AR to determine, by total weed leaf area index (LAI), the most effective timing for the initial application of glyphosate in narrow- and wide-row soybean production systems. The experiment was a completely randomized design. Palmer amaranth (*Amaranthus palmeri*), pitted morningglory (*Ipomoea lacunosa*), entireleaf morningglory (*Ipomoea hederacea* var. *integriuscula*), prickly sida (*Sida spinosa*), common cocklebur (*Xanthium strumarium*), barnyardgrass (*Echinochloa crus-galli*), broadleaf signalgrass (*Brachiaria platyphylla*), and large crabgrass (*Digitaria sanguinalis*) seed were spread across the field in varying densities in order to achieve varied weed densities. Asgrow 5601 RR soybean were planted at two row spacings: 51 cm (wide-row) and 19 cm (narrow-row). Plots were 6.25 m^2 and were trimmed to 4 m^2 at soybean harvest. Glyphosate was applied over-the-top at a rate of 1.12 kg ai/ha from 7 to 56 DAE and was repeated, as needed, through the growing season to prevent weed reinfestation. Prior to glyphosate application, crop and weed LAI were measured for 8 wide-row and 9 narrow-row plots based on plant samples taken fromtwo 0.25 m^2 subplots. Data were analyzed using surface response analysis with DAE and total weed LAI as the independent variables and soybean yield as the dependent variable. Percent yield loss was predicted based on models for the two row spacings. Predicted percent yield loss data were then analyzed by analysis of variance.

Percent yield loss in wide rows was significant when the weed canopy achieved an LAI of 1 after 10 DAE. Initial glyphosate timings could be delayed up to 30 DAE for total weed LAI values less than one in wide rows. Percent yield loss in narrow rows was significant at weed canopy LAI greater than 0.4. Similar to wide rows, glyphosate application can be delayed in narrow-row soybean as long as the weed canopy LAI remains small. However, yield loss in narrow rows significantly increases at smaller weed canopy LAI values than wide rows indicating a need to remove weeds earlier in narrow rows.

A QUANTITATIVE DESCRIPTION OF THE EFFECT OF SOYBEAN POPULATION AND GLYPHOSATE USE ON PITTED MORNINGGLORY (*IPOMOEA LACUNOSA*) INTERFERENCE IN DRILLED ROUNDUP READY SOYBEAN (*GLYCINE MAX*). J.K. Norsworthy and L.R. Oliver, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR 72704.

ABSTRACT

Current recommendations for drilled glyphosate-tolerant soybean in the southern U.S. involves sequential applications of glyphosate. Experiments were conducted at the Main Experiment Station at the University of Arkansas in Fayetteville to investigate the influence of soybean population, pitted morningglory density, and a single glyphosate application on growth and seed production of soybean and pitted morningglory. Delta King 5961 Roundup Ready® soybean was drill seeded at 247,000, 433,000, and 618,000 seed/ha. Four weeks after soybean emergence, average soybean densities over the three years were 217,000, 371,000, and 521,000 plants/ha. Pitted morningglory seed was planted (equally spaced) at densities of 0, 10, 16, and 62 plants/ha. Glyphosate at 1.12 kg ai/ha was applied at V4 to V6 (13- to 29-leaf morningglory) and none.

Pitted morningglory photosynthetic rate at 2 and 12 wk after treatment was reduced 64 and 80%, respectively, when treated with glyphosate. Straight line regression of pitted morningglory LAI vs. pitted morningglory growing degree days (GDD) revealed pitted morningglory density and glyphosate use directly influenced the rate at which pitted morningglory LAI increases. Glyphosate-treated pitted morningglory at 10 plants/m^2 never reached a "critical LAI" of 1; however, at 62 pitted morningglory/m^2 the critical level was reached by 700 pitted morningglory GDD. The rate of accumulation of pitted morningglory LAI was decreased 86 and 85% at 10 and 62 pitted morningglory/m^2 for treated compared to untreated pitted morningglory. Pitted morningglory biomass and LAI were highly correlated (r =0.95). Pitted morningglory produced a maximum of 24 million seed/ha in the absence of glyphosate at 217,00 soybean/ha. Pitted morningglory seed production declined with increasing soybean density in the absence of glyphosate with a 41% reduction in seed production when soybean population increased from 217,000 to 521,000 plants/ha. When treated with 1.12 kg/ha glyphosate, pitted morningglory seed production ranged from 380,000 to 700,000 seed/ha, enough seed to prevent depletion of the soil seedbank. Soybean seed yield was not influenced by pitted morningglory density when treated with glyphosate. In the absence of glyphosate, percent reduction in soybean seed yield increased with pitted

morningglory density ,with a 47, 62, and 81% reduction at densities of 10,16, and 62 pitted morningglory/m^2, respectively. Soybean competitiveness increased with soybean seeding rate, resulting in 16% less yield loss at 521,000 compared to 217,000 plants/ha. Glyphosate- treated pitted morningglory did not cause a reduction in soybean seed yield at all soybean seeding rates. Thus, a single application of glyphosate can provide enough season-long control of pitted morningglory to prevent soybean seed yield loss, potentially reducing producer inputs; however, pitted morningglory seed production will prevent depletion of the soil seedbank, allowing this weed to be a problem in future years and potentially altering composition of the soil seedbank.

INFLUENCE OF METAM SODIUM ON THE DISSIPATION OF EPTC AND PEBULATE IN PLASTICULTURE TOMATO PRODUCTION. C.L. Stiles, T.C. Mueller, and D.K. Robinson. University of Tennessee, Knoxville, TN 37996.

ABSTRACT

Methyl bromide may be involved in the depletion of the stratospheric ozone layer. As a result methyl bromide use in preplant soil fumigation is being phased out. A tentative deadline for the complete phase out has been set for 2005. As a result, tomato producers need alternatives to provide effective weed control. It has been estimated that a ban on the use of methyl bromide would cost producers and consumers in the United States more than $1 billion annually and could reduce tomato production by 69%. There are limited broad spectrum potential alternatives including metam-sodium, chloropicrin, dazomet, and 1,3-dichloropropene.

The phase out of methyl bromide has encouraged research into alternative options producing comparable weed control. Weed management strategies in plasticulture are simplified because most weeds cannot get through the plastic. However, control of escapes is more complex due to plastic row cover limiting cultivation and additional herbicide applications. Fewer herbicide options exist and there is enhanced potential for crop injury in this closed micro-environment. Even though these negatives in terms of herbicide availability exist, use of polyethylene mulch increases weed control and can provide optimum tomato production yield quality and quantity. As a result, plastic use in commercial vegetable production has increased in the past 25 years.

Dissipation of EPTC and pebulate in a Sequatchie silt loam soil under plastic mulch in the absence and presence of metam (110 kg ai/ha) under plastic mulch was examined in field experiments in 1998 and 1999 in Knoxville, TN. The soil was of the Sequatchie loam series (fine-loamy, siliceous, thermic Humic Hapudult) with a pH of 6.2, organic matter of 1.3%, cation exchange capacity of 5.5 cmol/kg, and sand/silt/clay percentages of 43/44/13, respectively. Plots were 2.2 m wide by 5.3 m long. In 1998 the study was initiated May 26. The 1999 experiment was initiated on April 14. Treatments were applied preplant incorporated (PPI) and were arranged in a split plot design with four replications. The main plot was the presence or absence of metam at 110 kg ai/ha. The subplot consisted of an untreated, EPTC at 3.43 kg ai/ha and pebulate at 6.72 kg ai/ha. Herbicide applications were made with a CO_2-pressurized backpack sprayer. EPTC and pebulate were applied first in 170 L/ha of water carrier. Metam was then applied over the herbicides at 940 L/ha. Due to the volatility of these compounds incorporation was conducted immediately after application. Following incorporation plastic was laid to prevent any herbicide loss.

Soil was collected from each plot, using a 8-cm diameter plugger type sampler to a depth of 0- to 8- cm at 0, 1, 2, 4, 8, 16, 21, and 28 d after treatment (DAT) in 1998 and 0, 1, 2, 4, 7, 14, 26, 35, 43, and 57 in 1999. Two soil samples were collected at each sampling date and mixed to form one sample. All samples were immediately frozen upon collection and immediately after sampling stored at -10 °C prior to analysis. For extraction, soils were thawed and mixed by shaking the bag to homogenize the sample. To reduce losses to volatility and degradation, sample preparation was done quickly (<4 hr). A representative 50 g sample (moist soil basis) was extracted with 100 ml of methanol by placing the soil plus methanol into a 250-ml low-density polyethylene screw top bottle. The bottle was then placed on a reciprocating shaker (Eberbach, Ann Arbor, MI) which was then operated at 80 cycles per minute for 16 hours. The bottles were removed from the shaker, allowed to statically equilibrate for one-hour, and then the methanol extract was filtered through two pieces of Whatman # 1 filter paper (Whatman, Clifton, NJ). An aliquot of the soil extract was placed into a 2-ml autosampler vial for analysis.

In the absence of metam, EPTC half-life (DT_{50}) was 9.0 d, and when applied in conjunction with metam increased to 20 to 23 d. For pebulate in the absence of metam, the DT_{50} varied from 6.1 to 9.8 d and increased to 22 to 23 d when applied in conjunction with metam. The increase in half-life with the addition of metam is thought to be due to metam causing a reduction in the soil microorganisms that degrade EPTC and pebulate.

EFFECTS OF SOIL ADSORPTION AND pH ON TOBACCO RESPONSE TO SULFENTRAZONE. J.A. Ferrell, W.W. Witt, and M. Barrett. University of Kentucky, Lexington, KY 40546.

ABSTRACT

Sulfentrazone was marketed for tobacco weed control at the farm level in spring 1997 as Spartan 75DF. Tobacco producers rapidly adopted sulfentrazone as an effective control measure for morningglory species (*Ipomoea ssp.*), yellow

nutsedge (*Cyperusesculentus*), and blacknightshade (*Solanumptycanthum*). Although weed control with sulfentrazone was highly favored, concerns developed over adverse tobacco response to sulfentrazone treatments. The phytotoxicity symptoms were necrotic lesions on leaf surfaces, chlorotic mottling, and/or crinkled leaf margins. The occurrence of these injury symptoms led to a series of experiments to better understand the behavior of sulfentrazone in soil.

Karnack silty clay, Crider silt loam, Lanton silt, Loring silt loam, which varied in organic matter and clay content, as well as a Maury silt loam that varied in pH, were selected for determination of sulfentrazone adsorption to soil. The batch equilibrium method was used to determine adsorption. Formulated and ^{14}C-sulfentrazone was added to one-gram of soil at: 0, 1, 2, 3, 4, and 5 x 10^{-6} M. Samples were brought to 10-ml total volume with 0.01 N $CaCl_2$ and placed on a horizontal shaker for 24 hours and then centrifuged at 10,000 rpm for 10 minutes. A one-milliliter aliquot was taken forquantification of radioactivity using liquid scintillation spectrometry. Adsorption isotherms were constructed for each soil using the Freundlich equation. Sulfentrazone adsorption increased as clay and organic matter increased and sulfentrazone adsorption increased as pH decreased. From these data it was hypothesized that higher soil pH, resulting in less soil adsorption, was partially responsible for phytotoxic responses of tobacco to sulfentrazone.

Sulfentrazone at 0, 0.19, 0.37, 0.56, 0.75 lbs./A, was thoroughly mixed with 400 g of Maury silt loam soil at a pH 4.8, 5.6, 7.2 and placed in 16 oz cups. TN90 tobacco seedlings, grown in float trays for 30 days, were transplanted into soil. The soil was weighed daily to determine water use and to bring the soil back to field capacity. Plants were harvested for fresh and dry weight determination after 21 days of growth. Tobacco grown at pH 7.2 had greater fresh and dry weight, as well as higher water consumption; however, statistical differences occurred only at the sulfentrazone rate of 0.75 lbs./A.

A hydroponics experiment was conducted to quantify tobacco root uptake of ^{14}C-sulfentrazone. KY14 tobacco transplants were grown for 24 hours in a water and buffer solution containing 1650 Bq of ^{14}C-sulfentrazone. PH was altered to 5.8, 6.5, and 7.2 using a 0.01 M potassium phosphate buffer. After 24 hours, the plants were removed from solution, sectioned into roots and shoots, weighed, then oxidized. ^{14}C-sulfentrazone absorption into roots, expressed as Bq per gram fresh root weight, was greater at pH 5.8 that at pH 6.5 or 7.2. The amount of ^{14}C-sulfentrazone in tobacco shoots was similar at each pH.

The sulfentrazone adsorption to soil was greatest at pH 4.8 and was attributed to the protonation of the amine nitrogen atom. The greatest absorption of sulfentrazone by tobacco roots also occurred at the acidic pH of 5.8. The greater uptake of the protonated sulfentrazone molecule suggests that much of the sulfentrazone injury noted to tobacco under field conditions could be attributed to acidic areas in tobacco fields.

VEGETATION COMPOSITION FIVE YEARS AFTER SILVICULTURAL TREATMENTS TO CONTROL COMPETITION IN A NATURAL STAND OF LOBLOLLY-SHORTLEAF PINES. M.D. Cain, USDA Forest Service, Southern Research Station, Monticello, AR 71656.

ABSTRACT

Woody nonpine vegetation, averaging over 6,000 rootstocks/ac, was controlled by chain-saw felling, chain-saw felling plus prescribed burning, or by a broadcast herbicide spray to release even-aged loblolly and shortleaf pine (*Pinus taeda* L. and *P. echinata* Mill.) saplings that became established from natural seedfall on a cutover area. Each method of competition control and an untreated check were replicated three times on 0.2-ac plots in a randomized, complete block design. Five years after release, vegetation composition and percent ground cover were found to be significantly (P<0.05) modified by the silvicultural treatments.

INTRODUCTION

Because of public concerns over the use of herbicides for vegetation management on public lands, some National Forests in the southeastern U.S. have proposed to increase the use of manual control techniques and fire while decreasing the use of herbicides (19). On National Forests in Arkansas, competing vegetation in pine stands is being operationally treated by hand-felling, but there is no documentation regarding the type of vegetation that reinvades these treated areas.

Growth of naturally established loblolly and shortleaf pine (*Pinus taeda* L. and *P. echinata* Mill.) regeneration can be substantially reduced during the first 11 years after establishment from seed in the absence of intensive release from woody and herbaceous competition on good sites (site index >85 ft for loblolly pine at 50 years) (6, 11). However, there is little published information regarding growth gains fromrelease when applied only once to naturally established pines of sapling size (4, 5). Consequently, the original objective of this study was to determine if sapling-size (0.6 to 3.5 inches dbh) pines exhibit a measurable growth response to a one-time release treatment. The purpose of the present paper is to document the composition of woody and herbaceous vegetation that was present 5 years after release treatments were applied.

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METHODS AND MATERIALS

The study is located on the Crossett Experimental Forest in southeastern Arkansas. Soil is Bude (Glossaquic Fragiudalf) silt loam and has a site index of 90 ft at 50 years for loblolly pine (18). Within an area of 5 ac, a mature stand of loblolly and shortleaf pines, averaging 9,000 fbm/ac (Doyle), was clearcut in August 1985 to control an infestation of southern pine beetles (*Dendroctonus frontalis* Zimm.). In April 1986, the clearcut was treated with hexazinone[1] (Velpar® L) at the rate of 3 lbs a.i./ac on a 3-ft by 3-ft grid using herbicide spotguns to control residual hardwoods. After that treatment, the area remained undisturbed. In summer 1992, the clearcut was occupied by a 7-year-old thicket of vines, brambles, woody shrubs, naturally seeded pines, and hardwood saplings that ranged up to 20 ft tall.

The 5-ac clearcut was subdivided into 12 treatment plots containing 0.2 ac (93.3 ft by 93.3 ft) each, with 0.1-ac interior subplots (66 ft by 66 ft). The 0.2-ac plots were delineated by mowing. Within each interior plot, 16 systematically spaced, permanent 1-milacre sample quadrats were established for assessing pretreatment density of competing vegetation and natural pine regeneration.

Based on a subjective assessment of competition, the clearcut area was scheduled to receive an operational application of a herbicide registered for releasing loblolly pine. A subsequent inventory indicated that the need for release was questionable because density of pine saplings was in accordance with published recommendations. Consequently, three release treatments were imposed along with untreated checks to determine if release was justified. Treatments included:
(*i*) Check - No pine release was done.
(*ii*) Chain-saw felling - Between April 18 and 20, 1994, all nonpine woody stems and woody vines were chain-saw felled near groundline. This treatment was imposed after hardwoods had completely refoliated following winter dormancy.
(*iii*) Herbicide spray - Since it was desirable to use herbicides that cause minimal damage to pines (4), Arsenal® Applicators Concentrate (imazapyr) was tank mixed with Escort® (metsulfuron methyl). In accordance with a recommendation by Edwards (12), the tank mix was Arsenal AC at 16 oz of product/ac (4 lbs a.e./gal) plus Escort at 1 oz of product/ac (60% a.i.) in a spray volume of 30 gal/ac, dispersed at 30 lbs/square inch using a Spraying Systems Co. adjustable Gunjet®. Cidekick® II was added as a surfactant at the rate of 0.5% of total solution. The addition of Escort was needed to control a broader spectrum of vegetation than can be achieved by Arsenal alone. On August 30, 1993, the herbicide tank mix was applied from atop a Genie® S-60 manlift boom at a height of about 20 ft above ground so as not to mechanically disturb any vegetation on plots being sprayed. This over-the-top broadcast technique was used to experimentally simulate aerial application of herbicide.
(*iv*) Fell & burn - Chain-saw felling was done using the same technique as in Treatment (*ii*) and was completed during the same time frame. Prescribed burning was accomplished on February 2, 1995. Nonpine woody vegetation was chain-saw felled to provide sufficient fuel to carry a fire because an earlier attempt to prescribe burn through patch clearcuts covered with uncut vegetation had failed (3). Burning was included in the present investigation to determine if fire would impede resprouting of severed hardwood rootstocks.

In autumn 1998, five growing seasons after treatments were applied, percent ground cover was ocularly estimated for various vegetative components within each of sixteen 1-milacre sample quadrats that had been systematically established on the 0.1-ac interior plots. Ground-cover estimates were made to the nearest 10% for pines, hardwoods, nonarborescent shrubs, and herbaceous vegetation. The dominant hardwood or shrub within seedling and sapling size classes was identified by genera on each sample quadrat. Seedlings were <0.6 inch dbh, and saplings ranged from 0.6 inch to 3.5 inches dbh. All seedling-sized rootstocks and sapling-sized stems were counted within each sample quadrat for calculation of density. A rootstock was comprised of either single or multiple stems (clump) of seedling size, which obviously arose from the same root system. Ground cover from herbaceous components was estimated separately for grasses, forbs, vines, and semi-woody plants. The herbaceous component having the greatest ground cover was identified by genera on each milacre quadrat.

The experiment was a randomized, complete block design with blocking based on the pretreatment density of pine saplings. Analysis of variance was used to evaluate treatment differences in woody-plant density and percent ground cover from the various vegetative components. Arcsine transformations were used in percent-cover analyses and square-root transformations were used in analysis of hardwood sapling density, but only nontransformed values are reported. Orthogonal contrasts were used to compare treatment differences. Statistical significance was accepted at the α=0.05 probability level.

RESULTS AND DISCUSSION

Before the present investigation was initiated, three events resulted in an adequate stand of natural pine regeneration on this site. These events included site disturbance from clearcutting the beetle infested pines in summer 1985; application

[1]This publication reports research involving herbicides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

The use of trade or firm names in this publication is for reader information and does not imply endorsement by the U.S. Department of Agriculture of any product or service.

of a soil-active herbicide (Velpar® L) in spring 1986; and a better-than-average pine seed crop that exceeded 1,000,000 potentially viable seeds/ac during the winter of 1986-87 (7). In autumn 1992, pretreatment density of natural pine regeneration averaged over 790 saplings/ac with no differences (*P*=0.56) among plot means (10). When cutover areas contain 700 stems of well-distributed loblolly and shortleaf pines/ac 3 years after their establishment from seedfall, natural pine regeneration is considered successful (14). Given these facts, forest landowners have the option of allowing established pines to grow to merchantable size without further silvicultural intervention or to release the pines from competing vegetation with the expectation of increasing their growth rate. Before release, sapling-sized hardwoods averaged about 1,700 stems/ac, with no differences (*P*=0.85) among plot means (10); yet there were twice as many hardwood saplings as pine saplings.

To reduce sprouting of severed hardwood stems, seasonal timing of manual or mechanical cutting techniques can be critical. For example, hardwoods tend to sprout less vigorously when cut during the growing season than when cut during the dormant season (13, 16, 21). Consequently, chain-saw felling of woody competition in the present study was scheduled during the spring, just after hardwoods had foliated.

Five growing seasons after treatments were applied, density of seedling-sized hardwoods on chain-saw fell plots averaged 37% less (*P*=0.068) than on herbicide-spray plots and 47% less (*P*=0.015) than on fell & burn plots (Table 1). This unexpected result has two possible explanations. First, the herbicide controlled not only woody plants but also herbaceous vegetation during the first year after treatment. Therefore, when compared to chain-saw felling, reinvading vegetation had less competition on herbicide treated plots which may have stimulated germination of more woody plants from the soil seed bank. There is evidence to suggest that germination by seeds in the soil is enhanced when exposed to light but inhibited by darkness or leaf shade (17). Secondly, density of hardwood saplings on chain-saw felled plots exceeded the density on both herbicide-spray and fell & burn plots by more than 1,000 stems/ac. A high sapling density would tend to reduce the number of shade-intolerant woody plants in the seedling size classes. Density of hardwood saplings ranged from <600/ac on herbicide treated plots to >2,000/ac on chain-saw fell plots (Table 1); although these differences are important, they were statistically nonsignificant (*P*=0.074).

When this 5-year assessment was made, American beautyberry (*Callicarpa americana* L.) was the dominant nonpine woody plant of seedling size across all treatments. Quadrat stocking for this species ranged from 56% on chain-saw fell plots to 81% on herbicide-spray plots. Chain-saw fell plots, with twelve genera, had the highest richness for seedling-sized nonpine woody plants. Fell & burn plots ranked second with ten genera, and herbicide-spray plots had eight genera. Check plots had the least richness with only six genera of seedling-sized woody plants.

In the sapling size classes, flowering dogwood (*Cornus florida* L.), a shade-tolerant species, was dominant on check plots with 29% quadrat stocking. In contrast, sweetgum (*Liquidambar styraciflua* L.), a shade-intolerant species and prolific stump sprouter, was the dominant sapling-sized hardwood on both chain-saw fell and fell & burn plots, with 25% and 33% quadrat stocking, respectively. On herbicide-spray plots, red maple (*Acer rubrum* L.) was the dominant hardwood of sapling size, but quadrat stocking of red maple averaged only 6% because there were no sapling-sized hardwoods on 81% of sample quadrats within herbicide treated plots.

Since there were no silvicultural treatments applied on check plots, they had the highest richness for sapling-sized hardwoods at 5 years after treatment, with eleven genera recorded. Chain-saw fell plots ranked second in richness with ten hardwood genera of sapling size. On fell & burn plots, five hardwood genera attained sapling size, while herbicide-spray plots had the least richness with only four hardwood genera in sapling size classes.

Five years after release, pine ground cover ranged from 42% on check plots to 61% on herbicide-spray plots (Table 2), but treatment differences were nonsignificant (*P*=0.299). However, ground cover from competing hardwoods was significantly reduced (*P*=0.002) by release treatments (Table 2). Mean hardwood cover on chain-saw fell plots and herbicide-spray plots averaged 47 percentage points less (*P*=0.001) than on check plots. Herbicide-spray plots had 24 percentage points less (*P*=0.028) hardwood cover than chain-saw fell plots, but hardwood cover was not reduced (*P*=0.205) by the addition of a prescribed winter fire after chain-saw felling.

Ground cover from nonarborescent shrubs ranged from 40% on check plots to 68% on herbicide-spray plots (Table 2), with significant differences (*P*=0.047) among treatments. Because of a higher percent ground cover from hardwoods on check and chain-saw fell plots, shade-intolerant shrub cover averaged 22 percentage points less on those treatments as compared to the mean of herbicide-spray or fell & burn plots, and the 21-point difference between chain-saw felling and herbicide spraying was significant (*P*=0.048).

Competition from herbaceous vegetation has been shown to reduce the growth of naturally established pine regeneration until such time when herbaceous species are shaded out by canopy closure (11). In the present study, vines were the most prolific component of herbaceous vegetation averaging 70% ground cover across all plots (Table 3), and mean vine ground cover among treatments was statistically nonsignificant (*P*=0.578). The dominant vines, ranked in terms of ground cover, were Japanese honeysuckle (*Lonicera japonica* Thunb.), greenbrier (*Smilax* spp.), Alabama supplejack (*Berchemia scandens* [Hill] K. Koch), morning glory (*Ipomoea* spp.), and grape (*Vitis* spp.). Grass cover on chain-saw fell plots averaged 44 percentage points less (*P*=0.002) than on fell & burn plots (Table 3). Since grass cover on burned plots averaged higher (58%) when compared to other treatments, fire may have enhanced seed germination for those species (1, 2, 15). Forbs and semi-woody plants were minor herbaceous components, averaging <10% ground cover across all treatments. Yet, herbicide-spray plots had significantly more ($P<0.01$) ground cover from these plants than chain-saw fell plots (Table 3), probably because the latter treatment had greater coverage from hardwoods (Table 2) which kept these shade-intolerant herbaceous species in check.

There are advantages and disadvantages from the use of either herbicides or manual treatments for competition control in pine stands (20). In the present study, an important disadvantage of chain-saw felling was its cost, which averaged about $400/ac as compared to $120/ac for the herbicide treatment (10). Five-year results suggest that chain-saw felling tended to increase hardwood ground cover when compared to herbicide sprays. This may be the result of more numerous sprouts per rootstock from chain-saw felling (8) and more rapid height growth of those sprouts compared to herbicide treatment (9). The application of fire after chain-saw felling tended to result in fewer hardwood saplings and more ground cover from grasses and semi-woody plants 5 years later when compared to chain-saw felling only.

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Table 1. Hardwood density 5 years after silvicultural treatments were applied for competition control in a natural stand of loblolly-shortleaf pines.

Silviculture treatments and orthoganal contrasts	Hardwoods	
	Seedling-size[a]	Sapling-size[b]
	Rootstocks/ac	*Stems/ac*
1. Check	4,313	1,979
2. Chain-saw fell	4,625	2,021
3. Herbicide spray	7,333	563
4. Fell & Burn	8,708	812
Mean Square error	2,228,624	107
P>F[c]	0.03	0.119
Orthogonal contrasts	*Probability of a greater F*[c]	
1 vs 2 + 3	0.165	0.148
2 vs 3	0.068	0.074
2 vs 4	0.015	0.161

[a] Seedling-size rootstocks were >0.5 ft tall but <0.6 inch dbh.
[b] Sapling-size stems ranged from 0.6 inch dbh to 3.5 inches dbh.
[c] The probability of obtaining a larger F-ratio under the null hypothesis.

Table 2. Percent ground cover from woody vegetation 5 years after silvicultural treatments were applied for competition control in a natural stand of loblolly-shortleaf pines.

silvicultural treatments and orthogonal contrasts	Woody plant ground cover		
	Pines	Hardwoods	Shrubs
	--------------------Percent--------------------		
1. Check	42	80	40
2. Chain-saw fell	52	45	47
3. Herbicide spray	61	21	68
4. Fell & Burn	37	32	64
Mean square error	0.026	0.013	0.012
P>F[a]	0.299	0.002	0.047
Orthogonal contrasts	*Probability of a greater F*[a]		
1 vs 2 + 3	0.231	0.001	0.065
2 vs 3	0.441	0.028	0.048
2 vs 4	0.286	0.205	0.081

[a] The probability of obtaining a larger F-ratio under the null hypothesis

Table 3. Percent ground cover from herbaceous vegetation 5 years after silvicultural treatments were applied for competition control in a natural stand of loblolly-shortleaf pines.

silvicultural treatments and orthogonal contrasts	Woody plant ground cover				
	Grass	Forbs	Vines	Semi-woody	Total herbaceous
	----------------	----------------	*Percent*	----------------	----------------
1. Check	26.8	0.1	64.6	0.2	76.5
2. Chain-saw fell	13.3	1.1	78.3	0.6	81.5
3. Herbicide spray	31.7	5.8	67.4	7.7	81.8
4. Fell & Burn	57.6	2.9	71.2	7.0	92.9
Mean square error	0.015	0.002	0.023	0.004	0.015
P>F[a]	0.013	0.006	0.578	0.006	0.208
Orthogonal contrasts			*Probability of a greater F*[a]		
1 vs 2 + 3	0.494	0.006	0.375	0.023	0.383
2 vs 3	0.052	0.007	0.311	0.009	0.950
2 vs 4	0.002	0.084	0.466	0.008	0.168

[a] The probability of obtaining a larger F-ratio under the null hypothesis

BIOLOGY OF PRICKLY NIGHTSHADES (*SOLANUM* spp.). C.T. Bryson, USDA-ARS, Southern Weed Science Research Unit, Stoneville, MS 38776.

ABSTRACT

Native and non-native prickly nightshades in the genus *Solanum* have long been troublesome weeds of pastures, feed lots, right-of-ways, and in vegetable, fruit, nut, and field crops. In addition to interfering with crop growth, quality, and yields, prickly nightshades interfere with manual and mechanical harvest efficiency. Prickly nightshades have received more interest since the introduction and rapid spread of tropical soda apple (*S. viarum* Dunal), initially into Florida in the early 1980s and then into Alabama, Georgia, Louisiana, Mississippi, North Carolina, Pennsylvania, South Carolina, Tennessee, and Puerto Rico. Currently, three non-native species of prickly nightshades, tropical soda apple, wetland nightshade (*Solanum tampicense* Dunal), and turkeyberry (*S. torvum* Sw.), are listed on the Federal Noxious Weed List. All three of these species are now present in the southeastern United States. Buffalobur (*S. rostratum* Dunal), horsenettle (*S. carolinense* L.), and robust horsenettle (*S. dimidiatum* Raf.) are prickly nightshade species that are native, at least in part, to the southeastern United States. Additional non-native invasive prickly nightshades that are established and possess weedy traits in the southeastern United States are Jamaican soda apple (*S. jamaicense* Miller), nipplefruit nightshade (*S. mammosum* L.), red soda apple (*S. capsicoides* All.), silverleaf nightshade (*S. elaeagnifolium* Cav.), and sticky nightshade (*S. sisymbriifolium* Lam.). Buffalobur is an annual. The other prickly nightshades are perennials in tropical, subtropical and/or temperate climates depending on the species. Only horsenettle, robust horsenettle, silverleaf nightshade, and sticky nightshade produce root systems deep enough to survive extended periods of time below 0 C. Because little is known about the comparative biology and ecology of the prickly nightshades, these species were grown in greenhouse at Stoneville, MS to determine growth parameters. Data on height and number of nodes and leaves were recorded weekly for 10 weeks following plant emergence with plant dry weights at the termination of experiments. Data on days to first bloom were taken in separate experiments. Plants were grown in 30 cm-diameter pots in a mixture of a Bosket sandy loam (Mollic Hapludalfs) soil and Jiffy Mix at 50/50 v/v, at temperatures of 30/20 ($\pm$ 2) C day/night, and 14 h daylight. Experiments were established in a randomized complete block design with seven replications and repeated. Data were subjected to analysis of variance and LSD values were calculated at 0.05 level of probability. At 10 wk after emergence, plant heights were 58, 24, 34, 90, 23, 79, 102, 69, 99, 45, and 49 cm; number of nodes/plant were 29, 14, 21, 38, 10, 20, 34, 35, 26, 12, and 22; number of leaves/plant were 30, 7, 25, 36, 18, 16, 34, 40, 26, 8, and 21; and plant dry weights were 15.3, 1.0, 8.2, 9.1, 8.6, 17.8, 14.4, 13.2, 11.4, 9.3, and 7.4 g/plant, for red soda apple, horsenettle, robust horsenettle, silverleaf nightshade, Jamaican soda apple, nipplefruit nightshade, sticky nightshade, buffalobur, wetland nightshade, turkeyberry, and tropical soda apple, respectively. The average number of days to first flower were least for buffalobur (36 days after emergence) and $\geq$ 48 days for perennial prickly nightshades species. Horsenettle, robust horsenettle, Jamaican soda apple, wetland nightshade, and tropical soda apple took the longest time

for first bloom ($\geq$ 70 days). Additional research is needed to determine the time between first flower and first fruit set and the total number of fruit produced by each species to determine reproductive potential by seed.

HOST PLANT RESPONSE TO PARASITIC WEEDS: IDENTIFICATION OF GENES INDUCED BY BROOMRAPE (*Orobanche*). L. Delo and J.H. Westwood, Department of Plant Pathology, Physiology, and Weed Science, Virginia Tech, Blacksburg, VA 24061.

ABSTRACT

Orobanche is an obligate holoparasite that lives on the roots of dicotyledonous plants. In order to lay the groundwork for new control strategies, we are investigating how *Orobanche* influences the expression of genes in the host root. One approach employs a variation of mutant screening called a "promoter trap" screen, whereby genes may be identified based on expression patterns rather than through loss of function. This screen is performed using plants that have been mutated with a randomly inserted T-DNA containing a promoterless reporter gene (GUS). Because the GUS gene contains no promoter to drive its own expression, it must insert into the genome close to an active plant promoter in order to be expressed. It is therefore possible to subject the plant to a stimulus such as parasitism by *Orobanche*, and by identifying blue color indicative of GUS expression associated with the parasitism, find genes that are turned on in response to *Orobanche* attack. To date we have screened over 11,000 individual plants, representing 1,060 independently transformed lines, and have found 128 plants with GUS expression associated with *Orobanche* attachments. These represent a wide range of expression patterns, with variations in intensity, tissue localization, and specificity to the parasite. For more detailed characterization of tagged genes, four individuals from the screen were selected based on their strong GUS expression and specificity for *Orobanche*. Progeny from these plants (named LD1, LD2, LD3, and LD4) were grown and stained for GUS activity at various stages to examine gene expression in the absence of parasitism. All showed a pattern of developmentally regulated expression, likely indicative of the gene's normal function in the plant, with expression observed primarily in association with vascular tissues and/or branch points. Because the presence of multiple T-DNA copies per plant can complicate subsequent analysis, copy number was determined by Southern hybridization, and LD3 and LD4 were found to contain a single copy whereas LD1 and LD2 contained two. Furthermore, LD4 was selected as the most promising because digestion with PstI and Southern blotting revealed a fragment small enough to be amplified by inverse polymerase chain reaction (PCR). Although this final step remains to be completed, we anticipate being able to assign an identity to the first of the unknown *Orobanche*-inducible genes in the near future. From the work completed so far, it is clear that parasitization by *Orobanche* induces the expression of many host genes, and we have generated a wealth of material from which to further investigate the host-parasite interaction.

WEED COMPETION IN GLYPHOSATE-TOLERANT SOYBEAN. J.W. Calfee J.A. Hoefer, and R.J. Smeda, Research Specialist, Graduate Research Assistant and Assistant Professor, Department of Agronomy, University of Missouri, Columbia, MO 65211.

ABSTRACT

Research was initiated in both central (Columbia) and northeast (Novelty) MO to determine which timing of a single application of glyphosate in transgenic soybean optimizes weed control and crop yield. Asgrow 3601 soybean was planted into 76 cm rows in mid- May and drilled into 19 cm rows in late June in both 1998 and 1999. A single application of glyphosate (0.84 kg a.e./ha) was applied at various stages of soybean phenology (VE, VC, V1, V2, V3, V4, V5, R1, and R3) with no further weed control utilized the remainder of the growing season. Weed biomass two weeks after the R1 or R3 application timing was measured to determine the relative effect of each glyphosate treatment on suppressing weeds. Soybean yield was also estimated.

Weed biomass was strongly dependent upon the timing of glyphosate application. In 76 cm rows, significant reinfestation of plots occurred if glyphosate was applied prior to V2 soybean, but weed biomass did not differentiate between treatments beyond V2 applications. Soybean yields were highest at the V2 and V3 applications timings, and declined for later applications. Soybean yields were also lower when applications were made before V2. Proper timing of glyphosate application is necessary because applications too early following soybean planting V1 (10 days) allowed significant reinfestation of weeds later in the season. Also, delaying applications beyond V3 (4 to 5 weeks) in 76 cm rows allows an unacceptable level of weed competition, reducing soybean yield. In 19 cm rows, glyphosate applications as soon as the VC stage resulted in significant reductions of weed biomass. No significant difference in soybean yield was noted when glyphosate was applied at VC through V4, but yields were lower for applications made after these timings.

INFLUENCE OF COVER CROP RESIDUES AND SOYBEAN ROW SPACING ON WEED DETECTION WITH REMOTE SENSING. T.H. Koger, D.R. Shaw, K.N. Reddy, and C.S. Bray, Department of Plant and Soil Sciences, Mississippi State University, MS 39762, and USDA-ARS, Southern Weed Science Research Unit, Stoneville, MS 38776.

ABSTRACT

Remote sensing technologies have been researched extensively in recent years to detect features in row crops and rangelands. Aircraft and satellite based sensor sources have both been used to successfully detect weeds when they are large. Many physical and chemical characteristics such as soil roughness, soil organic matter, and iron oxide content emit reflectance that sometimes makes detecting weeds from crops more difficult. However, other characteristics such as cover crop residues and row spacing may also influence our ability to detect shifts in weed populations that are often associated with these agricultural practices. The presence of cover crop residues and narrow soybean row spacing reduce weed populations that grow in association with soybean. The objectives of this research were to determine if late season weed populations can be detected and correlated to reflectance patterns acquired by low altitude fly-overs. The influence of rye cover crop residues and narrow row-spacing soybean on weed presence also was investigated.
Two split plot design experiments were established in 1998 at the USDA-ARS, Southern Weed Science Research Unit near Stoneville, MS. Main plot factors for the first experiment were conventional tillage prior to planting and no tillage, with a split plot factor of native vegetation and 'Elbon' rye (*Secale cereale* L.) at 84 kg/ha. Main plot factors for the second experiment were native vegetation cover crop residue and rye (84 kg/ha) and split plot factors of 19- and 94-cm row spacing. Rye plots were drilled on October 22, 1998, and desiccated with 1.1 kg ai/ha paraquat on April 21, 1999. All plots were planted with 'DP 3588' soybean (*Glycine max*) on May 15, 1999. All treatments were replicated four times in plots 4.5- by 12-m. Weeds evaluated included: barnyardgrass [*Echinochloa crus-galli* (L.) Beauv.], broadleaf signalgrass [*Brachiaria platyphylla* (Griseb.) Nash], and pitted morningglory (*Ipomoea lacunosa* L.). Weed populations for each weed species were estimated beginning in late May until canopy closure on a bi-weekly basis from nine 1-m^2 quadrats located in the center of each plot. After canopy closure, total percent of the plant canopy occupied by weeds was visually estimated for each plot on a bi-weekly basis. Digital images for both experiments were acquired on August 11, 1999, from ITD Spectral Visions. Plant canopy reflectance for Band 1 (540 nm green), Band 2 (695 red), and Band 3 (840 near infrared) was acquired at an altitude of 1828 m resulting in 1-m resolution. Multispectral digital imagery was collected with an 8-bit digital CCD array camera with a 1320 by 1035 pixel array. Spectral response of plant canopy was determined by selecting the center 10 pixels from each plot and averaging the pixel values for each reflectance band. Correlations between the visual ratings and the mean pixel response for each band were made for each treatment combination in both experiments.

Rye cover crop residues and narrow row spacing reduced late-season weed pressure. Rye residue in the conventional till and no-till treatments reduced overall weed populations 14 and 16% compared to no residue. Narrow soybean row spacing (19 cm) also reduced weed pressure by 15 to 20% in both the rye residue and native vegetation residue treatments. Changes in green and red reflectance (Bands 1 and 2) were directly correlated to fluctuations in weed pressure. In both the cover crop residue and row spacing experiments, measurements of green and red (Band 1 and 2) reflectance were directly correlated to fluctuations in weed pressure. Correlation values for Band 1 and weed pressure were 0.69 and 0.60, and were 0.64 and 0.59 for Band 2 and weed pressure. Near infrared reflectance (Band 3) reflectance was not correlated to late season weed pressure. Based on this data differences in late season weed pressure can be detected and are correlated to spectral reflectance for the green and red bands.

COMMON RAGWEED (*AMBROSIA ARTEMISIIFOLIA* L.) INTERFERENCE IN PEANUT (*ARACHIS HYPOGAEA* L.). S.B. Clewis, S.D. Askew, and J.W. Wilcut; Crop Science Department, North Carolina State University, Raleigh, NC 27695-7620.

ABSTRACT

Common ragweed is common throughout North America and infests cultivated fields, open disturbed habitats, and roadsides. Common ragweed is one of the more competitive and common summer annual broadleaf weeds in North Carolina-Virginia peanut. Common ragweed currently ranks as the third most troublesome weed of peanut in NC and infests 75% of the North Carolina-Virginia peanut acreage. Failure to control common ragweed would cost producers in North Carolina-Virginia an estimated $66,485,000. These losses reflect yield loss due to weed-crop interference and decreases in efficiency of harvesting operations including digging, inverting, and combining.

Field experiments conducted in 1998 and 1999 at Rocky Mount, NC evaluated the competitive relationship between common ragweed and peanut grown in North Carolina. The soil type was a Norfolk loamy sand. Sonalan was applied at 0.84 kg ai/ha PPI to control annual grasses. No postemergence (POST) herbicides were used. With the exception of common ragweed, the experimental area was kept weed-free by weekly hand-hoeing. The peanut cultivar 'NC 7' was planted 5 cm deep at 134 kg/ha. Planting dates were May 13, 1998 and May 12, 1999. The experimental design was a randomized complete block with 3 replications. Individual plots consisted of four 91 cm rows that were 6.1 m long. Fertilization and insect and disease management practices were standard for peanut production in North Carolina. Common ragweed seedlings at the cotyledon to 2-leaf stage were planted into plots immediately after peanut planting at the following densities: 0, 1, 2, 4, 8, 16, and 32 plants per 6.1 m of row. The common ragweed seedlings were planted

into the center two rows of each plot with the two outer rows left as weed-free borders. Height measurements of up to four common ragweed plants and four random peanut canopy diameter measurements were taken bi-weekly during the season.

Common ragweed did not affect peanut canopy diameter at any measurement (P>0.05). Canopy diameters averaged 102 cm in 1998 and 94 cm in 1999. Plant density did not affect common ragweed height, average late-season heights were 138 cm for 1998 and 132 cm for 1999. Trends in peanut canopy diameter are unlikely to be reliable estimates of competitive relationships. Common ragweed exhibited a quadratic relationship of decreasing biomass as plant density increased. This indicates intraspecific interference was occurring at higher weed densities. Maximum biomass at the lowest plant density was 1400g (dry weight) per plant which is evidence of the rapid accumulation of biomass by common ragweed in a single growing season. Common ragweed did not influence the occurrence of tomato spotted wilt virus (TSWV), early leaf spot (*Cercospora arachidicola* Hori.), southern stem rot (*Sclerotium rolfsii* Sacc.), and Cylindrocladium black rot (*Cylindrocladium crotalariae* Loos.). However, as the common ragweed density increased, the incidence of late leaf spot [(*Cercosporidium personatum* (Berk. & Curt. Deighton)] increased. The height and biomass of common ragweed likely contributed to the interception of fungicidal spray and the increase in late leaf spot incidence. In addition, large common ragweed plants shaded the peanut canopy thereby lengthening the dew period. Dew period is often an important factor in disease incidence. In this experiment it would take only 2 plants per 6.1m/row to decrease peanut yield 16% in 1998 and 12% in 1999. Storm is the postemergence standard for common ragweed control in peanut. Based on two quotes from North Carolina agricultural suppliers and a use rate of 1.5 pints of Storm and 1.0 pint of crop oil concentrate, an application of Storm would cost $34.33/ha. Considering the weed-free yield potential of this study (6250 kg/ha in 1998 and 3960 kg/ha in 1999) and a US support price of $0.67/kg peanut, one application of Storm would be equivalent to 0.82% and 1.29% yield loss in 1998 and 1999 respectively (based on the hyperbola equations for 1998 and 1999). An action threshold for common ragweed using Storm would be 1 plant per 68 m of row (147 plant/ha) in 1998 and 1 plant per 31 m of row (323 plant/ha) in 1999.

This data indicates common ragweed is among the most competitive weeds of peanut in North Carolina. In addition to competition for growth resources such as light, water, and nutrients; common ragweed intercepts fungicides leading to increases in foliar-borne pathogens such as *Cercosporidium personatum.* This pathogen is responsible for late leaf spot and is of significant economic importance to peanut growers. Although peanut yield and common ragweed biomass decreases with increasing plant density, peanut canopy diameter, and common ragweed height are not affected.

COMPARISON OF GRID SIZES FOR ACCURATELY DESCRIBING WEED POPULATIONS. F.E. LaMastus, D.R. Shaw, and M.C. Smith, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Site-specific crop management has become a popular and important area of research. Site-specific management involves identifying less productive areas of the field and creating management decisions to improve overall productivity. When weed infestations are found, herbicides can be applied strictly to the infestation, thereby eliminating the misuse of herbicides. To achieve this goal, new and timely sampling methods must be developed to pinpoint weed infestations before selective herbicide applications can be made.

In order to achieve these results, two soybean fields of 16 and 15 ha and were selected at the Black Belt Branch Experiment Station, Brooksville, MS. Soybean planting occurred on May 5, 1998, and May 27, 1999. Preemergence applications of 85 g ai/ ha flumetsulam and 3.1 kg ai/ ha metolachlor in 1998 and 46 g ai/ ha flumetsulam and 698 g ai/ ha pendimethalin in 1999 were applied to reduce the overall grass infestation. Sampling of each field occurred July 8 – 9, 1998 (8 weeks after planting (WAP)) and June 30 – July 1, 1999 (6 WAP). All weed species were counted during the 1998 and 1999 production season on a 10-m grid. At each node, a 0.581-m2 area was sampled. Predominant weed species for the East and South fields included pitted morningglory (*Ipomoea lacunosa* L.), sicklepod [*Senna obtusifolia* (L.) Irwin and Barnaby], and horsenettle (*Solanum carolinense* L.).
Data were eliminated from the database of weeds for each field to develop 40, 60, and 80-m grids. Distribution and population maps were interpolated using IDW and ArcView GIS. Data were extracted from the interpolated maps at known coordinates so that the observed population and the predicted population could be compared. The 10-m grid served as a standard to which all others were compared. When subjected to an ANOVA no differences were found between the different grid sizes for pitted morningglory and horsenettle. The only significant difference was that between the 80-m grid and 40-m grid for sicklepod, while the 60-m grid was not different from either grid size.

SICKLEPOD (*Senna obtusifolia*) RESPONSE TO SHADING. G.R.W. Nice, N.W. Buehring, R.R. Dobbs. North Mississippi Res. and Ext. Center, Verona.

ABSTRACT

Sicklepod (*Senna obtusifolia*) is a concern for soybean producers in the Southern States. A field study was conducted at the North Mississippi Research and Extension Center, Verona, in 1998 to investigate the effects of shading on sicklepod growth. Two locations were run in the same year. Plants were maintained at 20 plants/4 ft^2 by hand and watered to run off as needed, approximately twice a week. Treatments were 0, 47, 65, 80 and 95% shading. Individual shading enclosures were 8 ft^3, and were built with PVC piping and shade cloth. Treatments were applied when sicklepod was approximately at the third true leaf. Increased shading from 0 to 65% increased sicklepod height from 15.3 to 20.9 inches, but reduced sicklepod dry weight 59 and 34% in the two locations. However, sicklepod height was further reduced from 20.9 to 17.3 and 4.7 inches when shading was increased from 65 to 80 and 95%, respectively. A crop canopy that provided over 65% shading could suppress sicklepod growth.

EFFECTS OF INTERFERENCE AND TILLAGE ON HEMP SESBANIA AND PITTED MORNINGGLORY EMERGENCE, GROWTH, AND SEED PRODUCTION. M.L. Lovelace and L.R. Oliver, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR 72701.

ABSTRACT

Hemp sesbania (*Sesbania exaltata*) and pitted morningglory (*Ipomoea lacunosa*) are problem weeds in cotton and soybean throughout the Mississippi Delta. A field study was conducted in 1997 and 1998 to evaluate effects of interference and tillage on the emergence, growth, and seed production of hemp sesbania and pitted morningglory. The experimental design was completely random with four replications. Plots were tilled vs. no-till, containing three species combinations within each tillage system. Plots were initially four hemp sesbania, four pitted morningglory, or two hemp sesbania and two pitted morningglory. Plants were spaced 2 m apart within a 25-m^2 plot. Heights were measured and seed production was determine both years, and emergence was counted only in the second year.

In 1997, pitted morningglory grew more rapidly through 9 weeks after emergence (WAE), but hemp sesbania grew most from 9 to 15 WAE. Hemp sesbania height under interspecific interference (255 cm) was less than the height grown under intraspecific interference, which was 289-cm. Pitted morningglory produced 25,398 seed/plant, which was the most seed after one year of interference. Hemp sesbania produced more seed (21,516 seed/plant) when under intraspecific interference. Pitted morningglory interference with hemp sesbania restricted light interception and reduced seed production of hemp sesbania.

In 1998, 13 to 26% of the hemp sesbania seedbank emerged. Tilled hemp sesbania plots under interspecific interference resulted in the greatest germination. The lowest germination occurred in no-till hemp sesbania plots under intraspecific interference. Of the total hemp sesbania seed germinating in 1998, 98% emerged in the first 6 WAE. Pitted morningglory emergence was overall less than hemp sesbania. Tilled pitted morningglory plots under intraspecific interference emerged greater than other treatments, resulting in 17% of the seedbank emerging. No-till plots under interspecific interference resulted in only 8% of the seedbank emerging. Pitted morningglory would be expected to exist longer in the soil due to a lower germination percentage.

Hemp sesbania height differences were evident by 10 WAE. Hemp sesbania heights under intraspecific interference at 18 WAE were 117- and 119-cm tall compared to 86- and 98-cm tall under interspecific interference in no-till and tilled systems, respectively. Unlike the previous year, pitted morningglory length was affected by the presence of hemp sesbania. Pitted morningglory runner lengths under intraspecific interference were 63- and 65-cm long compared to 43- and 53-cm long under interspecific interference in no-till and tilled systems, respectively.

No-till and tilled hemp sesbania treatments under intraspecific interference produced 23 and 20 million seed per hectare from 228,800 and 229,200 plants/ha, respectively. This was greater than hemp sesbania under interspecific interference, which produced 15 and 16 million seed/ha from 128,800 and 165,600 plants/ha in no-till and till systems, respectively. Pitted morningglory produced substantially less seed than hemp sesbania. Pitted morningglory under intraspecific interference produced 8 million seed/ha from 384,000 and 630,000 plants/ha in no-till and tilled systems, respectively. Pitted morningglory under interference with hemp sesbania only produced 4 million seed/ha from 296,000 and 387,000 plants/ha under no-till and tilled conditions, respectively. Pitted morningglory interference was greatest early in the season; however, hemp sesbania compensated for lack of interference through prolific seed production.

DISTRIBUTION OF DICLOFOP-RESISTANT RYEGRASS POPULATIONS IN ARKANSAS. C.C. Wheeler, N.R. Burgos, and L.R. Oliver Crop, Soil, and Evironmental Sciences. University of Arkansas.

ABSTRACT

Herbicide-resistant weed populations have developed due to selection pressure fromcontinuous herbicide applications. Diclofop-resistance genes may spread to adjacent populations through wind pollination. The number of confirmed resistant populations in Arkansas increased from one in 1995 to fourteen in 1998. Only 25 of the 61 samples sent in 1999 have been tested to date, 18 of which were confirmed resistant to diclofop. There have been 11 counties in Arkansas with confirmed diclofop-resistant ryegrass as of 1999. The objective of this experiment was to analyze the genetic relationship between Arkansas ryegrass populations and world germplasmsamples. A *Loliumperenne* (perennial ryegrass) sample from Arkansas was compared to *L. perenne*, *L.rigidum* (rigid ryegrass), and *L. temulentum* (poison ryegrass) from world germplasm in the first experiment to see if markers generated from random and mini-satellite primers are able to differentiate various species of ryegrass. The second experiment compared the fingerprints of two resistant and two susceptible populations of *L. perenne* in comparison with the *L. perenne* sample in the first experiment.

DNA was amplified using minisatellite primers (MS) and some arbitrary primers (OP) in a 25 l total volume PCR reaction with 50 ng of DNA from the samples. The DNA fingerprint was visualized using

1% agarose/1x TBE gels and stained with
EtBr.

Data were analyzed to generate Jaccard's similarity coefficients (SC) between samples. The resistant and susceptible samples from Arkansas showed high genetic distances from the world germplasmspecies. The molecular markers were able to differentiate three ryegrass species from different parts of the world. More data and analysis of more samples are needed to sort out the genetic relatedness of Arkansas ryegrass populations. The spread of diclofop-resitance genes also needs to be understood.

PHYTOTOXICITY OF AMINO-OXYACETATE AND BOC-AMINOOXYACETATE ALONE AND COMBINED WITH *COLLETOTRICHUM TRUNCATUM* OR *ALTERNARIA CASSIAE*. R.E. Hoagland and K. Hirase. Southern Weed Science Research Unit, USDA-ARS, Stoneville, MS 38776, and Visiting Scientist from Mitsu Chemicals, Inc., Chiba, Japan.

ABSTRACT

There is interest in the use of plant pathogens for biological weed control. Although a relatively large number of such organisms can infect various weeds, many of these microbes lack sufficient virulence to be useful in bioherbicide programs. Some herbicides have synergistic interactions with pathogens that have increased weed control efficacy. Such interactions of chemicals and microbes can lower the concentrations of herbicides and pathogen propagules required to achieve adequate weed control. Aminooxyacetate (AOA) was patented as a herbicide in the mid-1960s. This compound is a pyridoxyl phosphate antagonist, and thus inhibits various enzymes (including transaminases) that require pyridoxyl phosphate as a co-factor. We examined AOA and its analog, *t*-butoxycarbonyl-AOA, for phytotoxicity, interactions with weed pathogens, and effects on a key enzyme in plants. Studies were performed on hemp sesbania [*Sesbania exaltata* (Raf.) Rybd. exA.W. Hill] and sicklepod (*Senna obtusifolia* L.) and *Colletotrichum truncatum* and *Alternaria cassiae*, pathogens of these weeds, respectively. Several bioassays for phytotoxicity and pathogenicity, and assays for extractable and *in vitro* activity of the enzyme cysteine synthase (pyridoxyl phosphate requiring) were utilized.

AOA and Boc-AOA (each 10^{-3} M) were applied (spray or root-fed) to 4-day old, dark-grown seedlings and shoot elongation was measured after 72 h growth in continuous darkness. These compounds were also applied to seedlings, alone or combined with the pathogens for tests of interactions. Extractable and *in vitro* activity of cysteine synthase was determined spectrophotometrically, based on formation of the ninhydrin–cysteine reaction complex. Chlorophyll accumulation in greening excised cotyledons was determined was determined using dimethyl sulfoxide extraction and spectophotometry.

There was little or no effect of foliar application of AOA or Boc-AOA on hemp sesbania shoot elongation, but both compounds reduced shoot elongation by 20-25% in sicklepod. Root-fed AOA was slightly more inhibitory on shoot elongation than Boc-AOA in hemp sesbania, and both compounds were equally inhibitory to sicklepod shoot growth. In these species, total chlorophyll content of greening cotyledons was inhibited by the compounds, but was reduced to a greater extent in sicklepod. These aminooxy compounds reduced extractable cysteine synthase activity by 30% in both species. *C. truncatum* infection in hemp sesbania also lowered activity (15%), but *A. cassiae* infection in sicklepod increased activity 20% above untreated control levels. *In vitro* enzyme assays resulted in equal inhibition (15%) when either chemical and the substrates were added simultaneously to the enzyme. However, when either inhibitor was preincubated (10 min) with enzyme without substrate, followed by substrate addition and assay, Boc-AOA inhibition was not increased further but, AOA inhibition increased by an additional 20%.

Results indicate that hemp sesbania was generally more resistant to the phytotoxicity of these compounds than sicklepod under these dark-growth conditions. Since cysteine synthase was inhibited *in vivo* and *in vitro* by AOA and Boc-AOA, and generally there were no major differences in phytotoxicity of the two compounds, the *t*-butoxycarbonyl group apparently does little to alter the activity of the AOA molecule. These chemicals had no apparent interactions with *C. truncatum* and *A. cassiae* efficacy on their respective weed hosts. The increase in extractable cysteine synthase activity in sicklepod following infection by *A. cassiae*, may be related to defense mechanisms of this weed against this pathogen.

PHYTOTOXICITY OF MIMOSINE AND ALBIZZIIN ON WEEDS AND CROPS. R.D. Williams, R.E. Hoagland and M.A.B. Mallik. USDA-ARS, Langston University, Langston, OK; USDA-ARS, Southern Weed Research Unit, Stoneville, MS; and Research and Extension, Langston University, Langston, OK.

ABSTRACT

Mimosine is a non-protein amino acid produced by certain legume species. Several reports indicate that mimosine has fungicidal and insecticidal properties, and may be involved in allelopathic interactions of *Leucaena leucocephala* (Lam.) deWit, a woody tropical legume. Albizziin is also a non-protein amino acid and little is known about its allelopathic properties. Both compounds are inhibitors of pyridoxyl phosphate, an important cofactor of various enzymes, including transaminases. Mimosa, or silk tree, (*Albizzia julibrissin* Durazz.) can be used as an inter-cropped woody species in pastures to provide additional forage for sheep and goats. Mimosa is known to contain mimosine, but the activity of this compound on seed germination and seedling growth is not well documented.

Both compounds were tested for effects on seed germination, seedling growth and cotyledon greening of hemp sesbania [*Sesbania exaltata* (Raf.) Rydb. ex A.W. Hill], sicklepod (*Cassia obtusifolia* L.) and wheat (*Triticum sativum* L.). Germination (radical protrusion) was conducted at 25 C in the dark, and was determined at 24, 48 and 72 h after imbibition. Shoot and root (radical) length measurements were made at 72 h. Albizziin did not affect germination, but mimosine (10^{-3} M) significantly reduced sicklepod and wheat germination. Shoot lengths of all species were reduced by mimosine (10^{-3} M), whereas only sicklepod and wheat shoot length were reduced by albizziin (10^{-3} M). Similar results were found for root elongation. Mimosine (10^{-3} M) reduced root elongation of all species, but only albizziin (10^{-3} M) reduced sicklepod and wheat root length. There was little or no effect of either compound at 10^{-5} M or 10^{-4} M on seed germination or seedling growth.

Cotyledons from 4-day old dark-grown hemp sesbania and sicklepod seedlings were excised and placed in well-plates containing 10^{-3} to 10^{-5} M solutions of each compound for 2 h in the dark. The plates were then placed under continuous low light (~ 85 μE m^{2} s^{-1}) for 48 h, the chlorophyll was extracted with DMSO and measured spectrophotometrically. Albizziin reduced chlorophyll content in hemp sesbania by 20%, 27% and 32 % at 10^{-5} M, 10^{-4} and 10^{-3} M, respectively. Similar results were obtained with this compound on sicklepod. Mimosine reduced chlorophyll content in hemp sesbania by 10%, 52%, and 99% at 10^{-5} M, 10^{-4} and 10^{-3} M, respectively. However, the effect of mimosine on sicklepod was slightly less, and reduced chlorophyll content by 10%, 32% and 64%.

Generally, both compounds exhibited allelopathic activity on these species. Only mimosine at 10^{-3} M inhibited wheat and sicklepod germination. However, germination is not always a sensitive bioassay for allelopathic compounds. Both compounds significantly inhibited shoot and root elongation. Cotyledon greening was inhibited by both mimosine and albizziin (10^{-3} M and 10^{-4} M). Overall, mimosine was the more active compound in these bioassays. The allelopathic influence of these compounds in nature will require further investigation.

RHIZOBACTERIA FROM WEEDS AND CROPS. D.T. Gooden, H.D. Skipper, J.H. Kim, K. Xiong, J.R. Frederick, and T.L. Lalande. Department of Crop and Soil Environmental Science, Clemson University, Clemson, SC 29634-0359.

ABSTRACT

A critical research need in agroecosystems is to understand the bacterial interactions in the rhizosphere of crops and associated weeds. We are developing a database on rhizobacteria from roots of selected crop and weed species. Periodically, 40 randomly selected isolates on TSBA from each plant species were identified by GC/FAME analyses. Numerical populations of rhizobacteria were similar between plant species. Isolates identified from the non-rhizosphere soil were dominated by *Bacillus* and *Arthrobacter* genera. Isolates from peanut rhizosphere belonged to *Burkholderia* (33.3%), *Chryseobacterium* (43.3%), and four other genera (23.4%). Isolates from cotton rhizosphere were dominated by a single genus, *Burkholderia*, which accounted for 81.8% of the isolates. Common ragweed (*Ambrosia artemisiifolia* L.) rhizobacteria were dominated by *Burkholderia*, *Bacillus*, and *Xanthomonas* genera. Rhizobacteria from large crabgrass [*Digitaria sanguinalis* (L.) Scop.] were the most diverse with a total of 18 genera and 24 species being identified.

ACKNOWLEDGEMENTS

This project was partially funded by the Clemson University Agroecology Program, SC Soybean Board, S262 Regional Project, and SC Agriculture & Forestry Research System. We appreciate Dr. M. B. Riley for professional assistance with the GC/MIDI Microbial Identification System.

BIOHERBICIDAL CONTROL OF TEXAS GOURD (*Cucurbita texana*) in COTTON WITH *Fusarium solani* f. sp. *cucurbitae*. . D. Boyette and C.T. Bryson, USDA-ARS, Southern Weed Science Research Unit, Stoneville, MS 38776.

ABSTRACT

Texas gourd [*Cucurbita texana* (Scheele) Gray] is an escaped ornamental that has become a weed problem in localized areas of the Arkansas and Red River Valleys of Arkansas. Texas gourd has been a relatively minor weed in soybeans and cotton in Mississippi for several decades, but it has become increasingly more common and problematic during recent years. It is particularly troublesome in cotton because many chemical herbicides that formerly provided excellent control of this weed are no longer available.

A fungus isolated from greenhouse-grown Texas gourd seedlings was shown to incite a severe collar rotting disease on seedlings and mature plants. The fungus was identified as *Fusarium solani* App. & Wr. f. sp. *cucurbitae* Snyd. & Hans. (*FSC*). Greenhouse and field trials were conducted in Stoneville, MS in 1996-97 to evaluate various formulations and application methods, and to evaluate the bioherbicidal potential of *FSC* for controlling Texas gourd in cotton.

In greenhouse tests, Texas gourd was controlled 90-96% with preemergence applications of *FSC*-infested cornmeal/sand medium and with *FSC*-"Pesta" granules. Postemergence applications of these granular formulations were less effective, but over 95% control was achieved with postemergence applications of *FSC* formulated in 25% unrefined corn oil and 0.2% Silwet L-77 surfactant. Dew was not required to achieve optimal levels of weed control with either the preemergence granular formulations or with postemergence corn oil/surfactant applications.

Field tests were established in 1997 in a cotton field near Stoneville, MS, with a natural Texas gourd infestation. Test plots were 4 m (4 rows) wide and 12 m long. Treatments were replicated four times. Additional Texas gourd was seeded at a rate of 25 seed/meter of row to ensure a robust weed stand. Bioherbicide treatments were made in June, 1997. Results from the field experiment corroborated with our findings in the greenhouse. Preemergence applications of *FSC*-infested cornmeal/sand and *FSC*-"Pesta" granules controlled 90-94% of the weeds. Postemergence applications of *FSC* formulated in corn oil/surfactant were equally efficacious in controlling Texas gourd. No visible damage occurred to cotton with any of the treatments.

These results suggest that *Fusarium solani* f. sp. *cucurbitae* is highly effective in controlling Texas gourd in cotton. Because this weed appears to be spreading and chemicals that can control the weed are being removed from the market, there is potential for a niche market to utilize this pathogen as a bioherbicide for controlling this troublesome weed.

EVALUATION OF THE ANTI-BACTERIAL ACTIVITY OF THE HERBICIDE GLUFOSINATE ON *Pseudomonas syringae* PATHOVAR *Glycinea*. W.A. Pline, G.H. Lacy, V.K. Stromberg, and K.K. Hatzios. Virginia Polytechnic Institute and State University, Blacksburg, VA 24061-0331.

ABSTRACT

Glufosinate, a microbially derived herbicide controlling mono- and dicotyledonous weeds is now being used in Liberty-Link_(LL), glufosinate-resistant soybeans. Studies were conducted on *Pseudomonas syringae* pathovar *glycinea* (L-529) to estimate the anti-bacterial activity of glufosinate in culture and *in planta*. Bacteria were grown in Davis' minimal media supplemented by yeast extract containing concentrations of glufosinate ranging from 0.01 to 100 mM. Measurements of turbidity development over time at each different glufosinate concentration were used to develop growth curves. For *in planta* studies, bacteria were inoculated on LL soybeans at the V2 growth stage. Plants were treated immediately with 0, 0.5, and 1.0 kg/ha glufosinate and kept in a growth chamber at 301C with a 16-h day length and 75% relative humidity for 90 h. Bacteria were washed from the leaves, diluted, and plated on *Pseudomonas* Agar F. Bacteria were visually counted to determine whether glufosinate applications inhibited the numbers of *P. syringae* on soybean leaves. Growth curves showed inhibition of *P. syringae* at glufosinate concentrations greater or equal to 1 mM, and delay of growth at rates as low as 0.01 mM. LL soybeans inoculated with *P. syringae* showed a 45% reduction of live *P. syringae* three days after treatment with 0.5 kg/ha glufosinate and a 60% reduction after treatment with 1.0 kg/ha glufosinate.

CROP MONITORING USING REMOTE SENSING AND GPS TECHNOLOGIES. C.T. Leon, D.R. Shaw, and S.B. Blanche, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Remote sensing and global positioning system (GPS) technologies are being employed to monitor the in-season production of crops. The objective of this study was to determine the ability of remote sensing to detect crop stress and relate the stress factors to yield. Eventually remote sensing may be used to scout crops more efficiently and aid in management decisions throughout the growing season.

A 40 ha soybean field at the Black Belt Branch Experiment Station, Brooksville, MS, was used to conduct the experiment. Along with the multispectral images, a GPS unit was used to map field features such as drainage and shallow lime deposits. In addition 0.581-m^2 weed densities were collected on a 10x10 m grid system. Weed distribution and density maps were developed for sicklepod [*Senna obtusifolia* (L.) Irwin and Barnaby], horsenettle (*Solanum carolinense* L.), and total weeds present. Weed distribution maps were determined through interpolation of weed counts taken on June 30 – July 1, 1999. A multispectral image that was acquired on July 18, 1999, was used and converted to a normalized difference vegetation index (NDVI) to compare to the weed distribution maps and yield map. Correlations were made between NDVI, yield, sicklepod, horsenettle, and total weed data. NDVI and yield exhibited the closest relationships with a R^2 = 0.59. Other correlations existed between sicklepod and NDVI, total weeds and NDVI, although other factors contributed to the variance.

In conclusion, NDVI maps of the field display the overall vigor of the plants present, and may prove useful in determining how to monitor each field. Further research will be conducted to improve the correlation between late season multispectral images and yield. Building long-term databases on field history will enable more educated management decisions and generate trends in yield for each field.

USING A DISC-FLOW METHOD TO STUDY SORPTION-DESORPTION CHARACTERISTICS OF HERBICIDES IN SOILS. M.C. Smith, D.R. Shaw, W.L. Kingery, and F.E. LaMastus, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Thin-disc flow experiments may provide both kinetic and equilibrium data on solute-soil interactions in a more natural environment than static batch experiments. The objectives of this research were to determine the feasibility of using the thin-disc flow method to explore imazaquin-soil interactions, compare the results of thin-disc breakthrough concentration (BTC) curves to batch equilibrium experiments, and determine the feasibility of using non-radiolabeled herbicide for imazaquin-soil interactions. A Brooksville silty clay, pH 6.8, was air-dried, sieved to 1.7 mm, and autoclaved. In the BTC study, 3.0 g soil was place between two 0.45 mm filters and sealed in a 47 mm Nalgene® In-Line Filter Holder. The soil was conditions with 200 ml deionized water followed by 200 ml 0.5 M $CaCl_2$ followed by 1000 ml 5 mM $CaCl_2$. Imazaquin at 3.0 and 29.3 mM in 5 mM $CaCl_2$ plus KBr was then pumped at 3 ml min^{-1} through the soil disc. The effluent was collected in 5 or 10 ml fractions. After collecting 500 ml effluent, the flow was stopped and remained static for 23 hr. After this stoppage, flow was resumed, and fractions were collected for an additional 500 ml. A traditional batch equilibrium study was also conducted using 0.3, 0.6, 1.2, 5.0, and 10.0 mM imazaquin solutions and soil at a ratio of 2:1. The BTC effluent and batch equilibrium solutions were filtered through 0.45 mm syringe filters and analyzed by direct injection into a Hewlett Packard 1100 Series High Performance Liquid Chromatograph.

The BTC curves were almost identical for the 3.0 and 29.3 mM imazaquin solutions. Analysis of variance suggests concentration relative to initial concentration (C/Co) for the 3.0 and 29.3 mM imazaquin solutions differed only immediately after resuming herbicide solution flow after the 23 hr stoppage. Imazaquin was present in the initial samples at approximately 38% Co. At a cumulative volume of 50 ml, the C/Co was 99% for the imazaquin solutions. The low initial effluent concentration was probably the result of dilution. Currently, nonreactive Br^- concentrations in each sample are being analyzed to negate the dilution within the thin-disc system. When herbicide solution flow was resumed after the 23 hr stoppage, imazaquin concentration decreased to 90% and 80% Co with the 3.0 and 29.3 mM solutions, respectively. The decrease demonstrated equilibrium was not achieved during the first BTC. The difference in sorption between the 3.0 and 29.3 mM solutions suggests the quantity of the sorbed imazaquin may have been increasing with increasing solution concentration. This behavior is typical for interactions modeled by Freundlich equations at low concentrations. However, more data relating imazaquin concentration to adsorption are needed. Approximately 50 ml after resuming imazaquin solution flow, the C/Co for the second BTC was at least 98%. When the herbicide pulse stopped but flow continued with 5 mM $CaCl_2$, the imazaquin concentration in the effluent decreased to less than 2% Co after 100 ml additional flow. The Br^- tracer data will separate desorption from dilution. The BTC data suggest the kinetics for the 3.0 and 29.3 mM concentrations are equivalent and are typical for moderately adsorbed anions. However, it is possible that dilution resulting from hydrodynamic interactions could be the driving factor in the BTC curves observed. The first and second BTC data were analyzed using analysis of variance with a split-plot design. Imazaquin concentration was the main plot factor and first or second BTC curve was the subplot factor. When averaged over imazaquin concentrations, the linear regression of C/Co versus cumulative amount of imazaquin interacting with the soil disc did not differ in slope or y-intercept for the first or second BTC curves. When averaged over the first and

second BTC curves, the slope did not differ between the 3.0 and 29.3 mM concentration. Ignoring the forces of dilution, these data suggest sorption kinetics are driving the imazaquin-soil interaction. However, it would appear that the kinetics are equal for both imazaquin concentrations. Comparing the BTC study and the batch equilibrium study, the slope of the regression of imazaquin adsorbed versus equilibrium concentration differed. In the BTC study, for every 1 mM increase in equilibrium concentration, there was a corresponding 3.6257 mmole of imazaquin adsorbed per kg soil. In the batch equilibrium study, for every 1 mM increase in equilibrium concentration, the :mole of imazaquin adsorbed per kg soil increased by 0.3449 units. The difference in observed slopes suggests the thin-disk BTC study over-predicted the adsorption of imazaquin by soil under equilibrium conditions. Other researchers have observed the same relative difference between the two types of studies. The thin-disc flow method for studying imazaquin soil interactions is feasible and useful in generating dynamic, nondestructive data. However, because of hydrodynamic dilution during the initial pulse of herbicide, nonreactive tracers must be used to account for solution mixing and flow. With the limited data observed, the thin-disc soil method over-predicted imazaquin adsorption relative to the traditional batch equilibrium study.

IR-4 HERBICIDE REGISTRATION UPDATE FOR MINOR CROPS. M.P. Braverman, D.L. Kunkel, J.J.Baron, F.P. Salzman, and M. Arsenovic. IR-4 Project, Rutgers University. North Brunswick, NJ 08902-3390.

ABSTRACT

The IR-4 project is a national, publicly funded program to support the registration of pesticides and biological pest control agents on minor food crops. In contrast to the past few years, the year 2000 promises to be an active one for the review of herbicide petitions by the EPA. Herbicides that are expected to be registered are: clethodim for strawberry, celery, root vegetables (includes carrot and radish), leaves of root and tuber vegetables, cucurbit vegetables, cranberry, clover (seed), and rhubarb; clomazone for cucurbit vegetables (includes cucumber, squash and melon); clopyralid for head and stem Brassica sp.; glyphosate for use as a harvest aid on dry pea, paraquat for endive (shielded row middles), persimmon, artichoke and dry pea; sethoxydim for pistachio and safflower. Additionally, a petition for the use of glyphosate on numerous commodities as a pre-emergence application or postemergence directed or hooded application in mulched or unmulched row middles has been submitted to EPA. IR-4 has obtained over 300 post-FQPA registrations in 1999 is hopeful to obtain a greater number of registrations in the year 2000.

COMPETITION AND CONTROL OF SMELLMELON (*Cucumis melo L.* Var *dudaim* Naud.) IN COTTON (*Gossypium hirsutum*). C.H. Tingle, J.M. Chandler, C.A. Jones, and G.L. Steele, Texas Agricultural Experiment Station, Texas A&M University, College Station, TX 77843.

ABSTRACT

Smellmelon (*Cucumis melo L.* var. *dudaim* Naud) is quickly becoming a dominant weed in Texas' cotton and peanut fields. Its rapid growth and limited control measures give smellmelon an enormous competitive advantage over cotton (*Gossypium hirsutum*). Field studies were conducted in 1999 at the Texas Agricultural Experiment Station, near College Station, TX to determine the critical smellmelon density that causes a loss in cotton yield. Additional studies were conducted to determine the critical period of competition between smellmelon and cotton along with early and mid season control strategies.

Competition Study

The competition between cotton and smellmelon was determined by transplanting smellmelon at densities of 2, 3, 5, and 10 plants per 30 linear ft of cotton row. Plots were hand hoed to remove any additional weed species allowing smellmelon to compete full season. Yield was determined by harvesting the center row of each plot. Yield from the weed-free plot was 2392 lb/A. With the addition of 2 or 3 smellmelon per 30 ft, yield was significantly reduced to 1980 and 1985 lb/A, respectively. Yield was further reduced with densities of 5 or 10 smellmelon plants per 30 ft and was 1569 and 1526 lb/A, respectively.

Critical Period

To determine the critical period for smellmelon and cotton competition, studies were conducted evaluating the time of smellmelon introduction and removal. The purpose of the introduction study was to simulate smellmelon germination at different periods throughout the growing season, while the removal study simulated smellmelon control throughout the season. Times consisted of 0, 2, 4, 6, 8, 10, 12, and 14 weeks after planting (WAP) of cotton. Smellmelon densities of 10 plants per 30 ft of row were transplanted or removed at these periods. As before, any additional weeds were removed by hand hoeing and yields were determined by harvesting the center row. Results from full-season smellmelon competition was 1583 lb/A. By delaying the introduction period to 2 WAP, yield increased to 2169 lb/A. Similar yields were observed for the remaining introduction periods and ranged from 2213 to 2331 lb/A.

No yield differences were observed between weed-free and removal periods of 2 and 4 WAP which ranged from 2237 to 2331 lb/A. However, when smellmelon was allowed to compete with cotton for at least 6 weeks, yield was reduced

to 2167 lb/A. Cotton yield decreased for competition periods of 8, 10, and 12 WAP and was 1916, 1806, and 1699 lb/A, respectively.

Control Strategies

Smellmelon control was evaluated with various postemergence (POST) cotton herbicides. The herbicide treatments included glyphosate (1.0 lb a.i./A), pyrithiobac (0.063 lb/A), fluometuron (1.0 lb/A) + MSMA (2.0 lb/A), and bromoxynil (0.5 lb/A). Application timings consisted of POST-1 (2-6" smellmelon) or POST-2 (18-24" smellmelon). Smellmelon control was at least 98% with POST-1 applications of glyphosate, pyrithiobac, or fluometuron + MSMA. Control decreased to 50% with POST-1 applications of bromoxynil. When applications were delayed until POST-2, smellmelon control was 70% for either bromoxynil or fluometuron + MSMA. Smellmelon control was 82% with POST-2 applications of pyrithiobac, but only 27% for glyphosate.

ADJUVANTS FOR DRIFT CONTROL OF ROUNDUP ULTRA® HERBICIDE. J.E. Hanks[1], G.D. Wills[2], E.J. Jones[2], and R.E. Mack[3], USDA-ARS[1], Miss. Agric. and Forest. Exp. Stn.[2], Stoneville, MS, and Helena Chemical Co.[3], Memphis, TN.

ABSTRACT

A combination of field and laboratory studies were conducted to determine the effect of ten drift retardants (Table 1) on the efficacy, spray pattern, and droplet size of Roundup Ultra® spray solutions. The herbicide was applied in the field at 0.5 lb ai in 10 gpa at 43 psi using a tractor-mounted sprayer with eight TeeJet® Extended Range 110015VS nozzles spaced 19 inches apart along the boom. Field-plot applications were to 4 rows of three trifoliolate stage soybeans (*Glycine max* L.) 'ASGROW 5901RR' spaced 38 inches apart, 40 feet long and interspaced with 4- to 6-inch-tall barnyardgrass [*Echinochloa crus-galli* (L.) Beauv.], 4- to 6-inch-tall pitted morningglory (*Ipomoea lacunosa* L.), 2- to 4-inch-tall prickly sida (*Sida spinosa* L.), and 6- to 10-inch-tall smooth pigweed (*Amaranthus hybridus* L.) arranged in a randomized complete block design. Efficacy was determined by visual ratings whereby 0 = no control and 100% = complete kill of shoots. Data were subjected to analysis of variance. Means were separated using Fisher's Protected Least Significant Difference (LSD) at P = 0.05.

Spray patterns were determined using a single nozzle by applying 600-ml volumes of spray mixtures at 43 psi, similar to that of field applications, to a slanted sheet of corrugated metal with troughs spaced 2.5 inches apart and collecting in 100-ml graduated cylinders. Spray droplet size was determined using a Malvern 2600 Lc laser particle analyzer at 40 psi.

In the field studies at 2 WAT, soybeans showed no effect from any treatment. Barnyardgrass, pitted morningglory, prickly sida, and smooth pigweed were controlled 76 to 94% with Roundup Ultra alone. Control was increased to 81 to 100% with HM 9752. Control was either the same or decreased with all the other drift control adjuvants used in this study. In the laboratory studies, the spray width of the different treatment mixtures ranged from 30 to 45 inches with no correlation between the spray width and the percent control of the weedy species.

When the different drift retardants were added to solutions of Roundup Ultra at 0.5 lb ai in 10 gallons of water and sprayed at 40 psi, the percent of spray volumes in droplets larger than 105 microns were as follows: water alone 62%; Roundup alone, 60%; HM 9622-B 0.6 oz, 71%; HM 9622-B 0.8 oz, 72%; HM 9622-C 0.6 oz, 69%; HM 9622-C 0.8 oz, 71%; HM 9679-A 1% v/v, 68%; HM 9733A 0.6 oz, 74%; HM 9752 0.9 lb, 86%; HM 9847-A 0.9 lb, 74%; HM 9850 0.1 lb, 80%; HM 9861A 0.5% v/v, 73%; HM 9861-A 1% v/v, 83%; HM 9861-B 0.5% v/v, 67%; HM 9861-B 1% v/v, 79%; HM 9911 0.5% v/v, 62%; and HM 9911 1% v/v, 62%.

The most effective drift retardant mixed with Roundup Ultra which resulted in the greatest percent weed control, the greatest percent volume of spray droplets larger than 105 microns and an acceptably controlled spray pattern was HM 9752.

Table 1. Drift retardants and rates applied.

HM 9622-B	A proprietary blend of polyacrylamide polymers dispersed in aliphatic hydrocarbons (6 & 8 oz/100 gal)
HM 9622-C	A proprietary blend of polyacrylamide polymers dispersed in aliphatic hydrocarbons and nonionic surfactants (6 & 8 oz/100 gal)
HM 9679-A	A proprietary blend of surfactants and aliphatic hydrocarbons (1% v/v)
HM 9733-A	A proprietary blend of nonionic water soluble organic polymers, dispersion additives, and formulation aids (6 oz/100 gal)
HM 9752	A proprietary blend of polymeric viscosity modifiers and ammonium sulfate (9 lb/100 gal)
HM 9847-A	A proprietary blend of ammonia salts, organic polymers, polyacrylamide polymers and nutrients (9 lb/100 gal)
HM 9850	A proprietary blend of ammonia sulfate, polyacrylamide polymers, colloidal polymers, buffering agents, and sequestrants (1 lb/100 gal)
HM 9861-A	A proprietary blend of ammonia salts and polyacrylamide polymers (0.5 & 1% v/v)
HM 9861-B	A proprietary blend of ammonia salts and polyacrylamide polymers (0.5 & 1% v/v)
HM 9911	A proprietary blend of ammonia salts and polyacrylamide polymers, nutrients and micronutrients (0.5 & 1% v/v)

REMOTE SENSING OF SOYBEAN RESPONSE TO POSTEMERGENCE HERBICIDES. C.S. Bray, D.R. Shaw, J.A. Mills, and T.H. Koger, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762; and Monsanto Agricultural Products Co., Collierville TN 38017.

ABSTRACT

Remote sensing images, using multispectral or hyperspectral images, have proven to be a valuable tool in detecting stress which often result in delayed maturity and reduction in yield. Multispectral images by band differentiation separate out specific wavelengths to determine reflectance responses of the plant canopy. Using the multispectral images the reflectance can be evaluated and equated into a formula to determine a range of reflectance. One formula method used is NDVI (Normalized Difference Vegetation Index) with the formula near infrared – red / near infrared + red. This formula allows for the range of –1 to 1, with values close to 1 being " healthy" plants and values close to 0 "stressed" plants. With the specific reflectance responses of a crop at a given point of the growth stage, a system could be implemented to determine stress levels of a crop from remote sensing images.

An experiment was conducted using remote sensing multispectral images to observe the plant response to postemergence herbicides in soybeans. The postemergence herbicide treatments were 840 g ai/ha glyphosate followed by (fb) 630 g/ha glyphosate, 840 g /ha glyphosate, 630 g/ha glyphosate plus 4 g ai/ha chlorimuron, 630 g/ha glyphosate plus 140 g ai/ha acifluorfen, 630 g/ha glyphosate plus 9 g ai/ha cloransulam, 1000 g ai/ha bentazon plus acifluorfen plus clethodim, and sequential applications of 840 g/ha glyphosate fb 630 g/ha glyphosate, 630 g/ha glyphosate plus 4 g/ha chlorimuron fb 630 g/ha glyphosate plus 4 g/ha chlorimuron, 630 g/ha glyphosate plus 140 g/ha acifluorfen fb 630 g/ha glyphosate plus 140 g/ha acifluorfen, and 630 g/ha glyphosate plus 9 g/ha cloransulam fb 630 g/ha glyphosate plus 9 g/ha cloransulam. All plots were maintained using standard agronomic practices (fertilizer, irrigation, scouting). Images were acquired using a 4 CCD array camera (1320 by 1035 pixel array) with sensor ranging from 540 nm (green) to 840 nm (near infrared). All images are 8 bit image pixels. ITD Spectral Visions, Bay ST. Louis, MS, provided multispectral images on a weekly basis. Images were acquired at approximately 12,000 ft. with a 2-meter resolution. Areas of interest were randomly selected from both plot areas and NDVI values extracted to form a mean from that area of interest.

The multispectral images were analyzed using NDVI to evaluate the stress from postemergence herbicides. Individual treatments were not separable from the image by analysis of NDVI values. A difference was detected in the values in the conventional herbicide treatments from the reflectance responses as with the glyphosate treatments. The plant canopy response to the postemergence herbicides illustrate a variance of stress the postemergence herbicides induce. While distinct patterns were not visually observed, NDVI values illustrate the variance of reflectance responses of the soybean canopy from postemergence herbicide applications.

PRECISION FARMING TECHNIQUES FOR WEED MANAGEMENT. J.E. Hanks and S.J. Thomson, USDA-ARS, Application and Production Technology Research Unit, Stoneville, MS 38776.

ABSTRACT

Preliminary studies were conducted to investigate methods of geo-referencing weed locations in fields for site-specific application of herbicides with a sprayer controlled by a global positioning system (GPS) (Starlink Invicta 210S). Ground-based and aerial methods were examined. Ground-based methods included scouting fields with a backpack GPS and marking areas where weeds were present and remote sensing from a high-clearance sprayer using a video monitoring system (VMS-200 Red Hen Systems) that interfaced a digital video camera (Sony TRV-103) and GPS. Aerial remote sensing was from an agricultural spray plane with the same video monitoring system. Spectral reflectance data was

collected for six weeds with a spectroradiometer. Visible images and infrared images were obtained with the video system by using no filter or an infrared filter on the camera. Images were indexed on a computer in the laboratory using the VMS software that provided a geo-referenced path of the vehicle. By simultaneously indexing the tape and viewing the tape through a multimedia player with frame-grabbing software, images of geo-referenced areas were obtained and marked along the path of the vehicle. Images of the marked points could be viewed by clicking on any marked point and the VMS software would scroll the tape and locate the frame where the tape was marked, displaying the image on the multimedia screen. The geo-referenced path, with weedy areas marked, was imported into a geographical information system (GIS) (Vision 4.1.150) and overlaid with the field boundary. Aerial images of the entire field were geo-referenced then imported into the GIS. This provided a geo-referenced video image that could be viewed with the field boundary layer.

Scouting fields with a backpack GPS was the most accurate method and provided weed identification as the scouting was being conducted. Weedy areas could be marked as points, lines or polygons. Weed location data was imported into field boundaries previously processed in the GIS. In the GIS, polygons were drawn around the marked areas to consolidate small weedy areas. An application prescription was then written in the GIS and loaded into GPS-controlled sprayer that only applied herbicide were the weedy areas occurred in the field.

Ground-based remote sensing was conducted by driving through the field with the camera focused directly in front of the vehicle or driving the perimeter of the field with camera focused down the crop rows. Driving through the field provided more accurate location of weeds and often weed identification could be made without scouting the field. Driving the perimeter of field provided a visual record of where weeds were, allowing prescription maps to be written approximating weedy locations. Generally, the perimeter method required scouting the field to pinpoint exact coordinates of weedy areas. Although scouting was required, having coordinates of the rows where weedy patches were visible minimized time. These allowed the person scouting to go directly to areas where weeds were concentrated.

Location and identification of weedy areas from aerial images varied with height of the plane and field condition. Images obtained from heights of 120m and 460m over bare soil or where the crop canopy was small were adequate to identify concentrated patches of weeds, but not individual scattered weeds. At heights less than approximately 15m, images of individual weeds could be captured. Images from higher flights definitely required scouting to determine weed identification, but scouting was minimized by using the geo-referenced images indicating where the weedy areas were located. Broadleaf and grass weeds could be distinguished in images from low flights, but still required scouting for identification. Images from low flights had to be viewed in slow motion, making it very tedious and time consuming to process and capture images.

Weed plots were used to collect spectral reflectance data and remote images. Four broadleaf weeds (morningglory, prickly sida, hemp sesbania, and velvetleaf) and two grasses (johnsongrass and barnyardgrass) were individually planted in 3m by 3m plots; each separated by 5-15m of bare soil. Plots were replicated three times and thinned to maintain individual plots of single specie. The spectral reflectance data indicated differences among the weeds, which was also evident from images acquired over the weed plots. Hemp sesbania was easiest to distinguish among the plots, but when mixed in a crop canopy it could only be distinguished as a weed.

Each of the methods investigated has potential of identifying weeds in crops and providing maps for site-specific application of herbicides, but procedures will require significant refinement.

ASSESSMENT OF MORPHOLOGICAL CHANGES IN PLANT GROWTH REGULATOR TREATED 'TIFWAY' BERMUDAGRASS USING SCANNING ELECTRON MICROSCOPY. M.J. Fagerness, T.W. Rufty, Jr., and F.H. Yelverton, Crop Science Department, North Carolina State University, Raleigh.

ABSTRACT

Plant growth regulators (PGRs) are known to reduce biomass production in turf-type bermudagrass and also enhance shoot density. However, the morphological and/or physiological means by which such effects occur remain poorly understood. The use of scanning electron microscopy (SEM) as a tool for anatomical and morphological research has not been aggressively pursued in the disciplines of either turfgrass science or weed science. This technology may therefore be useful in determining morphological changes in turfgrass resulting from plant growth regulator (PGR) applications. An experiment based upon SEM principles was thus conducted using mature 'Tifway' bermudagrass cultures grown in the greenhouse. Samples were nontreated or treated with either trinexapac-ethyl (TE) or paclobutrazol (PB) at 0.11 or 0.56 kg a.i./ha, respectively.

Two and four weeks after treatment (WAT), tissue segments from each treatment group were harvested from either stolon node or intercalary leaf meristem regions of the plants. Samples were segmented using a razor blade for evenness of cut, were small enough to mount on SEM stubs, and were roughly 6-8 in number for each tissue type to ensure that proper representation of a particular treatment was feasible. Samples were biologically fixed in FAA for at least 24 hours and were then taken through a series of ethanol dehydrations until they were in 100% ethanol. Samples were dried at the critical point of carbon dioxide for 15 minutes and then sputter coated with 25 nm of gold/palladium. Samples were viewed in a Philips 505T scanning electron microscope at 16 kV and images were recorded digitally.

Results demonstrated that the intercalary meristem region of 'Tifway' bermudagrass was significantly compressed 4 WAT by either PGR while such an effect was less visible 2 WAT. Results supported continued analysis of the intercalary meristem region of bermudagrass using light microscopy for visualization of cell density and arrangement in these tissues in response to PGR applications. Suggestion of swollen stolon nodes and enhanced branching from them, as a result of PGRs, was first evident 2 WAT but became highly evident by 4 WAT, suggesting that shoot development from PGR treated stolons may be enhanced by PGRs. We therefore present that SEM is indeed a useful tool for detailing specific morphological changes in bermudagrass resulting from PGR applications.

BANKSIDE AERATOR FOR DECOMPOSITION OF BARLEY STRAW TO CONTROL ALGAE IN CATFISH PONDS. G.D. Wills, C.S. Tucker, J.F. Santucci, and E.J. Jones. Mississippi Agric. and Forest. Exp. Stn., Stoneville, Mississippi.

ABSTRACT

Off-flavor of pond-raised catfish (*Ictalurus punctatus*) caused by the cyanobacterium (blue-green algae) *Oscillatoria chalybea*, continues to be a problem for commercial catfish production in Mississippi. Researchers in the United Kingdom have controlled the growth of foul-tasting, blue-green algae in potable water supplies by decomposing barley straw (*Hordeum vulgare*) under aerobic conditions by floating the straw near the surface of the water. This procedure has been most effective when water temperature is above 60°F (10°C). The decomposing straw does not kill the blue-green algae but inhibits its growth and reproduction. Similar attempts to control the growth of blue-green algae in catfish ponds in Mississippi by floating barley straw in wire cages have not been successful because the barley straw in the catfish ponds decomposed only under anaerobic conditions. It was surmised that only anaerobic decomposition in the catfish ponds was due to low levels of dissolved oxygen and high levels of nutrients associated with the intensive fish culture conducted in these ponds.

A study is presently underway at Stoneville, Mississippi, using a bankside aeration system to obtain aerobic decomposition of barley straw in the water of catfish ponds. In this system, a method, as described by Dr. Jonathan Newman of the United Kingdom, was composed of a series of porous wire cages 4 by 5 by 1 foot deep (1.2 by 1.5 by 0.3 m deep) stacked 6 inches (15 cm) apart one above the other on the bank near the water. Straw was loosely layered 4 to 6 inches (10 to 15 cm) deep in each cage. Water was pumped from the pond and sprayed over the straw in the upper cage where it flowed by gravity through the straw in the cages below and was then piped back into the reservoir.

This study began on July 1, 1999, with four 1-acre (2.47 ha) ponds, each containing 6000 catfish which were fed daily. One pond had a bankside aerator system consisting of four stacked cages containing one 35-lb (15.9-kg) bale of barley straw in each cage. The total amount of straw in the four cages was equivalent to 3.2 lb/1000 sq. ft. (15.7 g/m^2) of pond surface area. Three similar ponds of catfish were untreated. Results for controlling off-flavor of catfish during August and September 1999, were inconclusive because of the amount of blue-green algae which was already established before the treatment began.

This study will continue beginning in March 2000 with the four 1-acre ponds with a bankside aerator functioning for each pond as described above and with similar ponds of catfish with no aerators to serve as untreated controls.

Captions:

Bankside aerator including (lower left) a Teel® self-priming centrifugal pump and (right) four wire cages, 4 ft. by 5 ft by 1 ft deep (1.2 m by 1.5 m by 0.3 m deep), stacked 6 in (15 cm) apart, each loosely filled with one bale (35 lb or 15.9 kg) of barley straw. Water is pumped from the pond and sprayed over the top where it flows by gravity through the barley straw and the open-air spaces and is fed through a pipe back into the pond as described by Dr. Jonathan Newman, IACR-Centre for Aquatic Plant Management, Sonning, Reading, UK.

Water is pumped from the pond through a screened inlet port which is floated near the surface to reduce the intake of silt and debris. A check valve is located immediately above the inlet part to maintain the water prime when the pump is not running.

FLUOMETURON AND NORFLURAZON LOSSES IN SURFACE RUNOFF AS AFFECTED BY TILLAGE SYSTEMS AND VEGETATIVE FILTER STRIPS. S.B. Blanche, D.R. Shaw and D.S. Akin, Department of Plant and Soil Sciences, Mississippi State University, MS 39762.

ABSTRACT

Field studies were conducted to evaluate the effectiveness of vegetative filter strips in conjunction with three different tillage systems: a conventionally tilled system (CT), a no-till system (NT), and a no-till with wheat (*Triticum aestivum* L.) residue system (NTR) for reducing runoff volume, sediment, fluometuron and norflurazon in surface runoff. Trials were conducted on runoff plots 4 m x 22 m in Brooksville, MS, on a Brooksville silty clay (fine montmorillinitic, thermic Aquic Chromudert, 3% slope, 3.2% organic matter content, pH 6.3 in Ap horizon). Cotton (*Gossypium hirsutum* L.) was planted in 76 cm rows and all plots received 1.7 kg ai/ha fluometuron and 1.7 kg ai/ha norflurazon PRE. A 1-m filter strip of switchgrass (*Panicum virgatum* L.), a perennial grass with a stiff, erect growth habit, was installed at the base of each tillage system, and an unfiltered plot was paired with it for comparison. The samples were analyzed using liquid-liquid extraction and HPLC methodology for determining fluometuron and norflurazon concentrations in runoff.

When a filter strip was present, cumulative runoff was reduced by 55%, 35% and 30% in the CT, NT and NTR systems, respectively. At 0 DAT, fluometuron losses from treatments containing a filter strip was reduced 66, 25 and 47% in CT, NT and NTR systems, respectively. Norflurazon losses from treatments containing a filter strip were reduced 73, 25 and 46% in CT, NT and NTR, respectively, at 0 DAT.

THE USE OF REMOTE SENSING TECHNOLOGIES IN WEED SCIENCE. J.C. Arnold, D.B. Reynolds, W.F. Bloodworth. Mississippi State University, Mississippi State.

ABSTRACT

An experiment was established to determine the cost effectiveness of site-specific crop management as compared to conventional methods with regard to weed control. A field approximately 20 acres in size located at the Black Belt Research Station near Brooksville, MS, was divided in 0.5 acre grids. At each 0.5 acre grid, weed counts were recorded. These counts were then submitted to Mississippi State University – Herbicide Application Decision Support System (MSU-HADSS), a prediction model that makes herbicide recommendations based upon weeds present and their respective densities, potential crop yield, expected crop price, and predicted yield losses due to weed competition. Each 0.5 acre grid was evaluated as an individual field. The field was naturally infested with johnsongrass (*Sorghum halepense*), bermudagrass (*Cynodon dactylon*), and yellow nutsedge (*Cyperus esculentus*). In the experiment two herbicides were recommended by MSU-HADSS to be used, Roundup Ultra (glyphosate) and Select (clethodim) + COC. Roundup Ultra was recommended for 61% of the field while Select + COC was recommended for 35% of the field. Due to sub-threshold weed densities, the remaining 4% was to be left untreated. Herbicide prices were generated using the MSU Budget Generator. Based upon recommendations by MSU-HADSS, a site-specific crop-weed management approach would cost $207.16 for the entire 20 acres. The site-specific management cost does not include the price of scouting and site-specific equipment that may be required for herbicide applications. A broadcast application of Roundup Ultra across the entire field would cost $199.60. In this experiment, the site-specific management approach did not reduce the total herbicide cost as originally predicted because of the weed spectra and distribution encountered.

ADSORPTION OF ATRAZINE AND METOLACHLOR ON BERMUDAGRASS (*CYNODON DACTYLON*) AND TWO SOILS. M.C. Dozier, Texas Agricultural Extension Service, Temple, Texas; S.A. Senseman, Texas Agricultural Experiment Station, College Station, Texas; D.W. Hoffman, Texas Agricultural Experiment Station, Temple, Texas; and P.A. Baumann, Texas Agricultural Extension Service, College Station, Texas.

ABSTRACT

Studies have been conducted to determine the effectiveness of grass filter strips in reducing off-target losses of pesticides, however, little work has been done to determine the adsorptive capacity of bermudagrass for pesticides. Therefore the following objectives were developed: 1) to determine and compare the adsorptive capacity of bermudagrass, a Weswood soil, and a Houston Black soil to atrazine and metolachlor and 2) to determine if the presence of one herbicide affects the adsorptive behavior of the other compound to these sorbents. Using a single point adsorption study, one g of fresh-cut bermudagrass clippings and 2 g of each soil were placed in centrifuge tubes. The chemical treatments were 1) ^{14}C atrazine only, ^{14}C atrazine + analytical grade metolachlor, 3) ^{14}C metolachlor only, and 4) ^{14}C metolachlor + analytical grade atrazine. All treatments were replicated three times. After shaking for 24 hr, all samples were centrifuged and a 1-ml aliquot from each sample was transferred into a vial containing liquid scintillation cocktail for analysis using a liquid scintillation counter. Results were reported in disintegrations min^{-1} (dpms). These results were converted to K_d using a modified version of the formula outlined in Talbert and Fletchall (1965). Both K_d values associated with the adsoption of atrazine (86.2) and metolachlor (131.5)for bermudagrass were significantly greater than the K_d values for Weswood (atrazine,20.0 and metolachlor, 28.4) and for Houston Black (atrazine, 35.8 and metolachlor, 33.5). The adsorption of atrazine to the sorbents was not affected by the

presence of metolachlor. When comparing the adsorption of metolachlor alone in solution to that of metolachlor and atrazine together in solution, no significant differences were observed for bermudagrass or the Weswood soil. However on the Houston Black soil, the addition of atrazine to the metolachlor solution significantly increased the adsorption coefficient or K_d value of metolachlor.

PITTED MORNINGGLORY (*Ipomoea lacunosa L.*) CONTROL IN ROUNDUP READY COTTON UNDER IRRIGATED CONDITIONS. E.W. Palmer and D.S. Murray. Department of Plant and Soil Sciences, Oklahoma State University, Stillwater, OK 74078.

ABSTRACT

A field experiment was initiated in 1999 at the Irrigation Research Station near Altus, OK to evaluate efficacy and economics of various glyphosate treatments compared to standard cotton herbicides. The experimental design was a randomized complete block with 4 replications. There were 21 treatments included in the experiment with varying application timings of PRE, POST-1, POST-2, POST-3, and POST-DIRECTED. Plot size was 4 m x 30 m. Pitted morningglory (*Ipomoea lacunosa* L.) was the predominant species. Visual weed control ratings and cotton yield data were collected from all plots.

Herbicides included: (PPI) trifluralin; (PRE) clomazone, fluometuron, prometryn, pyrithiobac, prometryn + pyrithiobac, or fomesafen; (POST-1) glyphosate, pyrithiobac, or glyphosate + pyrithiobac; (POST-2) glyphosate, pyrithiobac, or pyrithiobac + MSMA; (POST-3) glyphosate; and (POST-DIRECTED), glyphosate, lactofen, oxyfluorfen, or prometryn + MSMA. Trifluralin was applied to the entire study area prior to initiation of the experiment. Application of 2.2 kg/ha prometryn PRE improved early-season pitted morningglory control at least 20% when compared to other PRE treatments; however, no late-season differences were observed between treatments with or without prometryn PRE when glyphosate was applied either POST-1 alone or sequentially at POST-1 and POST-2. Glyphosate applied sequentially POST-1 and POST-2 improved season-long pitted morningglory control over a single glyphosate application POST-1. A single pyrithiobac application POST-1 controlled pitted morningglory as efficiently as sequential pyrithiobac applications POST-1 and POST-2. POST-3 and POST-DIRECTED treatments controlled pitted morningglory <50% when a POST-1 application was not included regardless of herbicide. However, if a POST-1 application was included in the treatment control was at least 80%.

Cotton treated with glyphosate POST-1 followed by pyrithiobac + MSMA POST-2 yielded 1050 kg lint/ha. This was 560 kg/ha more than cotton treated with glyphosate POST-1 alone. Net returns for weed control were not different for a single POST application of pyrithiobac or sequential glyphosate applications POST-1 and POST-2.

ON FARM RESULTS OF FALL APPLICATION OF DICAMBA OR GLYPHOSATE + 2,4-D TO PREVENT FIELD BINDWEED (*CONVOLVULVUS ARVENSIS*) AT WHEAT HARVEST. A.E. Stone and T.F. Peeper. Oklahoma State University, Stillwater, OK.

ABSTRACT

Field bindweed is economically important to Oklahoma wheat producers. It can delay and even stop wheat harvest by wrapping around the combine reel and cylinder. For the past fifty years, producers have been fighting this weed with herbicides, but to no avail. Field bindweed is a very difficult weed to control because of its extensive rooting system. Cultural control, such as using a sweep plow, continuously over the years can reduce field bindweed, but not eliminate it. In addition to cultural control, 2,4-D has been widely used to control field bindweed. Even when combining cultural control and a herbicide there is no way to eliminate the field bindweed. Therefore, the purpose of this research is to shift the focus of the farmer from spraying the field bindweed in the middle of the summer to spraying in the fall.

Nine cooperators participated in the program. They were given the suggestion to use either 64 fluid ounces per acre of Landmaster BW or 32 fluid of Banvel ounces per acre respectively. The producers were encouraged to make their own final decision of which rate to use. From the responses to the survey mailed to them after harvest, there was on overwhelming satisfaction with the fall spraying. Of the nine participants 78% reported that there was a little field bindweed present at harvest, while the remaining 22% reported that there was considerable field present at harvest.

ROOT-GROWTH RESPONSES OF 'PENCROSS' CREEPING BENTGRASS TO TRINEXAPAC-ETHYL AND VARIOUS ROOT-ZONE TEMPERATURES. H.D. Cummings, F.H. Yelverton, D.C. Bowman, and T.W. Rufty Jr., Crop Science Department, North Carolina State University, Raleigh, NC 27695-7620.

ABSTRACT

Maximum root growth of creeping bentgrass (*Agrostis palustris* Huds.) in North Carolina occurs in the spring and fall. The majority of creeping bentgrass roots die during the summer months in the 'Transition Zone'. Plant growth regulators (PGRs) like trinexapac-ethyl (TE) may be applied in the spring and fall for creeping bentgrass growth management, but

high rates of PGRs may hinder turfgrass quality. Using PGRs, which inhibits cell elongation, may impact creeping bentgrass rooting during its maximumgrowth period. If creeping bentgrass rooting is inhibited, its ability to survive the stress of summer in the 'Transition Zone' may be compromised, leaving the turf canopy open and susceptible to colonization by weeds. The objectives of this experiment were to determine the relative effects of TE on root-biomass production of creeping bentgrass maintained at various root-zone temperatures. In eight hydroponics chambers, 'Penncross' creeping bentgrass was seeded at a rate of 3 mg/cm^2 in 10 cm^2 cups with cloth bottoms held above a nutrient solution at 22 C. Plants were mowed every three days; nutrients were replaced on a regular basis to prevent depletion; and chambers were rotated weekly. Three weeks after germination, TE (1 EC) was applied to half the plants using a CO_2 backpack sprayer at 0.11 kg a.i./ha, twice the label rate. Four weeks later, TE was reapplied, and six treated and six non-treated plants were randomly assigned to seven chambers with nutrient solution temperatures maintained at 14, 18, 22, 26, 30, 34, and 38 C. When the experiment was repeated, TE was applied only once, two days before the initiation of temperature treatments. The nutrient solution temperatures encompass the range of soil root-zone temperatures encountered in sandy soils during one growing season in North Carolina. The experiment was conducted using a split plot design with six replications where temperature was the whole plot treatment, and TE was the subplot treatment. Plants were exposed to the temperature treatments for 16 days; nutrient levels, pH, day length, and irradiance were held constant. Root length was measured every two days. Shoot extension was measured before collecting clippings every three days. Fresh and dry weights of clippings were determined. After 16 days of temperature treatment, root fresh and dry weights were determined. Results of fresh root weight data analyses are discussed. Root-zone temperature had a greater effect than the TE treatment on fresh root-biomass production. The responses of root weights to temperature were non-linear and showed a large drop off at the 34 C treatment. The 38 C treatment was lethal to the plants. The interaction between root-zone temperature and TE was not significant. Although the TE treatment was statistically significant, the resulting increase in root biomass was small and may not be biologically significant. Since plants treated with TE in run 1 reported a greater increase in root biomass than run 2, TE may aid in pre-stress conditioning.

SORGHUM VARIETAL RESPONSE TO PROSULFURON. A.S. Sciumbato, S.A. Senseman, W.C. Rooney, C.H. Tingle and J.M. Chandler, Texas Agricultural Experiment Station, College Station, TX and E.P. Prostko, Texas Agricultural Extension Service, Stephenville, TX.

ABSTRACT

Prosulfuron is a sulfonylurea herbicide applied postemergence to control broadleaf weeds in grass crops including sorghum. During the summer of 1996 some Texas producers observed injury to their sorghum crops and suspected prosulfuron as the cause. This research was conducted in 1998 and 1999 in College Station and Stephenville, TX to compare susceptibilities of different grain sorghum varieties to prosulfuron. Sixteen different sorghum varieties were planted at each location and were treated with 1X and 2X rates of prosulfuron. Data recorded included plant height at 14 days after treatment (DAT), dry weight at 14 DAT, and seed head weight at harvest.

The application of prosulfuron consistently reduced sorghum dry weights each year at both locations. With the exception of College Station in 1998, prosulfuron also significantly reduced the height of all varieties tested. While all sorghum variety head weights were reduced in College Station by applying prosulfuron, similar results were not obtained in Stephenville where head weight results were not significantly different among treatments. These results suggest that there is no difference in prosulfuron tolerance among the sorghum varieties tested.

CHARACTERIZATION OF HOST PLANT RESPONSES TO BROOMRAPE (*Orobanche*) USING RNA ANALYSIS AND INDICATOR GENES. A.A.Griffitts, C.L. Cramer, and J.H. Westwood, Department of Plant Pathology, Physiology, and Weed Science, Virginia Tech, Blacksburg, VA 24061.

ABSTRACT

Orobanche is a parasitic plant that attacks the roots system of many important crops. In order to control this pathogen, it is important to understand the relationship between the host and the parasite. *Orobanche* penetrates the host root (aided by digestive enzymes) and forms connections to the host vascular tissue, from which it will draw all of its water and nutrient requirements. In order to investigate how the host plant responds to this attack, we are studying the patterns of expression of host genes, with emphasis on those involved in the mevalonic acid pathway. The first committed step of this pathway is catalyzed by HMGR (3-hydroxy-3methylglutaryl CoA reductase) which is regulated at the level of transcription of a family of isogenes. We have previously shown that hmg2, known to be specifically induced in defense situations, is expressed at the site of *Orobanche* parasitization in transgenic tobacco (*Nicotiana tabacum L.*). A second isogene, hmg1, differs from hmg2 in that it plays a role in general metabolic processes related to plant development, and is expressed in response to wounding rather than by specific pathogen interactions. In this study, tomato (*Lycopersicon esculentum Mill*) plants containing hmg1-GUS fusions were assayed, and Northern hybridization analysis was performed using hmg1 specific probes. Results indicated that hmg1 is also expressed during parasitization. Given the role of hmg1, it appears that the plant recognizes the injury caused by *Orobanche* and stimulates the expression of hmg1 to repair the site of parasitization. Another gene in the pathway, squalene synthetase, is similar to hmg1 in that it is also known to play a role in general cell growth and maintenance processes. However, squalene synthetase is induced in response to wounding yet repressed in response to pathogen elicitors. Results from Northern hybridization

analysis of *Orobanche*-infected tissue indicated that unlike hmg1, squalene synthetase is repressed in tissue parasitized by *Orobanche.* Together, these results indicate that the plant seems to shift metabolic energy away from cell maintenance in favor of defense and repair. By comparing the regulation of these three genes in response to *Orobanche* attack, we are able to gain a greater understanding of the host plants response to parasitization and explore potential gene candidates for future engineering strategies to create *Orobanche* resistant crops.

WEED CONTROL MECHANISMS IN MULTI-CROPPED FORAGES AND WATERMELON. W. Roberts, J. Shrefler, J. Duthie, J. Edelson, M. Biernacki, and M. Taylor, Oklahoma State University, Lane Agricultural Center, Lane, Oklahoma, 74555.

ABSTRACT

Most agriculture in southeastern Oklahoma involves cow-calf operations. Cultivated soils in the area are highly erodible by both wind and water, but permanent pastures keep vegetation on the soil and thus greatly reduce soil erosion. Watermelons are also well-suited to the climate of Oklahoma, and normally produce more income per acre than will pastures or hay. There are advantages to each crop, and opportunities for jointly producing both crops on the same farm. There are also opportunities to produce both crops on the same field in the same year.

A system is needed that would allow melon production in an established pasture or meadow for one year without damaging the stand of grass for the following years. An even better system would allow for production of both pasture grasses and watermelon on the same land in the same year. The purpose of this project has been to determine if watermelon and bermudagrass pastures can be grown in the same field in the same year. One approach to answering this question was to grow watermelon in strips in a perennial pasture or meadow. Only a small portion of the pasture was tilled and planted with melons, and the pasture was then allowed to return to grass.

Fields of bermudagrass have been used to grow both hay and watermelons. Hay is grown between the plots at the same time, and after the melons are harvested, the entire field is allowed to revert to bermudagrass. Grass is allowed to grow between the strips while the watermelons are being grown.

After three years, we have demonstrated that both hay and watermelon can be harvested from the same field in a single year. The tilled strips that were planted with watermelons in one year may be covered with bermudagrass later during the same year, and will certainly be covered with grass the following year.

After three years of research, the main limitation to watermelon growth seems to be weed control. Bermuda grass may be classified as a weed when it interferes with watermelon production, even though it is also classified as a crop when grown between the tilled strips or when it is grown before or after the crop of watermelons. If grasses are completely controlled in the tilled and planted row, broadleaf weeds may become a problem within the row.

Experiments were conducted for three years to compare techniques for controlling broadleaf and grass plant species in strips that had been tilled and then planted with watermelon. Each year, at least one cutting of hay was harvested. After the hay was removed from the field, 6 ft wide strips were tilled on 18 ft centers. The strips were planted with watermelon. Weed control strategies were applied as treatments. Treatments included a clean control, a weedy check, single cultivation, single cultivation plus Poast (sethoxydim), single cultivation plus Treflan (trifluralin), single cultivation plus Poast and Treflan, triple cultivation, triple cultivation plus Treflan, and triple cultivation plus Treflan and Poast.

Watermelons were harvested and yields recorded. A beaded cable was used to determine the percent of the field covered by grass, broadleaf weeds, watermelon plants, or bare soil. When considering all three years, the best yield of watermelon was produced when the weed control treatment included cultivation, Treflan, and Poast. In general, three cultivations did not significantly improve yield over one cultivation. Applications of Poast restricted the growth and regrowth of bermudagrass. Late applications of Poast may be considered detrimental, as regrowth of grass into the tilled strips was delayed.

After three years of research, we are recommending cultivation, followed by Treflan at the last cultivation, followed by Poast if grass growth is excessive in or near the row of watermelons. More work is needed concerning the timing of Poast, so that weed control can be achieved without un-necessary restriction of bermudagrass regrowth.

THE PERSISTENCE OF IMAZAPIC IN PEANUT CROP ROTATIONS OF TEXAS. M.A. Matocha, S.A. Senseman, W.J. Grichar, and E.P. Prostko. Texas Agricultural Experiment Station, College Station and Yoakum, Texas Agricultural Extension Service, Stephenville.

ABSTRACT

Field studies were conducted to determine carryover effects of imazapic on five rotational crops at Yoakum and Stephenville, Texas. Imazapic was applied to peanuts at 70, 140, and 210 g/ha in 1998. In 1999, conventional corn, IR

corn, grain sorghum, cotton, and soybean were planted into the same plots and were evaluated for carryover injury. Data collected included stand counts, plant heights, and destructive plant biomass samples. Soil samples were taken from the carryover plots throughout the year and were used in a controlled-condition bioassay to determine the amount of herbicide remaining in the soil over time.

All field data from both locations showed no significant carryover injury to any rotational crop from any of the three rates. Controlled-condition bioassay data indicated no significant reduction of plant height or fresh weight of cotton or grain sorghum from soil collected six months after herbicide application. This data supports data fromthe field and the conclusion that up to 210 g/ha of imazapic did not cause carryover injury to five rotation crops planted the following year.

INTERACTION OF PLANTING DATES AND PREEMERGENCE HERBICIDES ON WATERMELON STAND ESTABLISHMENT. C.L. Webber III and J.W. Shrefler, USDA, ARS, SCARL and Oklahoma State University, Lane Agricultural Center, Lane, OK 74555.

ABSTRACT

Watermelon (*Citrullus lanatus*), weeds, and herbicides interact with the environment to affect both initial and seasonal growth, establishment of watermelon and weeds, herbicide efficacy, and crop injury. In an attempt to maximize crop income, farmers pursue management strategies that will produce watermelons for the early peak watermelon market. The cold early-season soil temperatures not only impede initial watermelon growth, but may also increase herbicide crop injury and decrease weed control. Research was conducted in southeast Oklahoma (Lane, OK) to determine the effects of planting dates (soil temperatures) and herbicides on watermelon stand establishment. Certified watermelon seeds, cv. 'Allsweet', were planted 1.1 seeds/ft, 0.5 inches deep, in single rows, on raised beds with 6-ft centers at 4 planting dates (April 12, April 26, May 17, and May 31) in the spring of 1999. Within 24 h of each planting date, 10 herbicide treatments with 4 replications were applied at 19 gpa with a CO_2 backpack sprayer equipped with XR8002VS nozzles on 20-inch spacing. All herbicide treatments received 1 inch of water (sprinkler irrigation and/or precipitation) within 24-h of application to move the herbicides into the soil. Soil temperatures were collected daily (0800 HR) at the 1-, 2-, and 3-inch depths. Seedling emergence and plant populations were also recorded daily throughout the 63-day experiment. Herbicides were applied at recommended rates (1X), at twice the recommended rates (2X), and for one herbicide (halosulfuron-methyl) at three times the recommended rate (3X). The herbicide treatments included ethalfluralin at 1.125 lb ai/a (1X), ethalfluralin at 2.25 lb ai/a (2X), halosulfuron-methyl at 0.025 lb ai/a (1X), halosulfuron-methyl at 0.05 lb ai/a (2X), halosulfuron-methyl at 0.075 lb ai/a (3X), bensulide at 4 lb ai/a with naptalam at 2 lb ai/a (tank-mix, 1X), bensulide at 8 lb ai/a with naptalam at 4 lb ai/a (tank-mix, 1X), PCC-170 at 1.05 lb ai/a (1X), PCC-170 at 2.10 lb ai/a (2X), and a herbicide-free treatment. Soil temperatures at and just following planting ranged from 51°F for the first planting date, April 12, to 70°F for the fourth planting date, May 31. Final watermelon stands increased significantly with each succeeding planting date (averaged across herbicide treatments), increasing from24% to 86%, for April 12 to May 31, respectively. Only halosulfuron-methyl at the 2X and 3X rates significantly decreased watermelon stands compared to the herbicide-free treatment (averaged across planting dates). Halosulfuron-methyl at 0.05 lb ai/a (2X) decreased stands by 21.6% and halosulfuron-methyl at 0.075 lb ai/a (3X) decreased stands by 26.6% compared to the herbicide-free treatment. There were no significant interactions between planting dates and herbicide treatments. Herbicides did not significantly reduce watermelon stands at any of the planting dates, if applied at the recommended rates (1X). The effects of planting date and herbicide treatments on stand establishment for individual planting dates provide valuable information to evaluate the risks involved in selecting earlier planting dates. The results also provide insight into the extent watermelon seeding rates would need to be increased to compensate for decreased stand establishment as affected by the earlier colder planting dates.

RICE WEED CONTROL WITH GLYPHOSATE. S.N. Morris, E.P. Webster, K.J. Pellerin, and J.A. Masson. Louisiana State University Agriculture Center, Baton Rouge, LA.

ABSTRACT

A field study was conducted in 1998 and 1999 to evaluate glyphosate at different application timings and rates in a water-seeded culture. The water-seeded culture consisted of initial flooding and draining for 48 hours to stimulate rice seedling and establishment. Following the drained period, a permanent flood was established employing a pinpoint flood culture. The study was established at the Rice Research Station, near Crowley LA, on a Crowley silt loam with 1.4% OM and 5.5 pH. Plot size was 2 x 6 meters. The experimental design was a randomized complete block with three replications. Single applications of glyphosate were applied early postemergence (EPOST) at 2-3 leaf weeds, mid-postemergence (MPOST) at 4-5 leaf weeds, and late postemergence (LPOST) 5 leaf or greater, at rates of 0.42, 0.63, 0.84 kg ae/ha or sequential applications of the same rate EPOST followed by MPOST or LPOST or MPOST followed by LPOST. All herbicide applications were made under flooded conditions. In 1998 and 1999, visual control ratings of barnyardgrass [*Echinochloa crus-galli* (L.) Beauv.], and annual sedge (*Cyperus compressus* L.) were taken 14 and 28 days after the LPOST treatment (DAT). This study evaluated weed control only and no rice was planted because glyphosate-resistant rice was not available in 1998 and only in a limited amount in 1999. All data were subjected to

ANOVA testing all possible treatments. Treatment means were separated using Fisher's protected LSD at the 5% level of significance. A treatment interaction occurred for all weed control evaluations, and data were averaged over years.

At 14 DAT, barnyardgrass control was 84 to 93% with all treatments; except, single applications of 0.42 and 0.84 kg/ha glyphosate EPOST and 0.42 and 0.63 kg/ha glyphosate LPOST with 73 to 79% control. At 28 DAT, barnyardgrass control was 85 to 91% with MPOST, EPOST followed by MPOST, and MPOST followed by LPOST at all rates. Single applications of 0.42 and 0.63 kg/ha glyphosate LPOST and 0.42 and 0.84 kg/ha glyphosate EPOST followed by LPOST provided equal control of barnyardgrass. Control was 78 to 81% with 0.63 kg/ha glyphosate EPOST or EPOST followed by LPOST and 0.84 kg/ha glyphosate LPOST. However, with single applications of 0.42 and 0.84 kg/ha glyphosate EPOST control was 46 and 71%, respectively.

At 14 DAT, annual sedge control was 81 to 88% with glyphosate EPOST followed by MPOST or LPOST at all rates. Control was 72 to 78% with 0.42 and 0.63 kg/ha glyphosate EPOST, all rates MPOST, or MPOST followed by LPOST. With single LPOST glyphosate treatments control was reduced to less than 65%. AT 28 DAT, annual sedge control was 90 to 96% with all rates of glyphosate MPOST, EPOST followed by MPOST or LPOST, and MPOST followed by LPOST. Control was equal with single applications of 0.42 kg/ha EPOST and 0.63 kg/ha glyphosate LPOST. Annual sedge was controlled 80 and 83% with 0.63 kg/ha EPOST and 0.42 kg/ha LPOST and 77 to 78% with 0.84 EPOST and LPOST, respectively.

In conclusion, glyphosate can have a fit in a rice weed control program in water-seeded culture. The data indicates an EPOST followed by MPOST or LPOST glyphosate application at any rate generally increased control compared with any single glyphosate application at EPOST, MPOST, or LPOST. Glyphosate at higher rates can provide sufficient control at later application timings and could be used as a salvage treatment; however, yield reductions could occur by delaying initial application.

COMPARISON OF 3 POSTEMERGENT HERBICIDES FOR WEED CONTROL IN LEAFY BRASSICAS.
L. Brandenberger[1], R. Wiedenfeld[1], and R. Talbert[2], Texas A&M Research & Extension Center, Weslaco, Texas 78596, [2]Dept. of Agronomy, University of Arkansas, Fayetteville, AR 72701.

ABSTRACT

A herbicide study on direct seeded mustard and kohlrabi was conducted on a Runn silty clay at the Schuster Farm in Hidalgo County, Texas during the spring of 1999. Mustard (variety Florida Broadleaf) and kohlrabi (variety White Vienna) were established by direct seeding on January 20, 1999 on top of free standing raised soil beds spaced on 40 inch centers. Furrow irrigation was used for seed germination and establishment and was utilized for supplemental watering. Weed control in the field utilized Treflan applied pre-plant incorporated. Crop cultural practices were similar to those carried out in the adjacent commercial field. Both studies included a non-treated check and six herbicide treatments: Stinger (Clopyralid) at rates of 0.05 and 0.10 pounds active ingredient per acre; Goal (Oxyfluorfen) at rates of 0.25 and 0.50 pounds active ingredient per acre; Tough (Pyridate) at rates of 0.50 and 1.0 pounds active ingredient per acre (Table 1). Treatments were applied over the top of the existing crop and weeds on February 25, 1999 with a hand held spray boom at an overall rate of 30 gallons of spray material per acre. The crop was in the 15-20 leaf stage of growth at the time of treatment. The study was arranged in a randomized block design of three replications with plots 15 feet long by 3.3 feet wide (Table 1). Phytotoxicity was recorded on March 1 and 12, 1999 and efficacy was recorded on March 12, 1999. Phytotoxicity was recorded as the percent damage to the crop compared to the untreated check and efficacy was recorded as percent control of a given weed species compared to the untreated check. Efficacy ratings were recorded for spiny sowthistle (*Sonchus asper*), wooly croton (*Croton capitatus*), spurge (*Euphorbia* species), clover (species unknown), and volunteer dill (*Anethum graveolens*).

Ratings for phytotoxicity varied significantly for both days that observations were made. The first rating on March 1, 1999 varied from zero to 63.3% damage for treatments in the mustard study and from 1.7 to 18.3% damage in the kohlrabi study (Tables 2 and 3). Both Stinger treatments in the mustard study had zero percent damage on the first rating with the highest ratings recorded being 48.3 and 63.3 percent damage, respectively, for Goal at 0.25 and 0.50 lbs. a.i. (Table 2). Percent damage on the second rating for the mustard study ranged from zero percent damage for both Stinger treatments to 83.3 and 72.5 percent damage, respectively, for Tough at 0.50 and Goal at 0.25 lbs. a.i. Phytotoxicity ratings for kohlrabi varied significantly for both days (Table 3). On March 1, 1999 Stinger at 0.05 and 0.10 lbs. a.i. had the lowest percent damage recorded with 3.3 and 6.7 percent damage, respectively. The highest percent damage was 18.3 percent and was recorded by both Goal and Tough at 0.50 lbs. a.i. The damage ratings for kohlrabi on March 12, 1999 ranged from zero percent to 36.7 and 51.7 percent damage for Goal at 0.50 and Tough at 0.50 lbs. a.i., respectively. Efficacy ratings were made for percent control of both sowthistle and croton in the mustard study and varied significantly for both (Table 2). Percent control of sowthistle ranged from zero to 92.5 percent control. The five highest ratings for control of sowthistle were 92.5, 76.7, 76.7, 75.0, and 62.5 percent control, respectively, for Goal at 0.25, Tough at 0.5 and 1.0, Stinger at 0.10 and Goal at 0.5 lbs. a.i. Control of croton in the mustard study ranged from zero to 90.0 percent control. The two highest efficacy ratings were recorded by Stinger at 0.10 and Goal at 0.25 lbs. a.i., respectively, and resulted in 90.0 and 72.5 percent control of croton. Ratings for efficacy in the kohlrabi study were made on March 12, 1999 for five different species and included ratings for control of sowthistle, croton, clover, spurge, and volunteer dill, (Table 3). No significant differences between treatments were observed for the control of either

sowthistle or spurge in the kohlrabi study although ratings ranged from zero to 63.3 and zero to 33.3 percent control, respectively, for sowthistle and spurge. Control of croton varied significantly and ranged from zero for the untreated check to 93.3 and 76.7 percent control for Goal at the 0.25 and 0.50 lbs. a.i. rate. Percent control of clover varied significantly and ranged from zero to 100 percent. Stinger at 0.10, Goal at 0.25 and 0.50 lbs. a.i. rates resulted in 100, 80.0 and 83.3 percent control of clover, respectively. Stinger at 0.10 and Tough at 0.50 lbs. a.i. per acre provided the best control of volunteer dill in the study. Percent control of dill ranged from zero to 30 percent control for both Stinger at 0.10 and Tough at 0.50 lbs a.i.

Based on the results of this study it appears that Stinger at either rate did not cause significant damage to the crops studied. In contrast, Goal and Tough as utilized in the study have potential to significantly damage both mustard and kohlrabi. Although Stinger treatments did not result in the highest percent control for each of the weed control ratings in the study, the 0.10 lb. a.i. rate of Stinger did provide the highest control in four out of seven efficacy ratings that were taken.

The authors would conclude that further study of Stinger as a postemergent control for weeds in these two crops and other greens is warranted and should include an expanded study of additional rates and application timings.

Table 1. Postemergent Herbicides for use on Leafy Brassicas (Mustard & Kohlrabi) March, 1999 Hidalgo County, Texas, treatment descriptions.

Treatment number	Date applied	Rate	Growth stage
Untreated check	NA	NA	10-15 leaves
Stinger 0.05 lbs.	36215	0.05 lbs. ai/acre	10-15 leaves
Stinger 0.10 lbs.	36215	0.10 lbs. ai/acre	10-15 leaves
Goal 0.25 lbs.	36215	0.25 lbs. ai/acre	10-15 leaves
Goal 0.50 lbs.	36215	0.50 lbs. ai/acre	10-15 leaves
Tough 0.50 lbs.	36215	0.50 lbs. ai/acre	10-15 leaves
Tough 1.0 lbs.	36215	1.00 lbs. ai/acre	10-15 leaves

Table 2. 1999 Postemergent herbicide trial on mustard in Hidalgo County, Texas, phytotoxicity and efficacy.

Treatments	Phytotoxicity % damage [z]		Efficacy on March 12	
	36585	36230	Sow thistle % control[x]	Croton % control
Untreated check	0d	0c	0b	0c
Stinger 0.05 lbs.	0d	0c	13.3b	13.3c
Stinger 0.10 lbs.	0d	0c	75a	90a
Goal 0.25 lbs.	48.3b	72.5a	92.5a	72.5ab
Goal 0.50 lbs.	63.3a	48.3b	62.5a	53.3b
Tough 0.50 lbs.	18.3c	83.3a	76.7a	50b
Tough 1.0 lbs.	26.7c	35b	76.7a	56.7b

[z]Phytotoxicity % damage=the estimated percent damage to the crop relative to the remainder of the surrounding untreated field.
[y]Numbers in a column followed by the same letter are not significantly different based on Duncan's Multiple Range Test where P=0.05.
[x]Efficacy % control = the estimated percent control of a given weed compared to the untreated check.

Table 3. 1999 Postemergent herbicide trial on kohlrabi in Hidalgo County, Texas, phytotoxicity and efficacy.

Treatments	Phytotoxicity % damage [z]		Efficacy on March 12				
	36585	36230	Sow thistle % control[x]	Croton % control	Clover % control	Spurge % control	Dill % control
Untreated check	1.7d[y]	0d	0a	0c	0c	0a	0b
Stinger 0.05 lbs.	3.3d	11.7cd	10a	10c	13.3c	0a	0b
Stinger 0.10 lbs.	6.7cd	10cd	23.3a	23.3c	100a	33.3a	30a
Goal 0.25 lbs.	13.3ab	26.7bc	50a	93.3a	80ab	3.3a	0b
Goal 0.50 lbs.	18.3a	36.7ab	63.3a	76.7ab	83.3ab	0a	0b
Tough 0.50 lbs.	18.3a	51.7a	46.7a	46.7bc	36.7abc	20a	30a
Tough 1.0 lbs.	10bc	20bc	43.3a	36.7bc	33.3abc	25a	13.3ab

[z]Phytotoxicity % damage=the estimated percent damage to the crop relative to the remainder of the surrounding untreated field.
[y]Numbers in a column followed by the same letter are not significantly different based on Duncan's Multiple Range Test where P=0.05.
[x]Efficacy % control = the estimated percent control of a given weed compared to the untreated check.

VALIDATION OF THE COTTON HADSS MODEL FOR WEED MANAGEMENT ON THE TEXAS SOUTHERN HIGH PLAINS. L.L. Lyon, J.W. Keeling, P.A. Dotray, and L.K. Blair; Texas Agricultural Experiment Station and Texas Tech University, Lubbock, TX; and G.G. Wilkerson and J.W. Wilcut; North Carolina State University, Raleigh, NC.

ABSTRACT

Cotton production on the Texas High Plains differs from other regions because of the relatively short growing season, erratic rainfall, and the types of annual and perennial problem weeds. Pyrithiobac's recent introduction and cotton varieties resistant to glyphosate and bromoxynil provide producers several postemergence-topical herbicide options.

North Carolina State University developed a new computer-based program, Herbicide Application Decision Support System (HADSS), which recommends postemergence herbicide treatments based on weed density, weed size, weed competitiveness, and herbicide efficacy in cotton. HADSS was evaluated in 1999 field experiments at the Texas Agricultural Experiment Station near Lubbock. The objectives of this study were: 1) to evaluate the Cotton HADSS program for use on the Texas Southern High Plains; 2) to conduct field trials to validate HADSS recommendations and yield loss estimates; and 3) to obtain data in Roundup Ready, BXN, and conventional, non-transgenic varieties to include in the program.

Treatments were evaluated at a location naturally infested with Palmer amaranth (*Amaranthus palmeri*) and devil's-claw (*Proboscidea louisianica*). Treatments included: 1) trifluralin preplant incorporated (PPI) at 0.75 lb ai/A followed by (fb) postemergence HADSS recommendations (PPI fb POST (HADSS)); 2) postemergence HADSS recommendations alone (POST only (HADSS)); 3) trifluralin PPI fb commercial producer standards for the Texas Southern High Plains (commercial standard); 4) weed-free check; and 5) untreated check. All treatments were conducted in Roundup Ready, BXN, and conventional cotton varieties. Weed density was determined and applications were made at the 1-to 2-leaf, 6- to 8-leaf and 10-to 12-leaf cotton growth stages. Weed control was evaluated 14 days after each application. The experimental design was a randomized block with a split plot arrangement with four replications. Plot size was 27 by 50 feet.

HADSS recommendations paralleled producer standards in the Roundup Ready system. In the Roundup Ready system Palmer amaranth was controlled at least 98% in the PPI fb POST treatments based on HADSS and the commercial standards treatment, whereas control with POST only (HADSS) was 80%. Season-long devil's-claw control was at least 95% for all three treatments. In the conventional system, late-season Palmer amaranth was controlled 99% with the commercial standards, which was superior to the PPI fb POST (HADSS) recommendations (92%) and the HADSS recommendations alone (65%). Devil's-claw was controlled 95% with the commercial standards, which was better than PPI fb POST (HADSS) and POST only (HADSS) (88%). Palmer amaranth control in the BXN system with PPI fb POST (HADSS) and the commercial standards was 88%. This control was better than POST only (HADSS) (55%). Devil's-claw was controlled 95% with PPI fb HADSS recommendations and the commercial standards. POST only

(HADSS) controlled devil's-claw 88%. HADSS recommendations were different from commercial standards in the BXN and conventional systems.

The three herbicide treatments produced similar yield within each variety. Net returns over weed control costs in the Roundup Ready and the conventional systems increased compared to hand-hoeing alone. There were no differences in net returns between the treatments in the Roundup Ready and conventional systems. The commercial standards produced higher net returns than the two treatments based on HADSS recommendations and hand-hoeing alone in the BXN system.

RESPONSE OF LANDSCAPE PLANTS TO QUINCLORAC. W.C. Porter. Burden Research Plantation, Louisiana Agricultural Experiment Station, Baton Rouge LA 70809.

ABSTRACT

Quinclorac is a postemergent herbicide recently registered for use in turfgrass. Previously registered for use in rice production, off-target injury has been reported. Tomatoes were found to be especially sensitive. When quinclorac is used in turfgrass, many landscape plants can be in close proximity and subject to off-target application. This study was initiated to evaluate the response of several landscape plants to quinclorac contamination.

Landscape plants were established in 3-qt nursery pots and treated with quinclorac applied at 1/8X, 1/4X, 1/2X, and X (0.375 lb ai/A) rates. Plant materials used included monkeygrass (*Ophiopogon japonicus*), green liriope (*Liriope muscari*), 'Blackie' and 'Marguerite' sweet potatoes (*Ipomoea batatas*), 'Duckfoot Red' coleus (*Coleus blumei*), Asian jasmine (*Tracheloscpermum asiaticum*), 'Heatwave White' vinca (*Catharantheus roseus*), and shore juniper (*Juniperus conferta*). Injury evaluations were made at 1, 3, and 7 weeks after treatment (WAT). At 7WAT plant materials (except juniper) were harvested for dry weights.

Both cultivars of sweet potatoes were showing injury from all rates of quinclorac within 24 hr oftreatment. At 1 WAT, injury to the sweet potatoes ranged from 5 to 38%. Coleus showed injury beginning at the 1/4X rate. Injury to both sweet potatoes and coleus was in the form of twisting of stems and leaves. Injury to vinca was minor and was most noticeable at the full rate of quinclorac. Symptoms were leaf distortion and reduced size of flowers. Monkeygrass, liriope, Asian jasmine, and juniper did not exhibit any injury at this time.

By 3 WAT, injury to the sweet potatoes appeared to have ameliorated somewhat and had not progressed much. Coleus was now showing injury at the 1/8X rate of quinclorac. Vinca was showing injury at all rates ofquinclorac. Flower size was reduced. Asian jasmine was showing injury at the full rate of quinclorac. Monkeygrass, liriope, and juniper were still not showing any injury.

At 7 WAT, both cultivars of sweet potatoes were exhibiting severe levels of injury from all rates of quinclorac. Injury to coleus and vinca was significant at rates from 1/4X and higher. Asian jasmine injury was less than 10% for all rates of quinclorac. No injury was visible on monkeygrass, liriope, or juniper.

Dry weights of the plants mirrored the injury response for the susceptible plants except for vinca. As previously mentioned, injury to the vinca was primarily in the form of flower size. Vinca flower size became smaller as the quinclorac rate increased.

This research indicates that at rates included in this study, quinclorac is safe to use around several landscape plants that are used as ground covers or borders - monkeygrass, liriope, Asian jasmine, and shore juniper. Caution should be exercised around plantings containing herbaceous annuals such as ornamental sweet potatoes, coleus, or vinca.

EVALUATION OF FLUMIOXAZIN FOR COTTON (GOSSYPIUM HIRSUTUM L.) LAYBY WEED CONTROL. C.L. Main, J.A. Tredaway, and G.E. MacDonald, University of Florida, Gainesville, FL, and J.V. Altom, Valent USA Corporation, Gainesville, FL.

ABSTRACT

Season long weed control is essential for economical cotton (*Gossypium hirsutum L.*) production. Due to EPA imposed phase out of cyanazine, alternatives for layby weed control are needed. A possible alternative is the Valent compound, flumioxazin. Field experiments were conducted at Gainesville and Quincy, FL in 1999 to evaluate flumioxazin for layby weed control in cotton . Cotton (DPL 5415 Bt RR) was planted in May at Quincy and June in Gainesville. Treatments were arranged in a randomized complete block design with four replications. Treatments (lbs. ai/A) at both locations included flumioxazin (0.063 and 0.094), flumioxazin (0.063 and 0.094) + MSMA (2.0), flumioxazin (0.063 and 0.094) + glyphosate (1.0), and flumioxazin (0.063) + *S*-metolachlor (1.5). Additional treatments at Quincy included, lactofen (0.2) + MSMA (2.0), cyanazine (0.75) + MSMA (2.0). Treatments at both locations were applied using a CO2 tractor-mounted sprayer delivering 10 gallons per acre of water carrier. Data collected included eclipta (*Eclipta prostrata*), Florida pusley (*Richardia scabra*), pitted morningglory (*Ipomoea lacunosa*), cotton morningglory (*Ipomoea trichocarpa*

v. torreyana), sicklepod (*Senna obtusifolia*) and spotted spurge (*Euphorbia maculata*) control and cotton injury two and four weeks after treatment (WAT). Visual evaluations were based on a scale of 0 -100% with 0 indicating no cotton injury or weed control and 100 indicating cotton death or complete weed control. Seed cotton yield (lbs./A) was recorded 140 days after planting (DAP) at Gainesville and 155 DAP at Quincy.

All treatments except flumioxazin (0.063) controlled Florida pusley > 88% and spotted spurge > 97%, two and four WAT at Gainesville. At Quincy, all treatments except cyanazine + MSMA controlled eclipta, pitted, and cotton morningglory > 88% at 2 WAT. At 4 WAT control was maintained for pitted morningglory (> 83%) and cotton morningglory (> 86%) with all treatments except cyanazine + MSMA. Eclipta control was > 89% for all treatments except lactofen + MSMA and flumioxazin + *S*-metolachlor. Sicklepod was controlled 95% 4 WAT with flumioxazin (0.094) + glyphosate. Cotton injury at 2 and 4 WAT was < 9% for all treatments and diminished as the season progressed. No differences in yield were observed at Gainesville. Cotton yield at Quincy was decreased with flumioxazin (0.063) + *S*-metolachlor (1.5) from other treatments.

JOHNSONGRASS MANAGEMENT IN HERBICIDE RESISTANT CORN. W.G. Johnson, J.A. Kendig, J.D. Wait, C.S. Holman, J. Li, G.A. Ohmes, Assistant Professor, Assistant Professor, Research Specialist, Sr. Research Technician, Research Specialist, Research Associate, Department of Agronomy, University of Missouri, Columbia, MO 65211.

ABSTRACT

Field experiments were conducted to determine the efficacy of imazethapyr + imazapyr (Lightning™), glufosinate (Liberty™), glyphosate IPA (Roundup Ultra™), and sethoxydim (Poast Plus™) versus nicosulfuron (Accent™)-based programs on johnsongrass (*Sorghum halepense*) management in corn (*Zea mays*) at two distinct geographical regions in Missouri. Site 1 (Hartsburg) in central Missouri is a sandy loam soil in the Missouri River bottoms with 0.9% organic matter and a soil pH of 7.6. Site 2 (Portageville) is in the southeast Missouri Delta is a fine sandy loam soil with 1.5% organic matter and a soil pH of 5.5. Both sites contained natural infestations of both seedling and rhizome johnsongrass. Conventional tillage practices were used to produce the crop. The experimental design was a split plot with corn variety as the main plot and herbicide treatments as subplots. The four varieties of corn were Pioneer 33G26, Pioneer 3395IT (imidazolinone resistant), Pioneer 34T14LL (glufosinate resistant), and Dekalb 626 RR (glyphosate resistant). A preemerge blanket treatment of atrazine (1.5 lb/A) + isoxaflutole (0.094 lb/A) was applied at Hartsburg and S-metolachlor (1.2 lb/A) + atrazine (1.6 lb/A) was applied at Portageville. The subplot treatment structure included i) no POST treatment, ii) a single POST application, and iii) a sequential POST application within each corn variety. Initial POST treatments were applied to 6-12 inch tall johnsongrass. Sequential treatments were applied to 6 inch tall johnsongrass regrowth. Single POST treatments included nicosulfuron (0.032 lb/A), imazethapyr + imazapyr (0.056 lb/A), glufosinate (0.375 lb/A), glyphosate (0.75 lb/A), or sethoxydim (0.188 lb/A). Sequential POST treatments included nicosulfuron (0.016 fb 0.016 lb/A), imazethapyr + imazapyr (0.028 fb 0.028 lb/A at Hartsburg and 0.056 fb 0.056 lb/A at Portageville), glufosinate (0.27 fb 0.27 lb/A), glyphosate (0.75 fb 0.75 lb ae/A at Hartsburg and 0.75 fb 0.56 lb ae/A at Portageville), or sethoxydim (0.125 fb 0.125 lb/A). Appropriate spray additives for each herbicide were determined by label directions. Visual evaluations of corn injury and johnsongrass control were made at 3 weeks after the final POST treatment. Corn yield data was collected at harvest. ANOVA was conducted and means separated with an LSD at $P = 0.05$. At Hartsburg, sequential applications of nicosulfuron provided significantly higher control than single applications of nicosulfuron. Sequential applications of nicosulfuron, glufosinate, and both glyphosate treatments provided >93% johnsongrass control. All other treatments provided <82% control. At Portageville, all sequential treatments provided slightly higher control than single treatments. Sequential applications of nicosulfuron, imazethapyr + imazapyr, and glyphosate provided > 90% control. Control with imazethapyr + imazapyr was higher than at Hartsburg due to higher rates used at Portageville. Johnsongrass pressure was light and yield loss due to johnsongrass interference was minimal at both sites. At Hartsburg, yields were slightly higher with sequential applications of nicosulfuron and imazethapyr + imazapyr vs single applications. Yields with single vs sequential applications of glufosinate and glyphosate were similar. At Portageville, yields were similar with both single and sequential applications of all herbicides.

WEED CONTROL IN A CLOD-FURROW SOYBEAN PLANTING SYSTEM. W.P. Black, L.R. Oliver, and T.C. Keisling. University of Arkansas, Fayetteville and Northeast Research and Extension Center, Keiser, AR.

ABSTRACT

Water imbibition by the soybean seed is a crucial step in soybean growth. Without water uptake, germination can be inhibited. The clod-furrow soybean planting system is used to ensure that the soybean seed has sufficient moisture to germinate. In the clod-furrow system, the field is first hipped, similar to a conventional cotton planting system. The tops of the beds are then leveled using a field cultivator to create a flat planting surface. Soybean is then broadcast seeded using a pneumatic seeder. The beds are re-hipped, leveled, and then rolled. Rolling the beds helps irrigation water to soak throughout the bed. This planting system was developed to give producers an alternative planting system when experiencing a dry spring or early summer.

As with any planting system, it is necessary to develop effective weed control practices and programs within the clod-furrow planting system. This study focused on herbicidal control of problem weeds in soybean. Several grass and broadleaf species were used to determine herbicide efficacy. The control of broadleaf signalgrass (*Brachiaria platyphylla*), barnyardgrass (*Echinochloa crus-galli*), large crabgrass (*Digitaria sanguinalis*), prickly sida (*Sida spinosa*), pitted morningglory (*Ipomoea lacunosa*), entireleaf morningglory (*Ipomoea hederacea* var. *integriuscula*) and eclipta (*Eclipta prostrata*) was evaluated. Herbicide programs evaluated were: trifluralin (Treflan) at 0.75 lb ai/A (PPI), pendimethalin + imazaquin (Squadron) at 0.87 lb ai/A (PPI), metolachlor (Dual II Magnum) at 1.27 lb ai/A (PRE), dimethenamid (Frontier) at 1.27 lb ai/A (PRE), sulfentrazone + chlorimuron-ethyl (Canopy XL) at 0.23 lb ai/A (PRE), metribuzin + chlorimuron (Canopy) at 0.375 lb ai/A (PRE), pendimethalin + imazaquin (Squadron) at 0.87 lb ai/A (PRE), fomesafen (Reflex) at 0.375 lb ai/A + AG-98, 0.25 %V/V (V3), bentazon + acifluorfen (Storm) at 0.75 lb ai/A + AG-98 0.25 %V/V (V3), fluazifop-butyl + fomesafen (Typhoon) at 0.546 lb ai/A + AG-98 0.25% V/V (V3), glyphosate (Roundup Ultra) at 1.0 lb ai/A (V3), glyphosate (Roundup Ultra) at 1.0 lb ai/A (V3) fb glyphosate (Roundup Ultra) at 1.0 lb ai/A (V6), glyphosate (Roundup Ultra) at 0.75 lb ai/A (V3) fb glyphosate (Roundup Ultra) at 0.75 lb ai/A (V6) fb glyphosate (Roundup Ultra) at 0.75 lb ai/A (R1). Studies were established at Pine Tree (silt loam) and Keiser (heavy clay), AR in 1999. Soybean seed were planted on May 26 and June 22 at Keiser and Pine Tree, respectively. Each study utilized a randomized complete block design, and means were separated at the 0.05 significance level.

At Pine Tree, bentazon + acifluorfen was the only treatment that did not provide better grass control than the untreated check. Bentazon + acifluorfen, fomesafen, and fluazifop-butyl + fomesafen were weaker than the other treatments on all weed species. Soybean treated with fomesafen, bentazon + acifluorfen, and fluazifop-butyl + fomesafen yielded significantly lower than other treatments, and yield was equivalent to that of the untreated check. Soybean treated with trifluralin or pendimethalin + imazaquin yielded the same as the untreated check. All treatments provided excellent control of eclipta. Glyphosate treatments provided season-long control of all weed species. Preemergence herbicides provided season-long control of both grass species.

Similar to the Pine Tree location, glyphosate treatments at Keiser provided season-long control of all species. Metolachlor and dimethenamid resulted in less control of prickly sida and entireleaf morningglory than other treatments. Dimethenamid control of pitted morningglory was not significantly better than the untreated check. A single application of glyphosate provided control equivalent to that of sequential applications of glyphosate while also providing equivalent yield. As in Pine Tree, glyphosate treatments provided season-long control of weed species as well as slightly higher yields. All treatments provided excellent control of large crabgrass and broadleaf signalgrass.

EVALUATION OF EPIC FOR CONTROL OF GRASS AND BROADLEAF WEEDS IN CORN. B.A. Besler, W.J. Grichar, K.D. Brewer, Texas Agricultural Experiment Station, Yoakum, TX 77995 and A.T. Palrang, Bayer Corporation, Austin, TX 78739.

ABSTRACT

Field trials were conducted in four different locations throughout South Texas in 1999 to evaluate Epic 58 DF for grass and broadleaf weed control in corn. Corn tolerance was also evaluated. Epic (flufenacet + isoxaflutole) is a broad spectrum corn herbicide that is rate dependent on soil texture and organic matter. The four locations were chosen based on varying soil characteristics and weed density. Trials were located in Jackson County (fine texture), Lavaca County-Texas Agricultural Experiment Station (medium texture), Lavaca County-Hallettsville (medium texture) and Frio County (coarse texture). Weed species at each location were as follows: Jackson County – johnsongrass (*Sorghum halepense*), and Palmer amaranth (*Amaranthus palmeri*); Lavaca County (TAES) – Palmer Amaranth and Henbit (*Lomium amplexicaule*); Lavaca County (Hallettsville) – Texas panicum (*Panicum texanum*) and pitted morningglory (*Ipomoea lacunosa*). Test design at each location consisted of a randomized complete block with 4 replications. Plot size was 2-36 in rows by 25 ft long. Epic treatments were evaluated at 4, 6, 8, and 10 oz/A. Other standard corn herbicides were included in the study. All treatments were applied preemergence using a backpack sprayer with flat fan nozzles (SS11002) delivering 20 GPA. All data were subjected to analysis of variance (ANOVA) and significant means determined using Fisher's Least Significant Difference at P=0.05.

Epic, when applied on a finer texture soil in Jackson County resulted in less than 85% control of pigweed when rated 24 days after treatment (DAT). Among the four rates of Epic, 6 oz/A provided the best early season control at 83%. Pigweed control improved to 89% when Epic at 10 oz/A was tank-mixed with Atrazine at 1.65 lb/A. Mid to late season pigweed control was not evident with all four treatments of Epic. Season long pigweed control resulted with Topnotch 3.2 CS at 2 qt/A, Fultime 4L at 2.7 qt/A, Bicep II Magnum 5.5 L at 4.4 pt/A and Guardsman 5L at 3.76 pt/A. Early season johnsongrass control (24 DAT) using Epic at all four rates was less than 80%. Topnotch 3.2 CS provided the best early season control of johnsongrass followed by the tank-mix of Epic + Atrazine. No herbicide treatments provided adequate season long control. All Epic treatments numerically increased yield over the untreated check. The tank-mix of Epic + Atrazine provided a 37% increase in yield over the untreated check. Epic at 8 oz/A increased yields (27%).

At the Lavaca County (TAES) location, Epic at all four rates provided excellent to season long control of pigweed (better than 87%) and was comparable to the other standard corn treatments in the trial. Early season control (25 DAT) of Henbit with Epic at all four rates was greater than 96%. At 49 DAT, Henbit control was greater than 98% with all

herbicide treatments. All Epic treatments resulted in a slight to moderate increase in yield. Epic applied at 8 oz/A increased yield 25% over the untreated check. Frontier 6 EC at 1.72 pt/A increased yield by 26%.

The Lavaca County (Hallettsville) trial resulted in Epic providing adequate to good control of Texas panicum early season (18 DAT). Epic at 8 oz/A controlled Texas panicum 95%. At 32 DAT, Texas panicum control continued to be excellent with most herbicide treatments. Epic at 8 oz/A and 10 oz/A and Epic + Atrazine were the only treatments providing good to excellent control of Texas panicum. Early season pitted morningglory control was less than desirable for most treatments. Only the tank-mix of Epic + Atrazine resulted in morningglory control greater than 90%. Late season control (54 DAT) with all treatments were less than 70%. All treatments significantly increased yields over the untreated check. Yields for all four rates of Epic were higher than all other treatments.

Epic treatments at the Frio County location, controlled Texas panicum season long (≥90%). Yields were substantially enhanced with all herbicide treatments. Epic at 4 oz/A increased yields 26% over the untreated check. Yield increases ranged from15% to 26%. Epic at 10 oz/A was the only treatment that did not result in a yield increase over the untreated check.

No corn injury was noted with Epic at the Jackson County, Lavaca County (TAES) and Lavaca County (Hallettsville) trials. Although at the Frio County location, injury with Epic at 8 and 10 oz/A ranged from 13 to 22% respectively. At 28 DAT stunting was still evident with Epic at 8 and 10 oz/A (10 to 16.3%). Epic + Atrazine resulted in a 14.3% (17DAT) and 13.8% (28 DAT) stunting. However, when rated 85 DAT stunting was minmal and yields for most Epic treatments were not affected.

LIGHTNING HERBICIDE FOR WEED CONTROL IN CLEARFIELD CORN. J.R. Summerlin, Jr., E.R. Walker, R.M. Hayes, G.N. Rhodes, Jr., and T.C. Mueller, Department of Plant and Soil Sciences, The University of Tennessee, Knoxville, TN, 37996.

ABSTRACT

Current production practices are utilizing crop varieties selected for tolerance to herbicide applications. CLEARFIELD corn varieties (formerly IMI, IT or IR) possess modified ALS enzymes, which confer tolerance to herbicides from the imidazolinone family. Application or carryover of these herbicides to non-CLEARFIELD corn varieties may result in severe crop injury. The imidazolinone herbicide Lightning is labeled for use on CLEARFIELD corn. Lightning herbicide is a package mixture of the active ingredients imazethapyr and imazapyr. The use of Lightning in CLEARFIELD corn varieties has the potential to offer effective and economical weed control in a single herbicide application. In addition, this broad-spectrum control option may be beneficial to corn growers in areas were regulations prohibit atrazine use. The objectives of this research were to evaluate Lightning weed control systems in CLEARFIELD corn and to answer the following questions: 1) Is weed control in CLEARFIELD corn with Lightning herbicide comparable to standard weed control options? 2) Is a tank mix partner (such as Aatrex, Accent, Clarity, or Prowl) needed for adequate weed control with Lightning? and 3) Is the use of Lightning herbicide in CLEARFIELD corn an economically sound weed control decision?

The benefit of weed control using Lightning herbicide in CLEARFIELD corn was examined at Knoxville and Jackson, Tennessee in 1998 and 1999. The variety 'FFR 797 IT' was no-till planted between April 1 and May 15 depending on location and year. Herbicide treatments evaluated included Bicep II Magnum (4.2 pt/A PRE) alone and followed by either Accent (0.667 oz/A POST), Clarity (0.5 pt/A POST), or Accent + Clarity. Total POST programs evaluated were Basis Gold (14 oz/A POST) alone and Lightning (1.28 oz/A POST) alone and in combination with either Aatrex (1.5 pt/A POST), Accent (0.5 oz/A POST), Clarity, or Prowl (3.0 pt/A POST). All POST treatments included non-ionic surfactant at 0.25 % v/v. Treatments were arranged in a randomized complete block design with four replications. PRE applications were made immediately following planting. POST herbicides were applied before corn reached a height of 12 inches and before weeds exceeded 4 inches. Weed control and crop injury evaluations were taken at 2 and 4 weeks after POST application. Yield data was collected from the two center plot rows and adjusted for moisture content. Economic analysis was conducted using prices provided by local dealerships. Data were analyzed by the appropriate ANOVA and combined over years and/or locations when possible. Treatment means were separated by Fisher's Protected LSD at the 0.05 level.

Weed control following POST herbicide treatments was similar for all treatments at 2 weeks after treatment (WAT). At 4 WAT, Bicep II Magnum and Bicep II Magnum followed by (fb.) Clarity treatments did not control broadleaf signalgrass as effectively as other treatments. Incomplete broadleaf signalgrass control is likely due to the lack of a POST grass herbicide application. Lightning + Clarity and Basis Gold provided less broadleaf signalgrass control than Bicep II Magnum fb. Accent and Bicep II Magnum fb. Accent + Clarity, but were not different from other Lightning treatments. Sicklepod control (Knoxville only) was best achieved with applications of Bicep II Magnum fb. Clarity or fb. Accent + Clarity. The addition of Aatrex, Accent, Clarity, or Prowl to Lightning did not increase sicklepod control. All treatments provided good to excellent sicklepod control that extended to 8 WAT. This high level of control is likely a result of suppression in regrowth and germination by dry growing conditions. Excellent Palmer amaranth control (4 WAT) (Jackson only) was obtained with Basis Gold and treatments containing Clarity or Aatrex. Lightning alone did not provide acceptable Palmer amaranth control. The addition of Prowl to Lightning and following Bicep II Magnum

with Accent increased Palmer amaranth control over the herbicides applied alone, but control remained marginal. Crop injury following treatment was not significant. Corn yield was lower in the Bicep II Magnum treatment due to incomplete weed control. Economic returns following Basis Gold and Lightning + Aatrex were significantly higher than Bicep II Magnumalone or fb. Accent + Clarity. Returns in all remaining Lightning treatments did not differ from Bicep II Magnum alone or fb. Accent and/or Clarity.

This research indicates that Lightning herbicide is an effective and economical weed control option when used in CLEARFIELD corn. With the exception of Palmer amaranth, weed control utilizing Lightning herbicide in CLEARFIELD corn is comparable to industry standards for the weed species evaluated in these experiments. The addition of Aatrex or Clarity to Lightning was effective in controlling Palmer amaranth. In this research, Lightning alone or in combination with other POST herbicides provided an effective and economical weed control option that can be utilized in most growing situations including those that do not permit atrazine use.

BASIS GOLD – ORGANOPHOSPHATE INTERACTIONS WITH CORN. W.K. Vencill, University of Georgia, Athens and G. Hammes, Dupont, Hawkinsville, GA.

ABSTRACT

Field studies were conducted in Athens, Georgia in 1999 to evaluate the interaction of Basis Gold (rimsulfuron + atrazine + nicosulfuron) with chlorpyrifos and terbufos applied in a T-band at corn planting. Basis Gold (0.84 kg/ha), nicosulfuron (0.034 kg/ha), and atrazine (1.1 kg/ha) were applied at the four-leaf stage of corn that had received chlorpyrifos (7.1 or 14 kg/ha) or terbufos (7.1 kg/ha) at planting in a T-band application. Combinations of these treatments were applied 'Pioneer 3167' and 'Pioneer 3163' corn. Visual injury and weed control were evaluated on a 0-100% scale. Smooth pigweed (*Amaranthus hybridus*) and common cocklebur (*Xanthium strumarium*) control were >90%. Rimsulfuron+atrazine+nicosulfuron did not cause visual injury to corn not treated with organophosphate insecticides. When applied to corn treated with chlorpyrifos, injury symptoms appeared 7 DAT and peaked by 14 DAT. Visual injury symptoms were not visible by 24 DAT. Chlorpyrifos rate did not affect injury from rimsulfuron+atrazine+nicosulfuron. Visual injury was greater to 'Pioneer 3167' than 'Pioneer 3163' from chlorpyrifos. Corn yield in 'Pioneer 3163' and 'Pioneer 3167' were not significantly affected by corn chloropyrifos. When rimsulfuron+atarzine+nicosulfuron was applied to corn treated with terbufos, visual injury was >60% 14 DAT and injury did not diminish. There was not a varietal response observed with terbufos – rimsulfuron+atrazine+nicosulfuron interaction. Rimsulfuron+atrazine+nicosulfruon applied to terbufos treated corn reduced yields 50 to 70% when compared to atrazine applied to terbufos treated corn.

EFFECT OF DRILLED ROUNDUP READY SOYBEAN POPULATIONS ON ECONOMIC RETURN. J.T. Edwards, J.K. Norsworthy, and L.R. Oliver. University of Arkansas, Fayetteville.

ABSTRACT

Roundup Ready technology is an effective tool for control of many problem weeds, and Roundup Ready cultivars have been readily adopted. Increased seeding costs due to technology fees have led to a transfer of production costs from herbicide to seed expense. In 1998 a two-year study was initiated on a Sharkey clay at the Northeast Research and Extension Center at Keiser, Arkansas, to determine the optimal seeding rate of Roundup Ready soybean in terms of both yield and economics.

Soybean seed were drilled in 19-cm rows with a John Deere 750 no-till drill on June 2, 1998, and May 25, 1999 at twelve rates ranging from 185,000 to 1,485,00 seed/ha. Weeds present included: large crabgrass (Digitaria sanguinalis), barnyardgrass (Echinochloa crus-galli) , pitted morningglory (Ipomoea lacunosa) and spotted spurge (Euphorbia maculata). Each plot received a single application of either 0.56 or 1.12 kg ai/ha glyphosate when weeds reached a height of 5 to 7 cm. Weed control ratings were visually taken every two weeks following initial glyphosate application. Plots were resprayed with the original rate of glyphosate when control of any weed species fell below 90%. All plots were flood irrigated according to the Arkansas irrigation schedule. Gross margins were calculated by subtracting total weed control cost from total revenue received from sale of seed. Weed control costs included: seed cost at $1.14/kg, herbicide cost at $9.25/L at 480 g ai/L, and application costs of $11.12/ha per application. Selling price of $0.24/kg was calculated by taking the five-year average cash price at harvest.

Three applications of glyphosate were necessary to maintain 90% control at the three lowest seeding rates; however most seeding densities greater than 741,000 seed/ha did not require late applications of glyphosate due to quicker canopy closure. The 988,000 seed/ha rate had the highest yield of 3,317 kg/ha and a gross margin of $539.87/ha. The 247,000 seed/ha provided the highest gross margin of $625.00/ha. The lowest gross margin was $393.47/ha at the 1,482,000 seed/ha planting density. The greater yields and quicker canopy closure associated with higher seeding rates were not sufficient to offset increased planting costs; therefore, the low cost of glyphosate applications relative to Roundup Ready seed indicates that producers can easily offset higher herbicide and application costs with savings from reduced seeding rates.

EFFICACY OF ZA1296 IN CORN. G.A. Ohmes, J.A. Kendig, R.L. Barham, and P.M. Ezell. University of Missouri Delta Center, Portageville, MO 63837.

ABSTRACT

ZA1296 is an experimental compound being developed by Zeneca for preemergence (PRE) and postemergence (POST) use in corn (*Zea mays* L.). ZA1296 will primarily be used in combination with acetochlor when applied PRE for broadspectrum control (Black et al. 1999; Smith and Beckett 1999). The premix of ZA1296 plus acetochlor has provided control of several broadleaf and grass species (Smith and Beckett 1999). The objectives of this research were to evaluate crop safety and weed control with ZA1296 PRE, POST, and in programs.

Four studies were conducted in 1999 at the University of Missouri Delta Center's Lee Farm. The soil type was a Tiptonville fine sandy loam with 1.5% organic matter and pH of 5.5. Garst 8222 IT variety of corn was planted in 30 inch rows and conventional tillage methods were used. The studies utilized a randomized block design with 4 replications. Standard weed science methods were used to conduct research. A premix of ZA1296 and acetochlor applied alone at 1.969 and 2.188 lb ai/A was evaluated PRE. ZA1296 alone at 0.093 and 0.125 lb ai/A and tank mixed with atrazine at 0.25 lb ai/A were applied POST to 3- to 5-inch weeds following PRE applications of acetochlor alone at 1.8 lb ai/A and the ZA1296 plus acetochlor premix. A sequential application of ZA1296 alone applied PRE at 0.16 lb ai/A followed by a POST application at 0.094 lb ai/A to 3- to 5-inch weeds was evaluated, also. PRE and POST applications of ZA1296 at 0.17 and 0.1 lb ai/A, respectively, were evaluated on fourteen grass and broadleaf weeds in a multi-species test. Crop oil at 1% v/v was added to all POST applications.

No corn injury was observed from PRE or POST applications of ZA1296 alone or tank mixed with acetochlor. The premix of ZA1296 plus acetochlor at 1.969 and 2.188 lb ai/A provided >80% control of giant ragweed (*Ambrosia trifida*), Palmer amaranth (*Amaranthus palmeri*), velvetleaf (*Abutilon theophrasti*) and ivyleaf/entireleaf morningglory (*Ipomoea hederacea*) at 7 weeks after application (WAA). The lower rate of the ZA1296 premix provided 74% control of common cocklebur (*Xanthium strumarium*).

POST applications of ZA1296 alone at both rates provided more than 80% control of giant ragweed, ivyleaf/entireleaf morningglory, common cocklebur, and Palmer amaranth. ZA1296 POST did provide increased control of Palmer amaranth compared to acetochlor alone at 4 WAA. Acetochlor alone and followed by ZA1296 (at both rates) provided 75% and 100% control of Palmer amaranth, respectively. The addition of atrazine did not significantly enhance weed control or yield. ZA1296 was evaluated as a sequential herbicide program and provided equivalent weed control to other programs evaluated.

In the multi-species test, ZA1296 PRE provided >85% control of smooth pigweed (*Amaranthus hybridus*), Palmer amaranth, velvetleaf, prickly sida (*Sida spinosa*), sicklepod (*Casia obtusifolia*), pitted morningglory (*Ipomoea lacunosa*), ivy/entireleaf morningglory, and hemp sesbania (*Sesbania exaltata*). ZA1296, PRE, provided between 65% and 80% control of large crabgrass (*Digitaria sanguinalis*), barnyardgrass (*Echinochloa crus-galli*), and broadleaf signalgrass (*Brachiaria platyphylla*). It did not control giant foxtail (*Setaria faberi*), shattercane (*Sorghum bicolor*), and johnsongrass (*Sorghum halepense*). The weeds in the POST treatment plots were water stressed which may have affected control. ZA1296 provided 70% to 95% control of broadleaves. Grass control was not acceptable with the POST application.

Yield was not reduced by ZA1296 in any of the studies.

Literature Cited

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EFFICACY OF POSTEMERGENCE GRAMINICIDES ON COGONGRASS (*Imperata cylindrica*). D.B. Mask, J.D. Byrd, Jr., J.W. Barnett, Jr., Mississippi State University, Mississippi state, MS 39762.

ABSTRACT

Two field studies were conducted in Mississippi during the summer of 1999 to evaluate selective postemergence graminicides for cogongrass control. The studies were located at Camp Shelby Training Site near Hattiesburg and in Kemper county near Preston. Four postemergent graminicides were evaluated at two rates with either nonionic surfactant or crop oil concentrate and with single or sequential applications. The four postemergent graminicides included Assure 0.8EC at 20 or 40 fl oz/A, Poast HC 3.5EC at 18 or 36 fl oz/A, Fusilade DX 2EC at 16 or 32 fl oz/A, and Select 2EC at 8 or 16 fl oz/A. Sequential applications were made three weeks apart. Two additional graminicides were applied once at two rates using nonionic surfactant: Acclaim 1EC at 39 or 78 fl oz/A and Illoxan 3EC at 43 or 85 fl oz/A. The

application volume was 13 gallons per acre. Plots were visually rated at 21, 42, and 84 DAT. At 84 DAT, Select at 16 oz/A was the only graminicide to give more than 10% control at both sites. Illoxan at 43 and 85 oz/A gave greater than 10% control by the second and third ratings in Kemper county, but at Camp Shelby, Illoxan provided 0% control. All Poast, Assure, and Acclaim treatments gave less than 5% control at both sites by 21 DAT. Herbicide ratings were lower in Kemper county than Camp Shelby, possibly due to drought and high temperatures. A fourth control rating will be taken at 365 DAT to see if any control improved.

TORPEDOGRASS (*PANICUM REPENS*) CONTROL IN BERMUDAGRASS (*CYNODON DACTYLON*). M.W. Edenfield, B.J. Brecke, J.B. Unruh, and J.A. Dusky. University of Florida, Gainesville, 32601.

ABSTRACT

Torpedograss (*Panicum repens* L.) has been identified as one of the most troublesome weeds in Florida turf. Management of torpedograss is difficult due to its perennial nature and tolerance to many herbicides commonly used on warm-season turfgrass species. Research was conducted in 1998 and 1999 to evaluate torpedograss control with quinclorac at different rates, application timings, and in combination with other herbicides in 'Tifway 419' bermudagrass. Quinclorac resulted in better torpedograss control 3 WAT than a sequential application of diclofop alone or MSMA. There was no difference (P#0.05) between quinclorac treatments 3 WAT in 1998 or 1999 and control ranged from 75 to 90%. Single applications of quinclorac and sequential applications of diclofop and MSMA resulted in <70% torpedograss control 7 WAT in 1998. Quinclorac was most effective in 1998 when two application at 0.75 lb/A or three applications at 0.5 lb/A were made. By 16 WAT, quinclorac applied thrice at 0.5 lb/A and quinclorac + diclofop provided better control than a single application of quinclorac at 1.5 lb/A. Acceptable turfgrass quality was observed with all herbicide treatments.

Additional research objectives were to determine if nitrogen fertilizer or mowing intervals improved torpedograss control or ameliorated turfgrass injury from herbicides. Nitrogen fertilizer improved torpedograss control with quinclorac at 1.5 lb/A POST 7 WAT, but these differences were no longer evident by 13 WAT. Similar to the previous study, three applications of quinclorac were more effective for torpedograss control than two applications. Mowing 1 day prior to application resulted in better torpedograss control 7 and 13 WAT with a single application of quinclorac. There were no differences between sequential quinclorac treatments 6 WAT. Mowing did not influence control with sequential quinclorac treatment 6 or 12 WAT. Two applications of quinclorac 0.43G at 0.75 lb/A provided better control than two applications of quinclorac 75DF at 0.75 lb/A when applied 1 day following mowing. Three applications of quinclorac 0.43G at 0.5 lb/A provided better control than two applications of quinclorac 75DF at 0.5 lb/A when applied 1 wk following mowing.

PRACTICAL BUDGETS FOR EXTENDING ALFALFA STAND LONGEVITY BY INTEGRATED MANAGEMENT. D.C. Cummings, R.C. Berberet, J.F. Stritzke, and C.E. Ward, Oklahoma State University, Stillwater.

ABSTRACT

The profitability of an alfalfa stand decreases as alfalfa stem densities decline. When alfalfa stem densities are less than 25 stems/ ft^2, weeds can grow and compete with the alfalfa. At some stage the cost of chemical control for weed and insect pests becomes unprofitable and ineffective. The first objective of this research is to compare forage production potential of over-seeded cool-season grasses and grazing with conventional pest control and haying in thinning alfalfa stands. The second objective is to compare economic inputs and profitability of each treatment option for extending alfalfa stand longevity.

Two experimental sites were established on thinning alfalfa stands at Chickasha (24 alfalfa stems/ ft^2) and Paoli (12 alfalfa stems/ ft^2), OK. A randomized complete block design with five treatments and four replications was used at Chickasha, and a randomized complete block design with five treatments and three replications was used at Paoli. The treatments included 1) no over-seeded grass and grazed in March 1999, 2) ryegrass over-seeded in October 1998 and grazed in March 1999, 3) wheat over-seeded in October 1998 and grazed in March 1999, 4) no over-seeded grass, with herbicides (terbacil 0.5 lb a.i./A, norflurazon 0.98 lb a.i./A, and imazethapyr 0.05 lb a.i./A) and insecticides (cyfluthrin 0.04 lb a.i./A) and hayed in April 1999, and 5) no over-seeded grass, with no pesticides and hayed in April 1999. Before grazing the treatments in March, available forage was estimated by taking clippings from two 18 X 36 inch quadrats. After the March grazing period, and for all of the hayed treatment harvests, forage production was determined from a 3 X 15 ft^2 area using a Carter harvester. Before all harvests, percentages of forage composed of alfalfa, over-seeded grass, weedy grass, and broadleaf weeds were determined from visual estimates. Forage yield data were subjected to an Analysis of Variance and means were separated using Fisher's protected LSD (P< 0.05). Economic analysis was performed on each treatment at the conclusion of the 1999 growing season. Inputs based on values established by the Oklahoma State University Department of Agricultural Economics and the National Agricultural Statistics Service (1999) for dryland alfalfa hay production, were used in determining total expenditures, gross profit and return on investment for each treatment.

Total seasonal forage production at both sites was highest (P<0.05) with the over-seeded treatments. At Chickasha, seasonal forage production from the ryegrass over-seeded and wheat over-seeded alfalfa was 13,529 lb/A and 13,050 lb/A, respectively, compared to 10,877 lb/A from the herbicide + insecticide treated alfalfa. . At Paoli, seasonal forage production was highest (P<0.05) in the ryegrass over-seeded (13,684 lb/A) and wheat over-seeded (13,297 lb/A) alfalfa compared to both the no over-seeded, with no pesticide treated alfalfa (6192 lb/A) and the herbicide + insecticide treated alfalfa (5228 lb/A). At Chickasha, cool-season weed suppression was equal to the herbicide + insecticide treated alfalfa in the ryegrass and wheat over-seeded alfalfa, at the March and May harvest dates with less than 5% weeds in all three treatments. However, the best season long weed suppression resulted with the herbicide + insecticide treated alfalfa (450 lb weeds/A) compared to ryegrass over-seeded (2500 lb/A) and wheat over-seeded (2400 lb/A) alfalfa at Chickasha. At Paoli, weed suppression was greater (P<0.5) in the ryegrass over-seeded (524 lb weeds/A) and wheat over-seeded (1333 lb weeds/A) alfalfa compared to the herbicide + insecticide treated alfalfa (1724 lb weeds/A) in season long forage production.

Over-seeding with ryegrass or wheat into thinning alfalfa stands and then grazing in March was the most profitable treatment at both locations. Return above investment values for each of the treatments at Chickasha include: herbicide + insecticide treated alfalfa then hayed ($193.23), no pesticides and no over-seeding and hayed ($169.00), no over-seeding and grazed ($172.14), ryegrass over-seeded and grazed ($290.37), and wheat over-seeded and grazed ($257.56). At Paoli, the return above investment values were: herbicide + insecticide treated and hayed ($69.13), no pesticides, with no over-seeding and hayed ($97.55), no over-seeding and grazed ($127.13), ryegrass over-seeded and grazed ($160.98), and wheat over-seeding and grazed ($164.49).

CONTROL OF GREEN FLATSEDGE (*Cyperus virens* Michx.) IN PASTURE. J.D. Nerada and W.J. Grichar, Texas Agricultural Experiment Station., Yoakum, TX 77995; S.R. DeForest, Texas Agricultural Extension Service, Hallettsville, TX 77964.

ABSTRACT

Green flatsedge *(Cyperus virens* Michx.) is a native, warm season perennial which grows abundantly in the moist areas, in shallow water, and on the edge of streams, ponds, and lakes found along the coastal areas of south-central Texas. This flatsedge is noted to flower from May through October and dense stands of green flatsedge compete with many grasses and have overtaken many pastures. In a study conducted in south-central Texas, Roundup Ultra (glyphosate) at 2 or 4 pt/A and Velpar (hexazinone) at 2 pt/A provided > 85% green flatsedge control when rated 11 weeks after treatment (WAT). Grazon P+D (picloram + 2,4-D) at 2 and 4 pt/A and Weedmaster (dicamba +2,4-D) at 2 pt/A provided 69 to 78% control when rated 11 WAT. When rated 12 mo after treatment, Roundup Ultra at 4 pt/A controlled 90% green flatsedge while Roundup Ultra at 2 pt/A controlled 76% and Weedmaster at 2 pt/A controlled 64% green flatsedge. Very little regrowth of the native grasses was noted in the Roundup treated plots. Grazon P+D, Tordon (picloram), Remedy (triclopyr), Cadre (imazapic) and Amber (triasulfuron) failed to adequately control green flatsedge (< 50%).

EFFICACY OF HERBICIDES ON COGONGRASS (*Imperata cylindrica*). J.W. Barnett, Jr., J.D. Byrd, Jr., D.B. Mask. Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Field studies were conducted in 1999 at Kemper county near Preston and Pearl River county near Poplarville to determine the efficacy of selected herbicides on cogongrass. These studies evaluated two rates of 17 herbicides and a single rate of seven other herbicides. These treatments included Contain 1AS at 16 & 32 fl oz/A, V10029 80WP at 0.63 oz/A, Asulox 3.34SL at 128 & 192 fl oz/A, Accent 70DG at 0.67 & 1.34 oz/A, Beacon 75WG at 0.76 & 1.52 oz/A, Finale 1SL at 43 & 86 fl oz/A, Escort 60DF at 0.5 & 1 oz/A, Oust 75DG at 2.5 & 5 oz/A, Touchdown 5SL at 37.3 & 74.6 fl oz/A, Roundup Pro 4SL at 160 fl oz/A, Sencor 75DF + MSMA 6L at 8 + 38.4 oz/A, Facet 75DF at 10.7 & 21.4 oz/A, Bladex 4L at 64 & 128 fl oz/A, Diuron 80DF at 20 & 40 oz/A, Bicep 6L at 80 & 160 fl oz/A, Krovar I 80DF at 64 oz/A, MON 37500 75DF at 1.33 oz/A, Telar 75DF at 1 & 2 oz/A, Velpar 2L at 96 & 192 fl oz/A, Hyvar 2SL At 9 & 12 gal/A, Sahara 70WG at 264 oz/A, and Plateau 2SL at 10 fl oz/A. Kinetic was used with all treatments except Roundup, Krovar I, and Hyvar. Plot sizes were 6 ft x 20 ft, and the application volume was 40 gallons per acre at both locations. Plots were visually rated at 21, 42, and 84 days after treatment (DAT). After the third rating at Pearl River county, Hyvar was the only herbicide that gave more than 95% control. However Roundup at 160 fl oz/A, Sahara at 264 oz/A, Touchdown at 37 & 75 fl oz/A, Contain at 16 & 32 fl oz/A, Finale at 86 fl oz/A, Velpar at 192 fl oz/A, and Asulox at 192 fl oz/A, gave moderate control ranging between 50 and 70%, with control peeking at the second or third rating. Herbicide ratings were not as high in Kemper county, possibly due to drought and high temperatures which caused leaf curling and reduced leaf area contact. Even though ratings were lower, trends were similar to those in Pearl River county. Control with Sencor and MSMA in Kemper county was higher than in Pearl River county, 57% compared to 33%, perhaps due to hot, dry conditions. A fourth control rating will be taken at 365 DAT to determine if herbicides with slower acting modes of action will exhibit additional effects on the cogongrass.

CGA 362622 FOR TORPEDOGRASS (*Panicum repens*) AND PURPLE NUTSEDGE (*Cyperus rotundus*) CONTROL IN BERMUDAGRASS. B.J. Brecke and J.B. Unruh, University of Florida, West Florida Research and Education Center, Jay, FL 32565.

ABSTRACT

Torpedograss (*Panicum repens* L.) and purple nutsedge (*Cyperus rotundus* L) are two of the most troublesome weeds in Florida turf. Studies were conducted during 1998 and 1999 at the University of Florida, West Florida Research and Education Center, Jay, FL to evaluate CGA 362622 for control of torpedograss and purple nutsedge and to determine turfgrass tolerance. Experiments were initiated during the first week of June each year in areas naturally infested with torpedograss and/or purple nutsedge. Herbicides were applied with a backpack-type sprayer with CO_2 as propellant set at 20 psi to deliver 20 gpa. Visual weed control ratings (scale 0 = no control and 100 = complete control) and turfgrass quality ratings (scale 0 = dead turf and 9 = maximum turf quality) were made throughout the season.

CGA 362622 at rates of 0.022 to 0.066 lb a.i./A provided better torpedograss control 3 wk after treatment (90 to 100%) than 11 d after application (80 to 90%). Better late-season control was achieved with sequential treatments applied 6 wk apart than with single applications of CGA 362622. Torpedograss control with CGA 362622 was comparable to that obtained with quinclorac + diclofop, a combination which has provided excellent torpedograss control in previous studies.

In 1998, CGA 362622 provided better control of purple nutsedge 3 wk after application (90 to 100%) than 11 days after treatment (80 to 90%), similar to results observed with torpedograss. Single applications of CGA 362622 controlled purple nutsedge as well as sequential treatments in both 1998 and 1999. CGA 362622 controlled purple nutsedge better than halosulfuron or MSMA alone and provided control comparable to that observed with imazaquin + MSMA.

Bermudagrass and zoysiagrass quality were not affected by CGA 362622 when evaluated 4 d, 11 d or 3 wk after application at rates up to 0.09 lb a.i./A. St. Augustinegrass was still exhibiting unacceptable injury symptoms 3 wk after application at the same rates that did not damage bermudagrass or zoysiagrass. CGA 362622 has potential to provide control of both torpedograss and purple nutsedge in bermudagrass and zoysiagrass. Additional studies will be needed to verify these results and to determine the long-term impact of CGA 362622 on torpedograss rhizomes and purple nutsedge tubers.

EVALUATION OF POSTEMERGENCE PYRITHIOBAC APPLICATION RECOMMENDATION. G.G. Light, P.A. Dotray, and J.R. Mahan. Texas Tech University and USDA/ARS, Lubbock 79409.

ABSTRACT

Previous field studies have shown that pyrithiobac efficacy evaluated over two growing seasons on the Texas Southern High Plains was correlated with air temperature at the time of application (R^2 = 0.90). Based on these studies, an application temperature range that provided greater than 90% reduction in dry weight 14 days after postemergence pyrithiobac treatment was recommended. This temperature-based recommendation suggested that postemergence pyrithiobac applications be made when air temperatures are between 20 and 34 C. However, the potential utility of this recommendation to producers has not been examined.

Since a great deal of capital investment is associated with climate-related farm management decisions, these decisions should be based, in part, on a quantitative analysis of long-term climatic records. Empirical analysis of climate data can be made by determining the probability, duration, and frequency of an environmental parameter. Additionally, computer visualization of climatic data can provide a means of improving communication in pest management planning processes. The objectives of this study were to determine the probability, frequency, and duration of the recommended temperature range for postemergence pyrithiobac applications, and investigate the utility of using computer visualization to convey the significance of postemergence pyrithiobac efficacy thermal dependence.

Historic air temperature data sets collected over eleven growing seasons (1989 to 1999) were filtered for temperatures between 20 and 34 C and times between 8:00 a.m. and 8:00 p.m. using Microsoft Excel®. Probability was calculated by dividing the annual sum of hours within the range by the sum of total hours evaluated in each growing season. Frequency of each duration was determined by the number of days in each year that the applicable interval was within the specified length of time. Three-dimensional computer visualizations of the thermal dependence of pyrithiobac efficacy were made on a Silicon Graphics computer using Fledermaus® software. The x-axis represented the Julian calendar day, the y-axis represented the military time of day and the z-axis represented the air temperature. An overlaying color map was created by technicians at IVS, Inc. The color blue represented temperatures below 20 C. Temperatures above 34 C were represented in red, and temperatures within the recommended postemergence pyrithiobac application range were represented in green.

The recommended thermal range occurred during 59 to 93% of the daylight hours in a typical growing season. Conversely, up to 41% of pyrithiobac applications might be adversely affected by application temperature. In some years, the temperature exceeded 34 C for more than 6 hours on at least 50% of the days evaluated. Long durations of

temperatures exceeding 34 C might provide a narrow window for applications. Waiting for the "hot spell" to pass may allow the target species to grow beyond the recommended height at application for optimum pyrithiobac efficacy, resulting in less than acceptable weed control. However, the duration of temperatures below 20 C was generally less than 2 hours. These cooler temperatures predominantly occurred in the early hours of the morning, increased to 20 C, and remained within range for several hours. Therefore, delaying a postemergence pyrithiobac application until the minimum temperature of 20 C was reached could allow producers to obtain acceptable weed control.

Three-dimensional computer images of seasonal temperature data with a color overlay corresponding to the temperatures below, within, and above the recommended application temperature range were developed to provide a visualization of predicted seasonal efficacy. These computer images may allow producers to visually perceive the risk associated with making applications outside the recommended application temperature range. Producers may enhance the probability of achieving acceptable weed control by making postemergence pyrithiobac applications when the air temperature is between 20 and 34 C.

RESPONSE OF *LYCIANTHES ASARIFOLIA* (SOLANACEAE) TO HERBICIDE TREATMENTS IN TURF. M.L. Ketchersid, G.R. Taylor II, L. Rider, and W.G. Menn. Texas Agricultural Extension Service and Texas Agricultural Experiment Station, College Station.

ABSTRACT

Lycianthes asarifolia (Kunth & Bouché) Bitter was first recognized as a weed in Houston in July of 1997. This species has a prostrate, trailing growth habit, with stolons that root and produce leaves at every node similar to dichondra. However, this species is much larger and much more aggressive than dichondra. *Lycianthes* has overrun several residential yards, forming a dense, attractive ground cover in shaded areas. However, it is highly competitive in St. Augustine lawns under Houston environmental conditions. *Lycianthes* tolerates Houston's winter weather and suffers only partial dieback during the hottest summer days. Homeowners have not been able to selectively control this species and have asked for recommendations.

Initially, we thought this was a newly introduced weed localized in a small area of Houston, but we have collected survey evidence to indicate the plant has been in Texas at least 20 years. *Lysianthes* infestations have been located east to Liberty, south to Friendswood, north to Humble-Atascosita, and west to the Woodlands. We believe that *Lysianthes* could compete with native vegetation and thrive if it became established; however, it has not been located in the parks or nature areas in and around Houston. The pattern of occurrence indicates that this species was planted rather than accidentally introduced. Introduction was most likely associated with the nursery landscape business, garden clubs, and amateur horticultural clubs. At this point, establishment and spread of *Lysianthes* appears to be due to human activity.

A herbicide test was initiated in a home lawn with a uniform 70 % infestation of *Lycianthes*. The lawn was mowed at a 3 inch height. Weed leaves were smaller with petioles and internodes shorter under mowed conditions than when the weed was allowed to grow undisturbed. Ten treatments were applied to 3 X 9 ft plots. Three replications of each treatment were arranged in a randomized complete block design. Image, Weedar 2,4-D, Garlon 3A, Banvel, Confront, Millennium Ultra, Horse-Power, Cool Power, and Trimec Classic (all with 0.25% non-ionic surfactant), and Trimec Classic (without surfactant) were applied at 0.5, 2.0, 1.5, 0.75, 0.75, 1.4, 1.7, 1.6, 1.65, and 1.65 lb ae/A for perennial herbaceous weed control. The first application, made on April 3, 1998, produced no phytotoxic response; therefore, all treatments were repeated May 8, 1998. Ratings were made 14, 31 and 52 days after treatment (DAT) the values of the three ratings were averaged because they did not follow a trend over time. *Lycianthes* injury ranged from 16.1% for Image to 49.4 for Trimec Classic. Ratings were visual estimates of the percent of plants affected by curling, lack of vigor, and yellowed leaf color. In this same period, grass injury ranged from 17.8% for Image to 39.3% for Confront. In August, weed cover was reduced 10% in the Confront treatments but by October, five months after the second treatment, there was no residual control of *Lycianthes* evident in the lawn. At that time, the ground cover by *Lycianthes* was essentially 100%, the weedy plants in the lawn looked healthier and thicker than before we started and there was very little grass evident. Attempts to repeat this study in the summer of 1999 failed. Treated areas were rated as having 85% control and untreated areas were rated as 45% control but this reflected the effect of irrigation not herbicide treatments because our cooperator decided not to water the treated area. Our results agreed with surveys of lawn care professionals and home owners that no selective herbicide has been effective for controlling *Lycianthes* in a lawn.

Several volunteer home owners took a nonselective approach to *Lycianthes* control. Round-Up was applied as a 2% mixture over the top to control all herbaceous vegetation in the area. This treatment must be repeated a second time, a month to six weeks after the first treatment, whenever the *Lysianthes* begins to re-sprout. Some sprouts will continue to emerge over the next year or more and can be treated as single leaf spot treatments. When only one application of Round-Up was applied prior to re-sodding a lawn, the *Lysianthes* rebounded very quickly. In this case, the condition 4 months after treatment was more weedy than before.

Additional infested areas have been offered as test sites. We plan to test both selective and non-selective treatments on undisturbed rather than mowed plants and to test the use of additives to increase activity. In future studies, a cutting device will be used to cut all of the stolon connections between plots.

ALTERNATIVE WEED CONTROL OPTIONS FOR LARGE CONTAINER ORNAMENTALS. S.L. File, P.R. Knight, D.B. Reynolds, C. Gilliam, and J. Altland. Mississippi State University, Mississippi State, and Auburn University, Auburn, AL.

ABSTRACT

Herbicides applied to container-grown ornamentals may leach fromthe containers due to the large amounts of irrigation requiredunder typical nursery conditions. In addition to leaching, non-target herbicide losses pose serious environmental concerns. It is evident that high loss potentials exist for nurseries producing container grown ornamentals. Therefore, the objective of this research was to determine the effectiveness of alternative weed control options in suppressing weed growth when compared to traditional chemical methods. Uniform quart liners of *Lagerstroemia indica x faurei* ' Natchez' were planted in 15 gallon containers in June 1999, on a gravel container pad. Containers were watered using overhead irrigation and were uniformly infested with prostrate spurge (*Euphorbia supina)*. Treatments include 1) 3 lb ai/A Regal 0-0 3 G as a broadcast or individual container application, recycled newspaper pellets (1" thick), Spin-out coated recycled newspaper pellets (1" thick), 2) geotextile disks (Spin-out coated), 3) kenaf mulch, 4) waste tire crumbles, 5) wheat straw (2" thick), 6) oat straw (2" thick), 7) cereal rye straw (2" thick), 9)paper mill sludge (2" thick), 10) a handweeded, and 11) a weedy control. Treatments were organized in a randomized complete block design consisting of 8 single plant replicates. The geotextile disks, newspaper pellets treated with spin-out, and shredded rubber tire treatments all provided at least 80% weed control from 30 to 90 DAT. These data indicate that alternative weed control methods may provide a good environmentally friendly alternative to conventional weed control practices in large container grown ornamentals. The future research includes an economic evaluation of both labor cost and cost of the mulched, growth parameters taken at the initiation of study and at termination, and the possible benefits of the mulch to reduce evaporation and loss of herbicides.

DIFFERENTIAL SELECTIVITY OF CLOPYRALID AND TRICLOPYR IN WARM SEASON TURF. T.D. Scott, Arkansas State University, State University, AR 72467 and G.E. Coats, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Clopyralid and triclopyr combinations have been used in warm season turf to control broadleaf weeds; however, turfgrass injury has been observed in several turfgrass species. Most warm season turfgrasses have more tolerance to clopyralid than to triclpyr. Clopyralid and triclopyr combinations have been used in warm season turf to control broadleaf weeds; however, turfgrass injury has been observed in several turfgrass species. Most warm season turfgrasses have more tolerance to clopyralid than to triclpyr. Laboratory experiments were conducted to determine possible causes for the differential selectivity of clopyralid and triclopyr in bermudagrass and St. Augustinegrass. Plants were established in the greenhouse from sprigs collected at the Plant Science Research Center near Starkville, MS. The experimental design was a completely randomized design with five replicates of each treatment and the study was conducted twice. To better estimate whole plant conditions, non-radioactive treatments were applied broadcast in a spray chamber equipped with a CO_2 pressurized system calibrated to deliver 230 L ha^{-1} and a 8003 even fan nozzle fixed 30 cm from the target. Plants receiving ^{14}C-clopyralid were first sprayed with a broadcast treatment of 224 g ha^{-1} clopyralid and then spot treated with 10 :L of 0.005 M clopyralid containing 7.4 x 10^3 Bq ^{14}C-clopyralid. Likewise, plants receiving ^{14}C-triclopyr were treated with a broadcast application of 224 g ha^{-1} triclopyr before treatment with 10 :L of 0.005 M triclopyr containing 7.4 x10^3 Bq ^{14}C-triclopyr. St. Augustinegrass was treated on two leaves with each leaf receiving two drops of 2.5 :L. Bermudagrass was treated on five leaves with each leaf receiving one drop of two :L each. At harvest, plants were sectioned into treated shoot, non-treated shoots, and roots. Treatments were harvested at 48 and 168 hours after treatment (HAT) and the herbicides were extracted with acidified acetone. A 200 :L aliquot of the extract was placed in a scintillation vial, 15 mL scintillation cocktail added, and the radioactivity counted by liquid scintillation spectroscopy. Metabolism studies were conducted using thin layer chromatography on the treated shoot of the ^{14}C-treated samples to determine the amount of parent compound remaining in the plant 48 and 168 HAT. Analysis of variance was conducted on the absorption, translocation, and metabolism data and treatment differences were determined by Fisher's Protected Least Significant Difference (LSD) at the 5% level of significance. The herbicides were averaged over St. Augustinegrass and bermudagrass since there was no interaction between the grass species and herbicide treatment. Several differences in absorption and translocation were found; however the rate of metabolism in the grass species did not differ between the two herbicides. The percentage of parent herbicide in the treated leaves was 76% at 48 HAT and 67 to 72% at 168 HAT for both herbicides. More clopyralid than triclopyr was absorbed 48 HAT; however, by 168 HAT no difference was found. The grasses absorbed 25 and 16% of clopyralid and triclopyr, respectively, 48 HAT. The amount of herbicide remaining in the treated shoot was 91 to 94% for both herbicides at 48 HAT; however, at 168 HAT only 74% of the clopyralid was retained in the treated shoot. Clopyralid was translocated more than triclopyr in the grasses at both harvest timings. Increased translocation was to the non-treated shoot, with 8% of the clopyralid and 4% of the triclopyr translocated at 48 HAT. The increased translocation of clopyralid was even more evident at 168 HAT with 21% being translocated to non-treated shoots. No differences were observed between the two herbicides in the percentage of absorbed herbicide that was translocated to the roots at either harvest timing. The differential selectivity between clopyralid and triclopyr in warm-season turfgrasses can be partially attributed to differences in translocation of the two herbicides. Translocation of triclopyr, the more injurious herbicide, was less than

clopyralid. The type of injury observed with triclopyr could be explained by the herbicide remaining in the treated shoots. Typically, injury is seen on foliage present at the time of triclopyr application and new growth does not have the symptomology.

RESPONSE OF GLUFOSINATE-RESISTANT RICE TO GLUFOSINATE. D.Y. Lanclos, E.P. Webster, and S.N. Morris, Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

Two studies were conducted in 1998 and 1999 at the Rice Research Station near Crowley, Louisiana to evaluate crop response of glufosinate-resistant rice (*Oryza sativa* L.) lines to glufosinate applications throughout the growing season. Glufosinate-resistant rice 'CPRS PB-13' (Cypress transformant) was drill-seeded in 1998 and 1999 and 'BNGL HC-11' and 'BNGL-62' (Bengal transformant) were drill-seeded in 1998 and 1999, respectively. The soil was a Crowley silt loam with pH 5.5, 1.4% OM, and a CEC of 19.1. Plot size was 4.5' x 20'. Glufosinate was applied at 0.75 lb ai/A in single applications starting 2d after emergence (DAE) and continuing through 56 DAE at 7 day intervals. The area was maintained weed-free for the duration of the study. Days to 50% heading, plant height at harvest, and 100 count seed weights were also evaluated. Each study had a randomized complete block design with 4 replications. All data were subjected to ANOVA and means separated by Fisher's Protected LSD at the 0.5% level of probability. No difference occurred for year by treatment; however, a treatment interaction occurred for both studies. Therefore, data were averaged over years. CPRS PB-13 will be referred to as Cypress and BNGL HC-11and BNGL-62 as Bengal.

At 14 DAT, injury for the Cypress transformant was 1 to 8%. Injury consisted of mainly leaf chlorosis and necrosis. The 7 DAE treatment resulted in 8% injury and was higher compared with all other treatments. At 28 DAT, injury was reduced to 0 to 6% with no injury observed for the 28, 35, and 42 DAE treatments. The 7 DAE treatment was highest with 6% injury. Days to 50% heading were 89 to 90 d after planting (DAP) with little to no differences occurring. Plant height at harvest was reduced at the 21, 28, 35, and 42 DAE treatments compared with the nontreated. Yield for Cypress was 5890 to 6320 lb/A when treated 21, 28, 35, 42, and 49 DAE with no differences compared with the nontreated. However, yield was reduced at the 7, 14, and 56 DAE application timings when compared with the nontreated indicating that yield may be reduced when glufosinate is applied early or late in the growing season. There were no differences in 100 count seed weights when compared with the nontreated.

At 14 DAT, injury for the Bengal transformant was 4 to 14%. Bengal treated at 2, 7, 14 and 49 DAE was injured above 10%; however, all other treatments resulted in 6% or less injury. At 28 DAT, injury was less than 10% for all treatments. Days to 50% heading were 87 to 90 days with little to no differences occurring. Plant height at harvest was reduced for all applications except the 28 DAE timing compared with the nontreated. Plant height was reduced 6 cm compared with the nontreated when glufosinate was applied at 49 DAE. Yield was 7020 to 8325 lb/A for all treatments. Yield was reduced for the 7, 14, 49, and 56 DAE treatments compared with the nontreated. Seed weights differed from the nontreated at 14, 21, 28, 49, and 56 DAE timings.

In conclusion, glufosinate-resistant rice lines differed in their resistance to glufosinate applications. Trends have developed across both transformants in terms of injury. At 14 and 28 DAT, injury symptoms were similar and % injury increased with glufosinate applied prior to 21 DAE and after 42 DAE. Days to 50% heading, plant height, and 100 count seed weights were not adversely affected. Historically, conventional Cypress outyields Bengal; however, it appears that glufosinate-resistant Bengal has a higher yield potential than glufosinate-resistant Cypress. This research indicates that glufosinate applications should be made from 21 DAE to 42 DAE to minimize injury and maximize yield.

TOXICITY OF FOMESAFEN TO YELLOW NUTSEDGE (*CYPERUS ESCULENTUS* L.). D.O. Stephenson, M.G. Patterson, G.R. Wehtje, S.B. Belcher, W.H. Faircloth, J.C. Sanders. Department of Agronomy and Soils, Auburn University, Auburn, AL 36849.

ABSTRACT

Greenhouse studies were conducted in 1999 to determine the response of yellow nutsedge (*Cyperus esculentus* L.) to selective placement of fomesafen-treated soil above and/or below yellow nutsedge tubers. Four tubers were planted in pots that were divided in three layers. Two layers of soil at 500 grams each were split by a 1 cm layer of activated charcoal. Yellow nutsedge tubers were planted in the charcoal layer between the two layers of soil. Four rates of fomesafen were used. They were 0.125, 0.25, 0.38, and 0.50 lb a.i./A. Each rate was applied above, below, and above plus below the tubers. Fomesafen was combined with water and applied to the soil accordingly. The soil layers were brought to field capacity with the appropriate amount of water. Treatments were replicated four times. Data collected was percent weed control (0 = no control, 100 = total control) 28 and 35 DAT, shoot dry weight 28 DAT, and tuber dry weight 42 DAT.

Yellow nutsedge control increased with increasing fomesafen rate at 28 and 35 DAT regardless of placement. There was no difference in control between the below and the above plus below placements 28 DAT. Placement above tubers provided lower control than below or above and below. Shoot dry weight decreased as the fomesafen rate increased.

Shoot dry weight data 28 DAT with the below and the above plus below treatments were no different, and both decreased shoot dry weight more than the above only treatments. Conversely, the above and the above plus below treatments provided greater yellow nutsedge control 35 DAT as compared to the below placements. There was no difference in control between the above and the above plus below treatments 35 DAT. Tuber dry weight 42 DAT decreased with increasing rates of fomesafen. There is no clear difference between the three placements in decreasing dry weight of yellow nutsedge.

WEED CONTROL AND CROP TOLERANCE IN ROUNDUP READY CORN. W.F. Bloodworth, D.B. Reynolds, C.D. Rowland, and R.M. Cobill. Mississippi State University, Mississippi State.

ABSTRACT

In 1999, field experiments were conducted at the Plant Science Research Center, Starkville, MS, and the Black Belt Branch Experiment Station, Brooksville, MS, to evaluate Roundup Ready corn weed control. In both experiments, treatments were as follows: 1.0 lb ai/A Roundup Ultra (glyphosate) alone, 1.0 lb/A Roundup Ultra followed by (fb) 0.75 lb/A Roundup Ultra, 2.0 lb ai/A Aatrex (atrazine) fb 1.0 lb/A Roundup Ultra, 1.1 lb ai/A Bicep II Magnum (metolachlor + atrazine) fb 1.0 lb/A Roundup Ultra. Also included in the experiment for comparison were two industry standards: 2.2 lb ai/A Bicep II Magnum fb 0.031 lb ai/A Accent (nicosulfuron) + 0.25% v/v Ag-98; 1.0 lb ai/A Prowl (pendimethalin) + 1.5 lb ai/A Aatrex applied preemergence (PRE) fb 0.031 lb/A Accent + 0.25% v/v Ag-98 applied postemergence (POT). Treatments were applied broadcast at 15 gallons per acre and arranged in a randomized complete block design. Pitted morningglory (*Ipomoea lacunosa)* and large crabgrass (*Digitaria sanquinalis*) control and crop injury were evaluated 42 days after treatment (DAT). There was no significant difference in control or crop injury among treatments except Roundup applied alone at the Starkville location. Roundup applied in a single application did not give adequate control of large crabgrass or pitted mornigglory due to weeds emerging after initial applications.

Roundup Ready corn tolerance was evaluated in other experiments conducted in 1998 and 1999 at the Plant Science Research Center in Starkville, MS. A randomized complete block experimental design was used in conducting this experiment. Roundup Ultra was applied at rates of 1.0, 2.0, and and 3.0 lbs ai/A, to corn in the spiking, V2-V3, V4-V5, V6-V7, and V8 growth stages. Under weed free conditions, Roundup Ultra applied at the rates and corn stages evaluated did not significantly affect corn heights or yields.

Results indicate that Roundup alone does not provide adequate weed control unless applied with a residual herbicide or a second application of Roundup in situations where multiple flushes of weed emergence may occur. Roundup Ready corn exhibited no height reductions or crop injury when Roundup was applied at the rates evaluated to corn in the spiking, V2-V3, V4-V5, V6-V7, or V8 growth stages.

EVALUATION OF BROADLEAF HERBICIDES IN COMBINATION WITH ROUNDUP ULTRA AND TOUCHDOWN. J.M. Ellis, J.L. Griffin, D.K. Miller, and P.R. Vidrine, Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

Field studies were conducted in 1999 at the Ben Hur Research Farm near Baton Rouge, LA to evaluate Roundup Ultra or Touchdown in combination with Classic or Flexstar and to evaluate any subsequent effect of the combinations on soybean injury. The experimental design for both experiments was a randomized complete block with three replications. Treatments for the first study included Roundup Ultra at 1.5 pt/A or Touchdown at 1.2 pt/A applied alone or in combination with 0.25, 0.33, or 0.50 oz/A Classic. The second study included Roundup Ultra at 2.0 pt/A or Touchdown at 1.6 pt/A applied alone or with 0.38, 0.66, or 0.75 pt/A Flexstar. Data collected included visual weed control and soybean injury 14 and 28 days after treatment (DAT) and soybean yield.

In the first study at 14 DAT, control of prickly sida (*Sida spinosa* L.), hemp sesbania [*Sesbania exaltata* (Raf.) Rydb. ex A. W. Hill], wild poinsettia (*Euphorbia heterophylla* L.), and pitted morningglory (*Ipomoea lacunosa* L.) was increased with the addition of Classic to Roundup Ultra. In contrast, only pitted morningglory control was increased with the addition of Classic to Touchdown. The 0.25 oz/A rate of Classic when in combination with either Roundup Ultra or Touchdown was as effective as the higher rates. Comparing Roundup Ultra and Touchdown applied alone, only barnyardgrass [*Echinochloa crus-galli* (L.) Beauv.] and pitted morningglory control were equal (average of 91 and 69%, respectively). Touchdown at 14 DAT controlled more prickly sida (96 vs. 88%), hemp sesbania (92 vs. 78%), and wild poinsettia (99 vs. 92%) when compared with Roundup Ultra alone. At 28 DAT, the addition of Classic to Roundup Ultra did not increase control of barnyardgrass, prickly sida, or hemp sesbania. All rates of Classic in combination with Roundup Ultra increased wild poinsettia control, but only the high rate increased pitted morningglory control. For Touchdown, addition of Classic did not increase control of barnyardgrass, hemp sesbania, or pitted morningglory. All Classic rates with Touchdown increased control of prickly sida. For wild poinsettia, Classic at 0.33 and 0.50 oz/A with Touchdown increased control compared with Touchdown alone. Comparing Roundup Ultra and Touchdown applied alone, control 28 DAT was equal for barnyardgrass (77%), hemp sesbania (98%), and wild poinsettia (88%), but prickly sida was controlled more with Roundup Ultra (99 vs 90%) and pitted morningglory more with Touchdown (97 vs. 88%).

Soybean injury was 12% or less 14 DAT and was no greater than 3% 28 DAT. Soybean yields were equivalent for Roundup Ultra or Touchdown applied alone or in combination with Classic.

In the second study at 14 DAT, barnyardgrass, prickly sida, and wild poinsettia control in a practical significance was not increased with the addition of Flexstar to either Roundup Ultra or Touchdown compared with the herbicides alone. Barnyardgrass, prickly sida, hemp sesbania, and wild poinsettia were controlled at least 95% regardless of herbicide treatment. The combination of Flexstar at 0.66 and 0.75 pt/A with Roundup Ultra and Flexstar at all rates with Touchdown increased entireleaf morningglory (*Ipomoea hederacea* var. *integriuscula* Gray) control when compared with Roundup Ultra plus Flexstar at 0.38 pt/A, Roundup Ultra alone, and Touchdown alone. Control of prickly sida, wild poinsettia, and entireleaf morningglory was equal for Roundup Ultra and Touchdown applied alone. At 28 DAT, addition of Flexstar to Roundup Ultra did not increase the control of barnyardgrass, prickly sida, hemp sesbania, or entireleaf morningglory. Combination of all rates of Flexstar with Roundup Ultra increased control of wild poinsettia. Flexstar at 0.66 pt/A and 0.75 pt/A with Touchdown increased control of barnyardgrass and wild poinsettia, and all rates of Flexstar increased control of entireleaf morningglory and hemp sesbania. None of the Flexstar rates in combination with Touchdown increased prickly sida control. Control of all weeds was equal for Roundup Ultra and Touchdown applied alone and averaged 82, 93, 96, 87, and 81% for barnyardgrass, prickly sida, hemp sesbania, wild poinsettia, and entireleaf morningglory, respectively. Injury was no greater than 8% 14 DAT and was no greater than 2% 28 DAT. All herbicide treatments yielded higher than the nontreated check, however little or no difference was observed among herbicide treatments.

WEED POPULATION CHANGES IN ROUNDUP READY AND CONVENTIONAL HERBICIDE SYSTEMS.
S.G. Flint, J.C. Holloway, D.R. Shaw, W.B. Henry, Mississippi State University, and Novartis Crop Protection Corp, Greenville, Ms.

ABSTRACT

Field studies were conducted in 1998 and 1999 at the Novartis Crop Protection Delta Research Station, Greenville, MS, to monitor weed species shifts in Roundup Ready and conventional cotton (*Gossypium hirsutum* L.) and soybean [*Glycine max* (L.) Merr.]. Herbicides evaluated in cotton were glyphosate, fluometuron, prometryn, metolachlor, and pyrithiobac. Herbicides evaluated in soybean were glyphosate, flumetsulam + metolachlor and CGA 277,476. These products were used at half and full label rates. Glyphosate was used at 1.1 kg ai/ha as a POST treatment following either flumetsulam + metolachlor in soybean or fluometuron + prometryn + metolachlor in cotton. Two applications of glyphosate were used in cotton and soybean as a comparison treatment. POST herbicides in conventional systems were pyrithiobac in cotton CGA 277,476 in soybean. Plot integrity was maintained each year to evaluate weed shifts over time. Plots were 12 x 40 m in cotton and 9 x 40 m in soybean.

In 1998 initial weed counts were taken in four 1-m quadrates per plot. The pitted morningglory *(Ipomoea lacunosa* L.) population after treatment with the high and low rates of fluometuron + prometryn + metolachlor fb glyphosate for were 1.8 and 1.7/ m^2, respectively, in 1998, and were 0 and 0.9/m^2, respectively, in 1999. Two applications of gyphosate resulted in a pitted morningglory population of 2.3/m^2 in 1998 and 0.3/m^2 in 1999. Hemp sesbania [*Sesbania exaltata* (Raf.) Rybd. Ex. A. W. Hill] populations in cotton treated with two glyphosate applications were 9.0 in 1998 and 5.1/m^2 in 1999. Fluometuron + prometryn + metolachlor followed by pyrithiobac averaged 1.2/m^2 in 1998 and 0.1/m^2 in 1999.

In soybean two glyphosate applications resulted in 11.1/m^2 in 1998 to 1.7/m^2 in 1999 for hemp sesbania. Flumetsulam + metolachlor at high and low rates followed by glyphosate resulted in pitted morningglory populations of 5.7/m^2 in 1998 to 1/m^2 in 1999. In comparison, population following flumetsulam + metolachlor followed by CGA 277,976 was 9/m^2 in 1998 to 0.6/m^2 in 1999. Hemp sesbania population in soybean was 15.6/m^2 and 7.7/m^2 in 1998 and 1999, respectively, thus, weed populations showed a significant reduction over the two years with both Roundup Ready and conventional weed control systems, with no notable differences between systems in the second year.

RESPONSE OF *Poa* ECOTYPES TO HERBICIDES. J.S. McElroy, R.H. Walker, E. Van Santen, G. Wehtje and J. Belcher. Agronomy and Soils Department, Alabama Agric. Exp Stn, Auburn University, AL 36849-5412.

ABSTRACT

Recent research on the control of *Poa annua* has not focused on differences that may exist between varieties and distinct ecological populations of *P. annua*. However, possible differences may exist between *Poa annua* var. *reptans* and *P. annua* var. *annua* ecotypes response to herbicides. Evaluations were made of the following ecotypes response to preemergence and postemergence-applied herbicides: four from Augusta, Georgia (A4, A8, A14, A17), one from Auburn, Alabama (Auburn), and one from Fresno, California (Purchased). Varying ecotypic responses to herbicides could account for mixed results in research data published on *P. annua* control.

Laboratory studies: These studies were conducted to evaluate the response of ecotypes A4, A8, A14 and A17 to preemergence-applied herbicides. Herbicides evaluated were pronamide, prodiamine, oryzalin, trifluralin, simazine and

fenarimol. 12-well tissue-culture trays containing acrylamide copolymer combined with 0, 0.25, 0.5, 1.0, 2.0 or 4 ppm herbicide solution was utilized as the growth medium. 5 seeds per ecotype per well were replicated 12 times and repeated. Experiments were conducted under 24-h light, 64 F $\pm$ 2 F temperature. Measurement of shoot growth after 2 weeks was analyzed to determine herbicide concentration that reduced shoot growth by 90%. Pronamide, prodiamine, oryzalin and trifluralin effectively reduced shoot growth of all ecotypes >90% at all concentrations. Simazine produced variable results among ecotypes, but all ecotypes were determined to be resistant. Augusta ecotypes responded similarly to fenarimol, with 3.25 ppm reducing shoot growth by 90% on average.

Field Studies: These studies were conducted to evaluate response of Purchased, Auburn, and equally mixed amounts of ecotypes A4, A8, A14 and A17 (Augusta Mix) to postemergence-applied herbicides. Four inch diameter plugs were removed froma Tifdwarf bermudagrass (*Cynodon* spp.) putting green, filled with native sandy loam soil and seeded with an ecotype 8 weeks prior to treatment. Herbicides and rates were: pronamide, 1.5; ethofumesate, 1.25; rimsulfuron 0.032 and 0.064; primisulfuron 0.032 lb ai/A. Treatments were made with a CO_2 backpack sprayer in a water volume of 30 GPA. Percent control was visually rated 9 weeks after the first application and 3 weeks after the second application. The Purchased ecotype was controlled significantly less than the Auburn or Augusta Mix when averaged across herbicides. Pronamide and rimsulfuron at both rates provided effective control of Auburn and Augusta Mix ecotypes, but not the Purchased ecotype. No herbicide treatment provided an effective control of all ecotypes.

REDVINE (*BRUNNICHIA OVATA*) AND TRUMPETCREEPER (*CAMPSIS RADICANS*) RESPONSE TO GLYPHOSATE AND GLUFOSINATE MIXTURES WITH OTHER POST HERBICIDES. D. Chachalis and K.N. Reddy, USDA-ARS, Southern Weed Science Research Unit, P.O. Box 350, Stoneville, MS.

ABSTRACT

Redvine and trumpetcreeper are common perennial vines found in cultivated and reduced tillage fields, wastelands, fence rows, and riverbanks in the Mississippi Delta. Both species are among the ten most troublesome weeds in cotton and soybean due then its extensive deep root system that produces new sprouts when the foliage is killed with foliar-applied herbicides. Greenhouse studies were conducted to 1) determine responses of these weeds to glufosinate and glyphosate, 2) characterize the nature of interactions of mixtures of glufosinate and glyphosate with several selective POST herbicides, and 3) determine the effects of various adjuvants on glyphosate efficacy.

Control of trumpetcreeper was consistently higher than redvine regardless of herbicides, and trumpetcreeper regrowth was totally inhibited by both glufosinate and glyphosate. In both species, control and regrowth reduction with acifluorfen, bentazon, chlorimuron, pyriothiobac, and imazaquin was less than 58% and 69%, respectively. However, trumpetcreeper was more susceptible than redvine to selective POST herbicides. In all cases, control of both species with selective POST herbicides was lower than that of glufosinate or glyphosate. In both species, glufosinate mixtures with the selective POST herbicides were additive whereas glyphosate mixtures with POST herbicides were antagonistic in redvine. In trumpetcreeper, only acifluorfen mixture with glyphosate was additive whereas all the other mixtures were antagonistic.

In redvine, addition of methylated seed oil (MSO) or non-ionic surfactant (X-77) to glyphosate resulted in 22% lower control and 57% higher regrowth, respectively. All other surfactants (Silwet L-77, Agri-Dex, Dyne-Amic, Optima) and ammonium sulfate did not improve glyphosate activity. In trumpetcreeper, only addition of ammonium sulfate resulted in 16% higher control than glyphosate alone. Combination of ammonium sulfate with Silwet L-77, MSO, Agri-Dex, or Dyne-Amic did not improve glyphosate efficacy in both species.

INFLUENCE OF INCORPORATION DEPTH ON SPARTAN PERFORMANCE IN TOBACCO. G.K. Breeden, G.N. Rhodes, Jr., R.L. Ellis, and T.C. Mueller. University of Tennessee, Knoxville.

ABSTRACT

Tobacco (*Nicotiana tabacum*) is very important to the economy of Tennessee. In 1998 it was the leading cash crop at $232 million. Producers have experienced difficulty controlling morningglories (*Ipomoea* spp.) in tobacco. However, in 1997 Spartan (sulfentrazone) was introduced to the tobacco market. Spartan provides excellent control of morningglories and many other broadleaf weeds. It also provides good suppression of annual grasses. Tobacco injury had not been noted through several years of research. In 1997, however, producers experienced unexpected tobacco injury at several locations. This injury was believed to be related to incorporation depth. Field research was initiated with the following objectives: 1) To determine the influence of incorporation depth on tobacco injury and yield fromSpartan; and 2) To determine if differential injury occurred due to the grass herbicide tank mix partner.

Field experiments were conducted in 1997 and 1998 at Greeneville and Springfield, TN. A burley variety (TN-90) was used at Greenville and a dark fire cured variety (TN D950) was used at Springfield. All experiments were replicated 3 or 4 times in a randomized complete block design. Spartan plus Command (6.7 oz. + 2.0 pt./A) or Spartan plus Prowl (6.7 oz. + 2.5 pt./A) was either surface applied or preplant incorporated to depths of 2 or 4 inches. Herbicides were applied with a CO_2 pressurized tractor or 4-wheeler sprayer at 3 mph and 15 gpa. Incorporation was conducted with a

PTO driven roto-tiller. Crop injury was visually estimated using a 0-99% scale. The center two rows of each four row plot were harvested for yield, and grade indexes were calculated. The yield and grade indexes were averaged over the two years and the statistical analysis to detect treatment differences was SAS General Linear Models (GLM).

Chlorosis and/or stunting were the most common forms of tobacco injury. Tobacco injury was slight in most cases and tended to diminish as the season progressed. Injury from Spartan + Command in both 1997 and 1998 tended to increase with depth of placement. The influence of depth of placement on Spartan + Prowl was less clear. Injury tended to be greater with shallow placement. In 1997 the 2 inch depth caused more injury than the other depths, and in 1998 the 0 and 2 inch tended to cause more injury. The dark fire cured variety tended to exhibit less injury than the burley. There were no yield differences among treatments for burley or dark tobacco when compared to the hand weeded check. Likewise, there were no differences in grade.

The injury caused by depth of placement did not affect tobacco yield or the quality of the crop. The Prowl tank mix partner tended to cause greater injury at the shallow incorporation depths than did Command.

EFFECT OF DIURON IN FLOODWATER ON RICE. E.J. Jones, G.D. Wills, and J.E. Street, Delta Research and Extension Center, Stoneville, Mississippi.

ABSTRACT

A greenhouse study was conducted to determine the effect of diuron in floodwater on the yield of rice, *Oryza sativa* 'Lemont'. Individual treatments were applied to 24 plants grown four plants each in 6-inch-diameter plastic pots containing Sharkey clay (40.8 CEC) soil and flooded inside sheet metal pans measuring 25 by 36 by 10 inches (64 by 94 by 25 cm) deep. The study was conducted as two experiments where treatments were applied when rice, 6 to 10 inches (15 to 24 cm) tall, was flooded with distilled water to a depth of 2 inches (5 cm) above the level of the soil. Diuron was applied in the floodwater in Treatment No. 1 at 0.09 ppm, Treatment No. 2 at 0.18 ppm, and Treatment No. 3 at 0.00 ppm (control). At the time of treatment, rice in Experiment I had begun tillering, whereas, in Experiment II rice had not begun tillering.

Mature rice was harvested at 18 weeks after flood treatment using a stationary Almaco® panicle thresher. Rough rice seed from individual plants were separately threshed and weighed resulting in 24 replications per treatment. The least significant difference (LSD) between means was determined by Fisher's Protected LSD test at the 5% level.

In each experiment, rough rice yields were compared and are presented as a percent of the yield in the untreated rice. In Experiment I, diuron at 0.09 ppm increased yield 39% above the untreated control, whereas, diuron at 0.18 ppm decreased yield 55% below the untreated control. In Experiment II, rice yield was not significantly different between the treatment with diuron at 0.09 ppm and the untreated control treatment, whereas, the yield with diuron applied at 0.18 ppm was reduced to 48% below that in the untreated control treatment.

Rice plants in each experiment in this study were able to tolerate diuron at 0.09 ppm without significant loss in yield but not at 0.18 ppm.

It is a violation of Federal law to use diuron in a manner inconsistent with its labeling. Before using diuron, read and carefully observe the precautionary statements and all other information appearing on the product label.

Effect of diuron in floodwater on rice (average of 24 plants/treatment).

Treatment Diuron	Rough Rice Yield as % of Untreated[1/]	
	Experiment I	Experiment II
	---(%)---	
(ppm)		
0.09	139 A	84 A
0.18	55 C	48 B
Untreated	100 B	100 A

[1/]Values in the same column followed by the same letter are not different according to Fisher's Protected LSD test at P=0.05

EFFICACY AND ANTAGONISM OF RICE GRAMINICIDES. J.A. Kendig, G.A. Ohmes, P.M. Ezell, and R.L. Barham, University of Missouri Delta Center, Portageville, MO 63873.

ABSTRACT

Four new barnyardgrass herbicides are under investigation in rice. Three are ACCase-inhibiting graminicides (Aura (BAS 625H), Clincher (cyhalofop), and Ricestar (fenoxaprop + safener)). Regiment (bispyribac) is an ALS inhibitor which controls selected grass and broadleaf weeds. The comparative efficacy of these products is unknown. A thorough comparison of Ricestar, versus the unsafened fenoxaprop product Whip 360 is also needed. Weed control in rice requires the control of grass and broadleaf weeds. However, ACCase-inhibiting graminicides are often antagonized by broadleaf-tank mixtures. Antagonism data are needed for tank mixtures of common rice-broadleaf herbicides with the selective graminicides. Studies to determine the comparative efficacy and tank-mix antagonism potential were conducted in 1999.

In the comparative efficacy study, Whip 360 was applied at 0.06 and 0.08 lb ai/A, Ricestar was applied at 0.12 and 0.16 lb ai/A, Aura was applied at 0.067 and 0.094 lb ai/A, Clincher was applied at 0.125 and 0.188 lb ai/A and Regiment was applied at 0.0149 and 0.0198 lb ai/A to 2- to 3-leaf, 4- to 5-leaf, 6- to 8-leaf and 10- to 14-leaf barnyardgrass. The timings also corresponded to early POST, mid-POST, Preflood and postflood timings. Aura was applied with 1% v/v crop oil, Clincher was applied with 2.5% crop oil and Regiment was applied with 0.125% v/v of Kinetic silicone adjuvant. In the antagonism study Ricestar was applied at 0.16 lb ai/A plus 1% v/v crop oil concentrate, Clincher was applied at 0.188 lb ai/A plus 2.5% crop oil concentrate, and Aura was applied 0.094 lb ai/A plus 1% v/v crop oil concentrate. These herbicides were applied alone and in tank mixture with bentazon at 1 lb ai/A, acifluorfen at 0.5 lb ai/A, triclopyr at 0.375 lb ai/A, bensulfuron at 0.0375, halosulfuron at 0.063 lb ai/A, carfentrazone at 0.02 lb ai/A and EC propanil at 4 lb ai/A. Crop oil was not used with the EC propanil mixtures. Studies were conducted in barnyardgrass-infested rice weed research areas with normal weed science small-plot methodology.

Whip 360 usually provided the greatest barnyardgrass grass control. Ricestar provided 2 to 20% less control than Whip 360. Regiment or Ricestar usually provided the second best grass control. Aura usually provided the fourth best weed control and in five of 8 instances, Clincher provided the least barnyardgrass control. Tank mixtures of bentazon, halosulfuron, and carfentrazone appeared to be antagonistic to Ricestar. Halosulfuron appeared to be antagonistic to Clincher and bentazon may have been antagonistic to Aura.

UTILITY OF FIRSTRATE (CLORANSULAM-METHYL) IN SOYBEAN WEED CONTROL PROGRAMS. P.R. Vidrine, D.K. Miller, J.L. Griffin, and J.P. Caylor. Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

In 1999, two soybean field studies were conducted each at Alexandria, Baton Rouge, and St. Joseph, LA, to determine efficacy of FirstRate applied PRE or POST. In the PRE studies FirstRate was applied alone at 0.031 and 0.039 lb ai/a and 0.031 lb PRE followed later by Roundup Ultra POST at 0.75 lb. A standard treatment for comparison was Scepter at 0.125 lb PRE followed by Roundup Ultra at 0.75 lb. Weeds evaluated were browntop millet, seedling johnsongrass, barnyardgrass, broadleaf signalgrass, pitted morningglory, sicklepod, hemp sesbania, redweed, prickly sida, and smellmelon. Soil type at each location was clay. Soil moisture was adequate one month following PRE application but dry the remainder of the growing season. Water volume in spray solution was 15 GPA at all locations. Ratings were based on 0 to 100% scale.

Results from PRE studies indicate that FirstRate applied alone at either rate controlled greater than 80% of browntop millet, seedling johnsongrass, broadleaf signalgrass, pitted morningglory, prickly sida, and smellmelon. Less than 60% control of hemp sesbania and less than 70% redweed was obtained with FirstRate PRE at either rate when applied alone. Roundup Ultra at 0.75 lb applied three wk after planting was required as a sequential treatment to FirstRate to increase control of weeds more than 95%. No herbicide treatment differences in soybean yield were observed at Alexandria and treatments were greater than the untreated check. However, at St. Joseph, treatments that included Roundup Ultra were greater in yield than FirstRate applied alone. Herbicide treatments had greater yields than the untreated check.

POST herbicide studies at the three locations consisted of FirstRate at 0.016 lb, 0.016 followed by 0.016 lb, 0.031 lb, 0.016 lb followed by Roundup at 0.5 lb. A comparison treatment consisted of FirstRate at 0.016 lb followed by Select at 0.125 + Blazer at 0.25 lb. A crop oil concentrate at 1.2% v/v was added to all treatments except Roundup Ultra. Weeds evaluated consisted of pitted morningglory, sicklepod, hemp sesbania, prickly sida, smellmelon, and hophornbeam copperleaf. Weed sizes ranged from 2 to 8 in and had 2 to 8 leaves. Water volume was 15 GPA. Rating were based on 0 to 100% scale. Frontier at 1.0 lb, Dual II at 1.5 lb, and Prowl at 0.825 lb were applied PRE at Alexandria, Baton Rouge, and St. Joseph, respectively.

Results from the POST studies indicate that pitted morningglory was controlled following treatments that contained FirstRate either alone or in mixture. Poor control of sicklepod was observed following FirstRate applications. Hemp sesbania control was 71 to 78% following treatments with FirstRate. A sequential treatment of Roundup Ultra increased

control to 96%. Smellmelon control ranged from 82 to 93% following FirstRate applications. Adding Roundup Ultra as a sequential treatment increased control to 95%. Hophornbeam copperleaf control was 90 to 95% following all treatments. No differences in soybean yield were noted among herbicide treatments at either location and yields were greater than the untreated check.

In conclusion, FirstRate provides flexibility when used in a weed control program PRE and/or POST. Results demonstrate the utility of FirstRate PRE in providing broad-spectrum weed control. Escaped weeds from soil application can be controlled with a sequential POST applications or alternative POST herbicide(s). Mixing FirstRate with Roundup Ultra demonstrates further utility in providing improved weed control, especially for hard-to-control weeds such as morningglories, sicklepod, and prickly sida.

EVALUATION OF PURSUIT AND SCEPTER TANK-MIXES FOR POSTEMERGENCE AND RESIDUAL WEED CONTROL IN ROUNDUP READY SOYBEAN. D.R. Lee, D.K. Miller, J.L. Griffin, P.R. Vidrine, and C.F. Wilson, Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

Research was conducted in 1999 at the Northeast Research Station in St. Joseph, LA on a silty clay loam soil, pH 6.2. Experimental design was a randomized complete block with three replications. Herbicide treatments consisted of early postemergence (EPOST) applications of Pursuit (imazethapyr) at 1.08 oz/A (0.047 lb ai/A) or 1.44 oz/A (0.063 lb ai/A) or Scepter (imazaquin) at 1.4 oz/A (0.063 lb ai/A) in combination with Roundup Ultra at 1.0 pt/A (0.5 lb ai/A) and 1.5 pt/A (0.75 lb ai/A); Classic (chlorimuron) at 0.25 oz/A (0.004 lb ai/A) or Flexstar HL (fomesafen) at 1.0 pt/A (0.24 lb ai/A) in combination with Roundup Ultra at 1.0 pt/A; and Firstrate (cloransulam) at 0.15 oz/A (0.008 lb ai/A) in combination with Roundup Ultra at 1.5 pt/A. Roundup Ultra at 1.5 pt/A or 2.0 pt/A (1.0 lb ai/A) and a sequential Roundup Ultra program of 2.0 pt/A EPOST followed by 1.0 pt/A mid postemergence (MPOST) were included for comparison. All EPOST combination treatments included non-ionic surfactant at 0.25% v/v. EPOST application was 27 days after planting (DAP) to V3-V4 soybean with MPOST application 14 days later to V5 soybean. Weeds ranged from two to four inches at EPOST application and one to two inches at MPOST application. Asgrow 5901 Roundup Ready® soybean was planted on April 28. Herbicide treatments were applied broadcast at 15 GPA to all rows of each 13.33' x 20', 4 row plot. Weed control was visually rated 14 and 35 d after EPOST timing. Soybean yield was determined by harvesting the center two rows of each plot.

At 21 days after EPOST treatment (DAT), Pursuit in combination with Roundup Ultra at 1.5 pt/A, Scepter in combination with Roundup Ultra at 1.0 or 1.5 pt/A, Roundup Ultra alone at 2.0 pt/A, and the Roundup Ultra sequential treatment provided greater than 90% sicklepod (*Senna obtusifolia*) control (92 to 97%). All other treatments controlled sicklepod 83 to 88%. Hemp sesbania (*Sesbania exaltata*) was controlled 95% by the sequential Roundup Ultra treatment, which was equal to control with Roundup Ultra alone at 2.0 pt/A (88%), Roundup Ultra in combination with Classic (87%), Firstrate (87%), or Flexstar HL (92%), and Roundup Ultra at 1.5 pt/A in combination with Scepter or Pursuit at 1.08 oz/A (88%). All other treatments resulted in 75 to 85% control. Pitted morningglory (*Ipomoea lacunosa*) was controlled 93% by the Roundup Ultra sequential program, which was equal to all treatments (85 to 93%) except Roundup Ultra alone at 1.5 pt/A (82%). All treatments resulted in at least 97% control of entireleaf morningglory (*Ipomoea hederacea*). With the exception of Roundup Ultra in combination with Flexstar HL (82%), all treatments controlled barnyardgrass (*Echinochloa crus-galli*) at least 95%.

At 35 DAT, the Roundup Ultra sequential program resulted in 98% control of sicklepod, which was equal to Roundup Ultra alone at 2.0 pt/A (90%) or 1.5 pt/A (95%), and Roundup Ultra at 1.5 or 1.0 pt/A in combination with Pursuit at 1.08 oz/A (92%), and greater than all other treatments (77-87%). Hemp Sesbania was controlled 90% by the sequential Roundup Ultra program, which was greater than all treatments (63 to 80%) except Roundup Ultra in combination with Flexstar HL (82%). Pitted morningglory was controlled 97% by the Roundup Ultra sequential program, which was greater than all other treatments (80 to 88%). Entireleaf morningglory was controlled at least 95% by all treatments. Barnyardgrass was controlled at least 90% by all treatments except Roundup Ultra in combination with Firstrate (88%) or Flexstar HL (77%).

A yield of 30 bu/A was observed for the Roundup Ultra sequential program, which was equal to yield with Pursuit at 1.44 oz/A (24 bu/A) or Scepter (28 bu/A) in combination with Roundup Ultra at 1.5 pt/A, Classic (24 bu/A) or Firstrate (23 bu/A) in combination with Roundup Ultra, and Roundup Ultra alone at 2.0 pt/A (27 bu/A), and greater than all other treatments (16 to 22 bu/A).

In conclusion, with the exception of hemp sesbania (72-77%), Pursuit at 1.44 oz/A or Scepter in combination with Roundup Ultra at 1.5 pt/A provided at least 87% control of weeds evaluated 35 DAT. Reducing the Roundup Ultra rate with Scepter or the Roundup Ultra rate or Pursuit rate, in that respective combination, did not significantly reduce control compared to the highest rate combinations. Weed control with the Roundup Ultra sequential program or the single 2.0 pt/A rate was equivalent or greater on all weeds evaluated compared to Pursuit or Scepter/Roundup Ultra combination treatments. Pursuit at 1.44 oz/A or Scepter with Roundup Ultra at 1.5 pt/A and Classic or Firstrate with Roundup Ultra were the only combinations treatments that resulted in equivalent yield compared to the Roundup Ultra sequential program or the single 2.0 pt/A rate. In this study, these respective combinations eliminated need for a second Roundup

Ultra application to obtain maximum yield and an extra trip through the field. Yield was, however, also maximized with the single 2.0 pt/A rate of Roundup Ultra. Therefore, when comparing the single application and the above combination treatments, the best program in this case would be the most economical.

PEANUT CULTIVAR RESPONSE TO STRONGARM PREPLANT INCORPORATED. W.A. Bailey, J.W. Wilcut, S.D. Askew, J.F. Spears, T.G. Isleib, and V.B. Langston. Crop Science Department, North Carolina State University, Raleigh, NC 27695-7620 and Dow AgroSciences, the Woodlands, TX 77382.

ABSTRACT

Field studies were conducted in 1996 and 1997 to evaluate response of eight peanut cultivars to Strongarm (diclosulam) applied preplant incorporated (PPI) at 36 g ai/ha (27 g ai/ha is expected to be the registered rate of treatment) in a weed free environment. All plots were treated with Sonalan at 0.84 kg ai/ha PPI and kept weed free with weekly hand weedings as needed. Peanut cultivars used included NC 12C, NC 7, VAC 92R, NC-V11, NC 10C, AT VC 1, NC 9, and the experimental breeding line N90010E, hereafter referred to as NC 15. Visible injury three weeks after planting was less than 5% regardless of cultivar. No injury was observed at 42 days after planting. When measured at 9 weeks after planting, diameter of peanut canopy was unaffected by Strongarm treatment. Peanut yields were not influenced by Strongarm treatment with only cultivar influencing peanut yield. Strongarm treatment did not influence the incidence of early leaf spot, late leaf spot, southern stem rot, cylindrocladium black rot, or tomato spotted wilt virus. Strongarm did not influence peanut quality grade parameters including percentage of fancy pods, extra large kernels, sound mature kernels, total sound mature kernels, and other kernels.

PEANUT CULTIVAR RESPONSE TO VALOR PREEMERGENCE. J.J. Lowery, J.W. Wilcut, S.D. Askew, J.F. Spears, T.G. Isleib, and J. Cranmer. Crop Science Department, North Carolina State University, Raleigh, NC 27695-7620 and Valent USA, Cary, NC 27511.

ABSTRACT

Field studies were conducted in 1996 and 1997 to evaluate response of eight peanut cultivars to Valor (flumioxazin) applied preemergence (PRE) at 0.063 lb ai/ac in a weed free environment. All plots were treated with Sonalan at 0.75 lb ai/ac PPI and kept weed free with weekly hand weedings as needed. Peanut cultivars used included NC 12C, NC 7, VAC 92R, NC-V11, NC 10C, AT VC 1, NC 9, and the experimental breeding line N90010E, hereafter referred to as NC 15. Visible injury three weeks after planting was 9% or less regardless of cultivar. No injury was observed at 42 days after planting. When measured at 9 weeks after planting, diameter of peanut canopy was unaffected by Valor treatment. Peanut yields were not influenced by Valor treatment with only cultivar influencing peanut yield. Valor treatment did not influence the incidence of early leaf spot, late leaf spot, southern stem rot, cylindrocladium black rot, or tomato spotted wilt virus. Valor did not influence peanut quality grade parameters including percentage of fancy pods, extra large kernels, sound mature kernels, total sound mature kernels, and other kernels.

ROUNDUP READY® COTTON IN CONSERVATION TILLAGE. M.R. McClelland[1], J.L. Barrentine[1], K.J. Bryant[2], and E.P. Webster[3]. Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR 72701[1]; Southeast Research and Extension Center, Monticello, AR 71656[2]; and Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

The inclusion of glyphosate-tolerant (Roundup-Ready®) cotton into our arsenal of weed control options for cotton can benefit producers. Glyphosate (Roundup Ultra®) has a broad spectrum of activity and can be applied throughout the season. Topical applications can be made through the four-leaf stage of cotton growth, with later applications post-directed. Because glyphosate can be applied over-the-top early in the season, it may be especially beneficial in conservation-tillage cotton where early-season weed control is crucial in the absence of standard preplant incorporated herbicides. However, the economic performance of cotton programs in Roundup Ready cotton must be evaluated before producers can choose an appropriate program for a conventional or conservation production system. The objective of this study was to evaluate the efficacy and economic efficiency of herbicide programs using glyphosate in Roundup Ready, conservation-tillage cotton.

The experiment was conducted in 1996 through 1998 at Rohwer, AR, on a silt loam soil. Each plot was eight, 38-inch rows by 50 feet, and each experiment was an RCB with four replications. The conservation-tillage system used each year was a stale seedbed (beds hipped and leveled in fall 1995 and rehipped and leveled in early spring 1997 and 1998), after which no tillage was used. Conventionally tilled plots were disked and hipped in the spring, leveled at planting, and were cultivated during the season. Each plot was maintained in the same location in the field for the 3 years. Roundup Ready cultivars were planted 23 May 1996, 16 May 1997, and 8 May 1998. Glyphosate was applied to conservation-tillage plots at planting to control winter and early spring weeds. Herbicides were applied in 15 gal/A. Conventional- and conservation-tillage plots were treated with a standard (STD) herbicide program and with glyphosate

alone (RU,RU). Treatments in conservation-tillage plots also included two applications of glyphosate with a prior PRE treatment (PRE,RU,RU) and two applications of glyphosate with a layby treatment. The STD program was fluometuron 0.8 + pendimethalin 1.0 lb ai/A PRE followed by (fb) fluometuron 0.8 + MSMA 1.5 lb/A post-directed (DIR) fb cyanazine 1.0 + MSMA DIR, fb cyanazine DIR at layby. In the RU programs, glyphosate was applied at 1.0 lb ai/A over-the-top and fb 0.75 lb/A DIR. PRE and layby were the same as in the STD program.

Control of barnyardgrass (*Echinochloa crus-galli*) and pitted morningglory (*Ipomoea lacunosa*) was 84 to 100% and did not differ among treatments. Seedcotton yields differed slightly among treatments in 1996 (2400 to 2777 lb/A), but by 1998, yields did not differ (2912 to 3385 lb/A). No yield was obtained in 1997 because of an inadvertent overspray to the test area. For equivalent herbicide treatments, costs in conventional tillage were lower than in conservation tillage ($1.05 lower for RU, RU; $11.10 lower for the STD program). Stale seedbed was used rather than no-till because bed integrity was not maintained in the light soil at this location; therefore, cost of tillage differed only in the cost of disking. Savings in tillage costs in conservation tillage were offset by cost of the burndown treatment at planting. The cost of the two RU, RU programs was lower than the cost of standard programs. Returns over cost of weed control system were affected primarily by cotton yield, with slight differences in 1996 and no difference among treatments in 1998 (return was $464.82 to 589.61 in 1996 and $600.18 to 693.50 in 1998). Economic returns from glyphosate programs in a conservation system were no higher than from a standard program. However, glyphosate performed as well as a standard herbicide program and provides an economical alternative to the standard system.

V-53482 SYSTEMS for LAYBY WEED CONTROL IN COTTON. W.K. Vencill and E.F. Eastin, University of Georgia, Athens and Tifton.

ABSTRACT

Field studies were conducted in 1999 in Athens and Plains, Georgia to determine cotton safety and weed control from V-53482 applied post-directed. V-53482 was applied post-directed to cotton at 40-cm alone at 70 and 100 g/ha and in mixture with glyphosate (1100 g/ha) and MSMA (2200 kg/ha). Cyanazine plus MSMA were included for comparison purposes. A crop oil applied at 2.4 L/ha was added to all post-directed treatments. Visual injury to cotton and weed control were evaluated on a 0-100% scale. In Athens, cotton height, boll position, and total bolls per plant measurements were taken. Seed cotton yield was collected at both locations.

At the Athens location sicklepod (*Senna obtusifolia*), yellow nutsedge (*Cyperus esculentus*), and ivyleaf morningglory *(Ipomoea hederacea*) control was > 90% eight weeks after treatment (WAT) from all treatments containing V-53482. At the Plains location, Texas panicum (*Panicum texanum*) and sicklepod control were >90% eight WAT from all treatments containing V-53482. Red morningglory control was between 80 and 90% eight WAT from treatments containing V-53482.

Visual injury ranged from 10 to 30% ten days after treatment (DAT) in Athens and Plains. By 30 DAT, visual injury declined to 5 to 20% at the Athens location and no injury was detected 30 DAT at the Plains location. Differences in injury between the locations can be attributed to tractor-based herbicide application at the Athens location and a backpack-based application at the Plains location. Injury tended to be lower when V-53482 spray solution was applied only to the cotton bark area. Treatments containing V-53482 applied at 100 g/ha tended to be shorter at harvest. Total bolls per plant were lower when V-53482 was applied alone at 100g/ha, but not when V-53482 was applied at 100g/ha with 1100 g/ha of glyphosate. V-53482 did not affect boll postion on treated cotton plants. Significant differences in seed cotton yield were not observed amongst treatments containing V-53482.

EFFECT OF POSTEMERGENCE DIRECTED APPLICATIONS OF PERMIT ON COTTON GROWTH AND YIELD. C.F. Wilson, D.K. Miller, P.R. Vidrine, B.R. Leonard, and D.R. Lee, Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

Research was conducted in 1999 at the Macon Ridge Research Station in Winnsboro LA on a gigger silt loam soil (pH 6.0, OM 1.0%) to determine the effects of PDIR applications of Permit with or without MSMA on cotton growth and yield. Experimental design was a randomized complete block with a factorial arrangement of Permit rates applied either with or without MSMA. PDIR applications of Permit at 0.188 (0.25 oz/A), 0.38 (0.5 oz/A), 0.56 (0.75 oz/A), or 0.75 (1.0 oz/A) oz ai/A with or without MSMA at 0.8 lb ai/A (1.0 pt/A) were made to DP 458 BRR cotton at the 4 to 5 node growth stage. A nontreated check was included for comparison. Nonionic surfactant at 0.25%v/v was included with all treatments. Herbicide treatments were applied in conjunction with cultivation on a 20 in band at 15 GPA. Each 6.67' x 35', 2 row plot, including the nontreated check, received cultivation at the time of herbicide application. Plots received no preemergence (PRE) herbicides at planting on May 19. Research was conducted in a relatively weed free area and weeds which did emerge were controlled by hand hoeing, cultivation, and a PDIR application of pyrithiobac (Staple) at 1.0 oz ai/A (1.2 oz/A) plus fluazifop (Fusilade 2000) at 0.188 lb ai/A (24 oz/A) in conjunction with cultivation. Parameters measured included plant height 6, 21, 48, and 77 days after treatment (DAT), total plant dry weight (1 m of

row/plot) 33 DAT, node above white flower (NAWF) 45 DAT, and seedcotton yield. Data were subjected to contrast analysis.

A two-inch rainfall was received approximately two hours after herbicide application. A significant Permit rate by MSMA interaction was not noted for plant height 6, 21, and 77 DAT and seedcotton yield, therefore data for Permit rates are averaged across MSMA application for these respective parameters. At the time of the initial measurement, plants treated with Permit exhibited a slight chlorosis and visible height reduction. At 6 DAT, all rates of Permit resulted in equivalent heights, which represented a 33% reduction compared to the nontreated check. At 21 DAT, plants treated with Permit at 0.188 oz ai/A averaged 35.1 cm in height which was equal to the 34.1 and 33.4 cm for the 0.38 and 0.56 oz ai/A rates, respectively, and greater than the 0.75 oz ai/A rate (31.3 cm). All Permit rates resulted in a significant height reduction of at least 27% when compared to the nontreated check (48.4 cm).

A significant Permit rate by MSMA interaction was noted for plant dry weight, height 48 DAT, and NAWF. Although slight differences were noted within Permit rates applied with or without MSMA, all treatments resulted in significant differences for these respective parameters when compared to the nontreated check. Whole plant dry weight and plant height 48 DAT was reduced at least 19 and 16%, respectively, following application of Permit either with or without MSMA. A delay in maturity was observed as herbicide treatment resulted in a NAWF count of no lower than 4.7 compared to 4.3 for the nontreated check.

Severe late season drought adversely affected both final plant height and seedcotton yield. At 77 DAT, plant height following Permit application ranged from only 67.3 to 71.6 cm and was reduced at least 11% compared to the nontreated check. Seedcotton yield was extremely poor ranging from only 738 to 1032 lb/A. As a result, growth parameter reductions with Permit rates were not reflected in seedcotton yield reductions when compared to the nontreated check.

PDIR application of Permit with or without MSMA resulted in significant reductions for all growth parameters measured when compared to a nontreated check. Significant rainfall (2 in) within hours of application may have resulted in increased uptake of and subsequent increased injury potential from Permit. Growth parameter reductions were not manifested in seedcotton yield reduction. Poor growing conditions later in the season, as evidenced by no greater than a 14.6 cm height increase between the 48 and 77 DAT measurements, may have masked any negative yield effects following Permit application.

CGA-362622 APPLICATION TIMING, RATES, AND WEED SPECTRUM IN COTTON. J.C. Holloway, JR., J.W. Wells, M. Hudetz, W. Bachman, G. Cloud, J. Driver, B. Minton, S. Moore, D. Poterfield, M.G. Schnappinger, E. Rawls, and H.R. Smith, Novartis Crop Protection, Greensboro, N. C.

ABSTRACT

CGA 362622 is a new Novartis Crop Protection sulfonylurea herbicide developed for post-emergence weed control in cotton. The proposed ISO name is Trifloxysulfuron Sodium and the mode of action is an ALS inhibitor. It controls a wide spectrum of broadleaves, grasses, and sedges. The use rates of CGA 362622 are extremely low and vary between 2 - 6 g ai/A in cotton. CGA 362622 can be applied over the top of cotton at the early post application and post directed at the post, late post, and lay by application timings. CGA 362622 will be formulated as a 75 WDG.

CGA 362622 controls most troublesome weeds in cotton. Some weeds, which are controlled include: sicklepod (*Senna obtusifolia*), ivyleaf morningglory (*Ipomoea hederacea*), pitted morningglory (*Ipomoea lacunosa*), yellow nutsedge (*Cyperus esculentus*), common cocklebur (*Xanthium strumarium*), coffee senna (*Senna occidentalis*), Florida beggarweed (*Desmodium tortuosum*), common lambsquarters (*Chenopodium album*), redroot pigweed (*Amaranthus retroflexus*), hemp sesbania (*Sesbania exaltata*), purple nutsedge (*Cyperus rotundus*), ragweed (*Ambrosia* sp.), johnsongrass (*Sorghum halepense*), and spurge (*Euphorbia* sp.).

CGA 362622 controls key weeds, both small and large in cotton. The application window is large and can be applied to RR or BXN cotton as well as conventional cotton varieties.

PYRITHIOBAC INTERACTIONS WITH POST GRASS HERBICIDES FOR JOHNSONGRASS AND COMMON LAMBSQUARTERS CONTROL IN COTTON. K.D. Brewer, W.J. Grichar, and B.A. Besler, Texas Agric. Exp. Stn., Yoakum, TX 77995.

ABSTRACT

Johnsongrass [*Sorghum halepense* (L.) Pers.] is a severe problem in many cotton (*Gossypium hirsutum* L.) growing regions in the southwestern U.S. Other broadleaf weeds, such as common lambsquarters (*Chenopodium album* L.), can also become a problem. The introduction of POST graminicides have made a substantial impact on grass weed control in cotton. It is often desirable to apply herbicides in a mixture in order to broaden the weed control spectrum and to reduce application trips across the field. Studies have been conducted to evaluate the activity of various POST broadleaf

grass herbicides when applied in a mixture. Reduced grass control through antagonism often is a result of applying these combinations.

Field studies were conducted near Cuero in south-central Texas during the 1997 growing season to evaluate johnsongrass and common lambsquarters control with clethodim (Select), fluazifop-P (Fusilade), and fluazifop + fenoxaprop (Fusion) applied alone, in combination with, or in sequential applications of pyrithiobac (Staple).

The grass herbicides and rates used were clethodim at 0.14 kg/ha, fluazifop-P at 0.21 kg/ha, and a commercial premix of fluazifop-P and fenoxaprop at 0.14 kg/ha and 0.04 kg/ha, respectively. Pyrithiobac at 0.88 kg/ha was the broadleaf herbicide. An untreated check was included for comparison. Herbicides were applied individually and in tank mix combinations of each grass herbicide and pyrithiobac. Sequential applications, where pyrithiobac applied 24 h before or after the grass herbicide, were also evaluated. A crop oil concentrate (Agri-Dex) at 1.0% (v/v) was added to all treatments.

Plot size was 2 rows wide by 8 m long with 91 cm spacing. The experimental design was a randomized complete block with four replications. Herbicides were applied in water with a compressed-air bicycle sprayer calibrated to deliver 190 L/ha at 180 kPa. Johnsongrass was up to 15 cm tall at herbicide application.

When rated 4 weeks after application (WAA), pyrithiobac followed by fluazifop-P or clethodim 24 h later resulted in reduced johnsongrass control when compared with the POST grass herbicides applied alone. Common lambsquarters control was reduced when any of the grass herbicides were followed by pyrithiobac 24 h later or pyrithiobac was tank mixed with clethodim when compared with pyrithiobac alone.

When rated 10 WAA johnsongrass control was reduced only with the tank mix of clethodim and pyrithiobac compared to clethodim alone. Common lambsquarters control was reduced with all POST grass herbicides followed by pyrithiobac 24 h later.

Cotton seed yield with the POST grass herbicide alone or pyrithiobac alone were not significantly different from the untreated check. All herbicide combinations produced cotton yields which were better than the untreated check.

CONVERSATIONS ON CHANGE: A LOOK AT PERSPECTIVES ON AGRICULTURE. L.L. Whatley and R.L. Degner; American Cyanamid Company, Princeton, NJ 08543 and University of Florida, Gainesville, FL 32611.

ABSTRACT

The Council for Agricultural Science and Technology, CAST, has provided the framework for individuals from several scientific societies to explore ways societies can maintain relevance with their constituencies. Some of the individuals involved are exploring ways that societies can provide outreach, not only to their current members, but also to those outside the society. Recognizing that outreach is most successful when it is tailored to the needs of the recipient, the group conducted focus group interviews on agriculture in Baltimore, Chicago, and Seattle.

Nine to 10 registered voters participated in each focus group, and, with a facilitator, discussed American agriculture, American farmers and government policies on agriculture. Participants were registered and active voters, ranged in age from 30 to 55, and were *not* employed in farming or agriculture-related businesses. Occupations were varied, and included mostly private sector employees: secretary, accountant, bookkeeper, engineer, publisher, banker, dental assistant, manufacturer, teacher, mail carrier. The participants' sources for agricultural information included newspapers, magazines, television, the stock market, the television show "60 Minutes" and personal contact with farmers. Each session was recorded on video and audio tape so comparisons could be made between locations.

Despite the geographical distance, the groups had similar views. All felt that agricultural research was needed, but differed in their support for private versus publicly funded research. There was varying awareness of the Cooperative Extension Service; those who were aware of it mentioned homeowner services such as lawn care, gardening, and water testing. All had heard of biotechnology, but equated it with cloning. The general consensus was one of uneasiness with animal cloning; plant cloning was viewed as more benign.

These results are qualitative, *not* quantitative, and thus cannot be analyzed statistically. Thus, while interesting, they cannot be extrapolated to a wider group of individuals. Instead, the information gleaned should be used to stimulate further research into public perception of agriculture.

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USING DISTANCE TECHNOLOGIES TO REACH NON-TRADITIONAL AUDIENCES. K. Ragland, University of Kentucky, Lexington, KY.

ABSTRACT

Colleges of Agriculture are under increasing pressure to reach a growing number of clientele with information that is on-time, on-demand, and remotely accessible. Non-traditional audiences, such as K-12 students and teachers, urbanites, professionals seeking continuing education credit, and graduate and undergraduate students at remote locations, present content specialists with two unique challenges: providing content adapted for these new audiences and their needs and taking it to them through a convenient and effective medium. Distance technologies, including satellite, videotape, audio and video teleconferencing, compressed video, CD-ROM, and the Internet, provide content specialists with some valuable tools for reaching these audiences with information designed just for them and delivered in a format they want and will use. Unlike our traditional extension and academic structures, distance technologies actually reach into homes, schools, and businesses. They can provide information to users either synchronously or asynchronously. The information they convey can be very general or it can be structured to provide tailored information specific to the user's situation. These strengths make these tools appealing to Colleges seeking to tap new audiences, not only for their range, but because they can be very cost effective when trying to reach large numbers of widely dispersed clientele. The distance technologies are so new, potential users are often unclear about which media to use when. In general, content specialists should begin by asking three basic questions. First, what is the message? Any message can be conveyed via distance technologies, but certain messages are more suited to print, others to audio delivery, and others to visual delivery. Secondly, who is the audience? This question includes not only defining the exact group of people the specialist wishes to reach, but determining where they want their information, which technologies they have access to, and which technologies they will be comfortable using. Defining an audience this way quickly pares down the list of technologies that will work with a specialist's specific message for a specific audience. Once the potential user knows what the message is and who the audience is, the final question is which medium will most effectively deliver this message to this audience? This process leads to the appropriate technology or, more often, mix of technologies for a given audience. For example, trying to reach a nationwide K-12 audience with math and science information in a fun, fast-paced visual format can be accomplished through satellite, videotape, and Internet support. Teaching an undergraduate course for credit to students located across the country at other institutions not offering the course can be done through a Web-based learning environment because this audience has few access problems or through satellite or videotape if the subject matter is highly visual. Choosing the correct media for a given message to a given audience is the single most important decision the specialist will make in determining the success of any program delivered through distance technologies. Reaching non-traditional audiences is becoming a ubiquitous goal among Colleges of Agriculture and it is certainly a goal that can be reached with the technologies available today. The challenge is to select appropriate media for each message and then to effectively adapt our wealth of content to meet the needs of these new clientele.

CURRICULUM DEVELOPMENT AND TEACHER TRAINING EFFORTS THROUGH AG IN THE CLASSROOM IN OKLAHOMA, C.B. Cox, Department of Agricultural Education Communications and 4-H Youth Development, Oklahoma State University, Stillwater, OK 74078-6063.

ABSTRACT

Only a few generations ago nearly everyone in America had a direct connection to the land. Most families were involved in the production of food and fiber. Children played a vital role by participating in the chores of the farm; they had an understanding of the relationship between the bounty of the earth and the consumers of that bounty. Today, about 90 percent of the population is removed from direct contact with food and fiber systems. Generally, youth of today are provided few opportunities to participate in experiential learning activities that allow them to make a connection with this basic human enterprise. For those citizens who will determine policy related to the environment and agriculture, it is vital that they know agriculture still determines our nation's general welfare and standard of living through its related sciences and businesses. Oklahoma Extension educators are working with school systems, home-schoolers, commodity groups and volunteers to increase the knowledge and perception of our nation's number one industry. At the same, time 4-H is helping young people gain the information needed to make decisions that will help direct that industry in the future. The net result has been Extension providing leadership to the state's Ag in the Classroom program.

Four-H has led the way in the development and facilitation of a curriculum that uses agricultural concepts to teach core subjects like; math, sciences, language arts, social studies, information skills and reading. The Oklahoma Ag in the Classroom curriculum has been recognized as one of the most complete and research-based sets of instructional materials for young children as related to agriculture. In addition to a set of printed instructional materials, the Ag in the Classroom program provided educators with resources including a internet site, a quarterly newsletter, and a yearly summer institute that teams classroom teachers with OSU faculty. The program is now awarding over $10,000 annually to educators to assist them in enhancing their classroom instruction. Additional information about the program in Oklahoma, with links to programs in other states, visit the website at http://www.clover.okstate.edu/fourh/aitc/ .

RELATIONSHIP BETWEEN NORTH CAROLINA STATE UNIVERSITY AND AGRICULTURAL EDUCATION IN NORTH CAROLINA HIGH SCHOOLS. D.L. Jordan, Crop Science Department, North Carolina State University, Raleigh, NC 27695.

ABSTRACT

The curriculumused by North Carolina public school instructors in AgriculturalEducation was developed cooperatively among the North Carolina State Board of Education, the Department of Public Instruction, and the Department of Agricultural and Extension Education in the College of Agriculture and Life Sciences at North Carolina State University. Curricula included the following courses:Agriscience Applications,AgriculturalProduction and Management I and II, Animal Science I and II, Agricultural Engineering I and II, Horticulture I and II, and Environmental and Natural Resources I and II. A wide range of topics was included in each course. Weeds and their management were discussed in the Agriscience Applications and Agricultural Production and Management I. Pesticide handling and proper utilization were discussed these classes and in Horticulture II. A wide range of topics including social impact of production and pest management practices, environmentalism versus environmental science, biotechnology issues, integrated pest management, and pest identification and control were discussed in the courses. Although variation in actual instruction may exist across school systems, it appeared that fair and equal emphases were placed on the disciplines of insect, weed, and disease management.

A KID'S JOURNEY TO UNDERSTANDING WEEDS. S. Sherman. Intermountain Agriculture Foundation, Laramie, WY.

ABSTRACT

It's difficult for those not involved in natural resource management to think of a beautiful flowering plant as being a threat to our environment. To initiate the process of bring this reality to everyone, we have developed a 10-minute video and classroomactivity packet forthird-grade classroomuse. The video and activities bring the impact of invasive weeds to the classroom. Upon viewing the video and completion of the activities students become aware of their role in the spread of invasive weeds and are provided valuable suggestions for how they can keep our land and waterways healthy.

The video presents information in an entertaining, creative and memorable form. It tracks 5 third graders' journey from the inner city playgrounds to Colorado where they meet two rural friends. The video show kids talking to kids about real life problems associated with weeds in a format which children find appealing. The students from the city learn first hand how weeds are spread onto natural resource areas. Familiar scenes third graders can relate to are depicted and the majorcharacters are children and animals. For those viewing the video a connection is made between certain activities of North Americans and the control or spread of noxious weeds. Responsible stewardship activities and the concepts taught in the video are reinforced by the activities for classroom use. The activities regionalize the weeds of North America to 6 geographical specific area to enable teachers and students to focus on the invasive weeds found in their community. The activities are located on the back of ten different 8 x 11 photos which show a natural resource area being threatened by each of the 10 most invasive weeds. Background information concerning the weed, a picture of the weed dominating an area, a picture of the flower and the corresponding black line activity reinforce the concepts found in the video and further the awareness in the classroom. A Kid's Journey to Understanding Weeds@ is a vital part in bridging the understanding between kids and the threat of weeds to open spaces.

Students who experience AA Kid's Journey to Understanding Weeds@ have an opportunity to focus on the overall theme of biodiversity through preserving the rich natural resources of North America, ecosystems, critical thinking, survival, native versus non native, habitat, succession and populations The project can also be easily integrated into existing elementary curriculum and will help students reach the following benchmark standards in education adopted throughout North American schools. For example, Aby the end of the 5th grade, students should know that: for any particular environment, some kinds of plants and animals survive well, some survive less well and some cannot survive at all; organisms interact with one another in various ways besides providing food; many plants depend on animals for carrying their pollen to other plants or for dispersing seed; changes in an organisms habitat are sometimes beneficial to it and sometimes harmful; changes in environmental conditions can affect the survival of individual organisms and entire species; animals and plants sometimes cause changes in their surroundings; and things change in steady, competitive, or irregular ways-or sometimes in more than one way at the same time.@

Thanks to Weed Scientist throughout the 6 different regions the information provided is is current and well received by third grade classroomteachers. For more information contact Roy Reichenbach, Wyoming Weed and Pest Council 2219 Carey Ave. Cheyenne, WY 82001 or George Hittle at ghittle@wyoming.com.

OPTICAL SENSOR BASED VARIABLE RATE APPLICATION TECHNOLOGIES. J.B. Solie. Oklahoma State University, Stillwater.

ABSTRACT

Optically sensing red and near infrared light reflected from plants provides an important mechanism to sense certain plant properties and the information can be used to variably control sprayer or dry granular applicator application rate. Optical sensors can provide a measure of photosysnthetic activity of the plant by recording the amount of red light abosrbed by chlorophyl A and chlorophyl B. The amount of light reflected in the near infrared spectra is a measure of the ability of the plant to reflect heat and, consequently, the health of the plant. Optical sensor bandwidths vary, but typically they are centered at 650-670 nm for red and 780-850 nm for NIR. Because lighting conditions vary, optical sensors should measure both the incident and reflected light, and reflectance (the ratio of reflected to incident light intensity) calculated. Several vegetative indices can be calculated with these measurements. Probably the most common is the normalized difference vegetative index, NDVI.

Where:
NIR_{refl} = the intensity of the reflected near infrared light divided by the intensity of the near infrared incident light
Red_{refl} = the intensity of the reflected red light divided by the intensity of the red incident light.

Calculating reflectance does not completely compensate for changes in spectra of sunlight as the sun angle changes and the amount of dust, moisture, and other contaminants in the atmosphere change. Natural lighting sensors cannot be operated at night. Patchen, Inc., Ukiah, CA has developed a pulsed lighting technology that allows optical-sensors to be operated under all lighting conditions, including total darkness. These sensors measure both red and near infrared light and return a signal that is directly proportional to NDVI. Temperature changes and soil background color changes affect the sensor signal. However, the sensors can be periodically recalibrated to correct for changes. It is likely that this and other lighting technologies will be incorporated into future optical sensors.

There are three applications of this technology that are commercially available in some form: detecting and spot spraying weeds on bare soil surfaces, mapping plant health and crop potential yield, and variably applying N fertilizer. Optical sensor signals can be calibrated to distinguish between living plants and bare soil. This technology has been successfully used to spot spray weeds between crop row and to spot spray weeds in fallow fields. Savings in herbicides such as glyphosate can be as great as 90% and are directly proportional to the percentage of soil surface not covered by weeds. Currently, this technology is being used for specialty applications such as controlling weeds in vineyards and spot spraying weeds on highway shoulder pavement cracks. However, cotton producers in certain regions such as the high plains of Texas are adopting the technology. Patchen, Inc. is the only active supplier of equipment for this application.

There is considerable interest in mapping fields using machine mounted optical sensors, aerial digital imagery, or satellite imagery. Living plant biomass and grain-yield are exponentially proportional to NDVI. Oklahoma State University and other researchers have shown that NDVI is proportional to total plant nitrogen. These images can be used to identify crop management zones and detect plant stress from a number of sources including fertility, moisture, diseases, and insects. Currently, remote sensed data are used as a historical record of the crop, similar to combine yield monitor data. However, technology is now on the market to use electronic maps of NDVI to make spraying decision for the current crop. Turn-around time for optically sensing a field, building a map, and applying spray materials can be less than a week.

At least one company, a consortium lead by Norsk-Hydro, is marketing a variable application rate, fertilizer sprayer that is equipped with natural lighting based optical sensors. The University of Tennessee and Oklahoma State University have designed and tested integral lighting based sensor applicators. The greatest research challenge is the development of calibration algorithms that calculate application rates based on potential yield of the crop. A second challenge is to sense and apply fertilizer at a resolution high enough to optimizer returns. Recently published data by Oklahoma State University indicates that this resolution will be as high as 0.7 by 0.7 m for wheat.
The following predictions can be made for the evolution of optical sensor technology based on the current status of research and commercial development.

< Optical sensors mounted on ground based applicators will be equipped with integral lighting, eliminating their dependence on sunlight.
< Sensor resolution will increased.
< Sensor controllers will be equipped to perform image processing and their level of “decision making intelligence” will increase.
< Sensor data will be used to construct electronic maps for future decision making.
< Sensor equipped variable applicators will use both real-time and “historical” data to make decision.

REMOTE SENSING AS A TOOL FOR SITE-SPECIFIC WEED MANAGEMENT. D.R. Shaw, Remote Sensing Technologies Center and Plant and Soil Sciences Department, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Weeds are the most troublesome pests facing agriculture. However, weed scientists and producers have long known that weeds tend to be aggregated; that is, weed densities and species will be heterogeneous in fields. As much as 70% of fields producing row crops may have weed populations below threshold levels. In addition, species composition can change dramatically in fairly short intervals. Therefore, a "field average"weed population estimate may significantly overestimate the need for herbicides, and will typically recommend multiple herbicides that target different species. Another problem that weed scientists and producers face is how to arrive at an accurate assessment of weed populations. Research has shown that as many as nine samples per acre are required to develop an accurate population estimate. However, what typically occurs in practice is a few samples (often collected near the edges of fields where populations are not representative), or a "windshield estimate" based on what a producer thinks is present. An alternative strategy for development of site-specific estimates of weedy areas is the use of remote sensing. Research over the past several years has shown that remote sensing can be used in large areas with low (20 to 30 meter) spatial resolution to determine the presence or absence of weeds, especially invasive or noxious weeds in rangelands. Multispectral images, three to seven broad bands in the visible spectrum, from aerial or satellite platforms have been used in a number of instances. However, new technologies in remote sensing are now becoming available which are or will dramatically increase spatial, spectral, and temporal resolution. Of particular interest are 1) high spatial resolution (one to four meter) multispectral imaging capabilities from next-generation satellite systems, and 2) hyperspectral images, with 100 to 300 bands in the visible and infrared spectra. Theoretically, high spatial and spectral resolution imaging systems can lead to the development of libraries of specific reflectance patterns that can be attributed to individual plant species or groups of species. Once these have been developed and validated, imaging systems could be used to develop georeferenced maps of weed distributions in fields.

Research at Mississippi State University has demonstrated the potential utility of these systems. Several species have been grown in monoculture situations at various densities, and early results have indicated that separation between species is possible, especially at higher densities or with larger weeds. Discriminant analyses indicated that pitted morningglory (*Ipomoea lacunosa* L.) could be correctly classified with as little as 6% error. However, in other instances error rates were as much as 50%. Therefore, this demonstrates that a number of challenges exist for the successful development of weed recognition systems from aerial or satellite platforms. These include: improved spatial resolution for detection of smaller plants; improved temporal resolution for monitoring during the critical early period of weed and crop growth; improved spectral resolution to more accurately delineate different species; separation of mixed pixels into components (mixtures of weeds, crop, soil, etc.); improvements in computational processing time to provide information while it is useful; overcoming atmospheric and image rectification problems; management issues related to extremely large data sets; development of the remote sensing industry into viable businesses that understand agricultural applications; demonstration of how businesses can succeed economically with remote sensing products; and education at all levels (undergraduate, graduate, extension, and continuing education) on how to use remote sensing as an effective tool in weed management.

Future systems for site-specific weed management can be developed if these challenges can be overcome. If aerial or satellite imagery with sufficient spatial and spectral resolution were available, georeferenced data could be generated regarding where specific threshold-level weed infestations occur in a field, what species are present, and in what densities. This information could be linked to computerized decision-aids to generate site-specific herbicide recommendations. This georeferenced information could then be linked to a computer system on-board an applicator, thus enabling changing herbicides applied or rates as the applicator moves across the field. Benefits from this type of system would be both economic, reductions in the cost of herbicide treatment, and environmental, reductions in the amount of herbicides introduced into the environment. However, substantial challenges must be overcome for this to move from theory to reality.

CONDUCTING WEED SURVEYS WITH GLOBAL POSITIONING SYSTEMS. J.R. Martin and J.D. Green, Department of Agronomy, University of Kentucky, Lexington, KY 40546.

ABSTRACT

Ten counties that represent major grain producing areas of Kentucky were chosen for conducting field surveys during 1998 and 1999 to determine the major weed species that are present in soybean and corn fields. Approximately 2730 acres in 64 soybean fields and 1930 acres in 39 corn fields were surveyed. Fields were surveyed at 3 to 5 weeks after planting. Ideally this would allow time for weeds to emerge, but before a field was treated with a postemergence herbicide. The method involved walking in a predetermined pattern to divide a field into five acre segments. At each survey site the presence of all weed species that occurred was noted and the general infestation level determined. A hand-held GPS unit (i.e. Trimble GeoExplorer II) was used for weed species data collection and to document the location of specific survey sites. Fields were subsequently mapped using ArcView GIS (Geographic Information System) software. The percent frequency of the predominate weed species observed was determined by calculating the percent

of survey sites an individual weed species occupied relative to the total number of sites surveyed within a field, county, or production region of the state.

Using the GPS data and ArvView GIS software, data queries for the distribution of specific weed species can be shown within a field or over larger areas. Within all soybean fields surveyed, 97 different weed species were observed. Prickly sida, johnsongrass, honeyvine milkweed, wild garlic, and ivyleaf morningglory were among the top five most frequent species (22% or greater of the sites surveyed). In field corn, 66 different weed species were found with smooth pigweed, johnsongrass, yellow nutsedge, wild garlic, and horsenettle among the top five most frequent species.

A high percentage of weed species observed have perennial or biennial life cycles (over 40% of all species found in soybeans; greater than 50% of the species in corn) which reflect trends in weed management practices during the past several years. The presence of perennial species could be attributed to the high percentage of no-till and reduced tillage crop production that is practiced in Kentucky. Although several weed management tools have been available to combat johnsongrass, it was ranked as the second most frequent species found in soybeans and corn. The presence of prickly sida is possibly linked with the trend toward more postemergence herbicide applications. Future surveys will help measure the impact of herbicide tolerant crop technology on the occurrence of weed species and if wide spread adoption of these weed management practices result in a shift in the predominate weed species observed.

AN EVALUATION OF A SITE-SPECIFIC WEED MANAGEMENT STRATEGY. J.A. Tredaway, University of Florida, Gainesville, FL 32611, T.C. Mueller, University of Tennessee, Knoxville, TN 37901.

ABSTRACT

Due to increasing environmental concerns, alternative weed management methods may be necessary for compliance. Currently, conventional methods of blanket herbicide applications are most commonly implemented. Site specific weed management recognizes that fields vary according characteristics such as soil types, nutrient content, weed species, and density. It takes this variability into account and manages the fields accordingly. Therefore, our objective was to compare conventional to site specific weed management techniques based on weed species and density.

Field experiments were conducted in 1997 and 1998 in Knoxville, Tennessee. The study utilized a randomized complete block design with a split-plot treatment arrangement with nesting.

Preliminary research was conducted in 1996 to establish selective weed densities. Monocot and dicot densities were generated by applying selective herbicides. Weeds present included trumpetcreeper (*Campsis radicans*), common cocklebur (*Xanthium strumarium*), broadleaf signalgrass (*Brachiaria platyphylla*), and rhizome johnsongrass (*Sorghum halepense*). Field perimeters, plots, and weeds were mapped using global positioning systems (GPS).

In 1997 and 1998, weed density maps were used to determine atrazine applications in site specific areas of the experiment. Site specific areas determined to contain a high population of common cocklebur in 1996 received a 1x rate of atrazine. Low atrazine rates (0 in 1997 or 1/3x in 1998) were applied to remaining site-specific plots. Conventional plots received a 1x rate of atrazine. Broadleaf signalgrass was uniform throughout the field therefore both conventional and site specific plots received the 1x rate of alachlor.

Early postemergence (POST) herbicides included nicosulfuron and dicamba. Conventional and site specific plots received a 1x rate of nicosulfuron to control broadleaf signalgrass. Conventional plots received a 1x rate of dicamba to control common cocklebur. Dicamba was applied at 0, 1/3x, 2/3x, and Ix (0, 0.093, 0.19, and 0.28 kg ai/ha) to site specific plots. These rates were determined by the density of common cocklebur at the time of POST applications.

For the 1998 field season, weed densities were counted using a 1m^2 area for each sub-plot and recorded. A combine equipped with a yield monitor (AgLeader Yield Monitor 2000) and DGPS receiver (Trimble Ag 132) was used to harvest the corn (*Zea mays*). Yields were recorded using an AgLeader Yield Monitor 2000. Data were imported into ArcView for storage and generating yield maps.

Corn yields were similar between conventional and site specific plots in 1997 and 1998 when averaged over treatments. Comparison of POST treatments within the field indicated a significant difference between conventional and site-specific plots. Corn yields were lowest when atrazine was not applied preemergence (PRE) and dicamba rates were 0 or 0.093 kg ai/ha.

These data demonstrated that site specific weed management techniques may replace conventional techniques while maintaining yields. Site specific weed management may result in reduced herbicide use, therefore lowering cost of weed control. Data indicates that a PRE herbicide was important in these weed control systems.

WEED SURVEY – SOUTHERN STATES

2000

Grass Crops Subsection

(Corn; Grain Sorghum, Hay, Pastures, and Rangelands; Rice; Small Grains; Sugarcane; Turf; Wheat)

Theodore M. Webster
Chairperson

Information in this report is provided by the following individuals:

Alabama	John Everest	Mike Patterson
Arkansas	John Boyd	
Florida	Joyce A. Treadway (coordinator)	
	Barry J. Brecke	Joan Dusky
	J. Bryan Unruh	A.S. Blount
	C. G. Chambliss	J. J. Mullahey
Georgia	A. Stanley Culpepper	Tim R. Murphy
	Eric P. Prostko	R. Dewey Lee
Kentucky	J. D. Green	J. R. Martin
Louisiana	Donnie K. Miller (coordinator)	Jim Griffin
	Eric Webster	Roy Virdine
	Reed Lencse	Ron Strahan
	Dearl Sanders	Bill Williams
Mississippi	John Byrd	
North Carolina	Alan York	Fred Yelverton
	Jason Hinton	
Oklahoma	Don Murray	
Puerto Rico	Maria de L. Lugo	
South Carolina	Ed Murdock	Bert McCarty
Tennessee	G. Neil Rhodes, Jr.	Darren K. Robinson
Texas	Paul Baumann	Peter Dotray
	Todd Baughman	
Virginia	Scott Hagood	Jeff Derr
	Lloyd Hipkins	

Table 1. The Southern States 10 Most Common and Troublesome Weeds in Corn.

	States		
Ranking	Alabama	Florida	Georgia
Ten Most Common Weeds			
1	Broadleaf signalgrass	Crabgrasses	Crabgrasses
2	Crabgrasses	Goosegrass	Common cocklebur
3	Morningglories	Florida pusley	Texas panicum
4	Pigweeds	Texas panicum	Morningglories
5	Florida pusley	Sicklepod	Sicklepod
6	Sicklepod	Florida beggarweed	Pigweeds
7	Johnsongrass	Morningglories	Johnsongrass
8	Fall panicum	Pigweeds	Florida beggarweed
9	Cocklebur	Common cocklebur	Yellow nutsedge
10	Nutsedges	Nutsedges	Common bermudagrass
Ten Most Troublesome Weeds			
1	Johnsongrass	Texas panicum	Texas panicum
2	Broadleaf signalgrass	Florida beggarweed	Sicklepod
3	Morningglories	Sicklepod	Morningglories
4	Texas panicum	Nutsedges	Pigweeds
5	Fall panicum	Morningglories	Nutsedges
6	Sicklepod	Johnsongrass	Common cocklebur
7	Cocklebur	Common cocklebur	Florida beggarweed
8	Pigweeds	Pigweeds	Crabgrasses
9	Smooth crabgrass	Goosegrass	Johnsongrass
10	Wild radish	Crabgrasses	Pennsylvania smartweed

Table 1. The Southern States 10 Most Common and Troublesome Weeds in Corn (continued).

	States		
Ranking	Kentucky	Louisiana	Mississippi
Ten Most Common Weeds			
1	Smooth pigweed	Johnsongrass	Broadleaf signalgrass
2	Giant foxtail	Broadleaf signalgrass	Annual morningglories
3	Large crabgrass	Crabgrasses	Southern crabgrass
4	Johnsongrass	Morningglories	Common cocklebur
5	Ivyleaf morningglory	Itchgrass	Johnsongrass
6	Honeyvine milkweed	*Cyperus* spp.	Sicklepod
7	Fall panicum	Pigweeds	Purple nutsedge
8	Common cocklebur	Hemp sesbania	Pigweeds
9	Giant ragweed	Sicklepod	Pennsylvania smartweed
10	Yellow nutsedge	Barnyardgrass	Goosegrass
Ten Most Troublesome Weeds			
1	Honeyvine milkweed	Johnsongrass	Broadleaf signalgrass
2	Broadleaf signalgrass	Morningglories	Annual morningglories
3	Burcucumber	Itchgrass	Common cocklebur
4	Trumpetcreeper	*Cyperus* spp.	Common bermudagrass
5	Giant ragweed	Swinecress	Horsenettle
6	Johnsongrass	Culteaf eveningprimrose	Purple nutsedge
7	Common pokeweed	Ryegrass spp.	Sicklepod
8	Ivyleaf morningglory	Curly dock	Palmer amaranth
9	Fall panicum	Sicklepod	Southern crabgrass
10	Common cocklebur	Hemp sesbania	Yellow nutsedge

Table 1. The Southern States 10 Most Common and Troublesome Weeds in Corn (continued).

	States		
Ranking	North Carolina	Oklahoma	Puerto Rico
Ten Most Common Weeds			
1	Large crabgrass	Pigweeds	Johnsongrass
2	Broadleaf signalgrass	Large crabgrass	Crabgrasses
3	Redroot/Smooth pigweed	Johnsongrass	Red sprangletop
4	Common lambsquarters	Barnyardgrass	Itchgrass
5	Annual morningglories	Morningglories	Alexandergrass
6	Sicklepod	Common cocklebur	Goosegrass
7	Fall panicum	Shattercane	Junglerice
8	Common ragweed	Common lambsquarters	Horse purslane
9	Common cocklebur	Yellow foxtail	Pigweeds
10	Johnsongrass	Kochia	Wild poinsettia
Ten Most Troublesome Weeds			
1	Annual morningglories	Johnsongrass	Itchgrass
2	Burcucumber	Shattercane	Johnsongrass
3	Common milkweed	Barnyardgrass	Nutsedges
4	Hemp dogbane	Large crabgrass	Bermudagrass
5	Carolina horsenettle	Yellow foxtail	Crabgrasses
6	Common bermudagrass	Pigweeds	Goosegrass
7	Broadleaf signalgrass	Field sandbur	Junglerice
8	Texas panicum	Kochia	Alexandergrass
9	Purple nutsedge	Morningglories	Wild poinsettia
10	Fall panicum	Common lambsquarters	Red sprangletop

Table 1. The Southern States 10 Most Common and Troublesome Weeds in Corn (continued).

	States		
Ranking	South Carolina	Tennessee	Texas
Ten Most Common Weeds			
1	Southern crabgrass	Large crabgrass	Pigweeds
2	Palmer amaranth	Common cocklebur	Johnsongrass
3	Morningglories	Johnsongrass	Barnyardgrass
4	Sicklepod	Pigweeds	Sunflower
5	Broadleaf signalgrass	Ivyleaf/Entireleaf morningglory	Texas panicum
6	Goosegrass	Sicklepod	Broadleaf signalgrass
7	Nutsedges	Broadleaf signalgrass	Browntop panicum
8	Texas panicum	Common ragweed	Yellow nutsedge
9	Common cocklebur	Trumpetcreeper	Morningglories
10	Johnsongrass	Fall panicum	Junglerice
Ten Most Troublesome Weeds			
1	Bermudagrass	Broadleaf signalgrass	Pigweeds
2	Texas panicum	Common cocklebur	Johnsongrass
3	Morningglories	Sicklepod	Texas panicum
4	Broadleaf signalgrass	Honeyvine milkweed	Yellow nutsedge
5	Johnsongrass	Burcucumber	Sunflower
6	Nutsedges	Horsenettle	Barnyardgrass
7	Sicklepod	Bermudagrass	Morningglories
8	Common cocklebur	Trumpetcreeper	Broadleaf signalgrass
9	Palmer amaranth	Johnsongrass	Browntop panicum
10	Italian ryegrass	Giant ragweed	Junglerice

Table 1. The Southern States 10 Most Common and Troublesome Weeds in Corn (continued).

Ranking	State Virginia
Ten Most Common Weeds	
1	Fall panicum
2	Smooth pigweed
3	Crabgrasses
4	Foxtails
5	Johnsongrass
6	Morningglories
7	Common lambsquarters
8	Yellow nutsedge
9	Common ragweed
10	Bermudagrass
Ten Most Troublesome Weeds	
1	Johnsongrass
2	Bermudagrass
3	Common milkweed
4	Horsenettle
5	Hemp dogbane
6	Yellow nutsedge
7	*Rubus* spp.
8	Common lambsquarter
9	Smooth pigweed
10	Canada thistle

Table 2. The Southern States 10 Most Common and Troublesome Weeds in Grain sorghum.

	States		
Ranking	Alabama	Florida	Georgia
Ten Most Common Weeds			
1	Crabgrasses	Crabgrasses	Crabgrasses
2	Morningglories	Goosegrass	Common cocklebur
3	Broadleaf signalgrass	Texas panicum	Morningglories
4	Johnsongrass	Morningglories	Texas panicum
5	Cocklebur	Common cocklebur	Johnsongrass
6	Sicklepod	Sicklepod	Sicklepod
7	Pigweeds	Pigweeds	Pigweeds
8	Fall panicum	Florida beggarweed	Florida beggarweed
9	Florida pusley	Johnsongrass	Nutsedges
10	Texas panicum	Nutsedges	Bermudagrass
Ten Most Troublesome Weeds			
1	Johnsongrass	Crabgrasses	Texas panicum
2	Broadleaf signalgrass	Texas panicum	Johnsongrass
3	Morningglories	Goosegrass	Morningglories
4	Texas panicum	Sicklepod	Crabgrasses
5	Sicklepod	Pigweeds	Bermudagrass
6	Cocklebur	Morningglories	Common cocklebur
7	Fall panicum	Nutsedges	Sicklepod
8	Crabgrasses	Florida pusley	Pigweeds
9	Pigweeds	Florida beggarweed	Nutsedges
10	Florida pusley	Common cocklebur	Florida beggarweed

Table 2. The Southern States 10 Most Common and Troublesome Weeds in Grain sorghum (continued).

	States		
Ranking	Louisiana	Mississippi	North Carolina
Ten Most Common Weeds			
1	Crabgrasses	Broadleaf signalgrass	Large crabgrass
2	Broadleaf signalgrass	Southern crabgrass	Broadleaf signalgrass
3	Johnsongrass	Pitted morningglory	Redroot/Smooth pigweed
4	Barnyardgrass	Common cocklebur	Common lambsquarters
5	Morningglories	Sicklepod	Annual morningglories
6	Common cocklebur	Pigweeds	Sicklepod
7	Pigweeds	Common bermudagrass	Fall panicum
8	Goosegrass	Barnyardgrass	Common ragweed
9	Nutsedges	Johnsongrass	Common cocklebur
10	Sicklepod	Pennsylvania smartweed	Johnsongrass
Ten Most Troublesome Weeds			
1	Johnsongrass	Johnsongrass	Johnsongrass
2	Crabgrasses	Broadleaf signalgrass	Broadleaf signalgrass
3	Broadleaf signalgrass	Common bermudagrass	Large crabgrass
4	Barnyardgrass	Annual morningglories	Annual morningglories
5	Morningglories	Common cocklebur	Sicklepod
6	Common cocklebur	Purple nutsedge	Common milkweed
7	Pigweeds	Barnyardgrass	Hemp dogbane
8	Goosegrass	Palmer amaranth	Carolina horsenettle
9	Itchgrass	Honeyvine milkweed	Fall panicum
10	Nutsedges	Southern crabgrass	Common bermudagrass

Table 2. The Southern States 10 Most Common and Troublesome Weeds in Grain sorghum (continued).

	States		
Ranking	Oklahoma	Puerto Rico	South Carolina
Ten Most Common Weeds			
1	Pigweeds	Johnsongrass	Southern crabgrass
2	Large crabgrass	Large crabgrass	Palmer amaranth
3	Johnsongrass	Red sprangletop	Morningglories
4	Texas panicum	Itchgrass	Johnsongrass
5	Shattercane	Alexandergrass	Broadleaf signalgrass
6	Morningglories	Goosegrass	Sicklepod
7	Common cocklebur	Junglerice	Goosegrass
8	Fall panicum	Horse purslane	Common cocklebur
9	Yellow foxtail	Pigweeds	Nutsedges
10	Kochia	Wild poinsettia	Fall panicum
Ten Most Troublesome Weeds			
1	Johnsongrass	Itchgrass	Bermudagrass
2	Shattercane	Johnsongrass	Johnsongrass
3	Texas panicum	Bermudagrass	Broadleaf signalgrass
4	Barnyardgrass	Crabgrasses	Morningglories
5	Pigweeds	Goosegrass	Nutsedges
6	Fall panicum	Nutsedges	Sicklepod
7	Yellow foxtail	Junglerice	Palmer amaranth
8	Large crabgrass	Alexandergrass	Common cocklebur
9	Field bindweed	Wild poinsettia	Southern crabgrass
10	Field sandbur	Red sprangletop	Goosegrass

Table 2. The Southern States 10 Most Common and Troublesome Weeds in Grain sorghum (continued).

	States		
Ranking	Tennessee	Texas	Virginia
Ten Most Common Weeds			
1	Large crabgrass	Pigweeds	Fall panicum
2	Johnsongrass	Johnsongrass	Mornigglories
3	Common cocklebur	Sunflower	Johnsongrass
4	Pigweeds	Barnyardgrass	Smooth pigweed
5	Ivyleaf/Entireleaf morningglory	Texas panicum	Common lambsquarters
6	Sicklepod	Broadleaf signalgrass	Foxtails
7	Fall panicum	Browntop panicum	Common ragweed
8	Trumpetcreeper	Yellow nutsedge	Crabgrasses
9	Common ragweed	Morningglories	Yellow nutsedge
10	Broadleaf signalgrass	Silverleaf nightshade	Bermudagrass
Ten Most Troublesome Weeds			
1	Johnsongrass	Silverleaf nightshade	Johnsongrass
2	Common cocklebur	Pigweeds	Shattercane
3	Sicklepod	Johnsongrass	Bermudagrass
4	Ivyleaf/Entireleaf morningglory	Yellow nutsedge	Horsenettle
5	Trumpetcreeper	Sunflower	Common milkweed
6	Honeyvine milkweed	Barnyardgrass	Hemp dogbane
7	Broadleaf signalgrass	Broadleaf signalgrass	Yellow nutsedge
8	Pigweeds	Texas panicum	Smooth pigweed
9	Fall panicum	Browntop panicum	Fall panicum
10	Giant ragweed	Morningglories	Mornigglories

Table 3. The Southern States 10 Most Common and Troublesome Weeds in Hay, Pastures, and Rangelands.

	States		
Ranking	Alabama	Arkansas	Florida
Ten Most Common Weeds			
1	Crabgrasses	Buttercups	Wild radish
2	Dogfennel	Common ragweed	Sandburs
3	Buttercups	Lanceleaf ragweed	Smutgrass
4	Thistles	Persimmon	Briars
5	Pigweeds	Crabgrasses	Vaseygrass
6	Common bermudagrass	Foxtails	Dogfennel
7	Broomsedge	Dallisgrass	Tropical soda apple
8	Carolina horsenettle	Red sorrel	Southern waxmyrtle
9	Field sandbur	Bitterweed	Cogongrass
10	Smutgrass	Smooth pigweed	Torpedograss
Ten Most Troublesome Weeds			
1	Carolina horsenettle	Honeylocust	Sandburs
2	Pricklypears	Blackberry	Smutgrass
3	Smutgrass	Pricklypears	Tropical soda apple
4	Dalligrass	Horsenettle	Dogfennel
5	Crabgrasses	Greenbriar	Southern waxmyrtle
6	Torpedograss	Johnsongrass	Briars
7	Field sandbur	Crabgrasses	Horseweed
8	Blackberry	Dallisgrass	Cogongrass
9	Johnsongrass	Foxtails	Pricklypears
10	Horseweed	Sandburs	Horsenettle

Table 3. The Southern States 10 Most Common and Troublesome Weeds in Hay, Pastures, and Rangelands (continued).

	States		
Ranking	Georgia	Kentucky	Louisianna
Ten Most Common Weeds			
1	Crabgrasses	Foxtails	Crabgrasses
2	*Amaranthus* spp.	Large crabgrass	Broadleaf signalgrass
3	Thistles	Musk thistle	Foxtails
4	Carolina horsenettle	Tall ironweed	Curly dock
5	Bahiagrass	Buttercups	Wooly croton
6	Buttercups	Spiny amaranth	Dogfennel
7	Dogfennel	Chicory	Spiny amaranth
8	*Rubus* spp.	Broomsedge	Smutgrass
9	Bitter sneezeweed	Curly dock	*Rubus* spp.
10	Broomsedge	Common cocklebur	Buttercups
Ten Most Troublesome Weeds			
1	Carolina horsenettle	Tall ironweed	Smutgrass
2	Thistles	Multiflora rose	Bahiagrass
3	Bahiagrass	Musk thistle	Foxtails
4	Johnsongrass	Purpletop	Bluestem/Broomsedge
5	Crabgrasses	Blackberries	Buttercups
6	Smutgrass	Buckbrush	Southern waxmyrtle
7	Field sandbur	Broomsedge	Spiny amaranth
8	*Rubus* spp.	Eastern red cedar	Multiflora rose
9	Dogfennel	Horsenettle	Vaseygrass
10	Nutsedges	Nimblewill	Chinese tallow

Table 3. The Southern States 10 Most Common and Troublesome Weeds in Hay, Pastures, and Rangelands (continued).

	States		
Ranking	Mississippi	Puerto Rico	South Carolina
Ten Most Common Weeds			
1	Broadleaf signalgrass	Tall albizia	Crabgrasses
2	Dallisgrass	Cortadera (*Paspalum millegrana*)	Dewberry/Blackberry
3	Rootknot foxtail	Cortadero (*Paspalum virgatum*)	Thistles
4	Southern crabgrass	Casha	Dogfennel
5	Carolina horsenettle	Giant milkweed	Horsenettle
6	Dogfennel	Mesquite	Multiflora rose
7	Spiny amaranth	Thorny sensitive plant	Broomsedge
8	Thistles	Catclaw mimosa	Bitter sneezeweed
9	Blackberry	Climbing mimosa	Johnsongrass
10	Broomsedge	Wire weed	Curly dock
Ten Most Troublesome Weeds			
1	Rootknot foxtail	Tall albizia	*Cyperus* spp.
2	Broomsedge	Cortadera (*Paspalum millegrana*)	Sandburs
3	Carolina horsenettle	Casha	Horsenettle
4	Boneset	Mesquite	Bahiagrass
5	Dallisgrass	Climbing mimosa	Dogfennel
6	Dogfennel	Cortadero (*Paspalum virgatum*)	Dewberry/Blackberry
7	Spiny amaranth	Catclaw mimosa	Bitter sneezeweed
8	Thistles	Venezuela grass	Vaseygrass
9	Perilla mint	Giant milkweed	*Paspalum* spp.
10	Smutgrass	Wire weed	Pricklypears

Table 3. The Southern States 10 Most Common and Troublesome Weeds in Hay, Pastures, and Rangelands (continued).

	States		
Ranking	Tennessee	Texas	Virginia
Ten Most Common Weeds			
1	Large crabgrass	Wooly croton	Pigweeds
2	Buttercups	Western ragweed	Common lambsquarters
3	Spiny amaranth	Bahiagrass	Mustards
4	Buckhorn plantain	Marshelder	Ragweeds
5	Common cocklebur	Dallisgrass	Fall panicum
6	Horsenettle	Common broomweed	Foxtails
7	Johnsongrass	Bitter sneezeweed	Spiny amaranth
8	Brambles	Silverleaf nightshade	Biennial thistles
9	Tall ironweed	Field sandbur	Plantains
10	Musk thistle	Smutgrass	Buttercups
Ten Most Troublesome Weeds			
1	Horsenettle	Dallisgrass	Multiflora rose
2	Buttercups	Field sandbur	Red cedar
3	Musk thistles	Silverleaf nightshade	Common pokeweed
4	Brambles	Western ragweed	Dewberry/Blackberry
5	Buckhorn plantain	Pricklypears	Horsenettle
6	Tall ironweed	Carolina horsenettle	Milkweeds
7	Curly dock	Dogfennel	Hemp dogbane
8	Spiny amaranth	Texas bullnettle	Canada thistle
9	Common cocklebur	Johnsongrass	Docks
10	Dallisgrass	Common milkweed	Biennial thistles

Table 4. The Southern States 10 Most Common and Troublesome Weeds in Rice.

	States		
Ranking	Florida	Louisiana	Mississippi
Ten Most Common Weeds			
1	Texasweed	*Echinochloa* spp.	Barnyardgrass
2	Primrose willow	Red rice	Hemp sesbania
3	Fall panicum	*Leptochloa* spp.	Pitted morningglory
4	Purple and Yellow nutsedge	Ducksalad	Palmleaf morningglory
5	Sprangletops	Annual sedges	Red rice
6	Barnyardgrass	Hemp sesbania	Ducksalad
7	Dayflowers	Texasweed	Purple ammania
8	Pigweeds	Dayflowers	Amazon sprangletop
9	Goosegrass	Eclipta	Broadleaf signalgrass
10	Alligatorweed	Ammanias	Yellow nutsedge
Ten Most Troublesome Weeds			
1	Purple nutsedge	Red rice	Barnyardgrass
2	Yellow nutsedge	*Paspalum* spp.	Palmleaf morningglory
3	Texasweed	*Cyperus* spp.	Pitted morningglory
4	Alligatorweed	*Leptochloa* spp.	Red rice
5	Primrose willow	Alligatorweed	Amazon sprangletop
6	Fall panicum	Texasweed	Ducksalad
7	Guineagrass	Ducksalad	Purple ammania
8	Sprangletops	Dayflowers	Yellow nutsedge
9	Dayflowers	*Echinochloa* spp.	Broadleaf signalgrass
10	Barnyardgrass	Broadleaf signalgrass	Hemp sesbania

Table 4. The Southern States 10 Most Common and Troublesome Weeds in Rice (continued).

Ranking	State Texas
Ten Most Common Weeds	
1	Barnyardgrass
2	Junglerice
3	Red rice
4	Texasweed
5	Broadleaf signalgrass
6	Sprangletops
7	Dayflowers
8	Alligatorweed
9	Soft rush
10	Flatsedges
Ten Most Troublesome Weeds	
1	Barnyardgrass
2	Junglerice
3	Red rice
4	Texasweed
5	Broadleaf signalgrass
6	Sprangletops
7	Dayflowers
8	Alligatorweed
9	Soft rush
10	Flatsedges

Table 5. The Southern States 10 Most Common and Troublesome Weeds in Small Grains.

	States		
Ranking	Alabama	Florida	Georgia
Ten Most Common Weeds			
1	Wild garlic	Cutleaf eveningprimrose	Wild radish
2	Wild mustard	Virginia pepperweed	Italian ryegrass
3	Annual ryegrass	Italian ryegrass	Wild garlic/onion
4	Chickweed	Wild radish	Cutleaf eveningprimrose
5	Wild radish	Carpetweed	Henbit
6	Henbit	Corn spurry	Curly dock
7	Curly dock	Cudweeds	Vetch spp.
8	Virginia pepperweed	Curly dock	Swinecress
9	Cutleaf eveningprimrose	Wild garlic	Little barley
10	Little barley	Henbit	Common lambsquarters
Ten Most Troublesome Weeds			
1	Annual ryegrass	Wild radish/mustard	Wild radish
2	Wild radish	Wild garlic	Italian ryegrass
3	Wild mustard	Curly dock	Wild garlic
4	Wild garlic	Corn spurry	Curly dock
5	Chickweed	Cutleaf eveningprimrose	Henbit
6	Curly dock	Virginia pepperweed	Cutleaf eveningprimrose
7	Henbit	Italian ryegrass	Vetch spp.
8	Little barley	Henbit	Swinecress
9	Cutleaf eveningprimrose	Carpetweed	Little barley
10	Virginia pepperweed	Cudweeds	Common lambsquarters

Table 5. The Southern States 10 Most Common and Troublesome Weeds in Small Grains (continued).

	States		
Ranking	North Carolina	South Carolina	Virginia
Ten Most Common Weeds			
1	Common chickweed	Wild radish	Mustards
2	Henbit	Henbit	Common chickweed
3	Italian ryegrass	Chickweed	Henbit
4	Wild garlic	Italian ryegrass	Wild garlic
5	Wild mustard	Wild garlic	Knawel
6	Wild radish	Cutleaf eveningprimrose	Mayweed chamomile
7	Mouseear chickweed	Vetch spp.	Italian ryegrass
8	Knawel	Shepherdspurse	Mouseear chickweed
9	Cornflower	Corn spurry	Speedwells
10	Shepherdspurse	*	Vetch spp.
Ten Most Troublesome Weeds			
1	Italian ryegrass	Italian ryegrass	Italian ryegrass
2	Wild garlic	Wild garlic	Mouseear chickweed
3	Henbit	Wild radish	Speedwells
4	Knawel	Knawel	Vetch spp.
5	Mouseear chickweed	Curly dock	Wild garlic
6	Wild radish	Henbit	Mustards
7	Curly dock	Chickweed	Henbit
8	Speedwells	*	Knawel
9	Common chickweed	*	Mayweed chamomile
10	Corn gromwell	*	Common chickweed

Table 6. The Southern States 10 Most Common and Troublesome Weeds in Sugarcane.

	States		
Ranking	Florida	Louisiana	Puerto Rico
Ten Most Common Weeds			
1	Spiny amaranth	Johnsongrass	Nutsedges
2	Fall panicum	Bermudagrass	Crabgrasses
3	Guineagrass	Itchgrass	Itchgrass
4	Nutsedges (purple and yellow)	Red morningglory	Guineagrass
5	Giant bristlegrass	Pitted morningglory	Johnsongrass
6	Bermudagrass	Entireleaf morningglory	Junglerice
7	Goosegrass	Broadleaf signalgrass	Wild poinsettia
8	*Bracharia* spp.	Browntop panicum	Pigweeds
9	Napiergrass	Nutsedges	Morningglories
10	*Sorghum almum*	Wild poinsettia	Bermudagrass
Ten Most Troublesome Weeds			
1	Guineagrass	Johnsongrass	Itchgrass
2	Purple nutsedge	Red morningglory	Johnsongrass
3	Fall panicum	Pitted morningglory	Guineagrass
4	Giant bristlegrass	Entireleaf morningglory	Alexandergrass
5	Itchgrass	Itchgrass	Goosegrass
6	Napiergrass	Broadleaf signalgrass	Bermudagrass
7	*Sorghum almum*	Bermudagrass	Crabgrasses
8	Bermudagrass	Browntop panicum	Purple nutsedge
9	Balsam apple	Nutsedges	Paragrass
10	Morningglories	Wild poinsettia	Red sprangletop

Table 6. The Southern States 10 Most Common and Troublesome Weeds in Sugarcane (continued).

Ranking	State Texas
Ten Most Common Weeds	
1	Pigweeds
2	Browntop panicum
3	Junglerice
4	Johnsongrass
5	Barnyardgrass
6	Bermudagrass
7	Common sunflower
8	Southern crabgrass
9	Red sprangletop
10	Knotweeds
Ten Most Troublesome Weeds	
1	Pigweeds
2	Browntop panicum
3	Junglerice
4	Johnsongrass
5	Barnyardgrass
6	Bermudagrass
7	Common sunflower
8	Southern crabgrass
9	Red sprangletop
10	Knotweeds

Table 7. The Southern States 10 Most Common and Troublesome Weeds in Turf.

	States		
Ranking	Alabama	Arkansas	Florida
Ten Most Common Weeds			
1	Annual bluegrass	Crabgrasses	Crabgrasses
2	Crabgrasses	Annual bluegrass	Goosegrass
3	Goosegrass	Dallisgrass	Pennyworts
4	Wild garlic	Yellow nutsedge	*Cyperus* spp.
5	Henbit	Purple nutsedge	Dayflowers
6	Spurges	Bermudagrass	Annual bluegrass
7	Annual lespedeza	White clover	Bull paspalum
8	Lawn burweed	Lespedeza	Spurges
9	Nutsedges	Henbit	Sandburs
10	Chickweeds	Chickweeds	Beggarstick
Ten Most Troublesome Weeds			
1	Virginia buttonweed	Crabgrasses	Pennyworts
2	Bahiagrass	Yellow nutsedge	Torpedograss
3	Wild violet	Purple nutsedge	Florida betony
4	Ground ivy	Dallisgrass	*Cyperus* spp.
5	Florida betony	Virginia buttonweed	Goosegrass
6	Spurges	Pathrush	Crabgrasses
7	Annual lespedeza	Annual bluegrass	Annual bluegrass
8	Torpedograss	Bermudagrass	Sandburs
9	Nutsedges	Tufted lovegrass	Spurges
10	Wild garlic	Wild garlic	Beggarstick

Table 7. The Southern States 10 Most Common and Troublesome Weeds in Turf (continued).

	States		
Ranking	Georgia	Kentucky	Louisiana
Ten Most Common Weeds			
1	Crabgrasses	Large crabgrass	Crabgrasses
2	Annual bluegrass	Dandelion	Virgina buttonweed
3	Henbit	Broadleaf plantain	Dallisgrass
4	Common chickweed	White clover	Goosegrass
5	Dallisgrass	Common chickweed	Nutsedges
6	Goosegrass	Wild violet	Bermudagrass
7	Common lespedeza	Wild garlic	White clover
8	Nutsedges	Nimblewill	Bahiagrass
9	Wild garlic	Dallisgrass	Spurweed
10	Bahiagrass	Yellow nutsedge	Dandelion
Ten Most Troublesome Weeds			
1	Virginia buttonweed	Annual bluegrass	Virginia buttonweed
2	Nutsedges	Wild violet	Dallisgrass
3	Dallisgrass	Nimblewill	Bermudagrass
4	Violets	Virginia buttonweed	Torpedograss
5	Annual bluegrass	Star-of-Bethlehem	Doveweed
6	Woodsorrels	Dallisgrass	Goosegrass
7	*Phyllanthus* spp.	Bermudagrass	Bahiagrass
8	Wild garlic	Common lespedeza	Nutsedges
9	Bermudagrass	Yellow nutsedge	Spurweed
10	Florida betony	White clover	Green kyllinga

Table 7. The Southern States 10 Most Common and Troublesome Weeds in Turf (continued).

	States		
Ranking	Mississippi	North Carolina	Puerto Rico
Ten Most Common Weeds			
1	Southern crabgrass	Annual bluegrass	Bermudagrass
2	Annual bluegrass	Crabgrasses	Sour paspalum
3	Common chickweed	Dallisgrass	Sensitive plant
4	Henbit	Chickweeds	Garden spurge
5	Dallisgrass	Goosegrass	Tall fringe rush
6	Goosegrass	Henbit	Green kyllinga
7	Virginia buttonweed	Clovers	Goosegrass
8	Prostrate spurge	Dandelion	Nutsedges
9	Wild garlic	Wild garlic	Florida beggarweed
10	Common dandelion	*Kyllinga* spp.	Fingergrass
Ten Most Troublesome Weeds			
1	Virginia buttonweed	Annual bluegrass	Nutsedges
2	Common bermudagrass	Dallisgrass	Bermudagrass
3	Lawn burweed	*Kyllinga* spp.	Sour paspalum
4	Prostrate spurge	Crabgrasses	Tall fringe rush
5	Bahiagrass	Goosegrass	Green kyllinga
6	Goosegrass	Virginia buttonweed	Sensitive plant
7	Wild garlic	Purple nutsedge	Goosegrass
8	Purple nutsedge	Violets	Florida beggarweed
9	Henbit	Yellow nutsedge	Garden spurge
10	Annual bluegrass	Wild garlic	Fingergrass

Table 7. The Southern States 10 Most Common and Troublesome Weeds in Turf (continued).

	States		
Ranking	South Carolina	Tennessee	Texas
Ten Most Common Weeds			
1	Crabgrasses	Large crabgrass	Crabgrasses
2	Wild garlic/onion	Goosegrass	Dallisgrass
3	Dandelion	Dandelion	Goosegrass
4	Plantains	Annual ryegrass	Chickweeds
5	Annual bluegrass	Chickweeds	Henbit
6	Sandburs	Henbit/deadnettle	Virginia buttonweed
7	*Cyperus* spp.	White clover	K.R. bluestem
8	Goosegrass	Speedwells	Prostrate spurge
9	Chickweeds	Dallisgrass	Annual bluegrass
10	Henbit	Yellow nutsedge	Dandelion
Ten Most Troublesome Weeds			
1	*Cyperus* spp.	Virgina buttonweed	Dallisgrass
2	Sandburs	Common violet	Virginia buttonweed
3	Virginia buttonweed	Nimblewill	Slender aster
4	Dallisgrass	Dallisgrass	Yellow nutsedge
5	Parsley-piert	Indian mockstrawberry	Purple nutsedge
6	Annual bluegrass	Annual bluegrass	Bahiagrass
7	Annual lespedeza	Lovegrass	Dandelion
8	Spurweed	Goosegrass	Field sandbur
9	Wild garlic/onion	White clover	K. R. bluestem
10	*Kyllinga* spp.	Yellow nutsedge	Khakiweed

Table 7. The Southern States 10 Most Common and Troublesome Weeds in Turf (continued).

Ranking	State Virginia
Ten Most Common Weeds	
1	Large and smooth Crabgrass
2	Dandelion
3	Plantains
4	White clover
5	Common chickweed
6	Woodsorrels
7	Black medic
8	Mouseear chickweed
9	Henbit
10	Wild garlic
Ten Most Troublesome Weeds	
1	Virginia buttonweed
2	Nimblewill
3	Bermudagrass
4	Large and smooth crabgrass
5	Yellow nutsedge
6	Goosegrass
7	Violets
8	Dallisgrass
9	Perennial ryegrass
10	Corn speedwell

Table 8. The Southern States 10 Most Common and Troublesome Weeds in Wheat.

	States		
Ranking	Alabama	Florida	Kentucky
Ten Most Common Weeds			
1	Wild garlic	Cutleaf eveningprimrose	Wild garlic
2	Wild mustard	Virginia pepperweed	Common chickweed
3	Annual ryegrass	Italian ryegrass	Purple deadnettle
4	Chickweeds	Wild radish	Henbit
5	Wild radish	Carpetweed	Shepherdspurse
6	Henbit	Corn spurry	Philadelphia fleabane
7	Curly dock	Cudweeds	Pennsylvania smartweed
8	Virginia pepperweed	Curly dock	Common ragweed
9	Cutleaf eveningprimrose	Wild garlic	Marestail
10	Little barley	Henbit	Italian ryegrass
Ten Most Troublesome Weeds			
1	Annual ryegrass	Wild radish	Italian ryegrass
2	Wild radish	Wild garlic	Hairy chess
3	Wild mustard	Curly dock	Cheat
4	Wild garlic	Corn spurry	Wild garlic
5	Chickweeds	Cutleaf eveningprimrose	Star-of-Bethlehem
6	Curly dock	Virginia pepperweed	Curly dock
7	Henbit	Italian ryegrass	Pennsylvania smartweed
8	Little barley	Henbit	Marestail
9	Cutleaf eveningprimrose	Carpetweed	Cornflower
10	Virginia pepperweed	Cudweeds	Musk thistle

Table 8. The Southern States 10 Most Common and Troublesome Weeds in Wheat (continued).

	States		
Ranking	Louisiana	North Carolina	South Carolina
Ten Most Common Weeds			
1	Henbit	Common chickweed	Wild radish
2	Chickweeds	Henbit	Henbit
3	Annual bluegrass	Italian ryegrass	Chickweeds
4	Ryegrasses	Wild garlic	Italian ryegrass
5	Curly dock	Wild mustard	Wild garlic
6	Buttercups	Wild radish	Cutleaf eveningprimrose
7	Shepherdspurse	Mouseear chickweed	Vetches
8	Carolina foxtail	Knawel	Shepherdspurse
9	Wild garlic	Cornflower	Corn spurry
10	Cheat	Shepherdspurse	*
Ten Most Troublesome Weeds			
1	Ryegrasses	Italian ryegrass	Italian ryegrass
2	Curly dock	Wild garlic	Wild garlic
3	Carolina geranium	Henbit	Wild radish
4	Wild garlic	Knawel	Knawel
5	Little barley	Mouseear chickweed	Curly dock
6	Cheat	Wild radish	Henbit
7	Pennsylvania smartweed	Curly dock	Chickweeds
8	Horseweed	Speedwells	*
9	Cutleaf eveningprimrose	Common chickweed	*
10	Bittercresses	Corn gromwell	*

Table 8. The Southern States 10 Most Common and Troublesome Weeds in Wheat (continued).

	States		
Ranking	Tennessee	Texas	Virginia
Ten Most Common Weeds			
1	Chickweeds	Annual ryegrass	Mustards
2	Henbit/deadnettle	Tansy mustard	Common chickweed
3	Wild garlic	Turnipweed	Henbit
4	Hairy bittercress	Fixweed	Wild garlic
5	Virginia pepperweed	Cheat	Knawel
6	Annual ryegrass	Henbit	Mayweed chamomile
7	Curly dock	Corn gromwell	Italian ryegrass
8	Common vetch	Field bindweed	Mouseear chickweed
9	Cheat	Wild oat	Speedwells
10	Little barley	Kochia	Vetch spp.
Ten Most Troublesome Weeds			
1	Annual ryegrass	Field bindweed	Italian ryegrass
2	Cheat	Wild oat	Mouseear chickweed
3	Common vetch	Cheat	Speedwells
4	Wild garlic	Annual ryegrass	Vetch spp.
5	Little barley	Sunflower	Wild garlic
6	Cornflower	Rescuegrass	Mustards
7	Curly dock	Silverleaf nightshade	Henbit
8	Musk thistle	Henbit	Knawel
9	Henbit/deadnettle	Jointed goatgrass	Mayweed chamomile
10	Chickweeds	Red horned poppy	Common chickweed

ECONOMIC LOSSES DUE TO WEED IN SOUTHERN STATES

Grass Crops, Turf, Range, and Pastures

Eric P. Webster, Section Chair

The following estimates are based on the knowledge and experience of those individuals or other specialist within the state with whom they conferred.

Table 1. 1999 Estimated Losses Due to Weeds in **Alabama.**

	Corn	Grain Sorghum	Wheat	Oats
Cost of Herbicides				
a. Acres	210	8	100	17
b. Cost/A	19.00	9.00	5.00	3.00
c. Value	3990	72	500	51
Loss in Yield				
a. Acres	100	8	100	17
b. Cost/A	25.00	14.00	5.00	6.00
c. Value	2500	112	500	102
Loss in Quality				
a. Acres	50	4	100	10
b. Cost/A	4.00	5.00	3.00	6.00
c. Value	200	20	300	60
Loss in Extra Land Preparation and Cultivation				
a. Acres	150	8	50	10
b. Cost/A	5.00	4.00	3.00	4.00
c. Value	750	32	150	40
Loss in Land Value				
a. Acres	N/A	N/A	N/A	N/A
b. Cost/A	N/A	N/A	N/A	N/A
c. Value	N/A	N/A	N/A	N/A
Loss in Increase Cost of Harvesting				
a. Acres	125	5	30	13
b. Cost/A	4.00	5.00	3.00	4.00
c. Value	500	25	90	52
Total Losses	7940	261	1540	305

Acres = no. X 1000; Cost/A = $/A; Value = Acres X Cost/A X 1000.

Contributing Author: John Everest

Table 1. 1999 Estimated Losses Due to Weeds in **Alabama.**

	Alfalfa	Hay	Pastures	Turf
Cost of Herbicides				
a. Acres	10	200	250	500
b. Cost/A	15.00	11.00	8.00	25.00
c. Value	150	2200	2000	12500
Loss in Yield				
a. Acres	10	140	250	N/A
b. Cost/A	45.00	35.00	25.00	N/A
c. Value	450	4900	6250	N/A
Loss in Quality				
a. Acres	5	140	20	100
b. Cost/A	45.00	30.00	20.00	300.00
c. Value	225	4200	400	30000
Loss in Extra Land Preparation and Cultivation				
a. Acres	4	N/A	N/A	10
b. Cost/A	5.00	N/A	N/A	100.00
c. Value	20	N/A	N/A	1000
Loss in Land Value				
a. Acres	N/A	N/A	N/A	N/A
b. Cost/A	N/A	N/A	N/A	N/A
c. Value	N/A	N/A	N/A	N/A
Loss in Increase Cost of Harvesting				
a. Acres	N/A	N/A	N/A	10
b. Cost/A	N/A	N/A	N/A	100.00
c. Value	N/A	N/A	N/A	1000
Total Losses	845	11300	8650	4450

Acres = no. X 1000; Cost/A = $/A; Value = Acres X Cost/A X 1000.

Contributing Author: John Everest

Table 2. 1999 Estimated Losses Due to Weeds in **Florida**.

	Field Corn	Sweet Corn	Grain Sorghum	Sugarcane	Wheat
Cost of Herbicides					
a. Acres	75	44	15	426	10
b. Cost/A	19.00	15.00	18.00	18.00	4.00
c. Value	1425	660	270	7668	40
Loss in Yield					
a. Acres	55	11	15	456	30
b. Cost/A	32.00	275.00	10.00	42.00	5.00
c. Value	8400	3025	150	19152	150
Loss in Quality					
a. Acres	10	11	10	N/A	35
b. Cost/A	3.00	275.00	2.50	N/A	2.00
c. Value	30	3025	25	N/A	70
Loss in Extra Land Preparation and Cultivation					
a. Acres	75	22	10	350	18
b. Cost/A	5.00	10.00	2.50	25.00	3.00
c. Value	375	250	25	8750	54
Loss in Land Value					
a. Acres	5	N/A	3	350	N/A
b. Cost/A	10.00	N/A	10.00	11.00	N/A
c. Value	50	N/A	30	3850	N/A
Loss in Increase Cost of Harvesting					
a. Acres	100	4	10	75	35
b. Cost/A	3.50	12.00	2.25	25.00	3.00
c. Value	350	48	22.5	1875	105
Total Losses	3930	6978	15	426	619

Acres = no. X 1000; Cost/A = $/A; Value = Acres X Cost/A X 1000.

Contributing Author: Joyce Treadaway

Table 2. 1999 Estimated Losses Due to Weeds in **Florida**.

	Cereal Crops	Rangelands	Turf
Cost of Herbicides			
a. Acres	40	10	710
b. Cost/A	7.00	7.00	30.00
c. Value	280	70	21300
Loss in Yield			
a. Acres	75	8500	7
b. Cost/A	8.00	7.00	118.00
c. Value	600	59500	3220
Loss in Quality			
a. Acres	100	6800	245
b. Cost/A	2.00	4.00	310.00
c. Value	200	27200	75950
Loss in Extra Land Preparation and Cultivation			
a. Acres	35	2600	24
b. Cost/A	2.50	1.00	16.00
c. Value	87.5	2600	384
Loss in Land Value			
a. Acres	N/A	N/A	37
b. Cost/A	N/A	N/A	118.00
c. Value	N/A	N/A	4366
Loss in Increase Cost of Harvesting			
a. Acres	99	N/A	78
b. Cost/A	2.40	N/A	20.00
c. Value	237.6	N/A	1560
Total Losses	1405.1	32170	106780

Acres = no. X 1000; Cost/A = $/A; Value = Acres X Cost/A X 1000.

Contributing Author: Joyce Treadaway

Table 3. 1999 Estimated Losses Due to Weeds in **Georgia**.

	Field Corn	Grain Sorghum	Wheat	Other Cereals	Alfalfa
Cost of Herbicides					
a. Acres	300	50	225	70	10
b. Cost/A	18.00	7.00	5.40	2.60	15.00
c. Value	5400	350	1215	182	150
Loss in Yield					
a. Acres	230	40	112	35	5
b. Cost/A	24.00	15.00	5.20	6.00	50.00
c. Value	5520	600	582	210	250
Loss in Quality					
a. Acres	45	10	22.5	16	5
b. Cost/A	4.00	7.50	8.80	4.50	50.00
c. Value	180	75	198	72	250
Loss in Extra Land Preparation and Cultivation					
a. Acres	275	50	N/A	N/A	2
b. Cost/A	8.00	7.00	N/A	N/A	5.00
c. Value	2200	350	N/A	N/A	10
Loss in Land Value					
a. Acres	N/A	N/A	N/A	N/A	N/A
b. Cost/A	N/A	N/A	N/A	N/A	N/A
c. Value	N/A	N/A	N/A	N/A	N/A
Loss in Increase Cost of Harvesting					
a. Acres	120	27	50	16	N/A
b. Cost/A	3.00	3.00	1.50	1.50	N/A
c. Value	360	81	75	24	N/A
Total Losses	13660	1456	2070	488	660

Acres = no. X 1000; Cost/A = $/A; Value = Acres X Cost/A X 1000.

Contributing Author: Tim Murphy, Stanley Culpepper, and Eric Prostko

Table 3. 1999 Estimated Losses Due to Weeds in **Georgia**.

	Hay	Pasture	Turf
Cost of Herbicides			
a. Acres	400	400	600
b. Cost/A	10.00	8.00	25.00
c. Value	4000	3200	15000
Loss in Yield			
a. Acres	200	200	0.15
b. Cost/A	35.00	25.00	8000
c. Value	7000	5000	1200
Loss in Quality			
a. Acres	250	N/A	200
b. Cost/A	30.00	N/A	300.00
c. Value	7500	N/A	60000
Loss in Extra Land Preparation and Cultivation			
a. Acres	N/A	N/A	4
b. Cost/A	N/A	N/A	15.00
c. Value	N/A	N/A	60
Loss in Land Value			
a. Acres	N/A	N/A	15
b. Cost/A	N/A	N/A	125.00
c. Value	N/A	N/A	1875
Loss in Increase Cost of Harvesting			
a. Acres	N/A	N/A	15
b. Cost/A	N/A	N/A	20.00
c. Value	N/A	N/A	300
Total Losses	18500	8200	78435

Acres = no. X 1000; Cost/A = $/A; Value = Acres X Cost/A X 1000.

Contributing Author: Tim Murphy, Stanley Culpepper, and Eric Prostko

Table 4. 1999 Estimated Losses Due to Weeds in **Kentucky.**

	Field Corn	Grain Sorghum	Wheat	Pastures/Hay
Cost of Herbicides				
a. Acres	1200	8	300	500
b. Cost/A	25.00	15.00	10.00	10.00
c. Value	30000	120	3000	5000
Loss in Yield				
a. Acres	250	2	80	250
b. Cost/A	30.00	14.00	8.00	12.00
c. Value	7500	28	640	3000
Loss in Quality				
a. Acres	20	N/A	20	500
b. Cost/A	2.00	N/A	2.00	10.00
c. Value	40	N/A	40	5000
Loss in Extra Land Preparation and Cultivation				
a. Acres	250	2	100	N/A
b. Cost/A	6.00	6.00	6.00	N/A
c. Value	1500	12	600	N/A
Loss in Land Value				
a. Acres	N/A	N/A	N/A	N/A
b. Cost/A	N/A	N/A	N/A	N/A
c. Value	N/A	N/A	N/A	N/A
Loss in Increase Cost of Harvesting				
a. Acres	150	1	50	N/A
b. Cost/A	2.00	2.00	2.00	N/A
c. Value	300	2	100	N/A
Total Losses	39340	162	4380	13000

Acres = no. X 1000; Cost/A = $/A; Value = Acres X Cost/A X 1000.

Contributing Author: J. D. Green

Table 5. 1999 Estimated Losses Due to Weeds in **Mississippi**.

	Field Corn	Grain Sorghum	Rice	Wheat	Pasture	Turf
Cost of Herbicides						
a. Acres	200	60	245	210	200	450
b. Cost/A	13.00	7.00	42.00	6.00	4.50	26.00
c. Value	2600	420	10290	1260	900	11700
Loss in Yield						
a. Acres	68	50	70	56	4	N/A
b. Cost/A	15.00	10.00	40.00	6.00	6.00	N/A
c. Value	1020	500	2800	336	24	N/A
Loss in Quality						
a. Acres	N/A	N/A	65	25	0.5	14
b. Cost/A	N/A	N/A	53.00	24.00	6.00	300.00
c. Value	N/A	N/A	3445	600	3	4200
Loss in Extra Land Preparation and Cultivation						
a. Acres	170	75	130	18	2	N/A
b. Cost/A	9.00	9.00	15.00	6.00	8.00	N/A
c. Value	1530	675	1950	108	16	N/A
Loss in Land Value						
a. Acres	N/A	N/A	N/A	N/A	N/A	0.1
b. Cost/A	N/A	N/A	N/A	N/A	N/A	70.00
c. Value	N/A	N/A	N/A	N/A	N/A	7
Loss in Increase Cost of Harvesting						
a. Acres	65	25	28	10	10	N/A
b. Cost/A	6.00	6.00	10.00	5.00	5.50	N/A
c. Value	390	150	280	50	55	N/A
Total Losses	5540	1745	18765	2354	998	15907

Acres = no. X 1000; Cost/A = $/A; Value = Acres X Cost/A X 1000.

Contributing Author: J. D. Byrd

SUSTAINING MEMBERS

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Waldrum Specialties Inc.
4050 A Skyron Dr., Sky Run II-#A
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Weeds, Inc.
250 Bodley Rd.
Aston, PA 19014

Zeneca Ag Products
Rt. 1, Box 65
Leland, MS 38756

METRIC SYSTEM CONVERSION FACTORS*

Area Equivalents

One acre	=	43,560 square feet
	=	160 square rods (rd)
	=	0.405 hectares (ha)
	=	4840 square yards
	=	100 square meters
One hectare (ha)	=	100 are = 2.741 acres

Liquid Equivalents

One U.S. gallon	=	4 qt. = 8 pt. = 16 cups
	=	3.785 liters
	=	128 fluid ounces (oz.)
	=	231 cu inch
	=	8.3370 pounds of water
	=	3785.4 cu cm
One quart (qt)	=	0.9463 liters = 2 pints (pt.) = 32 fl. oz.
	=	4 cups = 64 tablespoons (Tbs.)
One Tbs	=	14.8 ml = 3 teaspoons (ts.) = 0.5 fl. oz.
One U.S. fluid ounce (oz.)	=	29.57 ml = 2 Tbs.
One British fluid ounce	=	28.41 ml

Temperature Equivalents

Degrees Centigrade	=	(/F - 32) x 5/9
Degrees Fahrenheit	=	(/C x 9/5) + 32

Length Equivalents

Centimeter (cm)	=	0.394 inch
Meter	=	3.28 feet = 39.4 inches
Kilometer	=	0.621 statute mile
Inch	=	2.54 cm
Foot	=	30.48 cm
Yard	=	0.914 meters
Rod	=	16.5 ft = 5.029 meters
Statute mile	=	1760 yards = 1.61 kilometers

Pressure Equivalents

1 pound per square inch (psi)	=	6.9 kPa

Weight Equivalents

One pound (avdp) (16 ounces)	=	453.6 grams
One short or net ton (2000 pounds)	=	0.907 metric tons
One long or gross ton (2240 pounds)	=	1.016 metric tons
Milligrams (mg)	=	102^{3} grams (g)
Microgram (µg)	=	102^{6} grams
Nanogram	=	102^{9} grams
Picograms	=	102^{12} grams
1 mg/g	=	1000 ppm
1 µg/g	=	1 ppm
1 nanogram/g	=	1 ppb
1 picogram/g	=	1 ppt
1 mg/kg or 1 mg/L	=	1 ppm
1 µg/kg or 1 µg/L	=	1 ppb

Conversions

	Multiply by to obtain	
foot candle	10.764	lux
gal (US)	3785	cubic centimeters
gal (US)	3.785	liters
gal (US)	0.83	gal. (Imperial)
gal	128	fluid ounces
gal/min	2.228×102^{3}	cu ft/sec
gal/acre	9.354	L/ha
hectares	2.471	acres (US)
kilograms	2.205	pounds
kg/ha	0.892	lb/acre
liters	0.0353	cu ft
liters/ha	0.107	gal/acre
meters	3.281	feet
miles/hr	88	ft/min
miles/hr	1.61	km/hr
ounces (fluid)	29.573	milliliters
ounces	28.35	grams
pounds	453.59	grams
psi	6.9	kilopascals
lb/gal	0.12	kg/L
lb/sq inch	0.070	1 kg/cm^2 (atm)
lb/1000 sq ft	0.489	kg/acre
lb/acre	1.12	kg/ha
square inch	6.452	cm^2
yards	0.9144	meters
parts per million (ppm)	2.719	lb ai/acre foot of water

*Conversion factors were taken from the "Herbicide Handbook of the Weed Science Society of America",

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HERBICIDE NAMES AND MANUFACTURERS

Common or Code name	Trade name	Chemical name	Manufacturer
Acetochlor	Harness Surpass	2-chloro-*N*-(ethoxymethyl)- *N*-(2-ethyl-6-methylphenyl) acetamide	Monsanto Zeneca
Acifluorfen	Blazer	5-[2-chloro-4-(trifluoro-methyl)phenoxy]-2-nitro-benzoic acid	BASF
Acifluorfen + bentazon	Storm	see acifluorfen and bentazon	BASF
Alachlor	Lasso Partner	2-chloro-*N*-(2,6-diethyl-phenyl)-*N*-(methoxymethyl) acetamide	Monsanto Monsanto
Ametryn	Evik	*N*-ethyl-*N**-(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine	Novartis
Asulam	Asulox	methyl[(4-aminophenyl) sulfonyl]carbamate	Rhone-Poulenc
Atrazine	AAtrex and others	6-chloro-*N*-ethyl-*N**-(1-methylethyl)-1,3,5-triazine-2,4-diamine	Novartis
Azafenidin (DPX R6447)	Milestone	2-[2,4-dichloro-5-(2-propynyl-oxy)phenyl]-5,6,7,8-tetrahydro-1,2,4-triazole[4,3-*a*]pyridin-3(2*H*)-one	DuPont
BAS 625H	Aura		BASF
BAY FOE5043	Axiom	*N*-(4-fluorophenyl)-*N*-(1-methyl-ethyl)-2-[[5-(trifluoromethyl)-1,3,4-thiadiazol-2-yl]oxy]acetamide	Bayer
BAY MKH 6561		Bayer	
Benefin	Balan	*N*-butyl-*N*-ethyl-2,6-dinitro-4-(trifluoromethyl)benzeneamine	Dow AgroSciences
Bensulfuron (DPX-F5384)	Londax	2-[[[[[(4,6-dimethoxy-2-pyrimidinyl)amino]carbonyl] amino]sulfonyl]methyl]benzoic acid	DuPont
Bentazon	Basagran	3-(1-methylethyl)-(l*H*)-2,1,3-benzothiadiazin-4(3*H*)-one 2,2-dioxide	BASF
Bromacil	Hyvar-X	5-bromo-6-methyl-3-(1-methylpropyl)-2,4 (1*H*,3*H*) pyrimidinedione	DuPont
Bromoxynil	Buctril Bronate	3,5-dibromo-4-hydroxy-benzonitrile	Rhone-Poulenc Rhone-Poulenc
Carfentrazone (FMC 8246)	Shark	",2-dichloro-5-[4-(difluoro-methyl)-4,5-dihydro-3-methyl -5-oxo-1*H*-1,2,4-triazol-1-yl]-4-fluoro-benzenepropanoic acid	FMC

HERBICIDE NAMES AND MANUFACTURERS

Common or Code name	Trade name	Chemical name	Manufacturer
CGA-362622			Novartis
Chlorimuron (DPX F6025)	Classic	2-[[[[(4-chloro-6-methoxy-2-pyrimidinyl)amino]carbonyl] amino]sulfonyl]benzoic acid	DuPont
Chlorimuron + sulfentrazone	Canopy XL Authority Broadleaf	see chlorimuron and sulfentrazone	DuPont DuPont FMC
Chlorimuron + thifensulfuron	Synchrony	see chlorimuron and thifensulfuron	DuPont
Chlorsulfuron	Glean	2-chloro-*N*-[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl) amino]carbonyl]benzene-sulfonamide	DuPont
Chlorsulfuron+ metsulfuron	Finesse	see chlorsulfuron and metsulfuron	DuPont
Clethodim (RE-4560l)	Select Envoy	(*E*,*E*)-(±)-2-[1-[[(3-chloro-2-propenyl)oxy]imino]propyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one	Valent USA Valent USA
Clomazone	Command	2-[(2-chlorophenyl)methyl]-4,4-dimethyl-3-isoxazolidinone	FMC
Clopyralid	Lontrel Stinger	3,6-dichloro-2-pyridine-carboxylic acid	Dow AgroSciences Dow AgroSciences
Cloransulam	Firstrate	3-chloro-2-[[(5-ethoxy-7-fluoro[1,2,4] triazolo[1,5-*c*]pyrimidin-2yl)sulfonyl] amino]benzoic acid	Dow AgroSciences
Cloransulam + flumetsulam	Frontrow	see cloransulam and flumetsulam	Dow AgroSciences
Cyanazine	Bladex CyPro	2-[[4-chloro-6-(ethylamino)-1,3,5-triazin-2-yl]amino]-2-methylpropanenitrile	DuPont Griffin
Cyhalofop		(R)-2-[4-(4-cyano-2-fluorophenoxy) phenoxy]propanoic acid	Dow AgroSciences
2,4-D	Several	(2,4-dichlorophenoxy)acetic acid	Several
2,4-D+MCPP+ dicamba	Trimec Classic	see 2,4-D and MCPP and dicamba	PBI Gordon
2,4-DB	Butoxone Butyrac	4-(2,4-dichlorophenoxy) butanoic acid	Rhone-Poulenc Rhone-Poulenc
DCPA	Dacthal	dimethyl 2,3,5,6-tetra-chloro-1,4-benzenedicarboxylate	Zeneca
Dicamba	Banvel	3,6-dichloro-2-methoxy-benzoic acid	BASF

HERBICIDE NAMES AND MANUFACTURERS

Common or Code name	Trade name	Chemical name	Manufacturer
Dicamba + 2,4-D	Weedmaster	see dicamba + 2,4-D	BASF
Dichlobenil	Casoron	2,6-dichlorobenzonitrile	Uniroyal
Dichlorprop (2,4-DP)	Several	(±)-2-(2,4-dichlorophenoxy) propanoic acid	Rhone-Poulenc
Diclofop	Hoelon	(±)-2-[4-(2,4-dichloro- phenoxy)phenoxy]propanoic acid	AgrEvo
Diclosulam	Strongarm	*N*-(2,6-dichlorophenyl)-5-ethoxy-7- fluoro[1,2,4]triazolo[1,5-*c*]pyrimidine- 2-sulfonamide	Dow AgroSciences
Dimethenamid	Frontier	2-chloro-*N*-[(1-methyl-2-methoxy) ethyl]-*N*-(2,4-dimethyl-thien-3-yl)- acetamide	BASF
Diquat	Diquat	6,7-dihydrodipyrido[1,2-": 2',1'-*c*]pyrazinediium ion	Zeneca
Dithiopyr	Dimension	*S*,*S*-dimethyl 2-(difluoro- methyl)-4-(2-methylpropyl)-6- (trifluoromethyl)-3,5-pyridine- dicarbothioate	Rohm & Haas
Diuron	Karmex, Direx	*N*'-(3,4-dichlorophenyl)- *N*,*N*-dimethylurea	DuPont Griffin
Endothall	Endothal	7-oxabicyclo[2.2.1]heptane- 2,3-dicarboxylic acid	Pennwalt
Ethalfluralin	Sonalan	*N*-ethyl-*N*-(2-methyl-2- propenyl)-2,6-dinitro-4-(tri- fluoromethyl)benzenamine	Dow AgroSciences
Ethofumesate	Prograss	(±)-2-ethoxy-2,3-dihydro- 3,3-dimethyl-5-benzofuranyl methanesulfonate	AgrEvo
Fenoxaprop	Whip Bugle	(±)-2-[4-[(6-chloro-2- benzoxazolyl)oxy]phenoxy] propanoic acid	AgrEvo AgrEvo
Fluazifop-P	FusiladeDX	(*R*)-2-[4-[[5-(trifluoro- methyl)-2-pyridinyl]oxy] phenoxy]propanoic acid	Zeneca
Fluazifop + fenoxaprop	Fusion	see fluazifop and fenoxaprop	Zeneca
Flufenacet+ metribuzin+ atrazine	Axiom AT	N-(4-Fluorophenyl)-N-(1-methylethyl)- 2-[[5-(trifluoromethyl)-1,3,4-thiadiazol- 2-yl]-oxy]acetamide and metribuzin and atrazine	Bayer
Flumetsulam	Broadstrike	*N*-(2,6-difluorophenyl)-5-methyl [1,2,4]triazolo[1,5-"]pyrimidine-2- sulfonamide	Dow AgroSciences

HERBICIDE NAMES AND MANUFACTURERS

Common or Code name	Trade name	Chemical name	Manufacturer
Flumetsulam + clopyralid	Hornet	see flumetsulam and clopyralid	Dow AgroSciences
Flumetsulam + clopyralid + 2,4-D	Scorpion III	see flumetsulam and clopyralid and 2,4-D	Dow AgroSciences
Flumetsulam + metolachlor	Broadstrike SF + Dual	see flumetsulam and metolachlor	Dow AgroSciences
Flumiclorac	Resource	[2-chloro-4-fluoro-5-(1,3,4,5,6,7-hexahydro-1,3-dioxo-2*H*-isoindol-2-yl)phenoxy]acetic acid	Valent USA
Flumioxazin	Valor V-53482	2-[7-fluoro-3,4-dihydro-3-oxo-4-(2-propynyl)-2*H*-1,4-benzoxazin-6-yl]-4,5,6,7-tetrahydro-1*H*-isoindole-1,3(2*H*)-dione	Valent USA
Fluometuron	Cotoran Meturon	*N*,*N*-dimethyl-*N**-[3-(tri-fluoromethyl)phenyl]urea	Novartis Griffin
Fluroxypyr	Vista	4-amino-3,5-dichloro-6-fluoro-2-pyridyloxyacetic acid	Dow AgroSciences
Fluthiacet methyl	Action		Novartis
Fomesafen	Reflex	5-[2-chloro-4-(trifluoro-methyl)phenoxy]-*N*-(methyl-sulfonyl)-2-nitrobenzamide	Zeneca
Fosamine	Krenite	ethyl hydrogen (aminocarbonyl)-phosphonate	DuPont
Glufosinate	Ignite Liberty Rely	2-amino-4-(hydroxymethyl phosphinyl)butanoic acid	AgrEvo AgrEvo AgrEvo
Glyphosate	Accord D-Pak Roundup Ultra	*N*-(phosphonomethyl)glycine	Monsanto Monsanto Monsanto
Halosulfuron	Permit	methyl 5-[[(4,6-dimethoxy-2-pyrimidinyl)amino]carbonylamino-sulfonyl]-3-chloro-1-methyl-1-*H*-pyrazole-4-carboxylate	Monsanto
Hexazinone	Velpar	3-cyclohexyl-6-(dimethyl-amino)-1-methyl-1,3,5-triazine-2,4(1*H*,3*H*)-dione	DuPont
Imazamethabenz	Assert	(±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-4(and 5)-methyl-benzoic acid (3:2)	American Cyanamid
Imazamox	Raptor	2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-5-(methoxy-methyl)-3-pyridinecarboxylic acid	American Cyanamid

HERBICIDE NAMES AND MANUFACTURERS

Common or Code name	Trade name	Chemical name	Manufacturer
Imazapic (AC263222) (imazameth)	Cadre Plateau	(±)-2-[4,5-dihydro-4-methyl-4-4(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-5-methyl-3-pyridine-carboxylic acid	American Cyanamid
Imazapyr	Arsenal, Chopper Stalker Habitat	(±)-2-[4,5-dihydro-4-methyl-4-(l-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-3-pyridine-carboxylic acid	American Cyanamid American Cyanamid American Cyanamid American Cyanamid
Imazaquin	Scepter Image	2-[4,5-dihydro-4-methyl-4-(l-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-3-quinoline-carboxylic acid	American Cyanamid American Cyanamid
Imazethapyr	Pursuit	2-[4,5-dihydro-4-methyl-4-(l-methylethyl)-5-oxo-1*H*-imidazol-2-yl)-5-ethyl-3-pyridinecarboxylic acid	American Cyanamid
Imazethapyr + imazapyr	Lightning	see imazethapyr and imazapyr	American Cyanamid
Isoxaben	Gallery	*N*-[3-(1-ethyl-1-methyl-propyl)-5-isoxazoyl]-2,6-dimethyl-benzamide	Dow AgroSciences
Isoxoben + oryzalin	Snapshot DF	see isoxoben and oryzalin	Dow AgroSciences
Isoxoben + trifluralin	Snapshot TG,	see isoxoben and trifluralin	Dow AgroSciences
Isoxaflutole (EXP 31130A)	Balance	5-cyclopropyl-4-(2-methyl-sulphonyl-4-trifluoromethyl-benzoyl)isoxazole	Rhone-Poulenc
Lactofen	Cobra	(±)-2-ethoxy-1-methyl-2-oxoethyl-5-[2-chloro-4-(trifluoromethyl) phenoxy]-2-nitrobenzoate	Valent USA
MCPA	Several	(4-chloro-2-methylphenoxy acetic acid	Several
Mecoprop, (MCPP)	Several	(±)-2-(4-chloro-2-methyl-phenoxy)propanoic acid	Several
Mesotrione			Zeneca
Metham	Vapam	methylcarbamodithioic acid	Zeneca
Methyl bromide	Bromo-gas	bromomethane Corp.	Great Lakes Chem.
Metolachlor	Dual Pennant	2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl)acetamide	Novartis Novartis
Metolachlor+ atrazine	Bicep	see metolachlor and atrazine	Novartis

HERBICIDE NAMES AND MANUFACTURERS

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Metribuzin	Lexone, Sencor	4-amino-6-(1,1-dimethyl-ethyl)-3-(methylthio)-1,2,4-triazin-5(4*H*)-one	DuPont Bayer
Metribuzin + metolachlor	Turbo	see metribuzin and metolachlor	Bayer
Metribuzin + trifluralin	Salute	see metribuzin and trifluralin	Bayer
Metsulfuron	Ally Escort	2-[[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl) amino]carbonyl]amino]sulfonyl] benzoic acid	DuPont DuPont
Molinate	Ordram	*S*-ethyl hexahydro-1*H*-azepine-1-carbothioate	Zeneca
MSMA	Several	monosodium salt of methyl-arsenic acid	Several
Napropamide	Devrinol	*N*-*N*-diethyl-2-(1-naphthalen-yloxy)propanamide	Zeneca
Nicosulfuron	Accent	2-[[[[(4,6-dimethoxy-2-pyrimidinyl) amino]carbonyl]amino]sulfonyl]-*N*,*N*-dimethyl-3-pyridinecarboxamide	DuPont
Nicosulfuron + rimsulfuron + atrazine	Basis Gold	see nicosulfuron and rimsulfuron and atrazine	DuPont
Norflurazon	Solicam Zorial Evital	4-chloro-5-(metthylamino)-2-(3-(trifluoromethyl)phenyl)-3(2*H*)-pyridazinone	Novartis Novartis Novartis
Oryzalin	Surflan	4-(dipropylamino)-3,5-dinitrobenzenesulfonamide	Dow AgroSciences
Oxadiazon	Ronstar	3-[(2,4-dichloro-5-(1-methyl-ethoxy)phenyl]-5-(1,1-dimethyl-ethyl)-1,3,4-oxadiazol-2-(3*H*)-one	Rhone-Poulenc
Oxadiazon+ prodiamine	Regalstar		Regal Chemical Company
Oxasulfuron (CGA-277476)	Expert	2-[[[[(4,6-dimethyl-2-pyrimidinyl) amino]carbonyl]amino]sulfonyl] benzoic acid	Novartis
Oxyfluorfen	Goal	2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-trifluoro-methyl)benzene	Rohm & Haas
Oxyfluorfen+ oryzalin	Rout	see oxyfluorfen and oryzalin	The Scotts Company
Oxyfluorfen+ oxadiazon	Regal	see ozyfluorfen and ozadiazon	Regal Chemical Company
Oxyfluorfen+ pendimethalin	Ornamental Herbicide II	see oxyfluorfen and pendimethalin	The Scotts Company

HERBICIDE NAMES AND MANUFACTURERS

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Paraquat	Gramoxone Extra Starfire Cyclone	1,1'-dimethyl-4,4'-bi-pyridinium ion	Zeneca Zeneca Zeneca
Pelargonic acid	Scythe	nonanoic acid	Mycogen
Pendimethalin	Prowl Pendulum Pentagon PRE-M Corral	*N*-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzene-amine	American Cyanamid American Cyanamid American Cyanamid Lesco The Scotts Company
Pendimethalin+ imazaquin	Squadron	see pendimethalin+imazaquin	American Cyanamid
Pendimethalin+ imazaquin+ imazethapyr	Steel	see pendimethalin+imazaquin+ imazethapyr	American Cyanamid
Pendimethalin+ trifluralin	Tri-Scept	see pendimethalin+trifluralin	American Cyanamid
Picloram	Tordon	4-amino-3,5,6-trichloro-2-pyridinecarboxylic acid	Dow AgroSciences
Primisulfuron	Beacon		Novartis
Primisulfuron + dicamba	North Star	primisulfuron + 3,6-dichloro-2-methoxybenzoic acid	Novartis
Prodiamine	Barricade Factor	2,4-dinitro-N^3,N^3-dipropyl-6-(trifluoromethyl)-1,3-benzenediamine	Novartis
Prohexadione		3,5-dioxo-4-(1-oxopropyl) cyclohexanecarboxylic acid	BASF
Prometon	Pramitol	6-methoxy-*N*,*N**-bis(1-methyl-ethyl)-1,3,5-triazine-2,4-diamine	Novartis
Prometryn	Caparol Cotton Pro	*N*,*N**-bis(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine	Novartis Griffin
Propanil	Stam, Stampede	*N*-(3,4-dichlorophenyl) propanamide	Rohm & Haas Rohm & Haas
Prosulfuron	Peak	1-(4-methoxy-6-methyl-triazin-2-yl)-3-[2-(3,3,3-trifluoropropyl)phenyl-sulfonyl]urea	Novartis
Prosulfuron + primisulfuron	Exceed	see prosulfuron and primisulfuron	Novartis
Pyridate	Tough	*O*-(6-chloro-3-phenyl-4-pyridazinyl) *S*-octyl-carbonothioate	Novartis

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Pyrithiobac	Staple	2-chloro--6-[(4,6-dimethoxy-2-pyrimidinyl)thio]benzoic acid	DuPont
Quinclorac	Facet Drive	3,7-dichloro-8-quinoline-carboxylic acid	BASF BASF
Quizalofop	Assure II	(±)-2-[4-[(6-chloro-2-quinoxalinyl)oxy]phenoxy] propanoic acid	DuPont
Rimsulfuron	Titus Matrix Basis	*N*-[[(4,6-dimethoxy-2-pyrimidinyl)amino]carbonyl]-3-(ethylsulfonyl)-2-pyridine-sulfonamide	DuPont DuPont DuPont
Sethoxydim	Poast Poast Plus Vantage	2-[1-(ethoxyamino)-butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one	BASF BASF BASF
Simazine	Princep,	6-chloro-*N*,*N*'-diethyl-1,3,5-triazine-2,4-diamine	Novartis
Sulfentrazone	Authority	*N*-[2,4-dichloro-5-[4-(difluoro-methyl)-4,5-dihydro-3-methyl-5-oxo-1*H*-1,2,4-triazol-1-yl]phenyl]-methanesulfonamide	FMC
Sulfentrazone + chlorimuron	Authority BL Canopy XL	see sulfentrazone and chlorimuron	FMC DuPont
Sulfentrazone + clomazone	One-Pass Authority	see sulfentrazone and clomazone	FMC FMC
Sulfometuron	Oust	2-[[[[(4,6-dimethyl-2-pyrimidinyl)amino]carbonyl] amino]sulfonyl]benzoic acid	DuPont
Sulfosate	Touchdown	trimethylsulfonium carboxymethylaminomethyl-phosphonate	Zeneca
Sulfosulfuron (MON 37500)	Monitor	1-(4,6-dimethoxypyrimidin-2-yl)-3-[(ethanesulfonyl-imidazo[1,2-a]-pyridine-3-yl)sulfonyl]urea	Monsanto
Tebuthiuron	Spike	*N*-[5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2-yl]-*N*,*N** dimethylurea	DowAgroSciences
Terbacil	Sinbar	5-chloro-3-(1,1-dimethyl-ethyl)-6-methyl-2,4(l*H*,3*H*)-pyrimidinedione	DuPont
Thiafluamide+ metribuzin	Axiom		Bayer
Thiazopyr	Dimension Spindle Visor	methyl 2-(difluoromethyl)-5-(4,5-dihydro-2-thiazolyl)-4-(2-methylpropyl)-6-(trifluoro-methyl)-3-pyridinecarboxylate	Rohm & Haas Rohm & Haas Rohm & Haas

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Thifensulfuron	Pinnacle	3-[[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino] carbonyl]amino]sulfonyl]-2-thiophenecarboxylic acid	DuPont
Thifensulfuron + tribenuron	Harmony Extra	see thifensulfuron and tribenuron	DuPont
Triasulfuron	Amber	2-(2-chloroethoxy)-*N*-[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]benzene-sulfonamide	Novartis
Triasulfuron + dicamba	Rave	2-(2-chloroethoxy)-N-[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl) amino]carbonyl]benzenesulfonamide and dicamba	Novartis
Tribenuron	Express	2-[[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)methylamino]-carbonyl]amino]sulfonyl]benzoic acid	DuPont
Triclopyr	Garlon, Grandstand	[(3,5,6-trichloro-2-pyridinyl)oxy]acetic acid	Dow AgroSciences Dow AgroSciences
Trifluralin	Treflan, Trifluralin	2,6-dinitro-*N*-*N*-dipropyl-4-(trifluoromethyl)benzeneamine	Dow AgroSciences others
Trinexapac-ethyl	Primo Palisade	ethyl 4-(cyclopropylhydroxymethylene)-3,5-dioxocyclohexanecar=boxylate	Novartis Novartis

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