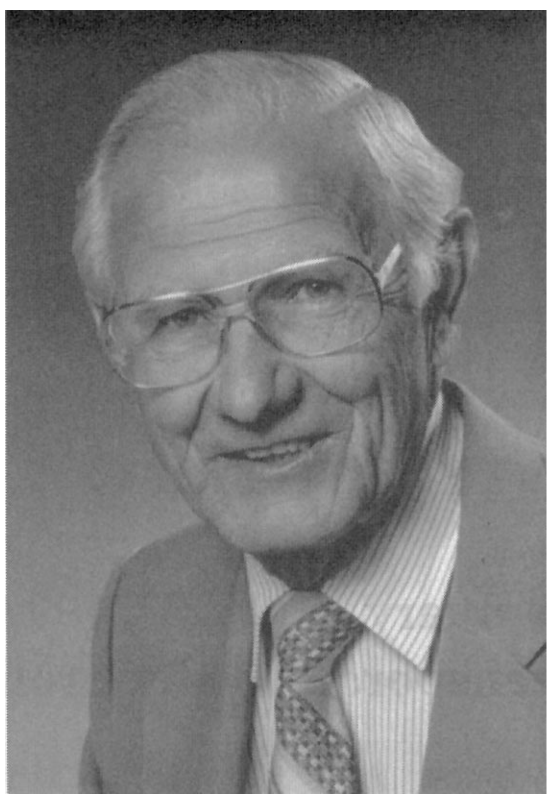
Glenn Charles Klingman



Allen Franklin Wiese

DEDICATION STATEMENT

Glenn Charles Klingman & Allen Franklin Wiese

The 52nd Proceedings of the 1999 Southern Weed Science Society's annual meeting are dedicated to Glenn Charles Klingman and Allen Franklin Wiese. Doctors Klingman and Wiese gave much to the SWSS, the profession of weed science, and to man-kind. Their valuable contributions and friendships will be sorely missed.

Glenn Charles Klingman, 83, died at the Brian Center in Durham, NC on July 27, 1998. The son of William Klingman and Mable Eickman, Dr. Klingman was born in Belleville, KS on January 7, 1915. He is survived by his wife of 59 years, C. Loree Klingman, two sons, two daughters and eleven grandchildren. He received his B.S. degree form the University of Nebraska in 1939; his M.S. degree from Kansas State University in 1941; and his Ph.D. from Rutgers University in 1950. Through his teaching at the University of Nebraska and North Carolina State University, Dr. Klingman's numerous students have gone on to strong positions of leadership in agronomy, weed science and administration. Following his tenure at North Carolina State University, Dr. Klingman worked for Eli Lily and Company in Greenfield, IN. His accomplishments in weed science are very significant and numerous. He was one of the earliest researchers with soil incorporated herbicides.

Dr. Klingman was the author or coauthor of numerous scientific and popular publications including *Crop Production in the South,* and in 1961, a true foundation text in weed science titled *Weed Control : As a Science.* This text was revised in 1975, with the help of coauthors Floyd Ashton and Lyman Noordhoff, and re-titled *Weed Science: Principles and Practices.*

Dr. Klingman was actively involved in the Southern Weed Science Society, where he served as the society's ninth President, and where he served on and chaired numerous committees and presented many papers. He was a President and Fellow of the Weed Science Society of America; President of the North Carolina chapter of Sigma Xi; and was appointed by the Governor of Indiana to the Indiana Pesticide Review Board. He is listed in the Who's Who in American Education; Leaders in American Science; Contemporary Authors; American Men and Women of Science; and Community Leaders and Noteworthy Americans.

Dr. Klingman was appreciated by his coworkers for his expertise in weed science and crop production. He was a valued member of the Research Triangle community, the agricultural and scientific communities, and the Southern Weed Science Society. Dr. Klingman will be greatly missed by friends and colleagues from across the United States.

Allen Franklin Wiese, 74, died January 21, 1999 in Amarillo, TX. The son of Paul Daniel and Elizabeth Marie Wiese, he was preceded in death by a son and his wife. He is survived by two daughters, Beth and Ann. Dr. Wiese was born in Eyota, MN on December 16, 1925. He was educated at the University of Minnesota, where he received his B.S. in 1948; the M.S. degree in 1951 and his Ph.D. in 1953. Dr. Wiese began his professional career at Texas A&M in 1953. Upon his retirement from that institution as Professor in 1989, he was named Professor Emeritus and maintained a close relationship with Texas A&M and the weed science community until his death. His accomplishments in weed science are very significant and numerous. He was one of the first researchers involved in limited tillage weed management systems.

Dr. Wiese was the author or coauthor of over 600 publications. He was an editor of the *Proceedings of the Southern Weed Science Society*; editor of *Weed Control in Limited Tillage;* and an associate editor of *Weed Science*. He was the winner of the Research Award from Texas A&M University in 1981. He was named a fellow of the Weed Science Society of America in 1979, and won that society's Research Award the following year. Dr. Wiese was also a Fellow of the American Society of Agronomy, and is listed in Who's Who in Science and Engineering.

Dr. Wiese was actively involved in the Southern Weed Science Society , where he served as the society's 27th President in 1974, and where he served on and chaired numerous committees and presented numerous papers. He received the Southern Weed Science Society Distinguished Service Award in 1977.

Dr. Wiese was appreciated by his coworkers for his expertise in weed science and crop production. He was a valued member of the Amarillo community, the agricultural and scientific communities, and the Southern Weed Science Society. Dr. Wiese will be greatly missed by friends and colleagues from across the United States.

PREFACE

These PROCEEDINGS of the 52nd 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 and Outstanding Young Weed Scientist 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 1999 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. 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

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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.

   (b) 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.

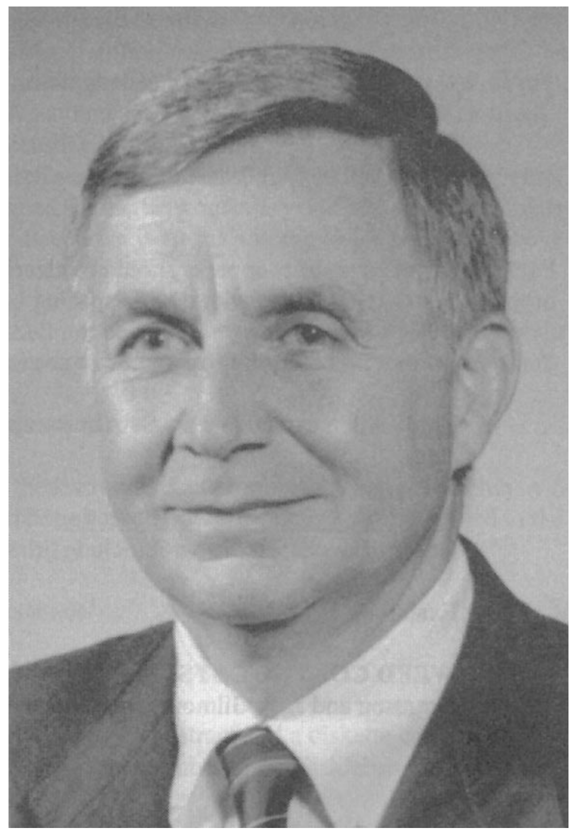
Tables and Figures - Place these after literature citations. Single space all tables. Tables should be positioned vertically on the page. Figures must be black and white photographs or pen and ink drawings on white bond paper. Store charts, graphs, figures, etc., as WPG files on diskette with abstract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

1999 AWARDS

1999 DISTINGUISHED SERVICE AWARD - ACADEMIA

Thomas J. Monaco

Thomas J. Monaco has been a member of SWSS since 1967. He and his students have participated in the annual meeting over the years by presenting papers and posters. He has served the society in many different roles including one term as Member-at-Large on the Board of Directors. He has served on numerous committees and chaired a number of them. From 1982 to 1984 he chaired the SWSS graduate program committee and during his tenure the committee completely revamped and reorganized the graduate poster contest. The result has been a much improved format and better organized contest. In 1981, he served as chairman of the Publications Committee. He and his committee were largely responsible for writing the recommendations and outline that resulted in publication of the 3rd edition of the SWSS Research Methods Manual. Although Dr. Monaco has been in an administrative position since 1988, he remains active in the affairs of the SWSS and has missed only three annual meetings since 1967.



Thomas J. Monaco has made significant contributions in providing the leadership for the development and registration of herbicides for weed control in many minor-use crops in North Carolina as well as the southeast. Prior to becoming Department Head, Monaco was involved in teaching in the graduate program in Horticultural Science. He taught several graduate level courses dealing with weed science. From 1969 to 1986, he taught a capstone course, “Principles and Methods of Weed Science,” which has a total enrollment of over 250 graduate students during that period of time. Also during his career he has served as adviser to 30 graduate students in Horticultural Science specializing in weed science.

Since 1998, Monaco has served as Head of the Horticultural Science Department. During this period of time, the department has tripled its external funding, has expanded research programs to incorporate biotechnology, enhanced its landscape horticulture teaching program in the development of a state of the art computer assisted design laboratory, elevated its Arboretum to national prominence, and has become one of the premier horticulture departments in the country.

1999 DISTINGUISHED SERVICE AWARD - INDUSTRY

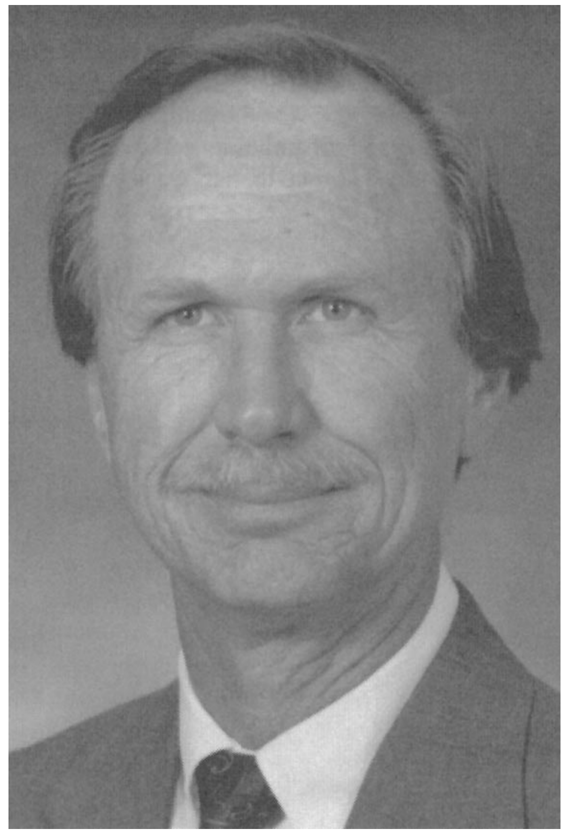
Laura L. Whatley

Dr. Laura Whatley is currently Manager of the State Regulatory Affairs group at American Cyanamid Company. She is a weed scientist with over 11 years experience in state regulatory affairs relating to crop protection products. Her previous positions have included three years in pesticide product development and three years as a university professor teaching and conducting weed science research. Dr. Whatley excels at translating technical information into language that non-scientists can understand, interacting with the public on scientific issues, and organizing and streamlining workloads for maximum efficiency. In addition to her management role, Dr. Whatley is active in several professional societies, including the Weed Science Society of America, Southern Weed Science Society, and the Council for Agricultural Science and Technology. She holds a B.S. in Botany from the University of Michigan, an M.S. in Crop Science from North Carolina State University, and a Ph.D. in Agronomy from the University of Illinois.

1999 WEED SCIENTIST OF THE YEAR

James H. Miller

With a broad background in forestry, gathered from experiences in diverse geographical regions (B.S. in 1967 in Forest Management from Oklahoma State University; M.S. in 1969 from Purdue specializing in Silviculture; Ph.D. in 1974 from Oregon State University in Ecology and Environmental Toxicology), Dr. Miller has served the USDA Forest Service in Auburn, Alabama since 1977. Currently, he is a Research Ecologist and Team Leader of the Forest Vegetation Management Research Unit.



His current research mission is to develop safe and effective forest vegetation management prescriptions, develop effective application systems for forestry herbicides, describe competition-crop interactions, and document treatment influences on soil productivity and floristic diversity.

During more than two decades, Dr. Miller has made a number of significant professional contributions. These include: Preparation of "Pest and Pesticide Management on Southern Forests," which has been adopted for training forest pesticide applicators in several southeastern states and has wide distribution to silviculture students; a "landmark study" on project yields and economic outcomes for loblolly pine plantations, an important tree crop in the southern United States; design integrated pest management approaches for kudzu and other non-native forestry weed species. Past awards recognizing Dr. Miller include a Superior Service Award for team leadership and Excellence in Research (1994) presented by USDA secretary Mike Espy. Dr. Miller is also acknowledged by his peers, having received the 1993 Research Award, presented by the Society of American Foresters and the Forest Service Chief's Ecosystem Management Award in 1992.

One of the hallmarks of Dr. Miller's career has been the plethora of research reports and technology transfer accomplishments, which have expanded knowledge on understory plant succession, soil sustainability, and commodity as well as non-commodity forest values. Most recently, Dr. Miller has organized preparation and publication of the *Forest Plant ID Guide*, which will provide written and visual identification of 289 commonly occurring forest plants from 170 different genera. This guide is set for publication in 1999.

Besides scholarly activity, Dr. Miller also has contributed to the weed science community and related professional societies. He has served on numerous committees, been a member of the SWSS for almost 20 years, and has worked diligently to elevate activity and participation in the forestry section of the SWSS.

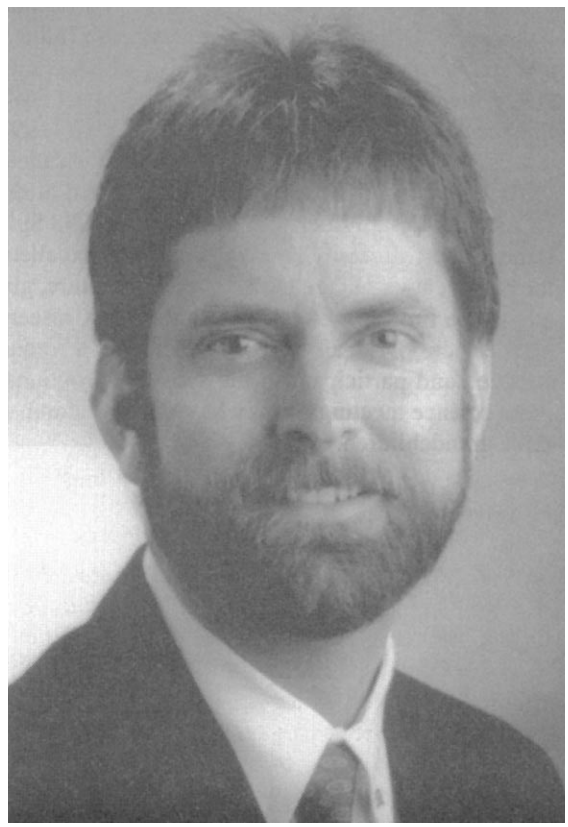
This short narrative is only a summary of the many contributions of Dr. James H. Miller to our society, and we proudly recognize his accomplishments.

1999 OUTSTANDING YOUNG WEED SCIENTIST AWARD

Daniel B. Reynolds

Dan Reynolds is a Professor of Weed Science with Mississippi State University. He is a native of Jerome, Arkansas, and received a B.S. degree in Agricultural Science from the University of Arkansas at Monticello and his M.S. degree in Agronomy from the University of Arkansas at Fayetteville. He received a Ph.D. in Crop Science from Oklahoma State University and joined the staff of the Louisiana Agricultural Experiment Station at the Northeast Research Station in 1986. Dan conducted weed control research in soybean, corn, cotton, and cereal grains in northeast Louisiana. In 1996, he joined the Department of Plant and Soil Sciences with Mississippi State University. Currently his responsibilities include teaching, weed control research in corn and cotton, and cotton defoliation. Dan has served or currently serves as a major advisor of seven graduate students. With the assistance of colleagues, Dan has developed effective weed control programs for the crops grown in Louisiana and Mississippi. He has been an invited speaker at many weed control program training seminars for extension, agri-chemical companies, and farm personnel. He is author or coauthor of 107 abstracts, 21 journal articles, 24 popular press articles, and several software series.

Dan has been very active in the Southern Weed Science Society (SWSS) at both the student and professional levels. He joined SWSS and the Weed Science Society of America (WSSA) in 1980 and has attended all meetings of the SWSS since then. He has participated in the Southern Weed Contest as a contestant and subsequently as a coach and in the Graduate Student Paper Contest in which he placed second on his M.S. and Ph.D. degrees. His service to the SWSS began as a graduate student by serving on the Placement Committee. Since then, Dan has served as chairman of the Graduate Program Committee, Terminology Committee, and Site Selection Committee, editor, section chairman for Agronomic Crops and Posters, Newsletter Editor, and has served as a member of the Publications Committee. In addition, he has also served as the Member-at-Large representative to the SWSS Executive Board. He is a member of CAST, the American Society of Agronomy, Mississippi Weed Science Society (Executive Board Member), International Weed Science Society, and WSSA, where he currently serves on the WSSA Resolutions and ARCPACS Committees.

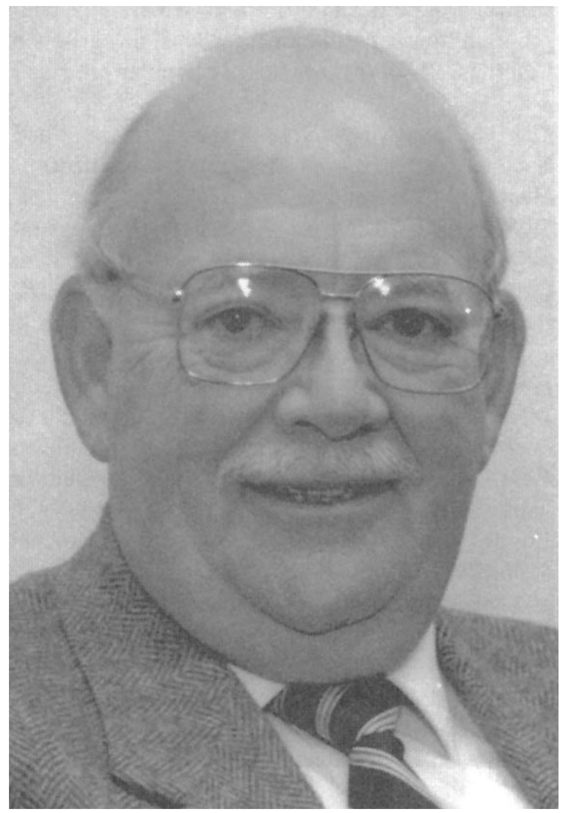


1999 OUTSTANDING EDUCATOR AWARD

Ronald E. Talbert

Ronald E. Talbert is a University Professor of Agronomy/Weed Science at the University of Arkansas with responsibilities in research and teaching at the undergraduate and graduate levels. Dr. Talbert obtained his B.S. in soils, and his M.S. and Ph. D. in weed science from the University of Missouri. He joined the Agronomy Department in 1963 to teach courses in weed science and conduct research on weed control in horticultural crops and factors affecting herbicide selectivity. Dr. Talbert and his students have investigated a number of research problems associated with the use of herbicides, their behavior in soil, factors affecting their selective activity, their persistence and carryover, and herbicide resistance in weeds.

He has directed or co-directed 52 graduate students, many of whom have won or placed second 14 times on Southern Weed Science Society (SWSS) Graduate Student Contest, 13 times in Southern Weed Contest, and 11 times in the Arkansas Pesticide Association Graduate Student Contest. Dr. Talbert is a Weed Science Society of America (WSSA) Fellow (1990) and Outstanding Teacher (1998); past SWSS President, SWSS Weed Scientist of the Year (1991), and SWSS Distinguished Service Award–Academia (1990); and IR-4 Meritorious Service Award (1991). At Arkansas, Dr. Talbert was awarded the 1998 Spitze Land Grant University Faculty Award for Excellence, the highest award in the Division of Agriculture, given only three times for excellence in teaching, research, and service. Dr. Talbert's wife, Alice, is a frequent attendee and participant in the spouses' programs at weed science meetings. They have three children and three grandchildren.



1999 OUTSTANDING GRADUATE STUDENT AWARD (M.S.)

Patrick A. Clay

Patrick A. Clay is Research Associate of Weed Science, Department of Plant Pathology and Crop Physiology in Baton Rouge, LA. He was raised in Winnsboro, LA and was employed as a cotton scout in his father's consulting business. He received his B.S. in Agronomy (1992) from Louisiana Tech University. While an undergraduate, he was employed by Monsanto Company as a research technician as part of a six month cooperative education program. Upon graduation from Tech he was employed by the Louisiana Agricultural Experiment Station as a Research Associate (Entomology) at the Macon Ridge Branch of the Northeast Research Station. In the fall of 1993 Pat was hired by Dr. Jim Griffin in the Department of Plant Pathology as Research Associate and M.S. student in Weed Science. His responsibility includes providing support for the soybean, sugarcane, and corn weed control research program. His thesis research investigated the effect of late season glyphosate application on weed seed production and germination.

As a graduate student Pat has been an active member of the Louisiana Plant Protection Association, American Society of Sugarcane Technologists, and the Southern Weed Science Society. He has participated in paper contest for each of these organizations and has been a member of the LSU Weed Team for several years. In 1996, Pat was selected to serve as the LSU representative to the SWSS Student Organization Board, and in 1997 as the student representative to the SWSS Executive Board. He is also very active in church and community activities.

1999 OUTSTANDING GRADUATE STUDENT AWARD (Ph.D.)

A. Stanley Culpepper

Stanley Culpepper grew up on a family farm near Woodland in rural eastern North Carolina. His parents and brother still live on and operate the farm.

Stanley and his seven classmates graduated from Northeast Academy in 1989. In the fall of 1989, he entered N.C. State University to pursue a bachelor's degree in Agronomy with a minor in Agricultural Business Management. He was active in several campus organizations, including the Agri-Life Council (vice-president), Agronomy Club (vice-president and president), the Agricultural Business Club (vice-president), Alpha Zeta, Gamma Sigma Delta, and Gamma Beta Phi. He was the recipient of the RJR Scholarship of Excellence, the Heath Chaplin Academic Scholarship, the Agronomy Senior Scholastic Award, and the Agronomy Student Award for Scholarship Achievement and Contribution. After graduating Summa Cum Laude in 1993, he entered a Master of Science program in weed science at N.C. State under the direction of Alan York. During this program, he received the Outstanding Crop Science Graduate Student award, won second place in the Southern Weed Science Society graduate student paper contest, and was elected to Phi Kappa Phi. In the spring of 1996, he continued in a Ph.D. program at N.C. State, again under York's direction. His dissertation focuses on weed management in transgenic cotton, corn and soybeans. He has presented his work at numerous professional meetings, field days, grower meetings, and industry training sessions. As a Ph.D. candidate, he won first place in the SWSS graduate student paper contest. Stanley anticipates completing his Ph.D. early in 1999. He is senior author on eight papers in refereed journals with four more planned. He also is senior author on 12 abstracts in proceedings of professional societies and co-author on two extension weed management guides.

SOUTHERN WEED SCIENCE SOCIETY
OFFICERS AND EXECUTIVE BOARD

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

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

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

SWSS ENDOWMENT FOUNDATION

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

BOARD OF TRUSTEES - EX-OFFICIO

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

AWARDS COMMITTEE, PARENT (STANDING)

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

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

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

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

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

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

CONSTITUTION AND OPERATING PROCEDURES COMMITTEE (STANDING)

G.D. Wills	2000

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

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

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

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

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

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

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)

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					

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

PROGRAM COMMITTEE - 2000 (STANDING)

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

PROGRAM COMMITTEE - 2001 (STANDING)

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

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

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

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

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

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	

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				

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

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

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

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

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	

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. FoyJ.H. Miller	D.G. Shilling	A.C. York	
L.B. Gillham	T.J. Monaco	B.D. Sims	S.M. Zedaker
J.L. Griffin			

CONTINUING EDUCATION UNITS COMMITTEE (SPECIAL)

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

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

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*

COMPUTER APPLICATIONS COMMITTEE (SPECIAL)

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

* indicates chairperson

Minutes for SWSS Summer Board Meeting
June 13-14, 1998
Four Seasons, Greensboro, NC

President Randy Ratliff called the meeting to order at 3:00 PM. Attendance included Past President Bob Hayes, President Elect- Don Murray, Vice President Laura Whatley, Secretary/Treasurer - Ted Whitwell, Business Manager - Robert Schmidt, Constitution and Operating Procedures Chair - Gene Wills, Forestry Representative - Shep Zedaker, Editor - Joan Dusky, Site Selection Chair- Dan Reynolds and Board Members -at- Large David Jordan, William Barrentine, William Witt, Cletus Youmans, CAST Representative - David Monks, Newsletter Editor - Tom Mueller, and Local Arrangements Chairman – Bill Lewis.

President Ratliff asked for adoption of the agenda and it was adopted.

Minutes
Minutes were passed out and the important sections were read and the minutes were approved. Minutes were approved as revised.

Room nights were discussed. The new hotel contract has 1240 room nights but we only need1100 room nights. Discussion was held about changing room nights.

Newsletter Editor Report
Tom Mueller recommended that Bert McCarty serve as the next newsletter editor. A motion was made to appoint Bert McCarty as newsletter editor effective January, 1999. The motion was seconded and it passed. Discussion was held about newsletter proofs going back to the editor before it is printed and mailed. The newsletter that contains the call for papers should go out first class.

CAST Report
David Monks is a member of both committees in CAST - Plant Protection and National Concerns. Discussion was held about issue papers on non-native pests and non-native plants. The impact of The Food Quality Protection act report will be developed. Shep suggested an issue paper is needed on the use of pesticides in forest. CAST does not use AESOP but Myers and Associates.

2001 Site Selection Report
Properties in the central region (TN, AL, MS, KY) were considered for meeting site in 2001. We need to do a better job in estimating our room nights and knowing how much business is generated at a property other than for the normal banquet. The estimate of 15 to 20 K in food and beverage business outside the normal banquet was used. Properties in Lexington KY, Biloxi, MS, Memphis TN, and Tunica, MS were recommended for consideration as meeting sites.

Murray moved that we negotiate with the Lexington property and the Biloxi property and the board will vote later after negotiations. Motion was seconded and passed.

Meeting Planner
Discussion was held about using Helms-Biscoe, a meeting-planning group, to find the best hotel in the region.
Dusky moved that we allow Helms-Biscoe present a proposal for a meeting site in 2002 for the eastern region.

SWSS WEB Site
MOP, officers, and committee assignments are ready to go on the SWSS WEB site. A decision needs to be made concerning the location of the WEB site. We also need a standing committee. Hayes moved that the SWSS WEB site be located at Mississippi State as a permanent site. The motion seconded and approved.

Dusky moved that we present to our membership a standing committee called a computer applications committee.
Motion was seconded and it passed.

Business Manager
The new business manager's contract would change the fee from $1000/mo to $1500/mo. Street moved that we increase the management fee of the Business Manager to $2000/mo. Witt seconded the motion. Discussion was held about waiting until the budget and overall financial status was evaluated. A motion was made to table this motion until later. The motion was seconded and it passed.

Our inventory was moved to a mini warehouse for storage because the previous storage area was closed. Bob moved all our publications. The storage costs for this inventory is $4000/yr. He is working to get all the negatives from the weed ID guides back from the publishing company.

Membership numbers have increased slightly.

Discussion was held about the Society paying for board member rooms at the annual meetings. Dusky moved that the Society pay for board members rooms at the annual meetings according to MOP guidelines and other board members would get a reduced rate if available. Motion was seconded and it passed.

The income from the Weed ID guides is decreasing but the CD income is still doing well.

Dusky moved to increase registration dues by $30 for members and $15 for students. It was seconded and the motion passed.

Hayes moved that we do not solicit industry to support the refreshment breaks for the annual meeting. The motion was seconded and it passed.

Murray moved that we sell the proceedings for $30 to others and $15 to students. The motion was seconded and it passed.

Dusky moved to increase the late registration fee to $25. The motion was seconded and it passed.

Murray moved to increase our one-day registration fees to $50. The motion was seconded and it passed.

Editors
Discussion was held about collecting diskettes, and it is left up to the editor as to how to collect these disks.

The program leader should enforce the rule of only 2 first author articles from a single member unless the sections need presentations.

Witt moved that the editor of the proceedings should not accept an abstract longer than 1 page or papers longer than 6 pages except for invited presentations. The motion was seconded and it passed.

Local arrangements
Fred Yelverton and Joe Neal will develop a program for the Lawn care group if program leader desires. Is the aquatic section is a viable section with 2 papers?
Refreshment break costs were over $5000 for 1998 conference. Should we cover breaks out of registration or reduce breaks? We need to increase fees $9-10/person for breaks.
Murray moved that the local arrangement committee approve a menu for the banquet of beef and fish in the range of approximately $25 pus tax and gratuity. The motion was seconded and it was approved. Complimentary rooms are based on the number of rooms. Rooms are $105/night, with 10 staff rooms at $95 and $85 for student rooms.

1999 Program
The theme of the general session will be "A glance to the past and a vision for the future". Gale Buchannan and Randy Ratliff will be keynote speakers. The general session will begin at 9:30 AM. The business meeting will be after the general session. A symposium about the role of the Society - science or service will be in the program.

Will moved that SWSS pay the travel expenses of Debbie Garvin to attend and present a GLP workshop. Hayes seconded the motion and it passed. Murray will contact Debbie Garvin.

Forest Plants and Shrubs of SE
Discussion was held about the sales of Forest Plants and Shrubs of SE publication with printing costs of $90,320 for 6000 copies. Marketing will be critical in order to sell the 6000 copies.

Hayes moved to accept the proposal (6000 copies for $90,320) for printing and $1000 for marketing this publication. Motion was seconded and it passed.

Hays moved that James Miller is the curator of the images and manuscript of the publication Forest Plants and Shrubs of Southeast until he unable to fulfill his obligation as determined by the SWSS board. SWSS board will approve future curators of the manuscript and images. The motion was seconded and it was approved.

Dusky moved that we approve the expenditures for the CD-ROM. The motion was seconded and it was approved.

Discussion was held about printing the next Weed ID guide (seventh set). The board is in favor of new ID guides. When the next set is closer to being ready to print,we can print them.

1998-99 Budget
Bob Schmidt reviewed the new budget and estimated a net loss of $51,000 due to the increased cost of printing the Forest publication.

Murray moved to reconsider the tabled motion. The motion passed and the original motion to increase the Business Manager's fee to $2000/mo passed.

A motion was made to approve the financial records for 1997-98. The motion was seconded and it passed.

A motion was made to approve the 1998-1999 budget as amended. It was seconded and approved.

Old Business
The following officers should be elected: CAST Representative, WSSA Representative, Vice President - Academic, Endowment Board member and Secretary/Treasurer.

Bob Hayes sent letters to previous SWSS presidents to help write the SWSS history and they were not interested in writing the history but would provide help. We should ask for volunteers in the newsletter. Bob will contact other retirees to determine interest.

There was an ARS proposal for a national weed management program (USDA 304 and 305) that would combine weed science with entomology. Randy wrote a letter in opposition to this program.

There was a request for having a program section on invasive weeds and this section will be placed in other existing program sections.

Randy will ask David Shaw or Joan Dusky to represent SWSS membership at WSSA summer board meeting.

A speaker at the banquet or entertainment was discussed.

Weed Contest funds should be moved to the Endowment Fund as soon as possible.

The use of CD-ROM in classroom settings needs revisited.

The contract for the Tulsa meeting needs adjustment.

Meeting was adjourned 11:55 AM on June14, 1998.

Minutes for SWSS Board Meeting
January 24 and 25, 1999
Holiday Inn Four Seasons, Greensboro, NC

President Randy Ratliff called the meeting to order at 1:30 PM. Attendance included Past President Bob Hayes, President Elect- Don Murray, Vice President Laura Whatley, Secretary/Treasurer - Ted Whitwell, Business Manager - Robert Schmidt, Constitution and Operating Procedures Chair - Gene Wills, Forestry Representative - Shep Zedaker, Editor - Joan Dusky, and Board Members -at- Large - Dan Reynolds, David Jordan, William Barrentine, William Witt, Cletus Youmans, CAST Representative - David Monks, Local Arrangements Chairman – Bill Lewis, Student representative John Isgrigg, CEU representative John Snodgrass - Texas Dept. of Agriculture.

President Ratliff asked for adoption of the agenda and it was adopted.

A motion was made to accept or reject committee reports at the end of the day. There was unanimous agreement.

Editor
Joan Dusky discussed the 1998 Proceedings and indicated that a request from NAL, FNIC, NIH to have an electronic version of the proceedings for WEB usage. Discussion was held about this and what our members wanted for electronic versions of our publications.

A motion was made that the computer application committee and editors consider this proposal and our membership needs and make a recommendation to the board. The motion received a second and it passed.

Secretary/Treasurers Report
The minutes of the summer board meeting were reviewed. Several errors were noted and it will be reviewed again after revision at the Thursday board meeting.

Cash assets on hand as of November 30,1998 was $36, 236.84. Total assets included several Certificates of Deposit of $321,040.35. The weed contest fund is considered as a liability of $36.308. Net worth of the society is $279, 925.

Business Managers Report
Weed ID guide sales are down but CDROM sales are up.

Awards
Award winners were notified. Only two to four nominees per award were received. More deserving members should be nominated for all awards.

Nominations
The results of the membership election were: Vice president - Joe Street, Sec. / Treas. - David Monks, WSSA Rep. - Barry Brecke, CAST Rep. - Alan York, SWSS Endowment -Tom Monaco.

Candidates were difficult to obtain for the offices. The past president should start early getting the candidates for offices.

Constitution and Bylaws
Ad-hoc committee of computer applications committee will be voted on as a standing committee at the business meeting. Discussion was held about the getting candidate photographs in the nomination packets for awards.

Local Arrangements
Bill Lewis reported on local arrangements and wanted those presiding to fill out attendance reports in program sections. Expenses were estimated at $20,112. We had 10087 reserved room nights about 3 weeks ago. AV equipment was less expensive this year. Four breaks are planned.

Program Committee
A total of 307 titles were submitted for the program. Tom Mueller will chair a one-hr. forum. There is an extra Agronomic section but no aquatic or equipment technology section. The General Session will start earlier and have 1 less speaker.

Cast Representative
David Monks reported that 4 new CAST reports are available. Task forces on non-native plants and non-native pests were assigned. Weekly updates are coming from Myers and Associates that house the library of CAST publications. Conversation on change continues to be an on-going CAST program.

CAST desires a brochure on the accomplishments of SWSS. Do we have a brochure for this purpose? WEB page would be the ideal place to put the accomplishments of SWSS. Laura Whatley will coordinate the writing of an accomplishment brochure that will also go on the WEB. Board members will email Laura contributions.

WSSA
The congressional fellow monies will shift to Rob Hegberg with AESOP. Jody Holt will become interim education director for WSSA. SWSS has several officers on WSSA Board. Electronic journal key words and a searchable database will be on WSSA WEB site.

Placement
David Jordan reported that 19 positions were available and 26 positions desired were in the placement room in 1998.

Research committee
There was a 50-page research report for several crops including Horticulture crops. The committee may go to a four-year rotation for research information on different crops in the proceedings.

Weed ID Committee
Funds to develop an interactive key are needed for the next CD Version. Color weed ID guides copies of new weeds are being explored. A new index is also being discussed. More advertisement is needed for the CD-ROM. We are getting more classroom requests for CD ROM use. Discussion was held about sending the CD-ROM to others such as Amazon.com and Books a Million

Weed Contest Committee
The contest was held at Memphis with 9 universities partisipating. University of Arkansas team placed first, Mississippi State - second, and LSU - third. The Weed Contest Fund should be moved to the SWSS Endowment. There is approximately $43,000 in the account.

A Kids Journey
Susan Surand reported on a SWSS funded project *kids' journey to understanding weeds*. Learning activities for a 3-grade program is being developed and she needs slides and technical help with certain invasive species.

Student Board
John Isgrigg indicated that the student board will meet on Monday morning with reports on a student survey. Students will meet with various SWSS committees.

Sales Coordinator -
CD -ROM advisement was placed in many areas. The CD-ROM should be advertised at the Beltwide Cotton conference and crop consultant meetings.

Continuing Education
CEU credits will be given to several states. John Snodgrass with the Texas Department of Agriculture was thanked for their efforts in getting CEU credits.

Vermeer Productions -

Alien Invaders is a documentary filmon invasive exotics that will be shown on PBS and other educational programs. A motion was made to donate $1000 to support this production. The motion was seconded and it passed. Discussion was held about getting a copy for the Society after its release.

Meeting was adjourned at 5:15 PM.

Monday, January 25, 1999
President Ratliff called the meeting to order at 10 AM.

Finance committee
It was suggested that David Monks, the incoming Secretary/Treasurer, visit the Business Manager's office and develop an understanding of the Society's financial picture early in his tenure. Discussion was held about the dual check-signing requirement of the insurance company that holds the surety bond on the Business Manager. David will check with the insurance company about the specific requirements. Dual signing of checks may not be required for checks under a certain amount. David will also get specifics about Bob Schmidt's back up including how she may be reached in an emergency.

Long range Planning
Several suggestions were made concerning future SWSS activities. President Ratliff encouraged the long range planning committee to do more strategic thinking and planning about fulfilling our mission and where the society will be in 50 years. Three or four long-term recommendations were requested from the Long-Range Planning Committee by the by the summer board meeting.

Local Arrangements
Dick Oliver is chair of local arrangements for the Tulsa meetings and his committees are working on the next year's meeting. Room nights should be checked and adjusted according to this meeting.

Forestry ID Guide
Jim Miller presented an update on the Forestry ID guide and provided a breakdown of potential profits. Discussion about the title of the book was held. A motion was made to set the charge for the Forestry ID guide at $36 per book including postage and handling with 50 complimentary copies for the authors. The motion was seconded and it passed.

Endowment Foundation
The Endowment Foundation desires to increase funding to $300,000, currently it is at $177,000. A GLP training session offered on the Sunday afternoon and Monday morning before the conference in Tulsa would hopefully attract non-members in addition to members. Income from the GLP conference would go to the Endowment. Registration fee would be $150 for an 8-hr session. Ray Smith will contact Norvartis for training availability. A brochure would be printed and mailed to clients. The endowment brochure should include annual meeting activities beyond the GLP training. Bob Schmidt will be requested to arrange and supervise the GLP training registration.

A motion was made to authorize and to support ($1000) the SWSS Endowment Foundation initiated GLP training program in Tulsa with income from the training going to the Endowment Fund. Motion was seconded and it passed.

Possible summer board meeting dates are June 12 and 13 or June 26 and 27.

Meeting was adjourned at 11:45 AM.

Minutes for SWSS Board Meeting
January 28, 1999
Holiday Inn Four Seasons, Greensboro, NC

President Don Murray called the meeting to order at 7:15 am.

Attendees included Don Murray (President), Bill Witt (Member-at-Large), David Jordan (Member-at-Large), David Monks (Secretary/Treasurer), Gene Wills (Procedures Chairman), Alan York (CAST rep), Randy Ratliff (Past-President), Barry Brecke (Member-at-Large), Laura Whatley (President-Elect), Bert McCarty (newsletter editor), Shep Zedaker (Forestry Advisor to the Board), Chris Tingle (Graduate Student Rep), Dan Reynolds (Editor), Cletus Youmans (Member-at-Large), and Bob Schmidt (Executive Secretary).

President Murray asked for adoption of the agenda and it was adopted.

Business Managers Report
Bob Schmidt indicated that there were approximately 500 people in attendance. He also indicated that 350 people were guaranteed for the banquet on Wednesday night and it appeared that 320 to 330 people attended. A motion was made to accept the report, a second followed and it was passed unanimously.

External Funding Committee Report
Doug Worsham gave this report. The committee compared declining attendance with the extinction of the dinosaurs. They predict that if membership continues to decline as it has in the last few years the society will be extinct by 2030. They emphasized the need for the society to change. The committee proposed to the Board the following:

1. **Plan for the near future, 3 to 5 years, on funding the Endowment growth from activities specific to and conducted by SWSS.**
2. **Arrange for a strong promotion of the Forest I.D. Guide when it becomes available.**
3. **Increase promotion of the Weed I.D. Guides.**
4. **Arrange for promotion of the CD Rom sales.**
5. **Investigate the practice of companies that match employee donations to nonprofit organization such as SWSS.**
6. **Consider another money making project such as the Herbicide Symptoms Guide.**
7. **Sell Graduate Student Contest Veteran badges or ribbons to attach to registration badges at annual meetings.**
8. **Consider selling on-line data and information. Also, what about a subscription type newsletter?**
9. **Consider a Diagnostic on-line Weed I.D. and Weed Problem web page.**
10. **Have students in the Society call SWSS members in their respective states for donations and pledges.**
11. **Consider transferring any excess funds each year to Endowment Foundation.**
12. **Symposia or workshops may offer a source of income.**

Motion was made for External Funding Committee to have available for the next annual meeting (2000–Tulsa) a badge or ribbon, etc. (as determined by the External Funding Committee) for approximately $10 to identify members as past participants in the graduate student programs. It was followed by a second and passed unanimously.

It was <u>suggested</u> (not voted on) by the Board to determine from members next year by questionnaire what other activities (workshops, etc.) they might be interested in.

Weed ID Committee Report
Mike Defelice gave this report. He indicated that the committee would like to change the name of the printed book to Southern Weed Science Society's Weeds of the United States and Canada. He indicated that Set #7 of the book is ready to print. A motion was made, a second and then it passed unanimously to authorize the Weed ID committee to prepare to print Set 7 and to get bids on printing for Board action on next years budget. The committee was seeking the Board to authorize $3,600 to pay graduate students for imputing data base of the taxonomic description for the CD Rom–version 3 (this became a motion, followed by a second and then passed unanimously). This will bring it up to 400 weeds. This is an increase of 38 weeds.

Sales Coordinating Committee

Mike Defelice gave this report. Suggested to the Board that committee make a significant promotion of sales of the CD Rom. This committee will propose ideas on promotion of the CD Rom at the summer board meeting. Defelice will contact American Phyto. press and see how much it would cost for them to advertise the CD Rom and sell it. He will also check into redistribution by other companies.

Contest Committee
Todd Bauman presented this report. There were 28 poster, and 51 papers in the three poster sessions and six paper sessions. The Board discussed the private viewing of posters in the graduate student contest by the judges evaluating them as the rules indicate. The Board indicated that if it is in the rules it should be adhered to. This will be worked out by the Program Chairman and the Chairman of the Graduate Student Paper contest committee.

Discussed that some of the Contest rules in the MOP were not consistent in language (ie indicates in one place 10 papers or less in a contest section but in another place it says 8 to 12 papers in a contest section. A motion was made to make the language consistent with 8 to 12 papers whenever number of papers is referred to. (There was a second and it passed unanimously).

Graduate Student Report
Chris Tingle gave this report. The graduate students would like a display that would have information about the Weed Science Programs of member universities on it. They will have a proposal developed by the summer board meeting. It was suggested that they have a larger display like an exhibitor. Possibility of a industry representative/graduate student mixer was discussed. Also discussed an icebreaker for graduate students to get to know each other. One possible icebreaker event that was discussed was a free luncheon. They will develop a proposal by summer board meeting on this. Chris Tingle also mentioned that there was confusion over abstract instructions. Dan Reynolds will check on this. Motion to accept report, seconded and passed unanimously.

1999 Program Chairman
Don Murray indicated that there were 6 non-members of societies that attended and presented papers.

2000 Program Chairman
Laura Whatley indicated that, at this time, there are 5 or 6 possible topics for the meeting that have surfaced. They are 1) Weed Science–outside the loop, 2) Precision Agriculture, 3) Global warming, 4) Wildlife issues and weed science, and 5) Regulatory issues. She concluded by asking for suggestions for the program.

It was suggested by Bill Witt that a profile of members be developed for the society.

Finance Committee Structure
It was stated that the current MOP says that the Finance Committee be chaired by the Vice-president. The question was whether this committee should be chaired by the secretary/treasurer instead of the vice-president since the vice-president changes yearly. This topic was tabled until the summer board meeting.

Paper Title Submissions for SWSS Annual Meetings
The board discussed whether titles of papers for the annual meeting should be submitted electronically or by hard copy. The was no action. However, title submissions will be electronically and hard copy in 1999.

Endowment Funds and Weed Contest Funds
The Board discussed the Endowment contribution by the Southern Weed Science Contest funds and this was deferred to the summer board meeting.

Refunds for SWSS Annual Meeting
The Board discussed refunds of registration costs for the annual meeting to no-shows. Currently, Bob Schmidt handles it on a case by case basis and refunds are made based on the reasons for not attending. No action, but the Board agreed with the way he currently handles it.

Election of Officers
The Board discussed election of officers and the method for informing newly elected officers. There was no action. However, upon receipt of the results of the election, the Secretary/Treasurer will send information immediately to the President and then the President will notify all nominees.

Summer Board Meeting
There was a motion for the summer Board Meeting to be June 12 and 13 in Tulsa, OK. It passed unanimously.

Membership Report
Several options for increasing membership was discussed. They were: 1) to have a separate line for membership on the pre-registration form, 2) discount society publications to members, 3) to have a membership form for SWSS through the web page, 4) consider having joint meetings with other organizations. Item #3 was received favorably by the Board.

Old Business
The Board discussed that the Editor be allowed to post an electronic copy of the proceedings on the web excluding committee reports and minutes and also have a hard copy. No action on this item however it will be done by the Editor in the year 1999.

New Business
Karen Defelice
There was a motion for the SWSS to send one dozen red roses to Karen Defelice and a Valentines card for all that she has done for the society. It passed unanimously.

Award Winners
The Board discussed that, with regard to nominators of members for awards, nominators be informed through subcommittee chairs of award candidates who did not receive awards. No action on this item however the Board agreed this was a good idea.

SWSS Logo
The President will request ideas from the membership using the newsletter for development of a logo for the society. No action.

Meeting was adjourned 11:00 am on January 28, 1999.

Southern Weed Science Society
Business Manager's Report

January 19, 1999

Membership as of December 31

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

Research Methods to date

Expense $37,107 Income $40,328

Weed Identification Guide to date

Expense $395,372 Income $704,462

Weed ID sales for the first 6 months is $7,935 as compared to $13,512 for the same period a year ago. Budget for year was projected with sales of $22,000

I have recovered the negatives of sets 1,4,5,6 from the printer that went out of business. I ws unable to find negatives for sets 2 and 3. We will have to reprint set #2 in the next year to 2 years. Extimated cost will be est $35,000.

Weed CD-ROM version 1, final report

Expenses $21,936 Income $57,691

Weeds of the United States and Canada CD-ROM

Expenses $3,978 Income $15,930

Preregistration

	1999	1998	1997	1996	1995	1994
Members	261	285	292	282	331	319
Students	116	74	74	63	67	63
Total	377	359	365	345	398	382
Percentage of final	61%	67%	62%	60%	56%	61%
Total Attendance	618	601	584	566	703	622

Investments

$55,000	CD 5.75 due 1/00
$70,000	CD 5.46% due 7/00
$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
$20,249	IMMA

SWSS Net Worth, May 31

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
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
1985	Houston	933	21,520	24,131
1984	Hot Springs	840	23,302	23,751
1983	Biloxi	905	20,532	24,535
1982	Atlanta	813	19,706	25,442
			$538,942	$600,900

Gain (Loss) ($68,264)
average loss $4,000/yr

Annual Meeting registration fees

Year	Member	Student
1999	$90	$45
1998	$60	$30
1997	$60	$30
1996	$60	$30
1995	$60	$30
1994	$50	$25
1993	$50	$25
1992	$50	$25
1991	$40	$20
1990	$30	$12
1989	$30	$12
1988	$30	$12
1987	$30	$12

AWARDS COMMITTEE REPORT - Presented by Robert M. Hayes

The annual call for nominations for the six awards (including two Distinguished Service Awards) was published in the summer and fall newsletters. There were two nominees for each of the Distinguished Service Awards, four for the Outstanding Young Weed Scientist Award, three for the Outstanding Educator Award, and three for the Weed Scientist of the Year Award, and four for Ph.D and 2 for M.S Outstanding Graduate Student Awards. We had excellent and deserving nominees for each award and the subcommittees had a difficult task selecting the winners. The award and recipients are as follows:

Distinguished Service Award Industry - Laura Whatley

Distinguished Service Award Academia - Tom Monaco

Weed Scientist of the Year Award - James H. (Jim) Miller

Outstanding Educator Award - Ron Talbert

Outstanding Young Weed Scientist Award - Dan Reynolds

Outstanding Graduate Student Award
M.S - Patrick Clay
Ph.D - Stanley Culpepper

Respectively submitted by,

Robert M. Hayes, Awards Committee Chair

Dave Prochaska, Distinguished Service Award Subcommittee, Chair

John Byrd	Scott Hagood	Harold Coble	Mark Boyles
Claude Derting	Phil Banks	Jerry Weber	Aithel McMahon

Mark Kurtz, Outstanding Young Weed Scientist Award Subcommittee, Chair

Bill Witt	Bert McCarty	David Shaw	Mike Chandler
Steve Williams	Jim Stritzke	J. L. Yieser	Bob Dill

Reid Smeda, Weed Scientist of the Year Award Subcommittee, Chair

John Wheete	Jim Burton	Kriton Hatzios	Euel Coats
Clete Youmans	Bob Hoagland	Andy Ezell	Ken Smith

Megh Singh, Outstanding Educator Award Subcommittee, Chair

Mike Barrett	Mike BravermanJerry Weber		David Shaw
Euel Coats	Wayne Keeling	Anne Wiese	Ed Murdock

Dave Gealy, Outstanding Graduate Student Award Subcommittee, Chair

Bill Johnson	B. Shiver	Peter Dotray	Jim Burton
Martin Locke	John Wilcut	Eric Webster	Todd Baughman

CAST REPRESENTATIVE REPORT - Presented by David W. Monks

CAST met on March 20-22, 1998 at Crystal City Marriott in Arlington, VA. Sue L.Sullivan was president and David R. Lineback, president-elect. The fall board meeting for CAST was held in Kansas City on October 9-11, 1998. Significant happenings in 1998 include Meyers and Associates replacing AESOP, Ltd for CAST's Washington representative, publications published on (1) Food Safety, Sufficiency, and Security; (2) Natural Occurring Antimicrobials in Food; (3) The Proposed EPA Plant Pesticide Rule; and (4) Feasibility of Prescription Pesticide Use in the United States. They can be accessed through CAST's wed site (www.cast-science.org).

Meyers and Associates house a library of CAST's publications, help arrange briefings, and provide weekly updates to board members on legislative activity in Washington. CAST is considering revising their strategic plan in the near future.

CAST will co-sponsor a workshop, "The FQPA: A Challenge for Science Policy and Pesticide Regulation," with the International Society of Regulatory and Pharmacology March 23-24, 1999 at the Hyatt Fair Lakes, Fairfax, VA. For registration information, contact ISRTP at (410) 992-9083 or rtp-isrtp@erols.com.

CAST has coordinated and supported **"Conversation on Change"** that the leadership in which various societies have participated. The following is from the web site (www.societies.org) describing "Conversation on Change".

We (societies) are a community seeking enhanced
•personal and organizational learning, growth, and development; •services, member participation, and leadership of our societies; •networks and collaborations among and between our societies and other organizations; and •communication of, and about, science, and agriculture.

The coordinating team (for Conversation on Change) is made up of six working groups:
Explorers. The mission is to bring in new and tenacious ideas, visions, and concepts to increase the relevancy of our professional societies (through increased service to members, increased member ownership, new and nontraditional members and customers, and new society forums).

Networking. The mission is to promote and facilitate communication among food, agricultural, and natural resource related societies and within the global community.

Orchid Complex. The Orchid Complex's driving reason to be is to create opportunities for other voices and collective ideas to "reach in" to the Conversations on Change and member societies. These voices might include professionals and leaders of NGOs, labor, citizen watchgroups, media, etc., in other words, those organizations who are not yet included as Conversations on Change partners, but who are actively seeking or creating guiding principles for agriculture, food and the environment in then next century.

Outreach. The mission is to develop strategies to enable/empower our societies to advocate the use of scientific information in the decision-making process by educating the public, being an advocate for agriculture, and responding to or avoiding crises by communicating a credible message. This team has three subgroups: media, policy/decision-makers, and K-80+ education.

Recognition. The mission is to strengthen services of CAST societies by providing opportunities to recognize the value of new and future society members. The PowerPoint presentation on portfolios is available.

Synergy. The mission is to enhance the value of individual societies to their members by promoting intersocietal communication and collaboration.

EDITOR'S REPORT - Presented by Joan A. Dusky

The 1998 Proceedings contained 517 pages and was assembled and mailed to the Business Manager in June, 1998. This was an increase of 46 pages from the 1997 Proceedings. The Proceedings contained all Executive Board minutes, committee reports, Business Managers, report, General Session presentations, Presidential Address, Award winners, abstracts and full papers. Following is the distribution of number of presentations and number of pages.

Section	Number presented	Number of pages	Number of papers
Minutes of Executive Board, Committee Reports, etc.		86	
General Session	3	8	3
Weed Management in Agronomic Crops	94	64	0
Weed Management in Turf, Pasture, and Rangeland	22	16	0
Symposium: Turfgrass Weed Control	12	10	0
Weed Management in Horticultural Crops	13	8	0
Forest Vegetation Management	32	56.5	12
Symposium: Forest Vegetation Management Interactions Forest Vegetation Management	8	35	4
Vegetation Management in Utility, Railroads and Highway Right-of-Ways, and on Industrial Sites	7	7	1
Biological and Aquatic Weed Management and New Weed Problems	3	2	0
Ecological and Physiological Aspects of Weed Management	18	13	0
Educational and Regulatory Aspects of Weed Management	6	5.5	1
Developments from Industry	14	8	0
Soil and Environmental Aspects of Weed Science	10	7.5	1
Posters	65	46.5	1
State Extension Publications, Weed Survey, Economic Losses, Indexes		91	
Total Abstracts and Papers	307	287	23
Total - Other		139	
Grand Total	**307**	**517**	**23**

FINANCE COMMITTEE REPORT - Presented by Don S. Murray

The finance committee met briefly and discussed items that the incoming secretary-treasurer should address:

- Visit the business office to become familiar with procedures
- Update Manual of Operating Procedures to include Secretary -Treasurer trip to business office once per term
- Get phone number, e-mail, etc. of business office back-up person so she can be contacted, if needed
- Review procedures for countersigning checks

Respectfully submitted,

L.L. Whatley, Chair
J. A. Dusky (Ex-Officio)
T. Whitwell
D. S. Murray
C. E. Snipes
L. Gillham
B. D. Sims

MEETING SITE SELECTION COMMITTEE - Presented by Daniel B. Reynolds

The meeting site selection committee considered properties in Alabama, Kentucky, Mississippi, and Tennessee. Past meeting histories and meeting requirements were provide to Kathy Tatom with Helms Briscoe to evaluate potential properties as well.

Letters of inquiry were sent to the Convention and Vistors Bureau of all major cities within the specified states. From the numerous responses the list was narrowed to two potential properties. The final properties were the Hyatt in Lexington, KY and the Beau Rivage in Biloxi, MS. A final item by item comparison was distributed to the Board of Directors and they voted via email to select the site for the 2001 annual meeting. The Board of Directors determined that the Beau Rivage was the most suitable site and it was selected for the 2001 annual meeting. Next year a property will be selected in the eastern region.

NOMINATING COMMITTEE - Presented by Bob Hayes

Nominations for the offices to be filled in 1999 were submitted by the nominating committee and the Board of Directors. Once nominations were compiled, each member of the nominating committee were asked to rank the suggested candidates. The top two individuals in each category were placed on the ballot and mailed to the voting membership. The voting members returned their ballots to Secretary-Treasurer Ted Whitwell, who then tallied the votes and found those **marked by an asterick to be the winners**. There were 263 members that voted and the elections was close for each office. An excellent slate of candidates was generated and the nominating committee THANKS those who agreed to be nominated.

Vice President	G. Euel Coats Joe Street*
Secretary/Treasurer	Joan Dusky David Monks*
WSSA Representative	Barry Brecke* Jackie Driver
CAST Representative	David Bridges Alan York*
SWSS Endowment	Tom Monaco* Aithel McMahon

Respectively submitted by,

Robert M. Hayes, Chair	Dick Oliver	John Byrd
Phil Banks	Jaime Yanes	Dudley Smith
John Wilcut	Charles Bryson	Harold Coble

PROGRAM COMMITTEE (1999) REPORT - Presented by Don S. Murray

"A Glance to the Past, a Vision for the Future" was selected as the theme for the 52nd Southern Weed Science Society Annual Meeting in Greensboro, NC. The General Session was moved to earlier in the morning in order to accommodate the Society Business Meeting which will be held immediately after the General Session.

The Board of Directors Meeting will begin on Sunday afternoon and continue Monday morning. Numerous committee meetings will also be held Monday morning. The formal program will begin Monday afternoon with five concurrent paper sessions and the poster session.

Tuesday's poster session will begin 30 minutes earlier so that the General Session can begin earlier. Dr. Henry Collins, formerly with Novartis, will welcome us to Greensboro. Dr. Gale Buchanan, Dean and Director of the Georgia Agricultural Experiment Station, will be the only invited speaker and will speak on Agriculture-Beyond 2000. Dr. Randall Ratliff will present his Presidential address on "SWSS-The Next Fifty Years." The Business meeting will be held immediately following the General Session.

The Graduate Student Contest will begin Tuesday afternoon with papers being presented in nine sections plus posters. Two sections will not appear in the program-Section VI Biological, Aquatic, & New Weed Problems and Section X Application Technology. Apparently, the Board previously had voted to eliminate Section X and I did not.

Wednesday will feature posters in the morning, five paper sessions in the morning, and four paper sessions in the afternoon. There were a total of seven Agronomic Crops sections, but no more than two were concurrent.

The mixer and banquet will conclude the meeting on Wednesday evening.

There were a total of 307 titles submitted for posters and papers for the meeting, down from 315 in 1998. The draft program was sent to Bob Schmidt in early November and the final program was received by the membership in early December.

PROGRAM COMMITTEE (2000) REPORT - Presented by Laura L. Whatley

The Program Committee met briefly to discuss the theme for the 2000 meeting. All present were in favor of a tie to Y2K, with themes such as “Y2K: What’s Next, ” “Y2K: The Challenge of Change,” “Y2K: Progression Through Change,” “Y2K: What’s Next for Weed Science?”, etc. The Committee will converse through e-mail to finalize the theme over the next few months.

Having a guest speak on global warming for the General Session was discussed; those present favored the idea.

Respectfully submitted,

L.L. Whatley, Chair
F. B. Walls
J. Higgins
W. Mitchem
J. Groninger
J. M. Taylor
K. A. Langeland
D. Gealy
J. Wilcut
K. R. Muzyk
J. E. Hanks
S. Senseman
P.A. Banks

RESEARCH COMMITTEE REPORT - Presented by Laura L. Whatley

The Research Committee has decided to expand the Economic Losses and Weed Survey - Southern States sections into four subsections, beginning in 2000. In addition, the former subsections will be redefined:

1) Grass crops, turf, range, and pastures
2) Broadleaf crops and forestry
3) Fruits, nuts, and vegetables
4) Aquatic, industrial, nursery and container ornamentals, and rights-of way

Thus, the Economic Losses and Weed Survey - Southern States subsections will move to a four-year rotation; for 2000 the subsection will cover grass crops, turf, range, and pastures; for 2001 broadleaf crops and forestry will be reported, etc.

Another change for the 2000 report will be expanding the "Chemical and Physical Properties of New Herbicides" section to include new herbicide uses.

Language describe the new report format will be submitted to the Constitution and Operating Procedures Committee for inclusion in the Manual of Operating Procedures.

Clyde Dowler suggested that Ted Webster take over the Weed Survey - Southern States portion of the report; Ted was present and willing to do so. That suggestion will be forwarded to the President for consideration.

Respectfully submitted,

L.L. Whatley, Chair
E. P. Webster
J. D. Byrd
C. C. Dowler
Vic Ford

RESOLUTIONS AND NECROLOGY REPORT - Presented by G. N. Rhodes, Jr.

RESOLUTION

Commendations for an effective meeting

WHEREAS the arrangements and programs for the 52nd annual meeting of the Southern Weed Science Society have 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 membership of the Southern Weed Science Society commend Chairman Bill Lewis and members of the local arrangements committee and Chairman Don Murray and members of the program committee for their outstanding efforts in behalf of the society.

NECROLOGY

Glenn Charles Klingman, 83, died at the Brian Center in Durham, NC on July 27, 1998. The son of William Klingman and Mable Eickman, Dr. Klingman was born in Belleville, KS on January 7, 1915. He is survived by his wife of 59 years, C. Loree Klingman, two sons, two daughters and eleven grandchildren. He received his B.S. degree form the University of Nebraska in 1939; his M.S. degree from Kansas State University in 1941; and his Ph.D. from Rutgers University in 1950. Through his teaching at the University of Nebraska and North Carolina State University, Dr. Klingman's numerous students have gone on to strong positions of leadership in agronomy, weed science and administration. Following his tenure at North Carolina State University, Dr. Klingman worked for Eli Lily and Company in Greenfield, IN. His accomplishments in weed science are very significant and numerous. He was one of the earliest researchers with soil incorporated herbicides.

Dr. Klingman was the author or coauthor of numerous scientific and popular publications including *Crop Production in the South,* and in 1961, a true foundation text in weed science titled *Weed Control : As a Science.* This text was revised in 1975, with the help of coauthors Floyd Ashton and Lyman Noordhoff, and re-titled *Weed Science: Principles and Practices.*

Dr. Klingman was actively involved in the Southern Weed Science Society, where he served as the society's ninth President, and where he served on and chaired numerous committees and presented many papers. He was a President and Fellow of the Weed Science Society of America; President of the North Carolina chapter of Sigma Xi; and was appointed by the Governor of Indiana to the Indiana Pesticide Review Board. He is listed in the Who's Who in American Education; Leaders in American Science; Contemporary Authors; American Men and Women of Science; and Community Leaders and Noteworthy Americans.

Dr. Klingman was appreciated by his coworkers for his expertise in weed science and crop production. He was a valued member of the Research Triangle community, the agricultural and scientific communities, and the Southern Weed Science Society. Dr. Klingman will be greatly missed by friends and colleagues from across the United States.

WHEREAS Dr. Glenn Klingman served with distinction at the University of Nebraska, North Carolina State University and Eli Lilly Company, and

WHEREAS Dr. Glenn Klingman, one of the true pioneers in weed science, provided numerous significant contributions to weed science and the Southern Weed Science Society,

THEREFORE BE IT RESOLVED that the officers and membership of the Southern Weed Science Society do hereby take special note of the loss of our coworker, Glenn Charles Klingman, and by copy of this resolution, we express to his family our sincere sympathy and appreciation for his contributions.

Allen Franklin Wiese, 74, died January 21, 1999 in Amarillo, TX. The son of Paul Daniel and Elizabeth Marie Wiese, he was preceded in death by a son and his wife. He is survived by two daughters, Beth and Ann. Dr. Wiese was born in Eyota, MN on December 16, 1925. He was educated at the University of Minnesota, where he received his B.S. in 1948; the M.S. degree in 1951 and his Ph.D. in 1953. Dr. Wiese began his professional career at Texas A&M in 1953. Upon his retirement from that institution as Professor in 1989, he was named Professor Emeritus and maintained a close relationship with Texas A&M and the weed science community until his death. His accomplishments in weed science are very significant and numerous. He was one of the first researchers involved in limited tillage weed management systems.

Dr. Wiese was the author or coauthor of over 600 publications. He was an editor of the *Proceedings of the Southern Weed Science Society*; editor of *Weed Control in Limited Tillage;* and an associate editor of *Weed Science*. He was the winner of the Research Award from Texas A&M University in 1981. He was named a fellow of the Weed Science Society of America in 1979, and won that society's Research Award the following year. Dr. Wiese was also a Fellow of the American Society of Agronomy, and is listed in Who's Who in Science and Engineering.

Dr. Wiese was actively involved in the Southern Weed Science Society , where he served as the society's 27th President in 1974, and where he served on and chaired numerous committees and presented numerous papers. He received the Southern Weed Science Society Distinguished Service Award in 1977.

Dr. Wiese was appreciated by his coworkers for his expertise in weed science and crop production. He was a valued member of the Amarillo community, the agricultural and scientific communities, and the Southern Weed Science Society. Dr. Wiese will be greatly missed by friends and colleagues from across the United States.

WHEREAS Dr. Allen Wiese served with distinction at Texas A&M University , and

WHEREAS Dr. Allen Wiese, one of the true pioneers in weed science, provided numerous significant contributions to weed science and the Southern Weed Science Society,

THEREFORE BE IT RESOLVED that the officers and membership of the Southern Weed Science Society do hereby take special note of the loss of our coworker, Allen Franklin Wiese, and by copy of this resolution, we express to Ann and the rest of his family our sincere sympathy and appreciation for his contributions.

Respectfully submitted,

Walt Bachman
Jerry Creighton
David Monks
Carroll Moseley
K. Reddy
H.R. Smith
J. Dan Smith
Jaime Yanes
G. Neil Rhodes, Jr., Chair

SALES COORDINATION REPORT - Submitted by Ann Wiese

The Committee wished to sincerely thank Mike DeFelice for all the promotional work he has done for the Weed ID CD. He has done all the work for the committee including compiling the list below.

Advertising for the SWSS Weed ID CD-ROM - 1998

- Bob Schmidt sent upgrade brochure to all owners for Version 1.0. All Version 1.0 owners have been notified of upgrade opportunity.
- Successful Farming "Ag Innovator Online" Web site - An announcement and description placed on their web page.
- North Central Weed Scientist List - announcement**.**
- Iowa State put an announcement on their web site. All midwest university weed scientists know about the CD.
- Agronomy News - Announcement will be published in next ASA Agronomy Newsletter.
- SWSS, NCWSS and WSSA newsletters - Announcements published in all three winter editions of these newsletters.
- Agrow World Crop Protection News - Announcement published in this international periodical.
- National Association of Agricultural Educators (NAAE) Announcement to be published in winter newsletter. One copy of the CD-ROM was donated as a door prize for their national meeting in December.
- JNRLSE (ASA) Sent copy of CD-ROM for a formal review article to be published in their journal. They did this for us with Version 1.0 as well.
- NCWSS conference in St. Paul - Mike DeFelice set up a booth with a computer and demonstrated the CD-Rom during the conference. He handed out order forms.
- Agronomy Society, Made inquiry for advertising rates to place adds in Agronomy Journal etc. This will be discussed at the SWSS meeting.
- Pioneer - Gave demonstration to Pioneer Hi-Bred technical training department. Pioneer "pre-purchased" 130 copies for their sales agronomists.
- Farm Journal Magazine - Announcement published in magazine. Possibly an article or review in the future.
- CTI-CLUES (Centre for Computer-Based Learning in Land use and Environmental Sciences), Aberdeen University, UK - Announcement and review for UK agricultural educators to be published in Newsletter and journal. SWSS conference. Booth and computer display with demonstrations of the new software.

Future Plans: DeFelice is currently working on sending out more announcements and review copies to several computer and training magazines, gardening magazines and more scientific societies. Mike would like to see an effort made to have the CD-ROM announced in University Extension crop protection/Agronomy/IPM newsletter this spring.

Respectfully Submitted, Ann M. Wiese

SOUTHERN WEED CONTEST COMMITTEE REPORT -- Presented by Eric P. Webster

The 19th annual Southern Weed Contest was held August 11, 1998, at the Agricenter International in Memphis, TN. Drs. Michael Kenty, Bob Scott, and Greg Stapleton and the entire American Cyanamid Company did an excellent job on providing the students with a challenging day. The weed identification, herbicide injury symptomology, sprayer calibration, and the field problem solving were all well prepared and challenging to all of the contestants. The mystery event was safely preparing a truck, trailer, and tractor for transport.

Teams from eight universities competed in this year's contest, including graduate teams from University of Arkansas, Louisiana State University, Mississippi State University, North Carolina State University, University of Tennessee, Texas A&M University, Texas Tech University, and an undergraduate team from Murray State University. The university participation this year was excellent. The Weed Contest Committee would like to encourage every university affiliated with the Southern Weed Science Society to attend the 1999 contest.

Winning teams and individuals were as follows:

Team Awards:

1st Place	University of Arkansas ($500)
2nd Place	Mississippi State University ($300)
3rd Place	Louisiana State University ($200)

Individual Awards:

1st Place	Jason Norsworthy, University of Arkansas ($400)
2nd Place	Case Medlin, Mississippi State University ($250)
3rd Place	Tate Castillo, University of Arkansas ($100)
4th Place	Shawn Askew, North Carolina State University ($75)
5th Place	Mike Lovelace, University of Arkansas ($50)

The traveling "Broken Hoe" trophy was presented to the University of Arkansas at the awards banquet. Plaques and cash awards were also presented to winning teams and individuals. The top ten individuals and contestants with the highest scores within each event were also recognized. This was an excellent contest to for students to demonstrate their knowledge and talent.

The Southern Weed Contest Committee wishes to thank all sponsors of the 1998 Southern Weed Contest. Sustaining members for 1997 included: Perennials ($2,000+)- American Cyanamid, BASF, DowAgro, Griffin, Novartis, Rhone-Poulenc, Zeneca; Biennials (1,000-1,999)-AgrEvo, Bayer, Monsanto, Valent, R&D Sprayers; Annuals ($1-999)-Helena, Rhom & Haas, Terra International; Dormant-American Ag, Cedar Chemical, DuPont, FMC, PBI Gordon, Stewart Ag, Stoneville Pedigree Seed, Uniroyal, Valley Chemical, Weed Systems. To maintain the excellent tradition of the Southern Weed Contest, the Southern Weed Contest Committee will again ask each company in 1999 to become, or continue to be, sustaining members of the Southern Weed Contest.

The 1999 Southern Weed Contest will be held in Greenville, MS, and hosted by Novartis Crop Protection. James Holloway and the staff of the Novartis Crop Protection Research Farm are planning an excellent contest, and everyone is encouraged to participate.

Respectfully submitted,

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

STUDENT ORGANIZATION REPORT - John Isgrigg III

The student organization met on January 25 at the SWSS annual meeting in Greensboro, NC.

Topics of Discussion

Committee meeting attendance by student executive board member representatives. Attendees are:

Chad Arnold	Student Paper Contest
Ginger Light	Weed Contest
Jimmy Summerlin	Outstanding Graduate Student

Summarization of student survey data and publication as a comparison tool for prospective graduate students to use while shopping university programs.

Arrangements for a guest speaker to address the student organization general session regarding a different topic concerning professional development each year. The speaker would be a university/industry professional who could address various aspects of career management, ethics in research, or other professional development topics.

Static display development for use as a recruiting tool by individual departments at respective universities, within the SWSS, and at state and national meetings. A project lead will be assigned at the organization meeting.

Need to schedule times for the student executive board meeting later on Monday to facilitate ease of travel for student board representatives as some are unable to attend due to additional funds needed for Sunday travel.

Development of an official weed seed set for use in preparation for the Weed Contest. All member universities do not have access to a complete set of weed seed and are subsequently unable to obtain them commercially. Each university would receive one master set of seed to use when preparing for the contest.

Selection of weed identification specimens by state. Concern over the preponderance of ‘Delta’ weeds was expressed. A request for the inclusion of weeds from outside the delta will be made at the annual committee meeting.

Outstanding graduate student nominations need emphasis in 1999. Encourage faculty to nominate students who are eligible.

Discussion of the SWSS website and publication of the proceedings were held. Opinions were mixed.

TERMINOLOGY COMMITTEE REPORT - Presented by James L. Griffin

Based on recommendation of the WSSA Terminology Committee, the WSSA Board of Directors approved official definitions of 'herbicide resistance' and 'herbicide tolerance'. Definitions are as follows. Herbicide resistance: "Herbicide resistance is the inherited ability of a plant to survive and reproduce following exposure to a dose of herbicide normally lethal to the wild type. In a plant, resistance may be naturally occurring or induced by such techniques as genetic engineering or selection of variants produced by tissue culture or mutagenesis." Herbicide tolerance: "Herbicide tolerance is the inherent ability of a species to survive and reproduce after herbicide treatment. This implies that there was no selection or genetic manipulation to make the plant tolerant; it is naturally tolerant." These terms in their proper context should be used where applicable in all future publications of WSSA as well as in papers and posters presented at the Southern Weed Science meetings and abstracts published in the SWSS Proceedings.

In has been brought to the attention of this committee that discrepancies exist in botanical nomenclature of certain weeds. WSSA has changed sicklepod (*Cassia obtusifolia)* to *(Senna obtusifolia)*. However, coffee senna (*Cassia occidentalis*) was not changed. There appears to be adequate justification for making this change as well. No additional common names of herbicides were approved by WSSA in 1998. This committee supports the WSSA Terminology Committee's recommendation to update the website to allow for cross referencing of herbicides by common names, chemical names, and manufacturer. There is also a desire to include old proposed common names that were not accepted and old manufacturer code names for ease in cross referencing. Additionally, it is important that the Society adopt a standard and uniform classification of herbicides by family and mode of action. This classification system should be integrated 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.

Respectfully submitted,

Jim Griffin, Chair
Charles Bryson
Terry Clason
Troy Klingaman
Robert Mack
Aithel McMahon
Ed Richard
David Shaw
Jerry Wells

SWSS WEED IDENTIFICATION COMMITTEE REPORT - Presented by Charles T. Bryson

In 1998, the Weed Identification Committee's main focus was to develop, review, and release version 2.0 of the "Southern Weed Science Society's Weeds of the United States and Canada." CD-ROM. Version 2.0 of the CD-ROM was completed and released for sale in early November, 1998. A promotional flyer was designed by Karen DeFelice and mailed by Bob Schmidt to all purchasers of Version 1. Announcements and courtesy copies of the CD-ROM were sent to farm press and professional agricultural societies for reviews, newsletter announcements, and promotions. Mike DeFelice promoted the CD-ROM at a booth at the NCWSS meeting in December.

This award winning interactive CD-ROM now contains botanical descriptions, distribution maps and over 2,000 photographs of 362 weeds common to the continental United States and Canada. New features in version 2.0 include 62 additional weeds, expanded interactive quiz exercises in the tutorials, audio narration, more illustrations and photographs, completely revised distribution maps that include Canada and Alaska, plant family descriptions, grass collar illustrations, expanded illustrated glossary, unique interactive visual key to identify seedling grasses, Larry Mitich's "Intriguing World of Weeds" articles from Weed Technology, ability to open multiple pictures, maps, and descriptions, open each individual weed "home page" with a photo of that weed, and the ability to create and save a presentation. These new additions integrated with existing features make this CD-ROM the primmer weed identification computer package available.

The committee expresses special thanks to Richard Carter for developing the plant family data base. These data based descriptions are the basic information needed to develop an interactive family key in v 3.0 and the backbone for interactive keys at the species level.

The following recommendations were approved by the SWSS Board Directors:

1. The Weed ID committee proceed and printing weed set number 7 of 50 weeds in 1999.
2. Change the name of the printed book to the "Southern Weed Science Society's Weeds of the United States and Canada" as soon as the current stock of binders are sold. This will synchronize the name of the bok with the CD-ROM and make it clearer to potential customers that the book covers the entire US and Canada, not just the Southern U.S.
3. Proceed with the development of Version 3.0 of the SWSS Weed ID CD-ROM. The CD-ROM will add at least 38 additional weed species to bring the total to 400. The addition of a complete interactive key to immature and mature stages of all 400 species will also be added. The time schedule: 1) All content assets (photos, descriptions, and characteristics charts for the key database) to be delivered to Mike and Karen DeFelice by January 1999; 2) Programming the CD-ROM to take one year with estimated delivery of a finished product by March of 2001; 3) The production of the CD-ROM will require approximately $1000.00 to transfer Arlyn's photos to Kodak Photo-CD; and 4) Approximately $20,000.00 will be requested at a later date to cover material costs (artist salaries, narration, software and hardware, CD-R production and beta testing, package and advertising design) to complete Version 3.0 of the CD-ROM.
4. A total of $3,600.00 was approved in 1996 and reapproved to pay the graduate students for developing the data base descriptions of immature and mature weeds to be used for the interactive key in the CD-ROM. Completion of this task is expected by December, 1999.
5. The Weed ID committee requested and the SWSS Board of Directors agreed that the Sales Coordination Committee and the SWSS Board of Directors make a significant commitment for advertising and marketing the Weed ID Guide, CD-ROM and Forestry Weed ID book during 1999 and that the Sales Coordination Committee develop a formal short and long range marketing plan for these products.

Respectfully submitted,

Charles T. Bryson, Chair

Committee:	M. DeFelice	C. Moseley
	C.D. Elmore	R. Muir
	J.D. Green	W.A. Skroch
	B. Johnson	R. Smeda

FOREST PLANT ID GUIDE SUBCOMMITTEE REPORT - Presented by J. H. Miller

The manuscript and photography are nearly complete for the field identification guide: “Forest Plants and Shrubs of the Southeast”. The book will contain descriptions of 181 genera of forbs, grasses, vines, shrubs, and palms, detailing 331 species. Final editing is underway, with invited comments from three “reader” reviewers being acquired. Comments from the four botanical reviewers have been incorporated. The introduction, glossary, and reference sections need to be written.

Photo selection and cropping are in progress so that scanning by the printer can commence soon. An additional 73 images were added this summer, with a total of 627 images to be included.

The Executive Board at their summer meeting approved publication of 6,000 copies by Craftmaster Printers, Auburn, Alabama. Miller will discuss with the Executive Board at the upcoming meeting regarding a revised plan with an initial printing of 3,000 or 4,000 copies and a planned reprinting. Revised cost estimates for a print-reprint approach and reported sells of a similar book will be provided.

Continued support and contributions by numerous individuals have brought this project to this point.

Respectfully submitted,
James H. Miller, Chair

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

CONTINUING EDUCATION COMMITTEE (SPECIAL) - Submitted by John M. Snodgrass for Randy Rivera

There were 74 licensed pesticide applicators that requested continuing education units (CEU's) from 14 state agencies during the1998 SWSS conference. The Texas Department of Agriculture (TDA) approved the meeting for recertification credit for licensed pesticide applicators. The department contacted the other states in the region for approval of recertification credit for applicators attending from their state also. Texas prepared the proper forms for the applicators and had personnel attend the meeting to distribute and collect these forms. The forms were returned at the end of the session. The certificate was mailed to the individual and a copy was sent to the state where they were licensed.

As of 1/22/1999 the following states have agreed to accept CEU's for the 1999 SWSS conference: Alabama, Florida, Georgia, Indiana, Kentucky, Louisiana, Mississippi, New Mexico, North Carolina, South Carolina, Tennessee, Texas and Virginia.

The program, on the top of page six, states that to obtain CEU credits, licensed pesticide applicators are to pick up are certification form near the registration table. As last year the forms are to be return to the table at the end of the conference.

EXTERNAL FUNDING COMMITTEE (SPECIAL) REPORT - Presented by Doug Worsham

We wished to preface this report by comparing the SWSS with dinosaurs. We weren't sure if that would be appropriate, but since President Randy Ratliffe shocked us in his presidential address on January 26 by showing the hypothetical headlines of the demise of the SWSS, we thought it would be O.K. to do this. We all know that the dinosaurs flourished for millions of years on earth. Then they became extinct. Leading theories are that they could not or did not adapt to a sudden, drastic change in the environment. Will the SWSS suffer the same fate? One can do interesting manipulations with data. From the trend in declining membership in the last two years, also presented by President Ratliffe, one can project that the SWSS would become extinct around 2030 if the trend didn't change. We know that this is unlikely to happen, but perhaps the Society needs to think about change.

Following are a number of ideas that members of the External Funding Committee members and others presented for increasing directly the funding of the Society, or for increasing the membership in the Society which would, in turn, increase the worth of the Society. Then more funds could be diverted to the Endowment Foundation for support of student programs.

1. The formation of this committee came out of some ideas the Endowment Foundation Board members had for asking national and regional foundations for support of our program, hence the name External Funding. With company consolidation, poor agricultural economy, and raging bio-technology, industry sources of funding for societies such as our are drying up rapidly. The U. S. crops protection chemical industry is projected to be facing a 1.5 to 2.0 billion dollar reduction in sales due to bio-technology. This has all companies pushing for cost improvement and efficiencies. Unless a company is involved in both crop protection chemicals and bio-technology, asking for support is not likely to be fruitful. With the turn-down in industry, private foundations are receiving many of the funding requests today, but have not, as a group, been supportive of programs such as ours. The committee felt that we had better plan for the near future, three to five years, on funding the Endowment growth from activities specific to and conducted by SWSS. This should not preclude us, however, from preparing a request if anyone knows of a likely foundation source.

2. Arrange for strong promotion of the Forest I.D. Guide when it becomes available in 1999. It should be useful to many more vegetation managers than just foresters.

3. Since sales of the Weed I.D. Guides are declining, we believe that increased efforts in promotion and advertising are needed.

4. Arrange for more promotion of the CD ROM sales.

5. Investigate the practice of companies that match employees donations to non-profit organizations such as ours. Perhaps this practice could be expanded.

6. Is it too late to launch another money-making project such as the long-delayed Herbicide Symptoms Guide? There are many others available now, but they are probably not as good as one the SWSS could produce.

7. Sell "Graduate Student Contest Veteran" badges or ribbons to attach to registration badges at annual meetings. There is a large number of such persons active in our society now, if we can convince them to advertise their past participation in the contests. Publicity would need to accompany such an endeavor, reminding former contestants that they were once supported by the SWSS, and that it would be appropriate to give something back. This should encourage current student contestants when they see how many successful SWSS members were also once contestants.

8. Another money-making project could be selling something that we have to offer that is marketable. We could consider selling "on-line" data and information. Could we create an on-line paid subscription type newsletter that would attract paying customers? This could include such things as detailed, early evaluations of product performance; current weed-pest problems being encountered in various states; product performance; farmer attitudes, personnel changes; and other news and views. It is somewhat doubtful if our members would embrace this idea as it was not possible to resurrect even a simplified version of the SWSS Research Report. However, reporting of data from one computer to another might make this task easier.

9. Have a "Diagnostic On-Line Weed I.D. and Weed Problem" web page. This would make us of digital cameras to submit pictures in real time to a diagnostic center. Some states and companies now have such a service. There would be a charge by SWSS to users.

10. Have students in the Society call SWSS members in their respective states for donations and pledges. This must work well since nearly all colleges have undergraduate students call alumni for donations and pledges. One university has an incentive program with prizes for the student collecting the most money. An added benefit to this program would be that a student calling a SWSS member would have to have a good knowledge of the benefits of the student program. We believe that many students do not realize fully what the Society does for them. A quick survey of a few students indicated that probably one-half of them would be receptive to such an undertaking.

11. The Committee suggests that the SWSS Board of Directors continue to transfer any excess each year to the Endowment Foundation.

12. The Committee believes that the major method by which income can be increased is to provide services such as workshops or symposia which would include a registration fee. A good example of this was the Turf Symposium last year at the Birmingham meeting. This brought in around 150 persons for one day and brought in around $5,000 to the Society. Auburn University, however, covered some of the expenses.

There are numerous groups which aren't a part of the Society but could benefit from some type of training by SWSS experts. We have lost the aquatic group and almost lost the forestry group. The SWSS changed, however, to accommodate the forestry group better and now the SWSS meeting is said to be the premier forestry meeting in the country. It also has some international involvement.

The success of the Purdue Weed Training course and Ladlie's Training sessions attest to the fact that such training is needed by a diverse number of practitioners. SWSS could not duplicate these intensive training sessions, but could offer mini-versions. A compilation of possible groups which could benefit from training which could be offered by or through the sponsorship of SWSS follows:

- (a) vegetation managers in many areas - rights-of-way, public lands, parks and recreational areas, etc. Many states now have or are forming vegetation management societies. These should be within the SWSS.
- (b) the invasive plant managers. With increasing publicity and funding, these groups will likely form their own societies.
- (c) turf and landscape managers.
- (d) those interested in adjuvants.
- (e) private consultants. They are not getting the technical information they need in their annual meetings.
- (f) those interested in the economics of weed management.
- (g) the I.P.M. practitioners.
- (h) training of various kinds for federal and state employees.
- (i) cooperation with the Quality Assurance Society.
- (j) a workshop on basics of herbicide action.
- (k) a workshop on the basics of bio-technology as it pertains to herbicide resistant plants and herbicide tolerant crops.
- (l) environmental aspects of vegetation management in different areas.
- (m) weed management in wildlife food plantings.
- (n) a GLP workshop

Such workshops could be held on Sunday afternoon and Monday morning of the annual conference. A registration fee would be charged and if the SWSS program contained material the particular group was interested in, some might stay and become members of SWSS. We suggest sending out a broad-brush survey to members of different groups to identify what their needs are and where SWSS could be of help. We conclude by pointing out that if the Society does just a few of these things, our membership could increase, or at least not decrease, and the financial health might improve enough to meet the Endowment Foundation's goal of finally supporting the entire student program.

Footnote: The Endowment Foundation Board, at its meeting on January 25, voted to approach the SWSS Board of Directors for permission to plan a GLP training session on Sunday afternoon and Monday morning at the next annual meeting with proceeds going to the Foundation. The SWSS Board of Directors approved this proposal at its meeting on the same day.

MEMBERSHIP COMMITTEE REPORT 1999 - Presented by Bobby Walls

A meeting of the Special Membership Committee met during the 1999 Annual Meeting. Previous recommendations from the committee to the Board were reviewed. An analysis of the decline in membership was discussed. The Committee concluded that part of the decline in members is the reduction in the core numbers from the industry and academia. The committee further concluded that even with the decline in membership that the Society is serving it's members with a quality organization. This is evidenced by the fact that the number of papers presented has not declined. Therefore, the Committee made the following Recommendations to the Board:

1. That a *separate line item for membership* be included on the pre-registration forms mailed to members. The amount charged for the *membership only category* be inexpensive and set by the board. This will allow for those not attending to participate in society membership. This category of membership should receive only the Society's newsletter.

2. Offer Society's Publications for sale to members at a discount.

3. Provide means of joining the Society by the Society's WebPages.

4. Investigate the possibility of holding joint meetings and offering memberships to those involved in non traditional groups such as new emerging exotic plant groups.

Respectfully Submitted:

John Byrd	Bill Kline
Ray Cooper	Martin Locke
S.O. Duke	James Miller
Tim Murray	B.D. Sims
Tom Peeper	Greg Stapleton
John Wilcut	Bobby Walls, Chairman

SWSS GENERAL SESSION

AGRICULTURE – BEYOND 2000

Gale A. Buchanan
Dean and Director
The University of Georgia
College of Agricultural and Environmental Sciences

Your invitation to address the general session of the Southern Weed Science Society is greatly appreciated. I consider it a genuine honor to be asked to share a few thoughts with you but even more importantly, I appreciate the opportunity to renew old friendships. Although I have been away from the Society and "honest work" for about 20 years, some of my fondest memories go back to my active participation in the SWSS.

The first time I attended a meeting of the Southern Weed Conference, the forerunner of the SWSS, was in 1961 in St. Petersburg, Florida. Of course, I attended as a student. After completing my Ph.D. in 1964, I was a regular from 1965 to 1979. This organization began in June 1948 when 73 persons interested in weed control met at the Delta Branch Experiment Station in Stoneville, Mississippi and organized the Southern Weed Conference. The purposes of the Conference were, "to bring together those persons from any state, area, institution or agency, who are directly interested in weed control, to exchange ideas, experiences, opinions, and information, and discuss and plan means of securing more adequate weed control through more and better correlated and coordinated effort on weed research and control by Federal, State, and local public or private agencies." Obviously, there have been many changes since the early days of our Society.

Please allow me to compliment you for your efforts to maintain the strength of this organization. In my opinion, you probably do the best job of any such organization in the country in bringing academia and industry together. I've always been impressed how industry and academia work together so effectively. Obviously, the true beneficiaries of this effort are the clientele who depend upon the fruits of your efforts.

From the earliest point of recorded history, about 8000 B.C., to the early 19th century, agriculture changed very little. Indeed, a farmer in Europe in 1750, about the beginning of the industrial era, would be comfortable with the tools, equipment and operation of a farmer along the Tigris River in 5000 B.C.! Think how a farmer of 1750 would react if he were dropped in a typical barnyard of a farm today! I am sure that tractors, computers, pesticides and all of the things we take for granted today would "blow his mind."

For most of this early time, people were the main source of power. The introduction of animal power was a tremendous innovation that lasted well into the 20th century. Probably the most significant aspect of early agriculture is that almost everyone practiced it. When the U.S. Department of Agriculture was founded in 1862, more than 90% of the American population was farming or living in rural areas. Subsistence farming was a way of life for the vast majority of our population.

While steam power was the next innovation and forerunner of the mechanical age, it was the gasoline engine that really ushered in the mechanical age of agriculture. Depending upon our age and geographical location, many of us observed this transition firsthand. I can easily recall when just about everybody was getting a tractor and how the arguments were raised that this new innovation would compact the soil, perhaps putting an end to agriculture as we knew it. They were right about that last part: It did change agriculture as we knew it, but not for the reasons they perceived.

The industrial era brought about radical changes in agriculture. The obvious changes were the replacement of people power with machines and innovative means of using animal power. But the most powerful change was the introduction of the experimental method. The beginning of formal agricultural research is easily observed at Rothsted Experiment Station in England. Scientific experiments were begun there early in the 19th century and in Germany and other European counties quickly followed suit. This innovative idea quickly crossed the Atlantic with the opening of the Connecticut Agricultural Experiment Station in the mid 1870's. The Hatch Act of 1887 provided for the State Agricultural Experiment Station System, soon followed by the Smith-Lever Act which created the Cooperative Extension Service.

The next major innovation in agriculture was the introduction of chemicals. While some inorganic materials were used, such as sulfur for control of diseases and salt for weed control on the roads, the introduction of organic chemicals in the 1940's really gave rise to the modern age of agricultural chemicals. Although we had been dealing with weeds since the domestication of plants as crops, the appearance of chemicals provided the stimulus for the development of the Southern Weed Conference and many other such organizations and societies.

Many of us here today clearly recall the introduction of the phenyl acetics which were soon followed by the substituted ureas, thiol carbamates and many, many other herbicidal chemicals. Then, the dinitroanilines in the 60's were real breakthrough. These were, indeed, exciting times for weed science. This was before there were questions about such things as fate, toxicity and persistence of pesticides.

The stage was set for the latest truly major innovation that will change the face of agriculture forever. The Austrian monk, Gregor Mendel, conducted research with peas in 1856 which showed that various traits were inherited. His simple, yet eloquent experiments elucidated some of the fundamental laws of heredity. Other scientists followed his lead and by employing various breeding techniques started to develop plants and animals in ways that were more favorable for use by man. Agriculture reached milestone in the 1940's with the development of hybrid vigor and the first successful commercial hybrid corn. The next step was molecular genetics and the age of biotechnology. This technology is in an infancy, but its promise for the future is indeed mind boggling.

Have you ever stopped to realize that our discipline, weed science, has been a key component in each of these eras? Weed science has always been at the forefront of embracing new and innovative technology. It is also interesting to realize that we are still searching for new ways to utilize old technology. In addition to mechanical, cultural and other traditional means of
controlling weeds, we investigated flame, microwave energy, and other innovative means as well.

The real challenge for us in weed science today is how we fare in some of the major trends affecting agriculture in the future. Some of these trends will have little or no impact on weed science. However, some will have far reaching implications on the future of this discipline. We must be poised to take advantage of any opportunity that will enhance the success of our discipline. I would like to share with you what I think will be a few significant trends impacting agriculture that will shape weed science in the coming years.

<u>Trend #1 - Funding for Agricultural, Teaching, Research, and Extension will continue to be Highly Competitive and not Adequate to Meet all Needs.</u>

I wish I didn’t have to see this as a future trend, but the key question is “How does weed science position itself for the future?” In industry I think the answer is pretty clear. Results that have promise of momentary payoff will clearly drive weed science. In academia, however, the question is a bit more complex.. At a time when problems continue to mount including globalization and the implementation of new technology, along with the traditional problems of weather and environmental considerations, agriculture is truly at a crossroads. I do not wish to belabor the point, but the commitments for support of agricultural research and extension programs, by both State and Federal governments, are static or even in a period of decline. And it comes at a time when support for research in most areas of science at the national level has experienced unprecedented growth. In fact, it has been suggested that we as a nation should double our commitment to Federal support for science research within the next few years. Unfortunately, agriculture always seems to be left out of the scenario of these exceedingly commendable goals. In fact, we in agriculture, are not even considered in the national science agenda. There continues to be greater demands while there is at best a stable or declining resource base.

The state of Federal formula funds for support of agricultural research and cooperative extension programs are particularly troubling. Although these funds represent only a small percentage of funding in most states, they are extremely important because they provide the framework by which research and extension programs are coordinated at the regional and national level. Despite the importance of these funds, the emphasis at the national level is moving toward competitive grants in the model used by NIH, NSF and other granting agencies. Competitive grants, which by nature emphasize basic rather than applied sciences, are important, but I firmly believe that increases in competitive grant programs should not be at the expense of base or formula funding which provides flexibility for both long-term approaches and immediate emergency responses.

Lack of departmental status has and continues to hamper support for the discipline of weed science. Unfortunately, I can tell you that it is not in the cards. In fact, there are going to be far fewer academic departments in the future and there are going to be fewer colleges of agriculture in the future. Some have predicted only 20 colleges of agriculture by 2020. My guess is probably 30 by 2030! We must ask the critical question, "What can we do to help the situation?" For example, we must make sure that administration, our peers and our decision makers really know the value of our contributions. We must continue to form alliances and develop collaborative relationships wherever possible to capitalize on strengths of other disciplines and

finally, we need a few good, enlightened administrators, and of course, a little luck.

Trend # 2 - Increasing Role of Biotechnology in Agriculture.

One can hardly argue that this trend is already set, but in the next few years this concept will rapidly gain momentum. Weed science is already at the table and capitalizing on this technology. The real challenge is to ensure that biotechnology has benefit for all concerned, including the farmer, agribusiness and, indeed, the consumer. I predict that advances in molecular biology during the next several decades will have as pronounced an influence on agriculture as the use of chemicals has had in the past. Weed science must and will be, highly involved.

Trend # 3 - Prescription Approach to the Utilization and Implementation of all Technology.

Documentation of every aspect of agriculture will undoubtedly be a key component in the future. We will be required to account for fertilizers, water, and pesticides as much as the pharmacist must account for the prescriptions he fills today. Weed science must be prepared and ready to play a leading role in this process. And remember - although we perceive our profession as noble and of benefit to mankind, to some members of our society we are perceived as "bad guys."

Trend # 4 - Health Issues will become an Integral Part of Agriculture.

In the future, plants will be designed and developed, not only for nutrients, but for health uses as well. It will take a crystal ball to predict what some of these will be, but some successes such as grain with particular levels of amino acids or peanuts with more desirable levels of fat or improved fatty acid composition point to the future. It is also anticipated that there will be plants that include medicinal attributes. Weed science should be ready for such innovative approaches in the future.

Trend # 5 - Increasing Sophistication of Technology.

Eleven percent of Georgia farmers already are on the Internet. That is not enough. I visualize a day in the very near future when the computer will be as necessary for a farmer as a tractor and combine. Indeed, computer sophistication will be necessary for survival. Distance diagnostics through digital imaging (DDDI)is a reality in Georgia and the surface is only scratched.

I just learned this week that we are planning the next step to take DDDI using satellite communication.

I am aware of your efforts to use computer models to prescribe the nature of treatments for controlling weeds. I can only say "you are right on target." Precision farming that utilizes geographical information systems (GIS) employing global positioning satellites (GPS) provide efficiencies in many aspects of agriculture, especially for weed science. Let me simply say this is, indeed, the wave of the future. Keep moving as quickly and rapidly as possible. Weed science has a key role in these critically important areas.

Trend # 6 - Changing Structure of Agriculture.

If you haven't noticed, agriculture that existed 50 years ago doesn't exist any more. Vertical integration of poultry is all but complete and swine is moving in that direction. More and more we see crop and livestock grown on contract. This will continue to grow rapidly in the future. Increase in crop consultants is occurring at a very rapid pace and contract production on many specialty crops will quickly become the norm. In addition, marketing will become increasingly as important as production. Increased development of value-added and name-brand products will occur. There will be increased on-farm processing and distribution units. Such changes will impact on how both industry and academia interact with the producers and users of technology. It has already impacted how industry interacts with the farmer. We must be ready.

Trend # 7 - Increased Globalization of Agriculture.

This trend was initiated some years ago, but with GATT and NAFTA and other agreements that will undoubtedly come, there is rapidly becoming one agricultural economy in the world. Expected decoupling of U.S. agriculture from the federal government will further enhance this process. Weed science must contribute to the enhancement and competitiveness of U.S. agriculture in the world marketplace.

Trend # 8 - Environmental Issues will become more Important in the Future.

You probably don't want to hear that, but I can assure you environmental issues will remain an integral part of agriculture in the future. My view is environmental concern is a "growth industry." Weed science is very much involved in many aspects of the environmental picture. Quality of water, air and even life, are an everyday components of agriculture. We also must be concerned about poisonous plans and other undesirable problems such as pollen from weeds. How we deal with weeds that are environmentally unfriendly is a critical issue for the future.

Trend # 9 - Closer Linkage of Industry and Academia.

The emergence of the university-industry linkage, especially in start-up type companies in biotechnology is rapidly becoming a reality. We have several such relationships at the University of Georgia. These involve faculty who work part time for the University and the remainder for the corporation. I am not sure just where we are going, but it is a reality that we must consider.

It should be apparent by now that most, if not all of the trends I have mentioned relate somehow to technology. That is how less than 2% of our people can do today what 90% did just a hundred years ago. Technology also is the competitive edge our U.S. farmers have in the global competition for markets. But this dependence on technology means that those who continue to practice agriculture will require a much higher level of training than was needed previously. Those of you in academia must set the bar higher, and industry must demand more from us in colleges of agriculture.

I have touched briefly on several trends that I believe we in weed science, as well as agriculture in general, will face in the new millennium. It is critical that we face the changes and the new trends head-on. We must address them proactively and as Stephen Covey says in the "7 Habits of Highly Effective People," we must begin with an end in mind.

We in weed science have come a long way over the years. You have set the machinery in motion for a successful 21st century. What you continue to do from this day forward will determine the payoff, not only for you in weed science, but all of academia, industry and our clientele throughout the world.

I would like to close with a quote from our 1979 SWSS President Morris Merkle who quoted the Poet Braley:

> Don't worry and fret, fainthearted,
> the changes have just begun.
> For the best jobs haven't been started.
> The best work hasn't been done.

Thank you.

PRESIDENTIAL ADDRESS

SWSS: THE NEXT FIFTY YEARS

R. L. Ratliff, President, SWSS and Director Biological Research and Development
Novartis Crop Protection, Greensboro, NC 27419

Good morning, ladies and gentlemen, special guests, and members of the Southern Weed Science Society! Please allow me to personally welcome you to Greensboro and the 52nd annual meeting of the Southern Weed Science Society. It has been the utmost honor and privilege for me to serve as your President this year. I would be remiss if I didn't start by acknowledging the efforts and thanking the other officers, board members, committee chairpersons, committee members, Business Manager Bob Schmidt, and every member of the Southern Weed Science Society for all of your help and assistance during my term. I am especially indebted to Dr. William Lewis, Chairperson and the members of the Local Arrangements committee for all of their efforts to make our meeting run smoothly and to President-elect Don Murray and his program committee for organizing an outstanding program.

I am extremely grateful for the mentoring of Dr. Bob Hayes and many other Past-presidents who have counseled me during this year. Ms. Pat Dinnen, Ms. Jana Clark, and Ms. Dora Drake deserve special thanks for all of their efforts in assisting me administratively the past two years. I wish everyone could be as blessed as I am by having the support of Pat, Jana, and Dora at work and, my wife, Susan, and children, Tommy and Lauren, at home. I appreciate all that each of them has endured over the last couple of years so that I could enjoy the benefits of serving the SWSS.

I also would like to give a special thanks to Dr. Jerry Wells for showing me the true meaning of strength in the last couple of years.

Like many of you, I selected my title for this presentation last August. Also, like many of you, I have found it difficult to make my presentation live up to the challenge of my title. If I could accurately predict events for the next fifty years, this would be my farewell presentation. I don't claim to be a soothsayer, however, I do feel that we can learn much about the future from studying the past and I will draw upon the past events and present trends to at least identify some of our near term challenges and then speculate upon future opportunities.

We have just heard Dr. Gale Buchanan talk about what Agriculture will be like in the future, so I will not speculate about the mechanics of farming or weed control. Instead I would like to discuss some issues and challenges that the Southern Weed Science Society will face in the next 50 years.

SWSS DISBANDS: SOCIETY CEASES TO FUNCTION

This is the worst newspaper headline I could imagine reading ten years in the future about the Southern Weed Science Society. Some of the reasons that could cause the Society to fail include; lack of membership, member apathy, lack of recognition/visibility, bankruptcy, decline of agriculture, lack of focus and a lack of vision. I will now address each of these drivers of failure and give you my assessment of the likelihood of each of these occurring.

LACK OF MEMBERSHIP and **MEMBER APATHY**

There are several parameters that could indicate the SWSS is heading towards a disaster with number and involvement of members. The membership numbers indicate a gradual membership decline over the last 10 years, we have had some difficulty obtaining candidates for Society offices, and the number of award nominations are down. In contrast, we have seen some stability in the number of members lately and number of members appears to fluctuate more due to location than any other factor. Why would our membership be apathetic? Some may just be interested in presenting their information and not concerned about the Society. Others may feel that the Society doesn't do anything for them. They don't realize that we are the only Society that I know about that provided rooms for the graduate student members. The more other scientific societies that I am exposed to, the more I realize just how active and vibrant the SWSS is and how dedicated the Society is to education and the advancement of weed science. Although we have had some difficulty obtaining officer candidates and award nominees we also have the highest paper and poster numbers in the history of the Society. Additionally, we the highest percentage of our membership involved in committees in the recent history of the Society. Another way that the Society is involved in discussing membership issues is through the Conversations on

Change program sponsored by CAST. The Society has been involved in this initiative since its inception and is recognized within the program for our level of participation and leadership we have provided to the program.

LACK OF RECOGNITION/VISIBILITY
Weed science suffers from a lack of visibility because we don't have an "ology" in our name. We are a combination of a number of disciplines and suffer some lack of public recognition because the public can't easily label what we do. Even the USDA has trouble categorizing what we do among the physiologists, entomologists and plant pathologists.

BANKRUPTCY
This is one area in which we are very fortunate as a Society. The Southern Weed Science Society leadership has always tried to maintain a focus on financial solvency, in good times or lean times. Primarily due to the success of the SWSS Weed ID guides we have over 2 years operating expenses in the bank and have an Endowment Foundation approaching two hundred thousand dollars which will be used in the future to support the graduate program.

DECLINE OF AGRICULTURE
The biggest threat to the future of the SWSS may be the general decline in American agriculture. In a sense, our success may lead to our demise. We, as scientists, have advanced the state of farming so that fewer farmers are able to produce the food for the needs of a growing world population. Larger producers are, in general, more efficient so the average size of farms increases and the number of family farms decreases. Some of us have lamented the demise of the small, family farm without realizing that we share a portion of the blame for its elimination. Some speculate that these fewer farmers or large corporate farms will not need weed scientists as much as previously especially with the advent of new 'simpler' technologies such as herbicide tolerant crops. Our producers are definitely more technically astute than the farmers of a generation ago, however, the cropping systems are increasingly more complex as well. The number of applicable solutions to any given weed control problem are expanding exponentially and each option brings with it implications for this, and the next, crop. Additionally, there are more challenges facing our industry and agriculture needs educated, well-spoken advocates now more than ever.

One of the biggest challenges facing us as weed scientists is the Food Quality Protection Act, known more commonly as FQPA. To date, the primary focus of FQPA has been on insecticides and the EPA will revoke a large number of 'sleeping' tolerances soon and will propose revocation of several active organophosphate tolerances this year. The herbicide focus of FQPA will begin in late 1999 and heat up in 2000. 63 herbicides are included on EPA's Group 1 priority list for tolerance reassessment which had an original target of August 1999. Additionally, 45 herbicides are included on EPA's Group 2 list with an original target of 2002. Collectively, and individually, we can help ensure the successful implementation of the Food Quality Protection Act by supporting the IQG strategy of using sound science and a transparent process to implement the Act. We can provide public comment on the science policy documents and cooperate with information gatherers to provide accurate herbicide use information and comment on the benefits, alternatives, and target pests of the subject herbicides. Finally, we can work with the USDA and EPA in the decision making and implementation phase of FQPA. Remember, in the middle of difficulty lies opportunity and FQPA has the potential to become a nexus of opportunity that we cannot afford to waste.

LACK OF FOCUS
A threat to the SWSS that we cannot afford to underestimate is having a lack of focus. If the SWSS tries to become all things to all people we ultimately cannot act on any one issue. We must recognize that we have a very diverse membership with diverse goals and objectives, however, we are bound by a common mission and purpose to give us direction and guide our actions. In the past we have focused on educating our students and the advancement of our science to serve the growers of the Southeastern US, be they farmers, foresters, golf course superintendents or homeowners. If we continue to focus on the needs of our clients, we can't help but be successful.

LACK OF VISION

The Southern Weed Science Society has a history of great vision beginning at the founding in 1948. A group of visionary individuals gathered in Stoneville, MS to organize themselves to secure more adequate weed control. In 1953, President Dale Hinkle showed he was a man of vision by stating that he was disturbed about the lack of public support for agriculture research and noted that as the population was increasing the number of farms were decreasing as was agriculture research funding. That is a trend that has continued until today. President Glenn Klingman reported in 1956 that we needed to focus on producing better trained weed workers. We have maintained training as a primary aim of our Society until today. President Allen Wiese cautioned us in 1974 that we did a good job of talking to each other but not to others. I would submit that we all still could learn from Allen and do a better job of advocating weed science to others. Over 10 years ago, President Homer LeBaron proved he was a visionary by telling us about biotechnology and the great changes it could make in agriculture. The Board of Directors of the SWSS showed its vision when it approved the production and sale of the Weed ID guides. This was not an easy decision which carried a significant element of risk when the SWSS bet almost its entire net worth on the success of this publication. We owe everyone who had a hand in this idea and decision a great deal and maybe even our very existence. Thank, Chester McWhorter, Dennis Elmore, Arlyn Evans and many, many others. The formation of the Endowment Foundation was a visionary act of the Society to place funds aside for future generations of weed scientists. We have visionaries among us today, individuals who, although they may be at the end of their careers, are interested in the future success of others. Men like Ralph Baker who donated one thousand dollars of his hard earned retirement this year to the Endowment Foundation. I would challenge all of us to be visionaries and follow suit and donate to the SWSS Endowment Foundation.

Our future projects also are a measure of our vision. Sponsoring outreach efforts like the "A Kid's Journey to understanding Weeds" or the "Alien Invaders" television documentary. We are currently offering a CD ROM version of the compiled Weed ID Guide and have a SWSS website under construction. The Board is also studying the possibility of electronic publishing.

In closing I would like to suggest what I see as the future needs of the SWSS. I would challenge us to revisit our mission and playing field to be sure that they still meet our needs for the future. I would hope that we can energize our membership to be more active and participative in the Society and help it achieve its goals. I would urge each of us, individually, to become a more active advocate on agricultural issues and speak not to ourselves, but to others. To our neighbors, civic clubs, to our fellow church members, to the man on the street, and to the general public. My final admonition is to work to make sure the SWSS remains fast, focused, flexible, and fun. Fast to react to, or even lead, a changing world. Focused so that we do not dilute our message or efforts. Flexible to bend, not break, under the pressures of a changing environment. And Fun, because an organization that is fun grows and a growing organization is fun to work for and to belong.

WEED CONTROL IN OKRA-LEAF AND CONVENTIONAL COTTON. J. T. Staples, Jr., E. C. Murdock, J. T. Fowler, Jr., Clemson University Pee Dee REC, Florence, SC 29501.

ABSTRACT

Weed control programs for standard and okra-leaf cotton were compared to evaluate the relative competitiveness of the cultivars. The field trial was conducted in 1998 at the Edisto Research and Education Center, Blackville, SC. 'DP 51' and 'Fibermax 832' were planted May 27, 1998. Weed management programs evaluated were 1) trifuralin @ 0.75 lb ai/ac (1.5 pt/ac) applied preplant-incorporated; 2) treatment 1 followed by (fb) fluometuron + pyrithiobac applied preemergence @ 1.2+0.042 lb ai/ac, respectively (1.2 qt+0.8 oz/ac); 3) treatment 2 fb pyrithiobac applied (POST) @ 0.063 lb ai/ac (1.2 oz/ac)+surfactant; 4) treatment 3 fb prometryn + MSMA applied postemergence-directed @ 0.75 + 2.0 lb ai/ac, respectively (1.5 pt + 0.33 gal/ac); and 5) treatment 4 fb prometryn applied POST-directed at layby @ 1.0 lb ai/ac (1.0 qt/ac) + surfactant.

Complete control of goosegrass was observed with all herbicide treatments. Palmer amaranth was controlled 91% 8 weeks after planting (8 WAP) with trifuralin alone, and all other herbicide treatments provided 100% control. Trifuralin did not control sicklepod and tall morningglory. Trifuralin fb fluometuron + pyrithiobac controlled sicklepod and tall morningglory 87 and 75% 8 WAP, respectively. Sicklepod and tall morningglory control ranged from 96 to 99% for all treatments that included a postemergence herbicide. Total weed biomass in the untreated check was 3216 and 3171 lb/ac where 'DP51' and 'Fibermax 832' were planted, respectively. Weed biomass reductions were similar for standard and okra-leaf cotton. Trifuralin reduced weed biomass 36% compared to the untreated check. A 93% reduction in total weed biomass was observed with trifuralin fb fluometuron + pyrithibac. Other herbicide systems reduced total weed biomass 99 to 100%. When postemergence herbicides were used, lint yields averaged 455 and 536 lb/ac with 'DP51' and 'Fibermax 832', respectively, and were greater than yields attained with soil-applied herbicides only.

ROUNDUP READY COTTON WEED CONTROL SYSTEMS IN ALABAMA. S. B. Belcher, M. G. Patterson, W. H. Faircloth, and D. O. Stephenson IV, Auburn University and Alabama Agricultural Experiment Station, Auburn, AL.

ABSTRACT

Field trials were established in 1996 and 1997 at the Tennessee Valley Substation (TVS), Belle Mina, AL; Prattville Experiment Field (PEF), Prattville, AL; Wiregrass Substation (WGS), Headland, AL; and Gulf Coast Substation (GCS), Fairhope, AL to determine the effectiveness of Roundup Ready weed control systems in conjunction with more traditional weed control systems. Each test was conducted in a randomized complete block design with the plots measuring 13.3 ft. by 30 ft. Visual weed and crop injury ratings as well as seed cotton yield was collected at each site. Two problem weeds per site were targeted for control on the basis of their economic importance to the region. The targeted weeds for each site are as follows: velvetleaf, *Abutilon theophrasti* – TVS; sicklepod, *Senna obtusifolia* - TVS and PEF; pitted morningglory, *Ipomoea lacunosa* - PEF, WGS, and GCS; texas panicum, *Panicum texanum* – WGS; and barnyardgrass, *Echinochloa crus-galli* - GCS. DP 5415 RR was planted at all locations in 1996 and at TVS in 1997 while DP 5690 RR was planted at PEF, WGS, and GCS in 1997. All were under conventional tillage.

Treatments evaluated at each location were: 1) Treflan - 0.75 lbs. ai./A PPI, Cotoran – 1.5 lbs. ai./A PRE, Caparol + MSMA – 0.75 and 1.5 lbs. ai./A PDS; 2) Cotoran – 1.5 lbs. ai./A PRE, Staple – 0.063 lbs. ai./A POT, Bladex + MSMA – 1.0 and 1.5 lbs. ai./A PDS; 3) Cotoran – 1.5 lbs. ai./A PRE, Roundup – 1.0 lb. ai./A POT; 4) Cotoran – 1.5 lbs. ai./A PRE, Roundup – 1.0 lb. ai./A POT, Roundup – 1.0 lb. ai./A PDS; 5) Roundup – 1.0 lb. ai./A POT, Roundup – 1.0 lb. ai./A PDS, Roundup – 1.0 lb. ai./A PDS; 6) Roundup – 1.0 lb. ai./A POT, Roundup – 1.0 lb. ai./A PDS, Bladex + MSMA - 1.0 and 1.5 lbs. ai./A PDS; 7) Weedy check; and 8) Weedfree check.

Late season weed control ratings and seed cotton yield show the best treatments over both years were consistently Cotoran, Roundup, Roundup; Roundup, Roundup, Roundup; and Roundup, Roundup, Bladex + MSMA. All three of these treatments regardless of location or target weeds consistently had good to excellent weed control ratings (80-100%) with the exception of pitted morningglory. Pitted morningglory control at Prattville Field in 1996 was fair (70-79% weed control) for the Cotoran, Roundup, Roundup treatment and the Roundup, Roundup, Roundup treatment and unacceptable for the Roundup, Roundup, Bladex + MSMA treatment. However, in 1997, the Cotoran, Roundup, Roundup and Roundup, Roundup, Roundup treatments improved their weed control ratings for pitted morningglory to

the good to excellent range while the Roundup, Roundup, Bladex + MSMA treatment improved from unacceptable (<59%) to fair (70-79%) weed control.

Seed cotton yield in 1996 for the Cotoran, Roundup, Roundup treatment averaged 2308 lbs./A and 2407 lbs./A in 1997. The Roundup, Roundup, Roundup treatment yielded an average of 2318 lbs./A in 1996 and 2455 lbs./A in 1997. The final treatment was the Roundup, Roundup, Bladex + MSMA treatment which averaged 2309 lbs./A in 1996 and 2149 lbs./A in 1997. Yields for weedy check were 505 lbs./A in 1996 and 488 lbs./A in 1997. Weedfree yields were 2384 lbs./A in 1996 and 2404 lbs./A in 1997, respectively.

In conclusion, the Cotoran (PRE), Roundup (POT), Roundup (PDS); the Roundup (POT1), Roundup (PDS), Roundup (PDS); and the Roundup (POT1), Roundup (PDS), Bladex + MSMA (PDS) treatments consistently provided good to excellent weed control and optimum yields in 1996 and 1997 at four locations in Alabama.

SOIL-APPLIED FOMESAFEN COMBINATIONS FOR COTTON WEED MANAGEMENT. D. O. Stephenson, IV, M. G. Patterson, and J. N. Lunsford, Auburn University, Auburn, AL and Zeneca Ag Products, Enterprise, AL.

ABSTRACT

Soil-applied fomesafen combinations were evaluated as preemergence-applied (PRE) treatments in Roundup Ready cotton at the Wiregrass Experimental Station, Headland, AL, and Zeneca Research Site, Slocomb, AL, in 1998. Fomesafen was applied alone and in combination with either fluometuron or pyrithiobac. Glyphosate was used post-emergence (POT) at the four true leaf cotton stage and post-directed (PDS). Research focused on control of sicklepod (*Senna obtusifolia*), yellow nutsedge (*Cyperus esculentus*), and common cocklebur (*Xanthium strumarium*), which are troublesome in cotton production. Five trials were conducted. Two included sicklepod, one with pendimethalin applied pre-plant incorporated (PPI) at 0.82 lbs. ai/A, and the other without. Two cocklebur trials were conducted using the same design as the sicklepod tests. The fifth trial included yellow nutsedge and also had pendimethalin 0.82 lbs. ai/A PPI. Fomesafen rates included 0.25 and 0.38 lbs. ai/A. Fluometuron was applied at 1.25 lbs. ai/A and pyrithiobac at 0.047 lbs. ai/A. Glyphosate was applied POT and PDS at 0.5 lbs. ai/A. All treatments were applied with a mounted, compressed air sprayer calibrated to deliver 15 gpa. Two cotton varieties were used. Paymaster 1220 BG/RR was used in the sicklepod and yellow nutsedge experiments at Headland, AL. The two cocklebur experiments which were conducted at Slocomb, AL used Deltapine 90 RR. Data collected included visual weed control 14 and 56 days after treatment, crop injury, and seed cotton yields. Only 56 day ratings will be discussed.

Control of sicklepod by all PRE treatments was below 70%. The only exception was the fomesafen 0.25 + pyrithiobac 0.047 lbs. ai/A, which also had pendimethalin PPI. It provided 78% control. The POT treatment of glyphosate provided a significant increase in sicklepod control for all PRE treatments. Glyphosate applied PDS gave no significant increase to the POT treatment. Yellow nutsedge control was 75% for the fomesafen at 0.38 lbs. ai/A treatment. Glyphosate applied POT significantly increased control of the PRE treatments fomesafen 0.25, pyrithiobac 0.047, fluometuron 1.25 lbs. ai/A, and the untreated PRE. The only significant difference between the POT and PDS treatment was the fomesafen 0.25 + fluometuron 1.25 lbs. ai/A PRE treatment. In the common cocklebur trial without pendimethalin PPI, fomesafen 0.25 + fluometuron 1.25 lbs. ai/A gave control of 82%. In the common cocklebur trials with pendimethalin PPI, fomesafen 0.25, and fomesafen 0.25 + pyrithiobac 0.047 lbs. ai/A provided 72% and 83% control, respectively. The application of glyphosate POT provided a significant increase in control of most PRE treatments that were below 70%, but not the ones with ratings above 70%. Glyphosate applied PDS gave no significant increase for either trial. Seed cotton yields for the sicklepod trials with and without pendimethalin PPI showed a significant increase with the application of glyphosate POT. With the POT application, an increase of 1073 lbs. was recorded for the trial without pendimethalin PPI. Also, for the trial with pendimethalin PPI, an increase of 706 lbs. was obtained. There was not an increase with the PDS application of glyphosate for either trial. The seed cotton yield for the yellow nutsedge trial provided no significant differences between any of the applications. There was not a significant difference in seed cotton yield between any of the applications of the common cocklebur trials with or without pendimethalin PPI.

EFFICACY OF RESIDUAL HERBICIDES IN ROUNDUP READY COTTON SYSTEMS. J. W. Keeling, P. A. Dotray, T. S. Osborne, and J. D. Everitt, Texas Agricultural Experiment Station, Lubbock, TX 79401.

ABSTRACT

Field experiments were conducted in 1998 to evaluate preplant and preemergence herbicides alone and in combination with Roundup Ultra in Roundup Ready Cotton. Treatments were compared in cotton produced in conventional tillage, conservation tillage, and ultra-narrow row systems. A Roundup Ready variety, Paymaster 2326 RR, was planted in mid-May. Herbicide treatments in conventional and conservation tillage systems included Prowl applied preplant incorporated (PPI) + Caparol preemergence (PRE), Prowl PPI followed by (fb) Roundup Ultra postemergence-topical (PT), Caparol PRE fb Roundup Ultra PT, Prowl PPI + Caparol PRE fb Roundup Ultra PT, Prowl PPI fb Roundup Ultra PT and post-directed (PD), and Roundup Ultra PT and PD. In the conventional tillage test, Prowl + Caparol controlled Palmer amaranth (Amaranthus palmeri) 95-100% but devil's-claw (Proboscidea louisianica) control was only 30-40%. No silverleaf nightshade (Solanum eleagnifolium) control was observed. The addition of Roundup Ultra PT to any residual herbicide treatment controlled devil's-claw 80-90% and silverleaf nightshade 50-70%. Roundup Ultra PT + PD improved silverleaf nightshade control compared to treatments receiving only Roundup Ultra PT. Roundup treatments without a PPI or PRE herbicide did not control Palmer amaranth season-long.

In the conservation tillage test, Prowl PPI + Caparol PRE controlled Palmer amaranth and devil's-claw 80% and 45%, respectively. The most effective season-long Palmer amaranth and devil's-claw control (100%) was achieved with Prowl PPI fb Roundup Ultra PT + PD. Roundup Ultra applied alone (PT + PD) controlled devil's-claw as effectively as residual treatments that received a Roundup Ultra PT application, but did not control Palmer amaranth throughout the season. In the ultra-narrow row cotton test, Prowl PPI controlled Palmer amaranth 75% early-season, but control declined by 50% by season-end. Prowl PPI fb Roundup Ultra PT controlled Palmer amaranth 98%, devil's-claw 95%, silverleaf nightshade 70%, and johnsongrass (Sorghum halapense) 90%. Cotton yields correlated with overall weed control levels. In the conventional tillage test, similar yields were produced with all residual herbicide fb Roundup Ultra PT. All Roundup Ultra treatments produced cotton yields higher than the PPI + PRE treatment alone. In the conservation tillage tests, no differences in yield was observed between treatments. In the ultra-narrow row test, significantly higher yields resulted with the Prowl PPI fb Roundup PT treatment compared to Prowl PPI alone.

The addition of Roundup Ultra improved Palmer amaranth, devil's-claw, and silverleaf nightshade control compared to soil residual herbicides alone in all production systems. The use of residual herbicides in Roundup Ready systems will depend upon weed species present and weed infestation levels.

PREEMERGENCE VS. POSTEMERGENCE APPLICATION OF RESIDUAL HERBICIDES IN ROUNDUP READY COTTON. W. H. Faircloth, M. G. Patterson, S. B. Belcher, and D. O. Stephenson, IV, Auburn University and Alabama Agricultural Experiment Station, Auburn, AL.

ABSTRACT

Traditional preemergence herbicides used in cotton were delayed to postemergence-directed sprays to evaluate their usefulness when applied following a post-emergence Roundup treatement. Field trials were conducted on Alabama Agricultural Experiment Stations in Belle Mina, Prattville, and Headland, AL, in 1998. Herbicides evaluated included fluometuron (Cotoran), norflurazon (Zorial), clomazone (Command), pyrithiobac (Staple), and fluometuron plus pyrithiobac. Each of these five herbicide treatments was applied both preemergence(PRE) and postemergence-directed (PDS) in combination with pendimethalin (Prowl), which was applied as a pre-plant incorporated (PPI) herbicide. Untreated check plots were included at each site. Test plots were four rows (38 in.), 30 ft. long. Treatments were arranged in a randomized complete block design. All treatments were applied in a carrier volume of 15 gallons per acre with a tractor-mounted, compressed air sprayer at 38 #psi. The following rates (active ingredient per acre) of each herbicide were used: fluometuron-1.5 lb, norflurazon-1.5 lb, clomazone-1.0 lb, pyrithiobac-0.047 lb, and pendimethalin-0.8 lb. Visual crop injury and weed control ratings (on a scale where 0 = no injury or control and 100 = crop death or total weed control) were taken as well as seed cotton yield.

The predominant weed species at Belle Mina, AL, included large crabgrass [*Digitaria sanguinalis* (L.) Scop.], barnyard grass [*Echinochloa crus-galli* (L.) Beauv.], sicklepod [*Senna obtusifolia* (L.) Irwin&Barneby], and velvetleaf (*Abutilon theophrasti* Medik.). PDS applications of the herbicides gave excellent (> 90%) grass control. PRE applications also gave excellent grass control. Sicklepod control was significantly improved as a PDS application. As a PRE, no

herbicide treatment provided greater than 68% control of sicklepod. With velvetleaf, only pyrithiobac showed improved control as a PDS application. Fluometuron, pyrithiobac, and fluometuron+ pyrithiobac gave equivalent weed control as PDS and PRE applications. However, weed control whether PRE or PDS applications, with the exception of grasses, was not great enough to bypass a layby application later in the season. Plots receiving clomazone and pyrithiobac showed increases in seed cotton yield when used as PDS applications.

Pitted morningglory (*Ipomoea lacunosa* L.) and sicklepod were the dominant weeds in Prattville, AL. PDS applications of fluometuron and fluometuron+pyrithiobac showed significantly less morningglory control (20% less) than PRE applications. Norflurazon and pyrithiobac showed slightly lower morningglory control as PDS, while clomazone showed no difference from PRE application. Sicklepod showed significant decreases in weed control when herbicides were applied PDS. Clomazone was an exception that showed no decrease in sicklepod control as a PDS. Seed cotton yields also showed an increase in yield for clomazone PDS plots over clomazone PRE plots. Weed control in any treatment was not high enough to avoid a layby application of glyphosate.

Texas panicum (*Panicum texanum* Buckl.), in addition to pitted morningglory and sicklepod, predominated at Headland, AL. Neither PRE nor PDS applications showed superior morningglory control. Likewise, sicklepod control did not favor PRE or PDS applications. Pyrithiobac showed a sharp decline in sicklepod control when applied PDS. Texas panicum control showed no differences in control between PRE and PDS applications of these herbicides. Clomazone PDS gave higher yields than clomazone PRE. All other treatments showed no differences in yield. No treatment provided adequate weed control to avoid a layby application of glyphosate.

WEED CONTROL PROGRAMS IN ROUNDUP READY COTTON. J. A. Kendig, R. L. Barham, and P. M. Ezell. University of Missouri Delta Center, Portageville, MO 63873

ABSTRACT

The majority of our Roundup Ready research was reviewed to address the efficacy of programs with preemergence herbicides, postemergence tank mixes and Roundup rates and timings.

In the first group of studies, a standard set of preemergence treatments were evaluated in programs with two postemergence Roundup applications. These were 1) a dinitroanaline herbicide such as pendimethalin or trifluralin, 2) fluometuron, 3) dinitroanaline plus fluometuron, 4) dinitroanaline plus fluometuron plus clomazone and 5) no preemergence herbicide. Rates were 0.75 lb ai/A for trifluralin, 1 lb ai/A for pendimethalin, 1 to 1.5 lb ai/A for fluometuron and 0.5 lb ai/A for clomazone. A second set of studies investigated reduced herbicide inputs and compared factorial combinations of four preemergence treatments [1) trifluralin alone at 0.75 lb ai/A, 2) trifluralin plus fluometuron at 0.5 lb ai/A, 3) trifluralin plus fluometuron at 1.5 lb ai/A, 4) trifluralin plus fluometuron at 1.5 lb ai/A plus clomazone at 0.5 lb ai/A] and four early postemergence (3" cotton) treatments [1) fluometuron at 1 lb ai/A plus MSMA at 2 lb ai/A directed, 2) glyphosate at 0.75 lb ai/A, 3) glyphosate at 0.375 lb ai/A and 4) glyphosate at 0.188 lb ai/A. All treatments in the second study received cyanazine at 1 lb ai/A plus MSMA at 2 lb ai/A directed when cotton was 6 to 9".

In both sets of studies, weed control and cotton yields generally increased as dinitroanaline herbicides, fluometuron and clomazone were added incrementally to glyphosate programs. In the reduced-input study, yields also generally increased with glyphosate rate.

A third set of studies evaluated two POST glyphosate applications under the following programs: 1) glyphostae alone, 2) pendimethalin at 1 lb ai/A plus fluometuron at 1.2 lb ai/A, PRE 3) a layby application of 0.4 lb ai/A of cyanazine plus 1.5 lb ai/A of MSMA and 4) a standard herbicide program. In these studies there was no benefit from “moving” residual herbicides from PRE timings to layby timings.

Tank mixtures of pyrithiobac and propazine with Roundup were evaluated in a fourth set of studies; however, there was little consistency in rates in these studies. In some, but not all cases there were weed control benefits from these tank mixtures. However, a limiting factor with pyrithiobac mixtures is that glyphosate costs much less and higher glyphosate rates can often compensate for harder-to-control weed species.

A fifth study investigated timings and rates in glyphosate-only weed control programs. Treatments were a 5 by 2 factorial combination of 0.375 versus 0.75 lb ai/A (pint and quart) rates of glyphosate and five application schemes. Application schemes were 1) 3 and 6" cotton, 2) 1 and 6" cotton, 3) 1, 3 and 6" cotton, 4) 3, 6, and 12" cotton and 5) 1,

3, 6, and 12" cotton. 1 and 3" timings were applied over-the-top and 6 and 12" timings were applied in directed sprays. A 0.75 lb ai/A rate of glyphosate provided better weed control and yield than a pint of glyphosate. There were no statistical differences between application schemes.

Glyphosate/Roundup Ready weed control programs generally benefitted from the use of preemergence herbicides. Postemergence tank mixes provided limited benefits and no benefits were observed from residual layby treatments. Weed control was better when 0.75 lb ai/A of glyphosate was used versus 0.375 lb ai/A however, the exact time and number of applications had little effect.

TOLERANCE OF ROUNDUP READY™ COTTON TO MULTIPLE POSTEMERGENCE APPLICATIONS OF GLYPHOSATE. E. C. Murdock, Clemson University Pee Dee REC, Florence, SC 29501.

ABSTRACT

Tolerance of Roundup Ready cotton to postemergence (POST) and POST -directed applications of Roundup Ultra was evaluated under weed-free conditions at an on farm site in Horry County, SC. 'Paymaster 1220 BR' cotton was planted May 22, 1998, at a seeding rate of 4.4 seed/row foot. Treatments were arranged in a randomized complete block design with six replications. Crop response was evaluated following POST applications of Roundup Ultra @ 1.12 lb ae/ac (1.5 qt/ac) at the 2,4, and 2 + 4 true leaf stages; POST-directed applications at the same rate at the 6, 8, and 6 + 8 true leaf stages; and POST applications at the same rate at the 2 + 4 true leaf stages followed by (fb) POST-directed applications at the 6, 8, 10, 6 + 8, 8 + 10, 8 + 12, and 10 + 14 true leaf stages. Crop response following POST applications of Roundup Ultra @ .75 lb ae/ac (1.0 qt/ac) at the 2 + 4 leaf stage fb POST-directed applications at the same rate at the 6 + 8 true leaf stages was also evaluated.

Boll location on sympodial branches was similar with and without Roundup Ultra. In the untreated check, 52, 26, and 9% of the bolls were located at the first, second, and third or higher fruiting positions, respectively. Averaged over all Roundup Ultra treatments, 50, 25, and 11% of the bolls were located at these respective positions. Boll location at vertical plant strata was also similar with and without Roundup Ultra. In the untreated check, 56 and 31% of the bolls were located at nodes 6 to 10 and 11 to 15, respectively. Averaged over all Roundup Ultra treatments, 51 and 32% of the bolls were located at nodes 6 to 10 and 11 to 15, respectively. Lint cotton yields for all Roundup Ultra treatments were similar to yields attained in the untreated check. Lint cotton yield in the untreated check was 1046 lb/ac, whereas lint cotton yield averaged over all Roundup Ultra treatments was 1037 lb/ac.

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

ABSTRACT

Glufosinate-tolerant cotton lines were produced by constructing a chimeric bar gene from a DNA fragment that contained the coding sequence of the *bar* gene obtained from Streptomyces hygroscopicus. The *bar* gene is responsible for coding for the *pat* enzyme that enables the cotton to metabolize glufosinate. This chimeric bar gene was introduced into Coker 312 using Agrobacterium infection. Infected plants were screened for tolerance and seeds from tolerant plants were collected. Field experiments in 1997 and 1998 were conducted at the Texas Agricultural Experiment Station near Lubbock. Cotton growth and development was evaluated following glufosinate applications at various growth stages, at different rates, and with sequential applications to evaluate the performance of glufosinate-tolerant cotton. Weed management systems with glufosinate-tolerant cotton also were evaluated.

Glufosinate treatments were applied using a tractor-mounted compressed air sprayer or CO_2 backpack sprayer that delivered 10 GPA. Plots were maintained weed-free throughout the growing season. Glufosinate at 0.54 lbs ai/A was applied to glufosinate-tolerant cotton at the cotyledonary, 2-3 leaf, 4-5 leaf, first square, first bloom, peak bloom, cutout, or 50% open boll stages of growth. In a second test, glufosinate at 0.36, 0.72, 1.44, and 2.88 lbs ai/A was applied to 2-3 leaf cotton. In a third test, glufosinate at 0.54 lbs ai/A was applied to cotton in the 0-1, 3-4, 9-10, and 14-15 leaf stages in single and repeated applications. Visual injury was evaluated 7,14 and 21 days after treatment (DAT) and plant

heights were evaluated 21 and 56 DAT. Plants were mapped at harvest and lint yield and fiber quality assessments were made.

No visual crop injury was observed as a result of glufosinate applications during either year. No differences in plant height, nodes per plant, or number of first position bolls were observed following glufosinate applications in either year. Cotton yield was not adversely affected by any of the glufosinate applications in any of the tests. In all tests, no differences were found in fiber quality, which included micronaire, length, strength, leaf grade and color grade.

Annual and perennial weed control in glufosinate-tolerant cotton was evaluated in different weed management systems in 1998. Trifluralin was applied preplant incorporated alone at 0.75 lbs ai/A or used in combination with prometryn at 1.0 lbs ai/A applied preemergence and/or glufosinate at 0.36 lbs ai/A applied postemergence. Glufosinate was also applied alone. All glufosinate treatments were applied on an “as needed” basis. Palmer amaranth (*Amaranthus palmeri)* and devil’s-claw (*Proboscidea louisianica*) control was evaluated after each herbicide application. Trifluralin alone provided 94% control of Palmer amaranth and 0% control of devil’s-claw, while prometryn alone provided 96% and 0% control respectively. Palmer amaranth and devil’s-claw were controlled by glufosinate applications if the weeds were small and actively growing. If residual herbicides were not applied, control of Palmer amaranth was 78% and control of devil’s-claw was 89%, thus repeated applications of glufosinate were necessary. The combination of herbicides that provided the most effective control of both Palmer amaranth at 100% and devil’s-claw at 84% was the combination utilizing trifluralin, prometryn, and glufosinate.

Results from both 1997 and 1998 indicated that the transformation events in Coker 312 were successful and the gene for glufosinate tolerance was expressed. However, future studies are needed to better understand how to fully utilize glufosinate as a part of the overall weed management program. These data are useful for initial field experiments; however, regionally adapted stripper cultivars that have glufosinate tolerance would improve the productiveness of the glufosinate tolerant cotton system on the Texas Southern High Plains.

TOTAL POSTEMERGENCE WEED CONTROL IN ROUNDUP READY COTTON WITH COMBINATIONS OF ROUNDUP ULTRA AND STAPLE. D. K. Miller, C. F. Wilson, and J. L. Milligan, Louisiana State University Agricultural Center, Northeast Research Station, St. Joseph, LA 71366.

ABSTRACT

A field study was conducted in 1998 at St. Joseph, LA on a silt loam soil to evaluate the potential for combinations of reduced rates of Staple and Roundup Ultra to provide season-long weed control in Roundup Ready cotton. Roundup Ready PM 1220 BG/RR cotton was planted on June 8 following extremely dry conditions in the month of May. To assess residual benefits from Staple, herbicide programs included Roundup Ultra alone at 1.0 or 1.5 pt/A or in combination with Staple at either 0.6 or 0.9 oz/A applied EPOST (2-leaf cotton stage). In addition, sequential applications of Roundup Ultra at 2.0 pt /A EPOST followed by 1.5 pt/A MPOST (4-5 leaf cotton stage), and Roundup Ultra at 1.0 pt/A + Staple at 0.6 oz/A EPOST followed by either the same combination MPOST or Staple at 1.2 oz/A MPOST, were included for comparison. Application at the EPOST timing corresponded to 11 d after planting while MPOST treatment occurred 10 d later. Herbicide treatments were applied broadcast at 15 GPA to all rows of each 10’ x 40’, 3 row plot. Following conventional seedbed preparation, cultivation was not performed in conjunction with any weed control program. Visual injury estimates, plant height measurements, and weed control evaluations were made 4 and 11 d, 28d, and 26 and 40d, respectively, after EPOST application. Seedcotton yield was determined by harvesting the center row of each plot. Data were subjected to analysis of variance using PROC GLM and means separated using LSMEANS SAS procedure and Fisher’s protected LSD at 5% significance level (SAS Inst. 1989. SAS/Stat Users Guide. 6.0 4th ed. Vol. 2, SAS Institute. Cary, NC)

Although no greater than 12%, visual injury in the form of terminal yellowing 4 d after EPOST application was greater with the addition of Staple compared to Roundup Ultra alone. At 11d after EPOST application, however, no differences were noted among treatments (2 to 10%). Early visual injury was not manifested in height reduction 28 d after EPOST application as plant height was equal for all treatments (56 to 60 cm).

At 26 and 40 d after EPOST application, sicklepod, smooth pigweed, and entireleaf morningglory were controlled at least 83 and 83, 98 and 100, and 88 and 92%, respectively, and equally by all treatments.

Barnyardgrass control 40 d after EPOST application was increased with Staple addition at 0.6 oz/A compared to Roundup Ultra alone at the 1.5 pt/A rate applied EPOST (79 vs. 37%). Control was also greater for the sequential treatment of Roundup Ultra at 1.0 pt/A + Staple at 0.6 oz/A EPOST followed by the same combination MPOST compared to the Roundup Ultra only sequential treatment (88 vs. 73%).

Addition of Staple, at 0.6 or 0.9 oz/A, to the 1.0 pt/A rate of Roundup Ultra and at 0.6 oz/A to Roundup Ultra at 1.5 pt/A EPOST, significantly increased control of pitted morningglory and hemp sesbania 40 d after EPOST application.

Roundup Ultra at 1.0 pt/A in combination with Staple at 0.9 oz/A applied EPOST resulted in seedcotton yield of 2178 lb/A, which was greater than all other treatments (38 to 1786 lb/A). Addition of Staple at 0.6 or 0.9 oz/A increased yield at least 1666 and 1291 lb/A over that observed with Roundup Ultra alone at the rate of 1.0 or 1.5 pt/A, respectively, applied EPOST, indicating good residual activity from Staple. All Roundup Ultra + Staple single EPOST treatments, with the exception of Roundup Ultra at 1.0 pt/A + Staple at 0.9 oz/A which yielded more, resulted in yields equivalent to the sequential programs including Roundup Ultra alone or in combination with Staple.

Results indicate with adequate rainfall to realize residual benefits, reduced rates of Staple in combination with Roundup Ultra can provide season-long weed control and eliminate need for a second postemergence application in a total postemergence weed control program.

ECONOMICS AND SPECIES SHIFTS IN ROUNDUP READY COTTON. E. W. Palmer, R. B. Westerman, and D. S. Murray. Department of Plant and Soil Sciences, Oklahoma State University, Stillwater, OK 74078.

ABSTRACT

The first year of a three-year study with Roundup Ready cotton was initiated in 1998 at the South Central Research Station near Chickasha, OK to measure weed population shifts, evaluate weed control with glyphosate compared to standard cotton herbicides, and to compare the costs/profits associated with these treatments. The experimental design was a randomized complete block with 4 replications. Plot size was 12 m x 30 m. There were 16 treatments in this study with 10 containing glyphosate applied over-the-top. Johnsongrass [*Sorghum halepense* (L.) Pers.], silverleaf nightshade (*Solanum elaeagnifolium* Cav.), devil's-claw [*Proboscidea louisianica* (Mill.) Thellung], and common cocklebur (*Xanthium strumarium* L.) were the predominant species. Weed counts, weed and crop biomass, visual weed control ratings, and cotton yield data were collected from all plots.

All herbicides were applied at the 1X rate in this study. Herbicides included: (PPI) pendimethalin, (PRE) prometryn, pyrithiobac, or prometryn + pyrithiobac , and (POST) glyphosate, quizalofop, pyrithiobac, or glyphosate + pyrithiobac. No differences in silverleaf nightshade or devil's-claw counts or biomass were observed among treatments. Treatment with glyphosate alone or pendimethalin PPI + prometryn + pyrithiobac PRE followed by quizalofop applied sequentially reduced johnsongrass counts and biomass when compared to the least expensive standard treatment, pendimethalin PPI + prometryn PRE followed by quizalofop POST. Cotton biomass was not different among treatments containing PPI or PRE herbicides. However, the application of pendimethalin PPI followed by glyphosate reduced early season weed competition resulting in increased cotton biomass over glyphosate alone.

Cotton treated with glyphosate yielded 135 kg/ha more than cotton treated with pendimethalin PPI + prometryn PRE followed by quizalofop POST. When considering only herbicide, application, and technology costs, net return for glyphosate alone was $113/A higher than the least expensive standard treatment.

ECONOMICS OF WEED MANAGEMENT SYSTEMS IN TRANSGENIC VERSUS CONVENTIONAL COTTON (*GOSSYPIUM HIRSUTUM*) CULTIVARS. A. S. Culpepper and A. C. York, Crop Science Department, North Carolina State University, Raleigh, NC 27695-7620.

ABSTRACT

Transgenic, herbicide-tolerant cotton cultivars give growers new options to manage weeds. An experiment was conducted in conventionally tilled cotton at Rocky Mount and Goldsboro, NC in 1996 and 1997 to compare weed control, cotton yields, and net returns from various management systems in non-transgenic DPL 51, bromoxynil-tolerant Stoneville BXN 47, and glyphosate-tolerant Paymaster 1220 RR. Rocky Mount had a light infestation of broadleaf weeds and a severe infestation of large crabgrass (*Digitaria sanguinalis*). Goldsboro had a moderate infestation of broadleaf signalgrass (*Brachiaria platyphylla*) and a heavy infestation of prickly sida (*Sida spinosa*), smooth pigweed (*Amaranthus hybridus*), common lambsquarters (*Chenopodium album*), pitted morningglory (*Ipomoea lacunosa*), sicklepod (*Senna obtusifolia*), and jimsonweed (*Datura stramonium*). Pendimethalin preplant incorporated (PPI) was broadcast whereas fluometuron preemergence (PRE) and all postemergence (POST) treatments were applied in an 18-inch band. Early POST-directed (EPOST-DIR) and early POST over-the-top (EPOT) treatments were applied to four-leaf cotton. Late POST-directed (LPOST-DIR) treatments were applied to nine-inch cotton. All plots except the non-treated checks were cultivated, but cultivation controlled weeds poorly.

In non-transgenic cotton, pendimethalin (0.8 lb ai/A) PPI plus fluometuron (1.2 lb ai/A) PRE controlled sicklepod, pitted morningglory, and prickly sida 69 to 78% by late-season. Other species were controlled at least 90%. Pendimethalin, fluometuron PRE, fluometuron + MSMA (1.0 + 2.0 lb ai/A) EPOST-DIR, and cyanazine + MSMA (1.0 + 2.0 lb ai/A) LPOST-DIR (hereafter referred to as the standard system) controlled all species at least 98%. Compared with systems containing only soil-applied herbicides, the standard system increased yields and net returns 54 and 122%, respectively, at Goldsboro. Weed control, yields, and net returns were similar when pyrithiobac EPOT was substituted for fluometuron + MSMA EPOST-DIR. At Rocky Mount, yields and net returns were similar with all systems in non-transgenic cotton due to good large crabgrass control by soil-applied herbicides.

Systems in BXN cotton included pendimethalin PPI or pendimethalin PPI plus fluometuron PRE followed by bromoxynil (0.5 lb ai/A) or bromoxynil + MSMA (0.5 + 0.83 1b/A) EPOT and cyanazine + MSMA LPOST-DIR. The standard system also was included. Compared with a system of pendimethalin PPI, bromoxynil EPOT, and cyanazine + MSMA LPOST-DIR, adding fluometuron PRE and mixing MSMA with bromoxynil increased control of large crabgrass and broadleaf signalgrass. Fluometuron PRE did not increase control of broadleaf weeds, but MSMA mixed with bromoxynil increased control of sicklepod. The best BXN system overall was pendimethalin PPI, fluometuron PRE, bromoxynil + MSMA EPOT, and cyanazine + MSMA LPOST-DIR. This system controlled all weeds at least 97% with yield and net returns similar to those of the standard herbicide system.

Glyphosate-tolerant cotton treatments included glyphosate (0.8 lb ai/A) EPOT followed by glyphosate or cyanazine + MSMA LPOST-DIR. Each of these POST systems was applied with pendimethalin PPI and fluometuron PRE. The standard herbicide system also was included. All glyphosate systems controlled broadleaf signalgrass, sicklepod, prickly sida, and jimsonweed 96 to 100%. Total POST systems controlled common lambsquarters and smooth pigweed 95 to 96%. Adding pendimethalin and fluometuron increased control 4%. Glyphosate twice controlled pitted morningglory and large crabgrass 89 to 90% compared with 97 to 99% control by glyphosate systems with cyanazine + MSMA or pendimethalin and fluometuron. Similar weed control was noted with systems of glyphosate and cyanazine + MSMA, soil-applied herbicides and glyphosate, and the standard system.

At Goldsboro, yields and net returns with all glyphosate systems were equivalent to those of the standard system. However, yield and net returns were 23 to 36% greater with pendimethalin, fluometuron, glyphosate EPOT, and cyanazine + MSMA LPOST-DIR than with other glyphosate systems. At Rocky Mount, yields and net returns from systems with soil-applied herbicides were similar to those of the standard system. However, yields and net returns from total POST systems were 23 to 30% and 40 to 51% less, respectively, than with the standard system due to early season competition from the severe large crabgrass pressure. Losses in yields and net returns were alleviated in 1997 when total POST glyphosate systems were initiated at one-leaf cotton.

COTTON HERB- A NEW DECISION-MAKING TOOL FOR WEED MANAGEMENT IN COTTON. G. H. Scott, J. W. Wilcut, and G. G. Wilkerson, Crop Science Department, North Carolina State University, Raleigh, NC 27695-7620.

ABSTRACT

COTTON HERB is a computer program that aids weed management decision making in cotton. Inputs required by COTTON HERB include weed counts by species, heights of weeds and cotton, soil moisture status, anticipated yield potential of cotton in the field, selling price of cotton, and the cotton variety planted. COTTON HERB then calculates the expected yield loss based on weed populations and provides the user a list of herbicide choices based on the best combination of cost and weed control performances. COTTON HERB relies on accurate weed identification and timely scouting and herbicide application to ensure success. The objectives of this research were to evaluate weed control, cotton yield, and net returns to land, labor, and management systems with traditional management systems versus COTTON HERB in non-transgenic and transgenic cotton. The non-transgenic varieties were Stoneville 474 at Lewiston, NC and Deltapine 51 at Goldsboro, NC. Transgenic varieties at both locations included Stoneville BXN47 and Deltapine 5415RR (Roundup Ready). The tests were scouted four separate times and the results entered into the Cotton HERB program. The number one recommendation provided by Cotton HERB was then applied. Treatments included: nontreated for each variety, trifluralin PPI at 0.56 kg/ha followed (fb) by fluometuron PRE at 1.12 kg/ha fb COTTON HERB recommendations for each variety, COTTON HERB recommendations only without soil applied treatments for each variety, and a weedfree check for each variety, trifluralin fb fluometuron fb pyrithiobac EPOST at 0.072 kg/ha fb prometryn at 1.34 kg/ha + MSMA at 2.24 kg/ha late postemergence directed (LAYBY) for Deltapine 51 or Stoneville 474, trifluralin fb fluometuron fb bromoxynil EPOST at 0.56 kg/ha fb prometryn plus MSMA LAYBY for BXN 47, and trifluralin fb fluometuron fb glyphosate EPOST at 0.84 kg/ha fb prometryn plus MSMA LAYBY for Deltapine 5415RR. Weed control was estimated visually six weeks after the LAYBY applications for entireleaf morningglory (*Ipomoea hederacea* var. *integriuscula),* large crabgrass (*Digitaria sanguinalis*), sicklepod (*Senna obtusifolia*), smooth pigweed (*Amaranthus hybridus*), fall panicum (*Panicum dichotomiflorum*), goosegrass (*Eleusine indica*), yellow nutsedge (*Cyperus esculentus*), common lambsquarters (*Chenopodium album*), and prickly sida (*Sida spinosa*).

All weed management systems controlled all weeds at least 90% with the exception of sicklepod and common lambsquarters in non-transgenic cotton. Common lambsquarters was controlled less than 40% in non-transgenic cotton when no soil applied herbicide was used. This lack of control illustrates the lack of pyrithiobac POST activity on common lambsquarters. A total POST system in non-transgenic cotton which included pyrithiobac EPOST fb lactofen plus MSMA PDS fb prometryn plus MSMA LAYBY controlled sicklepod 80% which was less than all other systems which controlled sicklepod at least 90%. In Goldsboro, COTTON HERB recommended a fourth herbicide application in only the Roundup Ready variety system. The commercial standard treatments, which used soil applied, POST, and LAYBY herbicides had less herbicide cost than any of the HERB treatments. The Roundup Ready system was the least expensive system. Soil applied herbicides plus POST recommendations by COTTON HERB yielded equivalent to the weedfree check in all varieties. Systems which used only POST herbicides yielded less than the weedfree check and systems which use soil applied herbicides plus POST COTTON HERB recommendations. This reduced yield in both transgenic and non-transgenic cotton from POST only herbicide systems may reflect early season competition. Total POST systems may be of limited utility in fields with heavy weed infestations. Early season weed interference appeared to reduce cotton yield potential- regardless if late season weed control was excellent.

COTTON HERB can be a valuable resource and provide additional information for herbicide selection. The COTTON HERB systems provided excellent control of the weeds infesting the test areas. COTTON HERB accounts for the multiple populations of weeds found in most fields, and provides a grower with the economically best control option. COTTON HERB helps to relieve some of the uncertainty associated with deciding what combinations of herbicides are most effective. The COTTON HERB herbicide efficacy database is compiled from a number of extension publications from across the Cotton Belt. It is the most extensive database available in one source. Additionally, it accounts for differences in weed control based on weed sizes and drought stress. Finally, it provides the user an evaluation of potential economic losses based on the weed population present in that field. The user can then use this information for herbicide selection. It allows a producer to more accurately assess cost/benefit ratios and determine the amount of risk their enterprise is willing to assume.

ECONOMIC EVALUATION OF CONSERVATION TILLAGE SYSTEMS UTILIZING ROUNDUP READY COTTON. K. M. Bloodworth, D. B. Reynolds, and S. L. File. Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

With conventional cotton production systems the soil is tilled, a preplant incorporated (PPI) and/or preemergence (PRE) herbicide is applied, and from as many as three to four post-directed (PD) applications may be made. Production costs increase with each additional tillage or chemical input. These increased inputs reduce the net return from the crop and often do not control the target weeds. The introduction of Roundup Ready cotton may help to overcome some of these problems by reducing the number of tillage operations, herbicide applications, and types of herbicides needed, thus reducing production costs and increasing net return.

In 1996 and 1997 field experiments were conducted to compare no-till or stale seedbed production systems with conventional tillage systems utilizing Roundup (glyphosate) alone, Roundup + Bladex (cyanazine) layby, and a conventional herbicide program. In 1996 and 1997 no-till experiments were conducted near Leland, MS, and the Northeast Mississippi Branch Experiment Station (NMES) near Verona, MS. Stale seedbed experiments were conducted in 1996 and 1997 at the Delta Research and Extension Center (DREC) at Stoneville, MS and the Black Belt Branch Experiment Station (BES) near Brooksville, MS. Treatments were arranged as a split-plot factorial arrangement of treatments in a randomized complete block design with four replications. Main blocks were tillage treatments consisting of stale seedbed or no-till versus conventional tillage, with sub-block herbicide treatments of Roundup alone, Roundup + Bladex layby, or a conventional herbicide program. Roundup was applied at 1.1 kg ai/ha once over the top and then PD two times in the Roundup alone program. In the Roundup + Bladex layby, Roundup was applied at 1.1 kg/ha once topically, once PD, and was followed by Bladex + MSMA at 1.1 + 2.2 kg ai/ha applied as a layby treatment. In the conventional herbicide program a preemergence of Prowl (pendimethalin) + Cotoran (fluometuron) 1.1 + 1.7 kg ai/ha was applied, followed by Cotoran + MSMA 0.9 + 2.2 kg/ha PD, followed by Caparol (prometryn) + MSMA 0.6 + 2.2 kg/ha PD, followed by a layby application of 1.1 kg/ha of Bladex.

In the conventional tillage versus stale seedbed production system, all treatment combinations controlled pitted morningglory (*Ipomoea lacunosa)* at least 70%. The greatest yield and return came from the conventional tillage system, regardless of which herbicide program was used at all but one location. Yield and net return with Roundup alone was equal to or greater than with conventional herbicides, and greater than with Roundup + Bladex at all locations.

In the no-till system, pitted morningglory and broadleaf signalgrass (*Brachiaria platyphylla*) control did not greatly differ across herbicide treatment, tillage system, or environment. Yields varied among environments but were generally higher under conventional than no-till systems. Roundup alone provided a net return equivalent to conventional herbicides and greater than Roundup + Bladex.

ROUNDUP/BOLLGARD® COTTON RESPONSE TO WEED MANAGEMENT SYSTEMS. N. W. Buehring, G. A. Jones, R. R. Dobbs, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

A field study was conducted in 1997 and 1998 at the Northeast Branch Experiment Station, Verona, MS, to evaluate herbicide efficacy in Roundup/BT cotton. Plots were arranged in a randomized complete block design with four replications. All preemergence (PRE) and postemergence (POST) herbicide applications were made with a spray boom equipped with spray nozzles spaced 20 inches apart. Post directed (PD) and post directed layby (PDL) applications were made with a slide-shield sprayer which was equipped to direct herbicide to the base of the cotton plant and to the area between the row. POST, PD, and PDL herbicide applications were made to cotton in the 2 to 4 leaf stage, 6 to 8 leaf stage, and cotton 15 to 24 inches tall, respectively, and before weeds were taller than 4 inches or had 3 to 4 true leaves. Weeds evaluated were morningglory spp (*Ipomoea spp*), sicklepod (*Senna obtusifolia*), goosegrass (*Eleusine indica*), large crabgrass (*Digitaria sanguinalis*), and broadleaf signalgrass (*Bracharia platyphylla*). Weed infestation levels were light to moderate in 1997 and moderate to severe in 1998 .

The herbicide treatments were: (1) glyphosate at 1.0 lb ai/A POST, repeated at 0.75 lb ai/A PD and at 0.75 lb ai/A PDL; (2) glyphosate at 1.0 lb ai/A POST, repeated at 0.75 lb ai/A PD and followed by (Fb) cyanazine + MSMA at 1.25 + 2.0 lb ai/A PDL; (3) pendimethalin at 0.8 lb ai/A PRE Fb glyphosate at 1.0 lb ai/A POST, repeated at 0.75 lb ai/A PD and

at 0.75 lb ai/A PDL; (4) fluometuron at 1.2 lb ai/A PRE Fb glyphosate at 1.0 lb ai/A POST, repeated at 0.75 lb ai/A PD and at 0.75 lb ai/A PDL; (5) pendimethalin + fluometuron at 0.8 + 1.2 lb ai/A PRE Fb glyphosate at 1.0 lb ai/A POST, repeated at 0.75 lb ai/A PD and at 0.75 lb ai/A PDL; and (6) pendimethalin + fluometuron at 0.8 + 1.2 lb ai/A PRE Fb fluometuron + MSMA at 0.8 + 2.0 lb ai/A PD at 2 to 3 leaf cotton Fb cyanazine + MSMA at 1.0 + 2.0 lb ai/A PD Fb cyanazine + MSMA at 1.25 to 2.0 lb ai/A PDL. The drier and warmer early growing season in 1998 caused faster cotton growth and reduced weed reinfestation, and resulted in deleting all PD applications.

Both years all treatments showed good broadleaf weed and annual grass control. Both annual grass and broadleaf weed control 48 and 65 days after planting in 1998 and 1997, respectively, was greater than 90%. All treatments at maturity showed grass and broadleaf weed control were 88% or more. Lint yield for both years were not different and ranged from 800 to 1000 lb/A with the untreated check yield of 109 lb/A.

EFFECTIVENESS OF ROUNDUP READY PROGRAMS, FOR MANAGING TALL MORNINGGLORY (IPOMOEA PURPUREA) IN TEXAS COTTON. J. W. Smith III and P. A. Baumann, Texas Agricultural Extension Service, College Station, TX.

ABSTRACT

Approximately 5.2-5.6 million acres of cotton are planted each year in Texas and 1.1 million acres of Roundup Ready cotton were planted in 1998. Roundup Ready cotton has provided Texas producers with an additional tool for controlling a multitude of weed species. Dynamic weather such as untimely rain or high wind continues to cause problems for producers applying Roundup Ultra (glyphosate) in a safe and timely manner. Morningglory spp. in particular have been unforgiving to cotton producers when Roundup Ultra applications are not applied during the seedling stage of growth. When morningglory spp. commence vine growth, Roundup Ultra efficacy has generally been greatly reduced.

A study was initiated in 1998 to simulate delayed or missed early Roundup Ultra applications, to evaluate control measures on tall morningglory vines. Utilizing a randomized complete block design with three replications, experimental plots were four rows by twenty-five feet. Seven treatments were evaluated including an untreated control plot. Four treatments consisted of sequential applications of Roundup Ultra at 1.0 qt/A after morningglory vines reached 3-6" in length. Additionally, two of the four treatments had tank-mixes of Goal (oxyfluorfen) at 4.0 oz./A or Karmex (diuron) at 0.75 lb./A. These tank-mixes were applied through a hooded sprayer with Roundup Ultra at different application timings. A fifth Roundup Ultra treatment was applied when morningglory vines were 6-12" and was then followed up with a second application 18 day later. Ultra. A treatment of Prowl (pendimethalin) at 1.8 pts./A and Cotoran (fluometuron) at 1.5 pts./A was applied preemergence, followed by a delayed Staple (pyrithiobac sodium)application at 1.6 oz./A when morningglory vines reached 6-12." This treatment was followed fourteen days later with a tank-mix of Staple at 1.6 oz./A and MSMA at 1.33 qts./A, applied through a hooded sprayer. All treatments received a late season layby application of Karmex at 0.75 lb/A.

Roundup Ultra applied on morningglory with 3-6"vines provided 60-75% control. The Roundup Ultra hooded application on vines 6-12" resulted in only 25% control. Tank-mixes, of Goal or Karmex with Roundup Ultra in sequential hooded applications 24 days after an initial application of Roundup Ultra, did not significantly increase morningglory control versus where Roundup Ultra was applied alone in a like manner. When Roundup Ultra was applied 15 days after an initial Roundup Ultra application, there was not a significant increase in morningglory control compared to applications that were made 24 days after the initial application. Sequential hooded applications of Roundup Ultra were necessary to increase and maintain morningglory control at 65-85%. The preemergence treatment of Prowl and Cotoran did not provide any initial control of morningglory. When the preemergence treatment was followed by a Staple application on morningglory with 6-12" vines, control increased to 20%. Following the initial Staple application, a tank-mix of Staple and MSMA was applied 13 days later through a hooded sprayer on 6-12" regrowth of morningglory vines and control increased to 55%. The greatest significant, positive effects on morningglory control and cotton yields were seen where Roundup Ultra was applied on 3-6" morningglory vines and followed with sequential applications. In order to obtain acceptable tall morningglory control with Roundup Ultra, the vines should not exceed 6" in length. Sequential applications should be made as often as possible until desired control is obtained. Morningglory vines greater than 6" could not be acceptably controlled with sequential Roundup Ultra or Staple/MSMA applications examined in this study. The early broadcast application of Roundup Ultra provided initial control of Tall Morningglory, however, we observed a lack of coverage on morningglories in the row by the hooded sprayer applications. This allowed some morningglories to prosper under the protection of the cotton plants thus reducing control.

RESPONSE OF NON-TRANSGENIC RICE TO LIBERTY. H. C. Smith[1], J. E. Street[2], M. E. Kurtz[2], and D. B. Reynolds[1]. Department of Plant and Soil Sciences, Mississippi State University[1], Mississippi State, MS, 39762; Delta Research and Extension Center[2], Stoneville, MS, 38776.

ABSTRACT

Off-target deposition is an issue affecting all pesticide applications. Increasing acreage of transgenic cultivars and the development of new transgenic cultivars may increase the need for data assessing the impact of off-target drift on non-transgenic cultivars in such crops as rice (*Oryza sativa L.*). The advent of the Liberty Link herbicide system in rice has caused increased interest in the response of non-transgenic rice cultivars to Liberty (glufosinate). Field studies were conducted in 1998 at the Delta Research and Extension Center near Stoneville, MS, and the Plant Science Research Center at Mississippi State University to evaluate the affect of simulated Liberty drift on non-transgenic rice cultivars. Treatments were arranged in a factorial arrangement in a randomized complete block design with four replications. Experimental units were 5.5 by 15 feet and all applications were applied at a total volume of 15 gallon per acre with a CO_2 equipped backpack sprayer. Factor A was application timings of Liberty. Application timings included the 3 to 4 leaf, mid-tiller, panicle initiation, and booting stages. Factor B was herbicide rate. Rates of Liberty used were 0.5, 0.25, 0.125, 0.06, and 0.03 lbs ai/A. Visual ratings were of rice injury determined 7, 14, and 28 days after each application timing. Visual injury 28 days after treatment from Liberty applied alone at the booting stage ranged from 13% to 100% and from0 to 88% when applied at the 3 to 4 leaf stage. Machine harvested yield was measured and harvested samples were evaluated for milling yield and quality. In general, the greatest yield reductions were observed when Liberty was applied at the booting stage in comparison to the other application timings. Whole milling yield was affected more at the booting stage than at any other growth stage. Liberty applied alone at 0.5 and 0.03 lbs ai/A reduced yield from 54% to 100% and 0% to 20 %, respectively depending upon location and growth stage at the time of application.

BARNYARDGRASS (*ECHINOCHLOA CRUS-GALLI*) CONTROL IN DRY-SEEDED GLUFOSINATE TOLERANT RICE. B. J. Williams; Northeast Research Station, St. Joseph, LA and S. D. Linscombe; Rice Research Station, Crowley, LA, Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

Barnyardgrass control in glufosinate tolerant rice (*Oryza sativa*) was evaluated in 1997 and 1998 at the Northeast Research Station near St. Joseph, LA on a Sharkey clay soil. Glufosinate tolerant rice at 140 kg/ha was drill seeded in rows 19 cm apart. Permanent floods were established 4 to 5 weeks after planting each year. Nitrogen at 126 kg/ha, in the form of prilled urea, was applied just before permanent flood. All treatments received an additional 42 kg/ha of nitrogen at panicle initiation. 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. Herbicide treatments were arranged in randomized complete blocks with three replications. Weed control ratings, rice injury ratings, and rice yield data were subjected to analysis of variance by year. Means were separated using Fisher's Protected LSD at the 5% level. Only data collected in 1998 are discussed, since results were similar between years.

Single applications of glufosinate at 0.56 kg ai/ha applied early postemergence and postemergence controlled barnyardgrass 80 and 87%, respectively. Barnyardgrass control with 0.28 and 0.41 kg ai/ha glufosinate was less than 75%, regardless of application timing. Glufosinate at 0.41 kg ai/ha applied postemergence and middle postemergence following delayed preemergence applications of 1.12 kg ai/ha pendimethalin controlled barnyardgrass 93 and 90%, respectively. Barnyardgrass control was only 70 and 85% when glufosinate was applied early postemergence and late postemergence following pendimethalin, respectively. Rice yields were also maximized when glufosinate was applied either postemergence or middle postemergence following pendimethalin. In another study, sequentially applying 0.28 kg ai/ha of glufosinate (early postemergence/late postemergence) controlled barnyardgrass 92% and maximized rice yield. Glufosinate rates above 0.28 kg ai/ha did not improve barnyardgrass control or rice yield when applied sequentially.

Research indicates that sequential applications of glufosinate at 0.41 to 0.56 kg ai/ha will be required to control red rice (*Oryza sativa*). This research indicates that glufosinate programs designed to manage red rice will also control barnyardgrass. However, conventional rice herbicides may improve barnyardgrass control.

BARNYARDGRASS (*ECHINOCHLOA CRUS-GALLI*) CONTROL IN DRY-SEEDED IMIDAZOLINONE TOLERANT RICE. J. F. Liscano, B. J. Williams; Northeast Research Station, St. Joseph, LA, and T. P. Croughan; Rice Research Station, Crowley, LA, Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

Control of barnyardgrass in imidazolinone tolerant rice (*Oryza sativa*) was evaluated in 1997 and 1998 at the Northeast Research Station near St. Joseph, LA on a Sharkey clay soil. Imidazolinone tolerant rice '93-AS35-10' at 140 kg/ha was drill seeded in rows 19 cm apart. Permanent floods were established 4 to 5 weeks after planting each year. Nitrogen at 126 kg/ha, in the form of prilled urea, was applied just before permanent flood. An additional 42 kg/ha of nitrogen was applied at panicle initiation. 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. Herbicide treatments were arranged in randomized complete blocks with three replications. Weed control ratings, rice injury ratings, and rice yield data were subjected to analysis of variance by year. Means were separated using Fisher's Protected LSD at the 5% level. Only data collected in 1998 are discussed, since results were similar between years.

Barnyardgrass control increased from 73% to 93% and 90% when 0.70 kg ai/ha imazethapyr applied early postemergence was tank mixed with 1.12 kg ai/ha pendimethalin and 2.24 kg ai/ha propanil, respectively. Barnyardgrass was not controlled when 0.035 kg ai/ha imazethapyr plus 0.56 kg ai/ha pendimethalin was applied delayed preemergence. However, when 0.035 kg ai/ha imazethapyr plus 0.56 kg ai/ha pendimethalin was followed by 0.035 kg ai/ha imazethapyr barnyardgrass control was 100%, resulting in the highest rice yields (9,000 kg/ha). Imazethapyr at 0.035 kg ai/ha applied sequentially resulted in excellent barnyardgrass control and rice yields. Single applications of imazethapyr at 0.070 kg ai/ha controlled barnyardgrass 90 to 93% when applied delayed preemergence or at spike. Increasing the rate to 0.140 kg ai/ha did not improve barnyardgrass control. Tank mixing imazethapyr at 0.070 kg ai/ha with 1.12 kg ai/ha pendimethalin increased barnyardgrass from 90 to 95%. Sequentially applying Lightning (package mix of imazethapyr + imazapyr) at 0.035 kg ai/ha early postemergence and postemergence controlled barnyardgrass 98%. Imazaquin at 0.15 kg ai/ha applied early postemergence reduced rice stands 20% and reduced rice vigor 50%, resulting in low rice yields (2800 kg/ha).

Season long barnyardgrass control and maximum rice yields can be expected when imazethapyr is applied sequentially at 0.035 kg ai/ha, applied spike at 0.070 kg ai/ha, or 0.070 kg ai/ha plus 1.12 kg ai/ha pendimethalin is applied delayed preemergence. Rice tolerance to imazethapyr was excellent on Sharkey clay soils. However, imidazolinone tolerant rice was severely injured by imazaquin on Sharkey clay soils both years.

EFFICACY OF PURSUIT IN IMI RICE FOR BROAD SPECTRUM WEED CONTROL. M. E. Kurtz and J. E. Street, Miss. Agric. And Forest. Exp. Stn., Stoneville, MS.

ABSTRACT

Imidazolinone tolerant rice (IMI rice) was planted in two experiments on May 8, 1998 at Stoneville, MS on Sharkey clay soil. Imazethapyr (Pursuit) was applied PPI on May 5, 1998, PRE on May 11, 1998, and Early Post on May 27, 1998 for the control of red rice (*Oryza sativa)* which was planted in the center two rows of a six-row grain drill in experiment 1 and barnyardgrass (*Echinocloa crus-galli*) and pitted morningglory (*Ipomea lacunosa*) which were over-seeded in experiment 2. The PPI and PRE treatments were applied at 0.063 and 0.094 lb ai/A each. Early Post treatments (2-3 leaf rice) were applied at 0.032, 0.047, and 0.063 lb ai/A with Latron AG-98 at 0.25% v/v alone and in sequence with each PPI and PRE treatment. An untreated control served as a check. Treatments were evaluated for weed control and rice injury where 0 = no control or injury and 100% = complete kill. Data were subjected to analysis of variance and means were separated using Fisher's protected (LSD) at P=0.05.

Red rice control was evaluated about 2 wk after the Early Post treatment. The PPI and PRE treatments alone controlled red rice less than 30%. The Early Post treatments alone at the 0.047 and 0.063 lb/A rates were equal in control with all combinations of Early Post with PPI and PRE treatments which ranged from 84 to 94% control of red rice. The final rating on Aug. 14, 1998, revealed that red rice was not controlled by PPI or PRE treatments alone. Only Pursuit (0.063 lb/A) PPI and 0.094 lb/A PRE followed by 0.063 lb/A Early Post controlled red rice >90%.

Barnyardgrass did not germinate until the week of the permanent flood (June 23, 1998). All treatments resulted in >95% control except for the PPI and PRE treatments alone and the two lowest rates Early Post alone. Morningglory was not

controlled by any treatments alone. Both rates of Pursuit PPI + the high rate of Pursuit Early Post resulted in morningglory control >90%. The high rate of Pursuit PRE + the high rate Early Post, resulted in >90% control. However, when the permanent flood was established, morningglory control increased to >90% for all treatments where initial control was >30%.

POTENTIAL FOR BROAD-SPECTRUM CONTROL OF WEEDS IN GLUFOSINATE-TOLERANT RICE. C. C. Wheeler, F. L. Baldwin, R. E. Talbert, L. A. Schmidt, and J. S. Rutledge, Agronomy Department, University of Arkansas, Fayetteville and University of Arkansas Cooperative Extension, Little Rock.

ABSTRACT

Weeds are the number one yield constraint in Southern rice production. Of these, red rice (*Oryza sativa)* is the most difficult to control. To date, there are no effective control measures for red rice in dry-seeded rice. Genetically transformed rice varieties tolerant to glufosinate (Liberty[7]) have potential to provide this technology. Three studies were conducted in Arkansas in 1997 and 1998 to evaluate glufosinate for control of red rice and other weeds in genetically transformed rice cultivars. A red rice control study was conducted in transformed Gulfmont rice at Stuttgart, AR. Broadleaf signalgrass (*Brachiaria platyphylla*) was evaluated in transformed Cypress at Lonoke, AR. At Rohwer, the control of barnyardgrass (*Echinochloa crus-galli*), hemp sesbania (*Sesbania exaltata*), and Amazon sprangletop (*Leptochloa panicoides*) was evaluated in Bengal rice.

Rice at all locations was drill seeded. Red rice at Stuttgart was broadcast seeded prior to final seedbed preparation. The weed spectrum at Lonoke was a severe infestation of native broadleaf signalgrass and the propanil-resistant barnyardgrass was planted in rows across the plots. Herbicide treatments were applied with a CO_2 backpack sprayer. All treatments in the studies were applied at early postemergence (2- to 3-leaf rice), before flood (just prior to flooding), and both. Glufosinate rates were 0, 0.28, 0.42, 0.56, and 0.84 kg ai/ha. Yield and visual rating data were taken on the rice at the Rohwer and Lonoke locations. Only visual ratings were taken in the red rice studies as it was destroyed prior to harvest to prevent any potential outcrossing.

Glufosinate shows excellent potential for broad-spectrum weed control in genetically transformed rice. Two applications of glufosinate, at 0.42 kg ai/A or higher, provided near 100% control of red rice. Repeated applications of 0.28, 0.42, and 0.56 kg/ha provided better control than 0.84 kg/ha as a single treatment. Season-long control of broadleaf signalgrass and barnyardgrass was excellent with 2 applications of glufosinate at 0.42 kg/A or higher. No crop injury was observed with any treatment on Bengal or Cypress rice, but Gulfmont was injured up to 50% with the post flood application of glufosinate. Cypress yields at Lonoke were not significantly increased with the sequential applications of glufosinate. There was a significant yield increase in the Bengal variety with the sequential applications of glufosinate when compared to the 0.28, 0.42 and 0.56 kg rates as single application. There is excellent potential for the glufosinate technology for control of problem weeds in rice production; therefore, research and development of glufosinate-tolerant rice cultivars should be continued.

FENOXAPROP + SAFENER (AEF 046360) FOR WEED CONTROL IN RICE. F. L. Baldwin[1], T. L. Dillon[1], R. E. Talbert[2], L. A. Schmidt[2], and B. J. Williams[3]; [1]University of Arkansas Cooperative Extension Service, Little Rock, AR 72203, [2]Department of Agronomy, University of Arkansas, Fayetteville, AR 72704, [3]Louisiana State University Northeast Experiment Station, St. Joseph, LA 71366.

ABSTRACT

Fenoxaprop was found to be an effective herbicide for controlling grass weeds in rice by R. J. Smith, Jr. and others in the 1980's. In Dr. Smith's research at that time, an early application of propanil, followed by a preflood application of fenoxaprop, became the standard for comparing annual grass control programs. It was also found that several factors could influence the selectivity of fenoxaprop to rice. These included: rice variety, growth stage, nitrogen fertilization, how quickly the flood was applied, sunlight and temperature. While research was promising, combinations of these factors often led to severe rice injury in grower fields after fenoxaprop became a commercial product. Lawsuits often resulted and fenoxaprop (Whip 360) became a very limited herbicide, used primarily for salvage sprangletop control.

In 1997, AgrEvo introduced a "safener" for Whip 360, HOE 122006, which was tested on a very limited basis in University research programs. Preliminary results with Whip 360 + HOE 122006 indicated a remarkable reduction in

rice injury with little or no loss in weed control compared to Whip 360 alone. Research was expanded in Arkansas and Louisiana in 1998. For 1998, the HOE 122006 "safener" was formulated with Whip 360 as AEF 046360. Weed control studies at Stuttgart, AR and St. Joseph, LA showed no difference in control of propanil resistant and susceptible barnyardgrass (ECHCG) and bearded sprangletop (LEPFA). The treatments compared were Whip 360 @ 0.04 lb ai/A applied to 2-3 leaf rice, followed by Whip 360 @ 0.067 lb/A applied preflood and AEF 046360 @ 0.08 lb/A, followed by 0.13 lb/A at the same growth stages. These rates of AEF 046360 contain the same active rates of fenoxaprop as the Whip 360 rates - that is the 0.08 lb ai/A rate of AEF 046360 contains 0.04 lbs. of fenoxaprop and 0.04 lb. of "safener."

Crop injury studies were conducted at Lonoke, AR and St. Joseph, LA. In both studies, blanket herbicide treatments were used to maintain the test area weed free. Bengal rice, a variety known to be susceptible to fenoxaprop, was planted. Water management, nitrogen application practices and rice growth stages known to increase fenoxaprop injury, were used where possible. In the study at St. Joseph, comparing the same rates and application timings of Whip 360 and AEF 046360 described above, with a propanil followed by propanil standard, rice yields were 82, 152 and 183 bu/A for the Whip 360, AEF 046360 and propanil treatments respectively. At Lonoke, rice yields were 146, 192 and 190 bu/A for the same Whip 360, AEF 046360 and propanil rates and timings described above. In the Lonoke study, 2X rates of the two herbicides were also compared. Where Whip 360 was applied at 0.08 lb/A to 2-3 leaf rice, followed by 0.133 lb/A applied preflood, the rice yield was 67 bu/A. Where the same equivalent rates of fenoxaprop were applied at the same timings as AEF 046360, rice yield was 186 bu/A, which was equivalent to the propanil standard.

In summary, these results indicate a complete "safening" of the fenoxaprop on rice with no significant loss in weed control activity. If these results are duplicated in the field, it should allow the weed control potential of fenoxaprop to be fully developed. Fenoxaprop can expand the options for barnyardgrass and sprangletop control and is often the most desirable herbicide to be applied adjacent to broadleaf crops.

CONTROL OF RED RICE AND OTHER DIFFICULT WEEDS IN IMIDAZOLINONE TOLERANT RICE.
T. L. Dillon, F. L. Baldwin, University of Arkansas Cooperative Extension Service, Little Rock. R. E. Talbert. Department of Agronomy, University of Arkansas, Fayetteville.

ABSTRACT

Over the past several years, red rice has become an increasing problem for Arkansas rice producers. Currently there is not a herbicide available to control red rice in drill seeded rice. This represents a large obstacle for growers who wish to expand rice acreage. Producers are also faced with other hard to control weeds, such as propanil resistant barnyardgrass and yellownutsedge. Herbicide resistant crops, such as Roundup Ready soybean, have given producers more flexibility in management options in the past several years. In the next few years, rice producers may also have access to similar technology.

There are several lines of rice now being developed with tolerance to certain herbicides. Drs. Tim Croughan and Steve Linscombe are developing imidazolinone tolerant varieties at Louisiana State University. Of the imidazolinone herbicides, imazethapyr has been selected by American Cyanamid to be commercially developed for weed control on the imi tolerant rice lines.

In 1998, field studies were conducted near Stuttgart and Lodge Corner, Arkansas to evaluate imazethapyr applied alone and in programs with other herbicides for weed control in rice. In the study at Stuttgart, red rice was the predominant weed. There was a natural infestation of red rice present at the site. In addition, the area was overseeded to enhance the population. Normal rice cultivation practices were followed. Chicken litter was incorporated with a field cultivator (along with the red rice seed), and the preplant incorporated applications were made and also incorporated with the field cultivator. The study was planted and the preemergence treatments were then applied. The area was flushed as necessary to insure a proper stand of rice and the permanent flood was applied 6-16-98. Imazethapyr applied at the 0.125 lb/A rate ppi, provided 98% control of red rice. The same rate applied preemergence provided 99% control and the delayed preemergence treatment provided 93% control. However in the case of red rice, 100% control must be achieved for the program to be effective. Sequential applications of 0.063 lb/A ppi followed by 0.063 lb/A preflood provided 100% control. The 0.063 lb/A early postemergence application followed by the same rate preflood also provided 100% control of red rice. In a similar study in 1997, all treatments except the postflood treatments provided 100% control. However, the 1998 results are more consistent with other researchers' findings. That is, the sequential applications of imazethapyr are more consistent than the single applications.

The study at Lodge Corner was designed to compare several standard treatments with imazethapyr for yellow nutsedge control. Imazethapyr applied at 0.063lb/A preplant incorporated provided 85% control of yellow nutsedge. The same rate applied preemergence provided 44% control. A 0.063 lb/A rate applied at 2-3 leaf rice stage provided 91% yellow nutsedge control. A sequential application of imazethapyr applied at 0.063lb/A ppi followed by a preflood application of the same rate provided 100% control. These treatments provided control consistent with the Londax and Permit standards. This study area was overgrown with several weed species late in the season. These included barnyardgrass, sprangletop, red rice and various aquatic species. Imazethapyr provided exceptional control of these weeds, resulting in the only clean plots in the study.

In other studies, imazethapyr has provided effective control of broadleaf signalgrass, propanil resistant barnyardgrass, sprangletop, ducksalad and mud plaintain. In studies conducted near Lonoke, AR the residual control provided by 0.063 rate applied ppi provided excellent control of broadleaf signalgrass season long. Other herbicides applied either in tank mixtures or as sequential treatments with imazethapyr, usually did not improve the control of most weed species over imazethapyr applied alone. However, programs with other herbicides will be required if some species such as hemp sesbania and northern jointvetch are present. Imazethapyr applied to imi-tolerant rice has excellent potential for controlling a broad spectrum of weeds in Arkansas, including difficult to control species such as red rice. It can also provide full season control and is well suited to both ground and aerial application. The ability to control red rice in dry seeded rice can allow for increased profit and expansion of the rice acreage by producers in Arkansas.

EXPERIMENTAL HERBICIDES FOR WEED CONTROL IN RICE. E. P. Webster, W. Zhang, D. Y. Lanclos, J. A. Masson, and S. N. Morris, Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

Research was conducted at the Rice Research Station near Crowley, LA to evaluate experimental herbicides for potential use in rice (Oryza sativa L). All studies were established on a Crowley silt loam soil with 5.5 pH and 1.5% organic matter. Experiments were planted drill- or water-seeded in late May, 1998. The herbicides evaluated were clomazone, carfentrazone, V-10029, and halosulfuron. Clomazone and carfentrazone are under development by the FMC Corporation. Monsanto and the Valent U.S.A. Corporation are developing halosulfuron and V-10029, respectively.

Weed control and crop safety was evaluated for clomazone applied preplant incorporated (PPI), preemergence (PRE), and delayed PRE (DPRE) at rates of 0.2, 0.4, 0.6, 0.8, and 1.0 lb ai/A in a drill-seeded system. Annual sedge (Cyperus compressus L.), barnyardgrass [Echinochloa crus-galli (L.) Beauv.], hemp sesbania [Sesbania exaltata (Raf.) Rydb. ex A.W. Hill], and spreading dayflower (Commelina diffusa Burm. f.) control and rice injury were evaluated. At 7 d after DPRE, all clomazone treatments controlled barnyardgrass at least 90% and at 28 d after DPRE, 0.2 lb ai/A clomazone PPI was the only treatment with less than 90% control. Clomazone at 0.6, 0.8, and 1.0 lb/A PRE and 0.8 lb/A DPRE controlled spreading dayflower 90 to 93% 7 d after DPRE. At 28 d after DPRE, 90% control of spreading dayflower was obtained for all treatments. Clomazone at 1.0 lb/A PRE and DPRE controlled annual sedge 90% 7 d after DPRE, and at rates below 0.8 lb/A control was 44 to 73%. Hemp sesbania control was below 75% for all treatments 7 d after DPRE. Rice injury 7 d after DPRE, was above 20% for 0.4, 0.6, 0.8, and 1.0 lb/A PPI, 1.0 lb/A PRE, and 0.8 and 1.0 lb/A DPRE. However, at 28 d after DPRE, only 1.0 lb/A clomazone PPI injured rice more than 20%.

Carfentrazone was evaluated to determine weed control spectrum in drill- and water-seeded rice. In a drill-seeded system 0.32 oz ai/A carfentrazone postemergence (POST) to 2 to 3 leaf rice controlled Indian jointvetch (Aeschynomene indica L.), hemp sesbania, and spreading dayflower at least 80% 21 days after treatment (DAT). At 35 DAT, control was 75 to 93% for Indian jointvetch, hemp sesbania, and spreading dayflower. Barnyardgrass and broadleaf signalgrass [Brachiaria platyphylla (Griseb.) Nash] control was below 30% at each rating. In a water seeded experiment, a combination of carfentrazone at 0.32 oz/A plus clomazone at 0.6 lb/A was applied to pegging (PEG) rice and at 7 d after permanent flood (DAFLOOD) establishment. At 21 DAT, barnyardgrass, alligatorweed [Alternanthera philoxeroides (Mart.) Griseb.], and ducksalad [Heteranthera limosa (Sw.) Willd.] control was 90 to 94% with carfentrazone plus clomazone applied PEG compared with 25 to 60% control when treated 7 DAFLOOD. At 21 DAT, the tank-mix resulted in 10% stand reduction, 4% stunting, and no bleaching when treated 7 DAFLOOD compared with 18, 25, and 0%, respectively, for PEG treatment.

V-10029 was evaluated in drill- and water-seeded experiments when applied at 0.32 and 0.64 oz ai/A POST to 3 to 4 leaf rice. In the drill-seeded experiment barnyardgrass, broadleaf signalgrass, spreading dayflower and Indian jointvetch control was evaluated 14 and 28 DAT. Barnyardgrass, spreading dayflower, and Indian jointvetch control was above

90% at 14 DAT and 88 to 95% at 28 DAT for both rates of V-10029. Broadleaf signalgrass control was below 70% for each rating regardless of rate. In a water-seeded study, 0.32 lb/A V-10029 was applied PPI and PRE prior to seeding. At 28 DAT, red rice (Oryza sativa L.), barnyardgrass, and ducksalad control was 93 to 96% with V-10029 PPI. At 42 DAT, V-10029 PPI controlled ducksalad 80%, red rice 93%, and barnyardgrass 96%. At each rating, rice injury was 14 and 21% with V-10029 PRE and PPI, respectively.

Halosulfuron applied POST at 0.75 oz ai/A to 3 to 4 leaf rice was evaluated in a drill-seeded system for control of barnyardgrass, broadleaf signalgrass, Indian jointvetch, hemp sesbania, annual sedge, and spreading dayflower. At 7 DAT, control was below 40% for all weeds evaluated. At 21 DAT, spreading dayflower, hemp sesbania, and annual sedge control was 60, 80, and 88%, respectively, and barnyardgrass, broadleaf signalgrass, and Indian jointvetch control was below 20%.

EVALUATION OF FACET DF AT DIFFERENT APPLICATION TIMINGS. S. N. Morris, E. P. Webster, and D. Y. Lanclos. Louisiana State University Agriculture Center, Baton Rouge, LA 70803.

ABSTRACT

A field study was established at the Rice Research Station, near Crowley, LA, in 1998 to evaluate Facet DF at different application timings and rates in drill-seeded rice. Facet DF was applied preplant incorporated (PPI), preemergence (PRE), and delayed PRE (DPRE) at rates of 0.33, 0.5, and 0.66 lb pr/A. Command at 1.0 pt/A and Prowl at 2.4 pt/A at the same application timings and a standard treatment of Facet at 0.5 lb/A plus Prowl at 2.4 pt/A applied DPRE were included for comparison. Control of barnyardgrass [Echinochloa crus-galli (L.) Beauv.], broadleaf signalgrass [Brachiaria platyphylla (Griseb.) Nash], hemp sesbania [Sesbania exaltata (Raf.) Rydb. ex A. W. Hill], Indian jointvetch (Aeschynomene indica L.), spreading dayflower (Commelina diffusa Burm. f.), and annual sedge (Cyperus compressus L.) was visually evaluated 14 and 42 days after the DPRE treatment (DAT). Rice injury was visually evaluated 7, 14, and 42 DAT. The experimental design was a randomized complete block and treatment means were separated by Fisher's Protected LSD at the 5% level of probability.

At 14 DAT, control of barnyardgrass and broadleaf signalgrass was above 90% for all treatments except Prowl DPRE with 88 and 80% control, respectively. Control of hemp sesbania was 95% with the standard of Prowl plus Facet DPRE, and all rates of Facet DPRE had control of 93 to 97%. However, Command at all timings controlled hemp sesbania 65 to 67%. The standard treatment controlled Indian jointvetch 97% and Facet PPI at 0.5 and 0.66 lb/A, all rates of Facet DPRE, and Prowl DPRE at 2.4 pt/A had equal control. Control of spreading dayflower was 80 to 88% with Command at all application timings, but control was less than 60% with all other treatments. Control of annual sedge with the Facet plus Prowl standard was 97%, and all rates of Facet DPRE had equal control. Annual sedge control with Command at all timings was less than 20%.

At 42 DAT, control of barnyardgrass for all treatments except 0.33 lb/A Facet PRE was equal to Facet plus Prowl DPRE that had 97% control. Facet plus Prowl DPRE had 97% broadleaf signalgrass control. All other treatments had equal control of broadleaf signalgrass except Facet PPI and PRE at 0.33 lb/A and Prowl PRE and DPRE. Hemp sesbania control was 94% with Facet plus Prowl DPRE and control was equal for all single applications of Facet, however, control was less than 65% with all Command timings. Control of Indian jointvetch was 94% with the Facet plus Prowl standard, and control with the Facet and Prowl DPRE applications was 89 to 90%. Control of Indian jointvetch with all other treatments was less than the standard. Facet plus Prowl DPRE controlled spreading dayflower 93%. Command at all timings had equal control of spreading dayflower, but control with all other treatments was less than the standard. Annual sedge control with Facet 0.5 and 0.66 lb/A at all timings was equal to the standard treatment control of 93%.

Rice injury 7 DAT, was below 10% for Facet at all rates and application timings and 11 to 15% for Command. Incorporated Prowl at 2.4 pt/A injured rice 23% compared with 5 and 10% for Prowl PRE and DPRE, respectively. At 14 DAT, rice injury was less than 10% for all treatments and by 42 DAT little to no injury was observed.

In conclusion, the Facet plus Prowl standard treatment had the most consistent control throughout the growing season. Single applications of Facet and Command PPI or PRE offer broad spectrum weed control with the option to use ground application rather than aerial application. However, knowledge of the weed spectrum will be critical to selecting the best weed control program.

EVALUATION OF IMAZETHAPYR ON IMIDAZOLINONE-RESISTANT RICE. J. A. Masson, E. P. Webster, and S. N. Morris. Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

A field study was established in 1998 at the Rice Research Station near Crowley, LA to evaluate application timings and rates of imazethapyr for weed control and injury on imidazolinone-resistant (IR) rice in water-seeded culture. IR-rice, '93 AS-3510', was planted May 22, 1998 on a Crowley silt loam soil with a pH of 5.5 and 1.4% OM. The experimental design was a randomized complete block with four replications. Plot size was 5' x 20'. Imazethapyr was applied preemergence following pre-germinated seeding (PRE-SEED), at pegging (PEG), and at early postemergence (EPOST). Imazethapyr was applied at 0.063 and 0.094 lb ai/A at all timings. The PEG and EPOST timings had an additional imazethapyr rate of 0.125 lb/A. Non-ionic surfactant at 0.25% v/v was added to all EPOST applications. Barnyardgrass [Echinochloa crus-galli (L.) Beauv.], red rice (Oryza sativa L.), ducksalad [Heteranthera limosa (Sw.) Willd.], and Indian jointvetch (Aeschynomene indica L.) control and rice injury were evaluated 14 and 35 d after EPOST (DAEPOST).

At 14 DAEPOST, 0.063 and 0.094 lb/A of imazethapyr EPOST were the only treatments that had at least 90% control of barnyardgrass and red rice. All rates and timings of imazethapyr had less than 80% control of ducksalad and Indian jointvetch. The PRE-SEED applications injured rice less than 10%. Imazethapyr at 0.094 and 0.125 lb/A PEG injured rice 21 and 20%, respectively. Injury was 36 to 49% with imazethapyr applied EPOST.

At 35 DAEPOST, red rice and barnyardgrass control was greater than 90% for all treatments. Ducksalad control was below 70% for all imazethapyr rates and timings. All PEG treatments controlled Indian jointvetch more than 90%. Rice injury was similar to that observed 14 DAEPOST.

In conclusion, red rice and barnyardgrass were adequately controlled by all imazethapyr rates and timings evaluated in this study. Indian jointvetch control was greater than 90% 35 DAEPOST. An IR-rice production system will require additional herbicides to control ducksalad. This study indicates that an application of imazethapyr PEG has little adverse effect on the IR-rice; however, other research has shown excessive injury with a PEG application of imazethapyr. The discrepancy in results indicates that crop injury remains a concern with IR-rice.

RESPONSE OF FLUE-CURED TOBACCO TO SPARTAN (SULFENTRAZONE) AT FIVE LOCATIONS. D. T. Gooden and E. C. Murdock, Clemson University, Florence, SC 29501.

ABSTRACT

Sulfentrazone (Spartan) has been used for effective control of nutsedge and morningglory in flue- cured tobacco. In the last two 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. Injury symptoms have most often occurred 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.

In 1998, four tests were conducted on farm and two tests were established at the Pee Dee Research and Education Center (PDREC). The objective was to determine the effects of application method, soil type, and location on the response of tobacco to sulfentrazone. Soil types for all locations contained at least 80% sand and had an organic matter content of 0.7 to 17%. One site was classified as a sand with less than 1% organic matter although label directions prohibit the use of sulfentrazone on these soils. The labeled rate for the other four locations was 0.25 lb ai/ac. Sulfentrazone was applied PPI at 0.25 and 0.375 lb ai/ac for the four sites located on-farm. The PPI rate used for the PDREC was 0.25 lb ai/ac. PRE treatments were applied at 0.25 lb ai/ac for all locations. On-farm tests were replicated three times with a 1/16 acre plot size. The PDREC tests consisted of two-row plots, 45 feet long, with four replications. All beds were "knocked-off" prior to the PPI and PRE application of sulfentrazone. PPI treatments were incorporated with a power tiller and bed shaper. Tobacco injury was rated at 3, 5, and 7 weeks after transplanting. Yield and quality were determined for all tests.

Sulfentrazone applied at 0.375 lb ai/ac resulted in significant leaf flecking at one location. In the on-farm tests, tobacco yields were slightly lower when sulfentrazone was applied @ 0.375 lb ai/ac compared to 0.25 lb ai/ac. However, yields attained in the untreated check and when pendimethalin was used alone were similar to yield levels with sulfentrazone @ 0.375 lb ai/ac. Evidence suggests that PRE treatments of sulfentrazone resulted in less injury than PPI treatments.

However, tobacco yields were greater when sulfentrazone was applied PPI than with PRE applications. This was attributed to the better weed control observed with PPI applications. Results of the four tests indicate that tobacco injury due to sulfentrazone application has few lasting effects when used at the recommended rate.

POTENTIAL FOR COTORAN TO CARRY OVER TO FLUE-CURED TOBACCO. A. L. Bradley, Jr.; North Carolina Cooperative Extension Service, Tarboro; R. B. Batts, A. C. York, and F. H. Yelverton, North Carolina State University, Raleigh.

ABSTRACT

Experiments were conducted at two sites over four years to determine the potential for fluometuron (Cotoran) to carry over to flue-cured tobacco. Six two-year cotton/tobacco rotations were established, beginning in 1995, 1996, and 1997. Three were established at the Upper Coastal Plain Research Station near Rocky Mount, NC and three at the Lower Coastal Plain Research Station near Kinston. Cotton plots were 8 wide rows x 60 feet. The following year, tobacco plots were 6 rows transplanted into the center 40 feet of the previous year's plot. Cotton treatments consisted of fluometuron applied preemergence a broadcast at 1.5 lb ai/a or as a 50% band at 1.5 lb/a (0.75 lb/planted acre) followed by none, one, or two POST-directed applications of fluometuron in a 50% band at 1.5 lb/a (0.75 lb/planted acre). The first POST-directed application was made when cotton was 4 to 6 inches tall and the second was applied to 8- to 12-inch cotton. A non-treated check was also included. After cotton harvest, sites were disked once. Land was disked twice the following spring and bedded prior to tobacco transplanting. All tillage was done parallel to the initial cotton rows. No significant differences occurred among any treatment for cotton yield.

Visual injury and chlorosis were estimated at 2, 4, and 6 weeks after tobacco transplanting. Tobacco yield, quality indices, and value were also recorded. No differences were seen between the methods of preemergence application for these parameters. Only POST-directed application effects were evident. Although both visual injury and chlorosis were present at 4 weeks after transplanting, they were most severe at the six-week evaluation. At this time, significant injury was observed at five of six sites from three fluometuron applications, and two of six sites with two fluometuron applications. Visual injury with three fluometuron applications was 24% at Rocky Mount in 1998 and less then 13% at all other locations. No differences in visual injury occurred at Kinston in 1997. Percent of plants showing chlorosis was also significant at five of six sites with three fluometuron applications and at one site with two fluometuron applications. Up to 67% of the plants had some level of visible chlorosis at Rocky Mount in 1998 with less than 30% chlorosis at all other sites. As with visual injury, no differences were observed at Kinston in 1997. Data for tobacco yield, quality, and value were pooled across locations as well as preemergence application methods. No significant differences occurred among treatments for any of these parameters. Weather records over the course of these experiments suggest below normal rainfall during the cotton growing season may lead to an increase in visible injury from fluometuron.

WEED CONTROL IN NO-TILL TOBACCO PRODUCTION SYSTEMS. R. Ellis, G. N. Rhodes, B. Sims, and T. C. Mueller, Department of Plant and Soil Sciences, University of Tennessee, Knoxville, TN 37901-1071.

ABSTRACT

Tobacco is an important crop in the southeastern United States. Weed control is essential in producing a high yielding, high quality leaf. Traditionally, cultivation and hoeing have been the main methods of weed control. Cultivation 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. This may require longer rotation periods for fields or even leaving some land out of tobacco production. No-till systems would allow production on sloping fields while decreasing soil erosion. Weed control in these no-till systems would be largely chemical, and herbicide options are limited in tobacco.

Studies were conducted on the Tobacco Experiment Station in Greeneville, TN in 1997 and 1998 in order to evaluate pre-transplant herbicide programs in no-till burley tobacco. The experimental design was randomized complete block with each of the seven treatments replicated four times. Treatments consisted of Spartan (6.7 oz/A) + Command (2.0 pt/A), Spartan (6.7 oz/A) + Prowl (2.5 pt/A), Spartan (6.7 oz/A) + Devrinol (2.0 lb/A), Prowl (2.5 pt/A) + Devrinol (2.0 lb/A), Spartan (6.7 oz/A), Command (2.0 pt/A), and a weedy check. Rye was seeded in the fall of the year prior to transplanting. TN 90 was transplanted in mid to late June at a population of 7100 plants per acre.

Smooth pigweed control was greater than 95% on all plots which had Spartan applied except for the Spartan + Command in 1997 which was 76%. Spartan provided better than 85% control of cocklebur in 1997. Spartan + Prowl provided 96% control of large crabgrass 31 days after transplanting. Spartan + Command provided 92% control of large crabgrass 31 days after transplanting. Tobacco injury did not exceed 11% in any of the treatments. Yields in 1998 were comparable to average state yields.

Mulch provided by a cover crop combined with a good pre-transplant herbicide combination, can provide effective weed control in no-till burley tobacco.

INFLUENCE OF APPLICATION VARIABLES ON PERFORMANCE OF SPARTAN IN TOBACCO. G. K. Breeden, G. N. Rhodes, Jr., and T. C. Mueller; University of Tennessee, Knoxville 37996.

ABSTRACT

Spartan, a 75 % DF formulation of sulfentrazone, was introduced to the tobacco (*Nicotiana tabacum*) market in 1997. The herbicide provides excellent control of broadleaves and sedges, and gives good suppression of grasses. There were no significant crop injury problems noted with this product during years of previous research. Unexpected injury, however, was noted in some locations in 1997. Tobacco injury was expressed as stunting and discoloration. This injury was believed to be related to depth of incorporation. Field experiments were conducted at Greeneville and Springfield, TN in 1997 and 1998 to determine the influence of incorporation depth on weed control, tobacco injury and yield.

All experiments were replicated 4 times in a randomized complete block design. Experimental units consisted of four row plots, 14 feet wide by 30 feet long. 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 and 4 inches. Herbicides were applied with a CO_2 pressurized tractor or 4-wheeler sprayer at 15 gpa. Herbicides were incorporated with a PTO driven roto-tiller. At Greeneville, ‘TN-90' burley tobacco was used while ‘TN D950' dark fire cured tobacco was used at Springfield. Weed control and crop injury were estimated visually using a 0-99% scale. The center two rows of each plot were harvested for yield.

Weed control was excellent at all locations with combinations of Spartan plus Command and Spartan plus Prowl. Weed control was 90% or greater for smooth pigweed (*Amaranthus hybridus* L.), large crabgrass [*Digitaria sanguinalis* (L.) Scop.], goosegrass [*Eleusine indica* (L.) Gaertn.], Pennsylvania smartweed (*Polygonum pensylvanicum* L.), carpetweed (*Mollugo verticillata* L.) and yellow nutsedge (*Cyperus esculentus* L.). Weed control was not influenced by depth of incorporation. In 1997 at Springfield, all injury was 20% or less at 15 days after treatment (DAT) with a slight increase in injury with incorporation. At 64 DAT all treatments exhibited 5% or less injury, except for Spartan and Prowl incorporated to a depth of 2 inches, which was 10%. In 1998 at Springfield stunting and chlorosis were both 10% or less until 48 DAT, with no injury after this point in the growing season. At Greeneville in 1997 stunting was 21% or less 26 DAT and showing a slight increase with incorporation. By 59 DAT all stunting was below 11%. Chlorosis in 1997 also showed the trend increasing with incorporation at 26 DAT; however, this dissipated by 59 DAT. At Greeneville in 1998 stunting injury was 13% or less at 33 and 69 DAT. Chlorosis was 21% or less at 33 DAT with no chlorosis evident at 69 DAT. Tobacco injury was slight in most cases, and tended to increase with incorporation. Tobacco injury decreased throughout the growing season and did not affect yield.

EVALUATION OF WEED MANAGEMENT SYSTEMS IN ROUNDUP READY™ CORN. J. R. Summerlin, Jr., R. M. Hayes, G. N. Rhodes, and T. C. Mueller, Department of Plant and Soil Sciences, The University of Tennessee, Knoxville, TN 37912.

ABSTRACT

Since the early to mid 1990s crop varieties tolerant to selected herbicides have become more important in agricultural production. STS, Liberty Link, and Roundup Ready soybeans, IMI and SR corn, and Roundup Ready and BXN cotton are now allowing growers to choose herbicide programs that previously would have resulted in severe crop injury or crop death. Recently, corn varieties have been released that are tolerant to Roundup herbicide. These varieties have the potential to offer effective and economical weed control in single herbicide applications. However, current weed management systems must be evaluated and modified to provide the most effective and economical weed control recommendations.

Weed management systems in Roundup Ready corn were evaluated in 1998 at several locations in Tennessee. Research was conducted to determine if PRE herbicides are needed in combination with Roundup Ready technology and at what time Roundup Ultra applications should be made for optimum weed control. Treatments evaluated included Bicep II Magnum at 4.2 pt/A PRE, Roundup Ultra at 1.5 pt/A applied 2, 3, 4, or 5 weeks after crop emergence (WAE) and combinations of Bicep II Magnum and each of the Roundup Ultra treatments. Additional research was conducted to examine if tank mixes of Roundup Ultra and other POST herbicides increase weed control, what rate of Roundup Ultra is needed for effective weed control, and are sequential applications of Roundup Ultra necessary to maintain late season weed control in Roundup Ready Corn. Treatments evaluated included Roundup Ultra at 1.5, 2, and 3 pt/A applied 2 WAE alone or followed by Roundup Ultra at 1 pt/A applied 4 WAE. Roundup Ultra at 1.5 pt/A was also applied 2 WAE in combination with Aatrex at 1.1 lb/A, Bicep II Magnum at 4.2 pt/A, or Clarity at 0.5 pt/A. Corn variety DK 493 RR was planted in all locations except Knoxville, where DK 591 RR BtY was planted. Research was conducted utilizing small plot field techniques and data were subjected to the appropriate ANOVA analysis and separated by Fisher's Protected LSD at the 0.05 level of significance.

Based on the weed species present, no benefit was derived from the addition of Bicep II Magnum as a PRE herbicide in Roundup Ready corn. Roundup Ultra applications earlier than 3 WAE were less effective 8 WAE than later application timings due to reemergence following treatment. At 8 WAE, applications of Roundup Ultra 3 WAE and beyond provided greater than 94% control of sicklepod and at least 82% rhizome johnsongrass control.

Roundup Ultra tank mixes and rate increases did not increase velvetleaf control 4 WAE. All 2 WAE applications provided greater than 95% velvetleaf control 4 WAE. Reductions in velvetleaf control were observed 10 WAE. Sequential applications did not significantly increase velvetleaf control. Roundup Ultra applications greater than 1.5 pt/A and Roundup Ultra tank mixes provided 90% or greater rhizome johnsongrass control 5 WAE. Reduced rhizome johnsongrass control (80%) was observed 5 WAE following Roundup Ultra at 1.5 pts/A 2 WAE. At 10 WAE rhizome johnsongrass control was less than 45% for the 2 WAE applications. Sequential applications effectively increased rhizome johnsongrass control to greater than 90%. No differences were observed between sequential applications.

Corn injury following Roundup Ultra treatment was minimal at all locations. The Roundup Ready corn hybrid used in these tests is not adapted to southern corn production. Thus, corn yields varied greatly across the test areas and were not different. Yields ranged from 68 to 106 bushels/A.

COMPARISON OF POSTEMERGENT HERBICIDE PROGRAMS IN IMIDAZOLINONE-TOLERANT CORN (*ZEA MAYS*). E. R. Walker, R. M. Hayes, G. N. Rhodes, Jr., and T. C. Mueller. The University of Tennessee, Department of Plant and Soil Sciences, Knoxville, TN, 37901.

ABSTRACT

Field experiments were conducted in 1998 in Jackson, Milan, Knoxville, and Spring Hill, TN, to compare postemergent herbicide programs in imidazolinone-tolerant corn. Each study was organized as a randomized-block design with four replications. All data was subjected to analysis of variance. Field corn variety FFR 797 IMI was planted in Jackson, Milan, Knoxville, and Spring Hill on May 14, May 15, May 15, and May 5, respectively, in silt loam soils on 30-inch rows. Preemergent (PRE) treatments were applied May 14, April 30, May 15, and May 6 at Jackson, Milan, Knoxville, and Spring Hill, respectively. Postemergent (POST) treatments were applied to 3-leaf, 4-inch corn in Jackson; 5-leaf, 10-inch corn in Milan; 6-leaf, 12-inch corn in Knoxville; and 6-leaf, 10-inch corn in Spring Hill. Control of broadleaf signalgrass (*Brachiaria platyphylla*), sicklepod (*Senna obtusifolia*), pitted morningglory (*Ipomoea lacunosa*), Palmer amaranth (*Amaranthus palmeri*), and large crabgrass (*Digitaria sanguinalis*) were examined 4 weeks after treatment. Corn injury and yield were also evaluated.

Lightning POST, Bicep II Magnum PRE followed by Accent POST, Bicep II Magnum PRE followed by Exceed POST, and Bicep II Magnum followed by Hornet POST controlled broadleaf signalgrass > 90%. Lightning POST and Bicep II Magnum PRE provided > 90% control of large crabgrass. Lightning + Aatrex POST , Lightning + Clarity POST, Bicep II Magnum followed by Clarity, Bicep II Magnum PRE followed by Exceed POST, Basis Gold POST, and Aatrex POST controlled Palmer amaranth > 95%, while Lightning POST, Bicep II Magnum followed by Exceed POST and Bicep II Magnum PRE followed by Hornet POST controlled pitted morningglory > 92%. Lightning POST, Bicep II Magnum followed by Exceed POST, Bicep II Magnum PRE followed by Hornet POST, and Aatrex POST provided > 85% sicklepod control. Corn injury < 15% and corn yields were not affected by the treatments.

CARFENTRAZONE - ETHYL FOR WEED MANAGEMENT IN FIELD CORN. T. W. Mize, FMC Corporation Agricultural Products Group, 7502 Dreyfuss, Amarillo, TX 79121-1414, and S. F. Tutt, FMC Corporation Agricultural Products Group, Box 574, Balaton, MN 56115.

ABSTRACT

Carfentrazone - ethyl is a new postemergence broadleaf herbicide in development by FMC Corporation on cereals and other crops under the experimental number F8426. It is an aryl triazolinone that acts to inhibit protoporphyrinogen oxidase in the chlorophyll pathway, causing rapid membrane disruption and quick desiccation and death of sensitive weed species with no soil carryover. Carfentrazone-ethyl received federal registration in 1998 under a safer pesticide review and will be marketed as a postemergence herbicide under the trade name Aim[R].

Summarized data from field trials conducted from 1993 to 1998 show Carfentrazone - ethyl at 0.008 lb ai/A with nonionic surfactant (NIS) will at times exhibit crop response on field corn as a 5-10% necrotic speckling that is rapidly outgrown within 7 to 15 days after treatment with no effect on yield up to the 4x use rate.

Weed efficacy trials show Carfentrazone-ethyl alone provides control of Pigweed *spp*., Nightshade *spp*., Lambsquarters, and Velvetleaf. Significant enhancement of weed control on additional weed species is facilitated with the Carfentrazone - ethyl rate of 0.008 lb ai/A by the addition of dicamba, atrazine, nicosulfuron, and several other products. Additive activity over that of the herbicides used alone was seen in the control of Pigweed *spp*.,(including Waterhemp spp.), Morningglory *spp.,* Cocklebur, and Kochia (SU-resistant).

Carfentrazone - ethyl is expected to be a valuable addition in the management of weed pests in corn with a novel mode of action useful in resistance management strategies, low use rate technology, rapid knockdown activity, no carryover, and an excellent weed control spectrum when used in combination with atrazine, dicamba, and several other tank mix partners. Research will continue on further defining optimum complementary herbicide partners and rates.

EVALUATION OF IMAZAPIC WEED MANAGEMENT SYSTEMS AND TOLERANCE IN IMI-CORN. A. M. Thompson, J. M. Chandler, Texas Agricultural Experiment Station, College Station, TX 77843, and P. R. Nester, American Cyanamid Company, The Woodlands, TX 77381.

ABSTRACT

Field experiments were conducted in 1997 and 1998 at the Texas Agricultural Experiment Station, in Burleson Co., TX to evaluate weed control and crop tolerance of imazapic to different rates and application timings in IMI-CORN. Treatments included in the evaluation of weed control were imazapic at 0.032 (0.5X) and 0.063 (1X) lb ai/A applied preemergence (PRE), early postemergence (EPOST), and late postemergence (LPOST). Atrazine plus metolachlor (Bicep II) at 3.54 lb/A applied PRE followed by primisulfuron (Beacon) at 0.036 lb/A applied LPOST and imazethapyr plus imazapyr (Lightning) at 0.056 lb/A, also applied LPOST, were used as commercial standards. An untreated check was included for comparison. Treatments included in the evaluation of corn tolerance were imazapic at 0.063 (1X), 0.094 (1.5X), 0.125 (2X), and 0.188 (3X) lb/A, applied both EPOST and LPOST. The two corn varieties evaluated in this experiment were Garst 8326IT and 8396IT. In both experiments EPOST treatments were applied when the corn was at the 2 to 3 leaf stage, 4-5 in. tall. LPOST treatments were applied when corn was at the 6 to 8 leaf stage, 8-9 in. tall. Visual weed control ratings were taken at 3, 5, 8, and 12 weeks after treatment (WAT), while crop response ratings were taken at 7, 14, 28, and 56 days after treatment (DAT). Weed species evaluated were johnsongrass [*Sorghum halepense* (L.) Pers.], smellmelon (*Cucumis melo* L.), and Texas panicum (*Panicum texanum* Buckle.).

Increased levels of weed control were observed in 1997. Due to extremely hot and dry weather conditions in 1998, weed control levels were reduced. In 1998, imazapic applied PRE 12 WAT at 0.032 and 0.063 lb /A provided between 67 to76% control of johnsongrass, smellmelon, and Texas panicum, while 88% control of smellmelon and between 74 to 78% control of johnsongrass and Texas panicum were observed with Bicep II followed by Beacon. At least 80% control of johnsongrass, smellmelon, and Texas panicum were observed with EPOST applications of imazapic at 0.063 lb/A. Imazapic at 0.032 lb/A provided greater than 70% control of all three weed species, with no significant differences detected among any of the treatments. LPOST applications of imazapic at 0.063 lb/A provided between 80 to 92% control of johnsongrass, smellmelon, and Texas panicum, while imazapic at 0.032 lb./A provided between 72 to 75% control of johnsongrass and Texas panicum and greater than 80% control of smellmelon.

In the evaluation of tolerance, crop response was noted when either stunting or interveinal chlorosis was observed. At 14 DAT EPOST applications of imazapic, across all rates, showed less than 10% crop response with both Garst 8326IT and 8396IT. A visual corn response of less than 10% was observed across both varieties with imazapic applied LPOST at 0.063 and 0.094 lb/A, while between 10 to 12% crop response was observed with imazapic at 0.125 and 0.188 lb/A. No significant differences were seen between any of the application timings or treatments within each variety. Although no significant differences in corn yields were detected with imazapic applied EPOST, significant yield differences were observed with LPOST applications.

In conclusion, imazapic has proven to be an effective tool in weed management systems in IMI-CORN, although extremely dry weather conditions and selection of application timing were shown to be critical. In addition, both varieties of IMI-CORN have shown acceptable crop response levels, however with LPOST applications lower yields were observed with higher rates.

WEED MANAGEMENT IN IMIDAZOLINONE-TOLERANT AND -RESISTANT CORN. S. D. Askew, J. W. Wilcut, and F. R. Walls Jr., North Carolina State University, Raleigh, NC 27695, and American Cyanamid Co., Goldsboro, NC 27530.

ABSTRACT

Imazapic preemergence (PRE) and postemergence (POST) and imazethapyr + imazapyr POST were evaluated in herbicide systems for weed management and yield potential in imidazolinone-tolerant (IT) and imidazolinone-resistant (IR) corn. Corn varieties, IR and IT, were planted at Lewiston, NC in 1998. Two separate randomized complete block trials were conducted with split plot treatment arrangements. Main plots were corn varieties and subplots were herbicide systems. Metolachlor PRE at 1.12 kg ai/ha was applied to the experimental areas and a nonionic surfactant at 0.25% v/v was applied with POST herbicides.

In the first trial which evaluated POST systems, a factorial subplot arrangement was as follows: POST options were 1) imazapic at 0.036 kg ae/ha, 2) imazapic at 0.072 kg ae/ha, and 3) imazethapyr + imazapyr (75/25% by wt) at 0.063 kg ae/ha; and tank mix options were 1) none (i.e. POST herbicides alone), 2) dicamba at 0.14 kg ae/ha, and 3) 2,4-D at 0.14 kg ae/ha.

A second trial evaluated various PRE and POST herbicide systems in subplots. Imazethapyr + imazapyr was applied POST at the above rate and imazapic was used PRE or POST at 0.036 kg/ha. These were used with various combinations of the following herbicides: atrazine at 1.12 kg ai/ha PRE or 0.56 kg/ha POST, imazethapyr at 0.036 kg ae/ha PRE, and nicosulfuron at 0.036 kg ae/ha POST.

Weed control was excellent with all imazapic and imazethapyr + imazapyr systems. These POST herbicides when applied following imazapic or atrazine PRE or mixed with dicamba or 2,4-D controlled common lambsquarters (*Chenopodium album*), common ragweed (*Ambrosia artemisiifolia*), large crabgrass (*Digitaria sanguinalis*), prickly sida (*Sida spinosa*), smooth pigweed (*Amaranthus hybridus*), Texas panicum (*Panicum texanum*), and yellow nutsedge (*Cyperus esculentus*) over 90%. Metolachlor alone controlled less than 40% of all weeds except large crabgrass (88%) and yellow nutsedge (67%).

In both trials, early season stunting was evident on IT corn while IR corn was not stunted. The stunting was transient as no stunting was observed late season. No differences in corn yield were noted in the POST systems trial but a variety main effect existed in the PRE and POST systems trial. When averaged over other factors, IR corn yielded 5040 kg/ha and more than IT corn (3360 kg/ha). Systems with imazapic or imazethapyr + imazapyr seem adequate for broad-spectrum weed control when following metolachlor with or without additional PRE herbicides. The yield difference between corn varieties suggests further research should evaluate PRE-POST systems effect on yield.

LIBERTY PLUS PREEMERGENCE OR POSTEMERGENCE HERBICIDES AND ROW SPACING FOR WEED CONTROL IN LIBERTY-LINK CORN. C. A. Jones, J. M. Chandler, Texas Agricultural Experiment Station, College Station, TX 77843; J. E. Morrison, USDA-ARS Temple, TX 76502; and T. J. Gerik, Texas Agricultural Experiment Station, Temple, TX 76502

ABSTRACT

In 1997 and 1998, field experiments were conducted at the Texas Agricultural Experiment Station in College Station, to evaluate herbicide combinations and row spacing for weed control in Liberty tolerant corn (*Zea mays* L.). Row spacings evaluated were 20 and 40 inches. Liberty-tolerant corn was planted at 29,000 plants/A and thinned to 26,000 plants/A to assure equal populations in both row spacings. Preemergence (PRE) herbicide treatments were applied after planting, while early postemergence (EPOST) treatments were applied to 4-5 leaf corn and late postemergence (LPOST) treatments were applied to 6-7 leaf corn. All herbicide treatments were applied in 20 GPA of water. Herbicide combinations were Liberty at 0.27 lb ai/A EPOST, AAtrex at 1 lb ai/A PRE followed by (fb) Liberty EPOST, AAtrex PRE fb Liberty EPOST fb Liberty at 0.27 lb/A LPOST, Liberty plus AAtrex at 1 lb/A EPOST, Liberty plus Prowl at 1 lb ai/A EPOST, and Liberty plus Exceed at 0.04 lb ai/A EPOST. Visual weed control was evaluated at 42 days after EPOST treatments. Weeds evaluated were johnsongrass *(Sorghum halepense*), Palmer amaranth (*Amaranthus palmeri* S.Wats.), and a mixture of ivyleaf and entireleaf morningglory (*Ipomoea hederacea* (L.) Jacq. and *Ipomoea hederacea var. integriscula* Gray). All data were subjected to ANOVA and mean comparisons were made by Duncan's multiple range test at P = 0.05.

Palmer amaranth control with a single Liberty application was 78%. However, the addition of AAtrex PRE or POST increased control to 88 and 90%, respectively. AAtrex fb sequential Liberty applications provided Palmer amaranth control of 96%. A tank mix of Exceed and Liberty increased Palmer amaranth control by 5% over Liberty alone. Morningglory control was 87% with Liberty alone. The addition of AAtrex in a tank mixture increased control to 91%, and AAtrex fb sequential Liberty applications provided 95% morningglory control. AAtrex fb Liberty, Prowl plus Liberty, and Exceed plus Liberty did not provide significant increased or decreased in morningglory control over a single Liberty application. Johnsongrass control with Liberty alone provided 84 to 89% control in 1997 and 1998. AAtrex fb sequential Liberty applications was the only treatment with significantly improved johnsongras control over a single Liberty application, and ranged from 94 to 96%. Row spacing was not significant for the control of any of the three species.

In 1997, all treatments significantly increased yield over the weedy check. Plots treated with a single Liberty application yielded 132 bu/A. AAtrex fb sequential Liberty applications and tank-mix of Liberty plus Prowl significantly yielded more than Liberty alone, with 152 bu/A each. The addition of AAtrex PRE or POST to a single Liberty application yielded 142 and 145 bu/A, respectively; this was not significant from Liberty alone or the higher yielding treatments. Row spacing was significant with 20-inch spacing yielding 145 bu/A and 40-inch spacing yielding 126 bu/A. Due to extremely dry conditions in 1998, treatments yields were not significantly different from Liberty alone with a yield of 47.5 bu/A. Row spacing did not significantly affect yields.

WEED MANAGEMENT IN LIBERTY LINK® CORN. A. C. York and A. S. Culpepper, Department of Crop Science, North Carolina State University, Raleigh, NC 27695.

ABSTRACT

Experiments at two locations each in 1996 and 1997 and one location in 1998 evaluated weed control, corn yields, and net returns with glufosinate-based systems and standard PRE and POST herbicide systems in glufosinate-resistant corn. Treatments consisted a factorial arrangement of PRE and POST herbicides by layby options. PRE and POST herbicides in 1996 included metolachlor at 1.5 plus atrazine at 1.2 lb ai/acre PRE, nicosulfuron at 0.5 oz ai/acre plus atrazine at 1 lb/acre POST, and glufosinate POST at 0.36 lb ai/acre alone or mixed with atrazine at 1 lb/acre. Crop oil concentrate at 1.0% (v/v) and ammonium sulfate at 3 lb/acre were included with nicosulfuron plus atrazine and glufosinate or glufosinate plus atrazine, respectively. PRE and POST herbicides in 1997 and 1998 included metolachlor plus atrazine PRE and nicosulfuron plus atrazine POST at previously mentioned rates. Other treatments included glufosinate at 0.27 or 0.36 lb/acre POST, glufosinate at 0.27 plus atrazine at 1 lb/acre POST, and metolachlor at 1.5 lb/acre PRE followed by glufosinate at 0.27 lb/acre POST. Layby options were none, ametryn POST-directed with drop nozzles, and cultivation (1996 only). POST herbicides were applied 4 weeks after planting when corn was 6 to 10 inches tall. Cultivation was performed 5 weeks after planting, and ametryn was applied with drop nozzles 7 weeks after planting

to corn 26 to 36 inches tall. Weed control was estimately visually throughout the season and yield was determined by mechanical harvest. Net returns to land, overhead, and management were calculated. Late-season weed control is reported.

A PRE and POST herbicide by layby interaction was not observed in 1996. No differences were noted among PRE and POST herbicides for weed control. Averaged over PRE and POST herbicides, prickly sida, pitted morningglory, large crabgrass, broadleaf signalgrass, and common lambsquarters were controlled 87, 95, 96, 97, and 100%, respectively. Cultivation did not increase control. Ametryn increased control of all species except lambsquarters to at least 98%. Corn yield averaged 112 bu/acre, and yield was reduced 28% in the non-treated check. Yield and net returns were similar with metolachlor plus atrazine PRE, glufosinate POST, and glufosinate plus atrazine POST. Yield and net returns were 18 to 25 bu/acre and $47 to 79/acre less with nicosulfuron plus atrazine. Low yield in systems with nicosulfuron plus atrazine POST was attributed to injury caused by the interaction between nicosulfuron and terbufos which was applied in the seed furrow. Cultivation or ametryn at layby did not affect yield or net returns.

Fall panicum in 1997 and 1998 was controlled 79 and 87% by glufosinate at 0.27 and 0.36 lb/acre, respectively. Mixing atrazine with glufosinate did not increase control but metolachlor PRE followed by glufosinate controlled fall panicum 98%. Metolachlor plus atrazine and nicosulfuron plus atrazine controlled fall panicum 86 to 88%. Glufosinate at 0.27 and 0.36 lb/acre controlled goosegrass 59 and 64%, respectively. Metolachlor PRE or atrazine mixed with glufosinate increased control to 98%. Nicosulfuron plus atrazine and metolachlor plus atrazine controlled goosegrass 69 and 99%, respectively. Both grasses were controlled at least 98% by all systems including ametryn at layby. Glufosinate at 0.27 and 0.36 lb/acre controlled pitted and tall morningglory 74 to 78% in 1997 and 83 to 84% in 1998. This compared with 83 and 35% control by metolachlor plus atrazine PRE in 1997 and 1998 and 90 and 98% control by nicosulfuron plus atrazine in 1997 and 1998. Metolachlor PRE did not increase morningglory control but glufosinate plus atrazine controlled morningglory 93% in 1997 and 98% in 1998. Metolachlor plus atrazine, nicosulfuron plus atrazine, and glufosinate plus atrazine controlled common lambsquarters and smooth pigweed completely. Glufosinate at 0.27 and 0.36 lb/acre controlled lambsquarters 89 and 94% and smooth pigweed 81 and 91%, respectively. Late-season sicklepod control was poor by all PRE and POST herbicides due to continued germination during the season. However, best control was obtained with glufosinate plus atrazine. Late-season control of morningglory, lambsquarters, pigweed, and sicklepod was at least 96, 98, 96, and 90%, respectively, in all systems containing ametryn layby.

Yields and net returns did not differ among PRE and POST herbicides in 1997 or 1998. Yields averaged 142 and 162 bu/acre in 1997 and 1998, respectively, and were reduced 50 to 60% in the non-treated check. Ametryn layby had no effect on yield or net returns in 1998 but increased yield and net returns 10 and 20%, respectively, in 1997.

WEED MANAGEMENT IN SETHOXYDIM-RESISTANT CORN. B. M. Spivey, A. C. York, A. S. Culpepper, and R. B. Batts, Crop Science Department, North Carolina State University, Raleigh, NC 27695.

ABSTRACT

Sethoxydim-resistant corn (*Zea mays*) offers growers another option for weed management. Sethoxydim effectively controls many grass species but is ineffective on broadleaf weeds. When emerged broadleaf weeds and grasses occur simultaneously in fields planted with sethoxydim-resistant corn, use of a tank mix of sethoxydim and a POST broadleaf herbicide would be desirable. Research in soybeans (*Glycine max*) has demonstrated antagonism of grass control when sethoxydim is applied in combination with various broadleaf herbicides. Antagonism often varies with the broadleaf herbicide and the rate at which it is applied. In some cases, this antagonism may be reduced or avoided by applying sethoxydim and broadleaf herbicides sequentially or by increasing the rate of sethoxydim. Antagonism also has been observed in field studies in North Carolina with mixtures of sethoxydim and certain POST corn herbicides. Additional studies, discussed below, were conducted in the greenhouse to further study the potential for antagonism when various POST corn herbicides were mixed with sethoxydim.

Treatments included atrazine, dicamba, bromoxynil, prosulfuron+primisulfuron, bentazon+atrazine, dicamba+atrazine, and 2,4-D arranged factorially with sethoxydim at 0, 10, 40, 90, 140, and 260 grams ai/ha. Broadleaf herbicides were applied at 0.5X and 1X the manufacturer's suggested use rate. Treatments were applied to large crabgrass (*Digitaria sanguinalis*) seedlings averaging 14 cm in height and 2 to 3 tillers per plant. Percent control was visually estimated at 10 and 20 days after treatment.

Data were subjected to ANOVA and nonlinear regression analysis. From the fitted regressions, the rate of sethoxydim to achieve 80% control (I_{80}) of large crabgrass with each combination was determined. The rate of sethoxydim required to achieve 80% control was significantly greater when applied in combination with the 0.5X and 1X rates of bentazon+atrazine, the 1X rate of dicamba + atrazine, and the 1X rate of atrazine. The rates of sethoxydim required to achieve 80% control with all other herbicide combinations were not significantly different from sethoxydim applied alone.

COMPARISON OF WEED MANAGEMENT SYSTEMS IN ROUNDUP READY, LIBERTY LINK, SR, AND NON-TRANSGENIC CORN. W. K. Vencill, University of Georgia, Athens, G. E. MacDonald, University of Florida, Gainesville, and E. F. Eastin, University of Georgia, Tifton.

ABSTRACT

Field studies were conducted in 1997 and 1998 in Athens, GA and Attapulgus, GA to compare weed management systems amongst transgenic corn varieties to conventional corn weed management systems. A single application of glyphosate early POST to glyphosate-resistant corn at 0.84 kg a.e./ha following atrazine applied PRE at 1.1 kg/ha or alachlor + atrazine applied PRE at 1.6 kg/ha provided >90% control of common cocklebur (*Xanthium strumarium* L.) common ragweed (*Ambrosia artemisfolia* L.), goosegrass [*Eleusine indica* (L.) Gaertn.] and *Ipomoea* morningglories 8 WAP. A sequential application of glyphosate (0.84 kg/ha at 2-leaf stage followed by 0.61 kg/ha at 4-6 leaf stage) without a PRE herbicide provided >90% control of the previously described weeds 8 WAP. Glufosinate applied to glufosinate-resistant corn provided >90% control of the previously described weeds when applied early POST at 0.37 kg/ha, as a sequential (0.37 kg/ha followed by 0.37 kg/ha), or as a tank-mix with atrazine applied at 1.1 kg/ha, or following a PRE application of atrazine applied at 1.1 kg/ha in 1997 and 1998. Sethoxydim applied at 0.21 kg/ha early POST to sethoxydim-resistant corn provided >90% control of the previously described weeds when applied in a tank-mix with dicamba applied at 0.55 kg/ha or following atrazine applied at 1.6 kg/ha or a prepackage mix of rimsulfuron + atrazine+nicosulfuron applied at 1.07 kg/ha in 1997 and 1998. A prepackage mix of imazapyr+imazethapyr applied early POST at 0.061 kg/ha to imidazolinone-resistant corn controlled the 62% of common cocklebur in 1998, 85% and 45% of common ragweed in 1997 and 1998, respectively, 73% and 40% of goosegrass in 1997 and 1998, respectively, and 60% *Ipomoea* morningglory control in 1998 8 WAP. In the conventional corn, atrazine plus alachlor applied PRE at 1.6 and 2.2 kg/ha, respectively provided >90% control of the previously described weeds in 1997 and 1998. Isoxaflutole plus atarzine applied PRE at 0.061 and 1.1 kg/ha, respectively provided >90% control of the previously described weeds in 1997 and 1998. In 1997, yields were not significantly different amongst conventional, glufosinate- and imidazolinone-resistant corn varieties. In 1998, under conditions of severe heat and drought, all yields were poor. However, glufosinate-resistant corn varieties tended to yield better than conventional corn ('Pioneer 3320), glyphosate-, sethoxydim-, and imidazolinone-resistant corn varietieis.

INFLUENCE OF WEED REMOVAL TIMING ON CORN GRAIN YIELD UTILIZING LIGHTNING AND LIBERTY HERBICIDE SYSTEMS. G. Stapleton, M. Wayland, and J. Dilbeck. American Cyanamid Co., Dyersburg, TN 38024, Cordova, TN 38018, and West Des Moines, IA 50266.

ABSTRACT

It has been difficult to define the critical period for competition in corn. Limited weed removal timing research on broadleaf weeds in corn has been conducted in the southern United States with virtually no work on competition utilizing herbicide resistant corn. Earliest research suggests that grasses are substantially more competitive to corn than broadleaf weeds.

A field study was conducted in northwest, Tennessee in 1998 to evaluate the effects of weed removal timing on corn grain yield and to identify the residual benefits of LIGHTNING herbicide in IMI-corn. Garst 8481 imidazolinone tolerant (IT) and 8481 Liberty Link (LL) was planted on April 15 in a conventional-tilled silt loam soil. The broadleaf weeds in the trial consisted of redroot pigweed, common cocklebur, Pennsylvania smartweed, and ivyleaf morningglory. Herbicide treatments included Bicep II PRE @ 3.54 lb ai/A followed by (fb) Liberty (0.36 lb ai/A for all application timings) MPOST fb Liberty Late-LAYBY, Liberty alone treatments consisted of initial POST applications at EPOST, MPOST, LAYBY, and Late-LAYBY. Additional Liberty applications were made as necessary to maintain plots weed-free. A single application tank-mix of LIGHTNING @ 0.056 lb ai/A plus Clarity @ 0.25 lb ai/A was applied MPOST. An untreated check was also used to evaluate the effects of season-long competition. PRE applications were made at

planting and EPOST, MPOST, LAYBY, Late-LAYBY treatments were applied when weeds were 2-5 inches, 7-10 inches, 12-16 inches, and 20-24 inches, respectively.

Yields were not statistically different across all herbicide treatments. This is consistent with the literature which suggests that broadleaf weeds can compete with corn for up to 8 weeks after planting (WAP) without affecting yield. However, an 8 and 14 bushel numerical yield loss occurred when weeds were removed after they reached 12-16 inches (7 WAP) and 20-24 inches (8 WAP), respectively. The LIGHTNING plus Clarity treatment yielded 127 bu/A whereas, the Bicep II fb Liberty fb Liberty yielded 126 bu/a with the Liberty total POST sequential treatments averaging 122.5 bu/A.

Residual benefits of LIGHTNING were particularly evident. A single application completely eliminated redroot pigweed, common cocklebur, Pennsylvania smartweed, and ivyleaf morningglory season-long through harvest. The Liberty total POST systems required multiple applications to provide the same level of control.

TEXAS PANICUM (Panicum texanum) CONTROL IN CORN UTILIZING HERBICIDE RESISTANT HYBRID TECHNOLOGIES. E. P. Prostko, Texas Agricultural Extension Service, Stephenville, TX 76401.

ABSTRACT

Texas panicum is considered to be one of the most common and troublesome weeds of field corn grown in Texas. Current control strategies are expensive and inconsistent. Field trials were conducted in central Texas in 1998 to evaluate the various herbicide-resistant corn hybrid technologies fortheirpotentialtoprovideacceptable and economical control of Texas panicum. Four trials were conducted in Erath and Hill counties in grower fields with extremely heavy populations (~7-25/ft^2) of Texas panicum. All treatments, including the appropriate spray adjuvants, were applied in 15 gallons of water per acre to Texas panicum that was 1-2" tall with 2-5 leaves. Liberty (glufosinate) at 0.26-0.36 lbs ai/A provided 85% control of Texas panicum 12 weeks after planting (WAP). Split applications of Liberty did not improve control. Texas panicum control with Liberty was reduced 10-20% when tank-mixed with either Aatrex (atrazine), Frontier (dimethenamid), or Axiom (fluthiamide + metribuzin). Lightning (imazethapyr + imazapyr) at 0.056 lbs ai/A did not provide acceptable control ofTexas panicum (42% at 12 WAP). Control with Lightning was improved to 88% when tank-mixed with Prowl (pendimethalin) at 1.0 lbs ai/A. Herbicide treatments that included Poast Plus (sethoxydim) at 0.19 lbs ai/A provided > 90% control of Texas panicum at 8 WAP. Single applications of Roundup Ultra (glyphosate) at 0.5-1.0 lbs ai/A provided 80-83% control of Texas panicum at 12 WAP. Roundup sequentials or tank-mixes with Dual (metolachlor) or Prowl did not improve control.

INTEGRATING GLYPHOSATE INTO CORN WEED MANAGEMENT STRATEGIES. J. A. Ferrell, W. W. Witt, and C. H. Slack, Department of Agronomy, University of Kentucky, Lexington.

ABSTRACT

Three field experiments were conducted in 1998 (1) to examine the efficacy of sequential glyphosate (Roundup Ultra) treatments with that of standard treatments used in Kentucky and (2) to evaluate the relative net profitability of each treatment. The experiments were planted at three sites, two at the Spindletop Experiment Station in Lexington and one at the West Kentucky Experiment Station in Princeton , on April 28, April 29 and April 25, respectively. DeKalb 591 was planted at all three locations. The studies were randomized complete block designs with plot dimensions of ten feet by thirty feet. Herbicides were applied with a CO_2 plot sprayer calibrated at 25 GPA with water as the carrier. Data collected consisted of visual ratings of weed control and crop injury 2, 4, and 8 weeks after treatment and corn grain yield. Yield data was collected by harvesting thirty linear feet of row. All studies used conventional tillage to for seed bed preparation. Data were analyzed for significance using analysis of variance.

The following treatments, all expressed as lbs. ai/ac, were evaluated: 1) Roundup Ultra at 1 lb. followed by Roundup Ultra at .75 lb.; 2) Harness Xtra at 3.36 lb.; 3) Harness Xtra at 1.68 lb. followed by Roundup Ultra at 1 lb.; 4) Harness Xtra at 2.24 lb. followed by Roundup Ultra at 1 lb.; 5) Bicep II at 3.6 lb.; 6) Bicep II at 3.6 lb. followed by Exceed at .036 lb. + COC + Liquid N; 7) AAtrex at 1 lb. + Princep at 1 lb. followed by Exceed at .036 lb. + COC + Liquid N; 8) AAtrex at 1 lb. + Princep at 1 lb. followed by Roundup Ultra at 1 lb.; 9) AAtrex at 1 lb. followed by Roundup Ultra at 1 lb.; 10) Guardsman at 2.8 lb.; 11) Guardsman at 2.8 lb. followed by Banvel at .125 lb.; and 12) Weedy Check. Preemergence treatments were applied the day of planting while postemergence treatments were applied to 2-4 inch weeds, approximately 3 weeks after the initial treatment.

Slight differences in weed control efficacy across all treatments for the dominant weed species of entireleaf morningglory, giant ragweed, common cocklebur, and common lambsquarters were noted. Statistical differences in efficacy rarely translated into yield differences across all treatments. Only one of the three studies showed statistical differences in yield at P<.10 level. Where differences were found the sequential Roundup treatment showed to be significantly greater than treatment 11, but not significantly less than any of the other treatments mentioned above. These data show that, in 1998, Roundup Ready technology resulted in performance at a level comparable with that of the above mentioned standards for Kentucky.

Relative net return was analyzed to determine if using Roundup Ready technology is a profitable option considering the low cost of many other corn herbicides. Net return was calculater as: (yield x market price) - fixed cost - herbicide cost. For market price the value of $2.06/bu was used as elevator price the day of harvest. Fixed cost was considered to be $264.54/ac as calculated by the UK Agriculture Economics Department and herbicide cost included technology fees of $6.00/ac and application cost of $4.00/ac. Net returns for each treatment were also separated with analysis of variance procedures. No significant differences in net return, at the P<1.0 level, were indicated for two of the three locations. Where differences were found

Roundup Ultra alone, or used in conjunction with traditional herbicides, was shown to be equally effective for controlling weeds, while not compromising net profit at three locations in Kentucky in 1998.

OPPORTUNITIES AND CHALLENGES FOR ROUNDUP READY CORN TECHNOLOGIES IN TEXAS. P. A. Baumann, E. P. Prostko, J. W. Smith III, B. W. Bean, J. E. Bremer, Texas Agricultural Extension Service, College Station, Stephenville, Amarillo, and Corpus Christi, P. A. Dotray and J. W. Keeling, Texas Agricultural Experiment Station, Lubbock, TX

ABSTRACT

The availability of Roundup-Ready corn technologies has certainly added to the arsenal of effective weed control options for Texas corn growers. However, a dilemma facing these value-conscious producers is whether to use this technology as a stand-alone approach or to integrate it with other effective herbicide program choices. Replicated small-plot field trials were established in several Texas counties (Hill, Lubbock, McLennan, Nueces, Potter and Williamson) during 1998 to evaluate control of seven different weed species from glyphosate (Roundup Ultra) early-postemergence (1-4" weeds) applications. Single applications of glyphosate at 0.75-1.0 lb ai/A provided at least 80% control of common purslane (Portulaca oleracea L.), Palmer amaranth (Amaranthus palmeri S. Wats), puncturevine (Tribulus terrestris L.), Texas panicum (Panicum texanum Buckl.), tumble pigweed (Amaranthus albus L.) and velvetleaf (Abutilon theophrasti Medik.). Single applications of glyphosate at 1.0 lb ai/A provided excellent control (94%) of johnsongrass (Sorghum halepense [L] Pers.) in McLennan County, but poor control (68%) in Nueces County. With the exception of johnsongrass in Nueces County, sequential applications of glyphosate or glyphosate plus residual herbicides did not improve weed control over that obtained from single applications. When glyphosate was applied early postemergence after preemergence applications of acetochlor (Harness) at 0.77 and 1.0 lb ai/A, seedling johnsongrass control was improved significantly in the McLennan County study. Corn injury was not observed in any of these studies except at the Potter County site where slight, but significant (11%) corn injury was shown 12 weeks after planting at the 1 lb ai/A rate. Conclusions drawn from all of these studies should be considerate of the fact that 1998 was a drought year where sequential weed flushes were not as probable as in most years. Therefore, the benefits of sequential treatments of glyphosate alone or in combination with Pre herbicide applications could not be fully assessed. Texas corn producers can be assured that glyphosate applications will provide effective control of many troublesome weeds. However, whether to combine these postemergence applications with preemergence herbicide applications will require consideration of weed pressure, species diversity, application flexibility, and the overall economics of these combinations.

WEED CONTROL IN IR CORN WITH LIGHTNING AS AFFECTED BY ADJUVANT AND APPLICATION TIMING. J. A. Bond, J. L. Griffin, E. P. Webster, J. M. Ellis, D. A. Peters, 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 imazethapyr and imazapyr, is a mixture of imidazolinone herbicides used postemergence in IR corn for grass and broadleaf weed control. Studies were conducted in 1998 at the R & D Research Farm in Washington, LA, to evaluate weed control with Lightning applied early postemergence (EPOST) and late postemergence (LPOST) with nonionic surfactant, methylated seed oil, silicone based nonionic surfactant, and ammonium sulfate adjuvants. Specific treatments included Lightning at 1.28 oz pr/A in combination with Induce (nonionic surfactant) at 0.25% (v/v), Induce + Actamaster (ammonium sulfate) at 0.25% (v/v) + 8.5 lb/100 gal, Sun-It II (methylated seed oil) at 1.5 pt/A, Sun-It II + Actamaster at 1.5 pt/A + 8.5 lb/100 gal, and Kinetic (silicone based nonionic surfactant) at 0.125% (v/v). The standard treatments for comparison were Accent + Buctril EPOST followed by LPOST at 0.67 oz pr/A + 16 oz pr/A and Bicep at 2.4 qt/A PRE followed by hand hoeing. Parameters measured included broadleaf signalgrass [*Brachiaria platyphylla* (Griesb.) Nash], itchgrass [*Rottboellia cochinchinensis* (Lour.) W. D. Clayton], and pitted morningglory (*Ipomoea lacunosa* L.) control 14 and 28 d after treatment (DAT) and corn yield.

Addition of Induce + Actamaster, Sun-It II, Sun-It II + Actamaster, or Kinetic to Lightning controlled weeds equivalent to Lightning + Induce within each application timing. An EPOST application of either Lightning plus the various adjuvants or Accent + Buctril controlled broadleaf signalgrass, itchgrass, and pitted morningglory better than a LPOST application. At 14 DAT, Lightning applied EPOST controlled broadleaf signalgrass 83 to 88% and itchgrass 84 to 90%. The LPOST application of Lightning controlled broadleaf signalgrass and itchgrass no more than 61% 14 DAT. At 28 DAT, Lightning applied EPOST controlled broadleaf signalgrass 89 to 94%, itchgrass 81 to 93%, and pitted morningglory 90 to 95%. The LPOST application of Lightning controlled broadleaf signalgrass no more than 65%, itchgrass no more than 56%, and pitted morningglory no more than 83% 28 DAT. Accent + Buctril controlled these weeds equivalent to Lightning treatments. Corn yields were equivalent for all herbicide treatments and were significantly greater than for the nontreated check.

The addition of adjuvants Induce + Actamaster, Sun-It II, Sun-It II + Actamaster, or Kinetic to Lightning was no more effective than the addition of Induce alone. Delaying herbicide application until LPOST when weeds reached the 4 to 20 inch stage reduced weed control compared with an EPOST application to 2 to 4 inch weeds. The most effective Lightning treatment controlled broadleaf signalgrass, itchgrass, and pitted morningglory no more than Accent + Buctril. Corn yield for the Lightning timing/adjuvant treatments was equivalent to a Bicep weedfree control.

ROUNDUP AND PERMIT WEED CONTROL PROGRAMS IN ROUNDUP READY CORN. D. A. Peters, J. L. Griffin, P. A. Clay, J. A. Bond, and J. M. Ellis, Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

A study was conducted in 1998 at the Ben Hur Research Farm in Baton Rouge, LA, to compare weed control in Dekalb 363 Exp RR corn with Roundup Ultra applied alone and following Harness or Harness Extra preemergence (PRE) and to evaluate Roundup Ultra and Permit in combination. Specific treatments included Harness at 1 and 2 pt/A PRE or Harness Extra at 2 and 4 pt/A PRE followed by (fb) Roundup Ultra at 1.5 pt/A early postemergence (EPOST); Harness at 1 pt/A PRE fb Roundup Ultra at 1.5 pt/A + Permit at 1 oz pr/A EPOST; Harness at 2 pt/A PRE or Harness Extra at 4 pt/A PRE fb Permit at 1 oz pr/A EPOST; Roundup Ultra at 1.5 pt/A EPOST; Roundup Ultra at 1.5 pt/A + Permit at 1 oz pr/A EPOST; Roundup Ultra at 2 pt/A late postemergence (LPOST); and a sequential application of Roundup Ultra at 1.5 pt/A fb 1.5 pt/A EPOST and LPOST. The standard treatment for comparison was Bicep II at 2.4 qt/A PRE fb Accent at 0.66 oz pr/A EPOST. Corn was planted March 27, 1998, and the experimental design was a randomized complete block with four replications. Broadleaf signalgrass [*Bracharia platyphylla* (Griesb.) Nash] and yellow nutsedge (*Cyperus esculentus* L.) were present in the experimental area. Broadleaf signalgrass was 1 to 2 inches tall at the EPOST application and 3 to 4 inches tall at the LPOST application. Yellow nutsedge was 2 to 5 inches tall at both the EPOST and LPOST applications.

Broadleaf signalgrass and yellow nutsedge control with half rates of Harness or Harness Extra was as effective as full rates when fb Roundup Ultra. Broadleaf signalgrass control 14 d after LPOST application was 79% for Roundup Ultra

applied alone EPOST and LPOST, EPOST in combination with Permit. In contrast, broadleaf signalgrass control 14 d after LPOST application was at least 93% when Harness or Harness Extra was fb a single application of Roundup Ultra and when Roundup Ultra was applied sequentially. Yellow nutsedge control 14 d after LPOST application was 73 to 81% when Harness or Harness Extra was fb Roundup Ultra and when Roundup Ultra was applied in a single application of EPOST. The single application of Roundup Ultra EPOST was as effective in controlling yellow nutsedge as the sequential applications. The combination of Roundup Ultra and Permit controlled yellow nutsedge 91% compared with 79% for Roundup Ultra alone. Harness or Harness Extra fb Permit controlled broadleaf signalgrass and yellow nutsedge as effective as when the PRE herbicides were fb Roundup Ultra. Bicep II fb Accent controlled broadleaf signalgrass 95% and yellow nutsedge 45%. Corn yields for the herbicide treatments were at least 1.8 times greater than for the nontreated check. The reduced broadleaf signalgrass control noted for the LPOST application of Roundup Ultra resulted in reduced corn yield.

For broadleaf signalgrass, sequential applications of Roundup Ultra were required to provide equivalent control to that of Harness or Harness Extra PRE fb a single Roundup Ultra application. In Roundup Ultra programs, half rates of Harness or Harness Extra were as effective as full rates. Roundup Ultra + Permit in a single application was more effective for control of yellow nutsedge than Roundup Ultra alone, but equally effective as sequential applications of Roundup Ultra. All Roundup Ultra treatments were more effective in controlling yellow nutsedge than Bicep II fb Accent. Differences, however, were not reflected in yield indicating that yellow nutsedge was not the primary yield limiting factor.

CORN AND COTTON RESPONSE TO DRIFT RATES OF NON-DESIRED HERBICIDE APPLICATIONS.
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 into susceptible crops causing damage. These factors may further be complicated by aerial applications. Field studies were conducted in 1998 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. Rates of Roundup (glyphosate) used in both corn and cotton were 0.375, 0.187, 0.093, 0.046, and 0.023 lb ai/A. Staple (pyrothiobac) rates used in corn were 0.5, 0.25, 0.125, 0.0625, and 0.0313 oz ai/A. 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 visual injury was greater with 0.093 lb ai/A and higher rates of Roundup, and the highest application rate reduced yield 39 to 86%. In general, as the rate of Roundup in corn increased, yield decreased. Corn visual injury was greater at the 2 and 6 to 8-leaf growth stage for all rates of Staple than at the 12 to 15-leaf growth stage. The greatest corn yield reductions for all rates of Staple were observed at the 6-8 leaf growth stage, and was reduced 41 to 89% by the highest rate. No visual injury was observed with Roundup applied in cotton, regardless of rate or application timing. Yield was reduced 20% by the highest application rate of Roundup in cotton.

ROUNDUP READY WEED MANAGEMENT SYSTEMS IN GEORGIA COTTON (*GOSSYPIUM HIRSUTUM* L.). H. M. Harris and W. K. Vencill, University of Georgia, Athens, GA 30602.

ABSTRACT

Field studies were initiated in 1889 in Midville and Plains, GA to compare systems utilizing glyphosate for weed control in glyphosate-resistant cotton. Five regimes were examined: i.) broadcast glyphosate application at the four true leaf stage (E-POST), ii.) pendimethalin plus fluometuron (PRE) followed by glyphosate E-POST fb cyanazine + MSMA tank mixed and applied in an early post-directed (EPD) spray, iii.) pendimethalin + fluometuron PRE fb glyphosate E-POST, iv.) pendimethalin + fluometuron PRE fb pyrithiobac E-POST, and v.) pendimethalin + fluometuron + fomesafen PRE fb glyphosate E-POST fb glyphosate EPD. Herbicides with rates are as follows: i.) pendimethalin 3.3 EC @ 0.84 Kg/Ha, ii.) fluometuron 4.0 SC @ 1.68 Kg/Ha, iii.) fomesafen 2.0 EC @ 0.45 Kg/Ha, iv.) glyphosate 3.0 EC @ 0.84 Kg Acid Equivalent/Ha, v.) cyanazine @ 0.84 Kg/Ha, vi.) MSMA 6.6 EC @ 2.24 Kg/Ha, and vii.) pyrithiobac 85 SP @ 0.071 Kg/Ha.

Glyphosate E-POST as a stand-alone treatment for control of sicklepod, morningglory, wild poinsettia, cocklebur, yellow nutsedge and texas panicum is inadequate (<80% control). However, pendimethalin + fluometuron fb glyphosate E-POST controlled all weeds, with the exception of morningglory, (>90%). Morningglory control was still good though, with the average control in four replications being (83.3%). Pendimethalin + fluometuron PRE fb pyrithiobac E-POST controlled Texas panicum, yellow nutsedge, and Florida beggarweed in excess of 80%, but control of sicklepod, morningglory, wild poinsettia, and cocklebur was less than 70% control for each weed. Pendimethalin + fluometuron fb glyphosate E-POST fb cyanazine + MSMA EPD provided (>80%) control of all weeds, with the exception of cocklebur and yellow nutsedge. Pendimethalin + fluometuron + fomesafen fb glyphosate E-POST fb glyphosate EPD controlled all weeds (>90%).

Cotton treated with pendimethalin + fluometuron fb glyphosate E-POST yielded best, producing 915 Kg lint/ ha. Treatments containing pendimethalin + fluometuron + fomesafen PRE fb glyphosate E-POST fb glyphosate EPD yielded second highest with a lint yield of 879 Kg/ha. Third highest in lint yield was pendimethalin + fluometuron PRE fb glyphosate E-POST fb cyanazine + MSMA EPD, yielding 779 Kg lint/ha. The fourth highest yielding herbicide program was pendimethalin + fluometuron PRE fb pyrithiobac, yielding 719 Kg lint/ha. Because of the obviously higher weed pressure experienced throughout the growing season due to poor control, the regime utilizing one application of glyphosate E-POST yielded only 609 Kg lint/ha.

INFLUENCE OF MALATHION TIMING ON COTTON RESPONSE TO PYRITHIOBAC. S. Seifert, C. E. Snipes, and R. L. Allen; 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 in 1994, 1995, and 1996 at the Delta Research and Extension Center, in Stoneville, MS to determine the most appropriate application timing of malathion relative to postemergence pyrithiobac from a cotton injury perspective. Treatments consisted of pyrithiobac at 70 g/ha applied postemergence with malathion applied 1 or 3 days before, at POST, and 1 or 3 days after pyrithiobac application. Dimethoate and esfenvalerate were applied only in combination with pyrithiobac at POST. Treatments were initiated approximately one month after cotton planting.

At 7 DAT, pyrithiobac plus malathion applied POST caused the highest incidence of injury, ranging from 21 to 34%. Malathion applied 1 day before pyrithiobac resulted in 15 to 18% injury while applied 1 day after pyrithiobac injured cotton 11 to 15%. Injury of cotton treated with malathion 3 days before or after pyrithiobac application was not significantly different compared to pyrithiobac applied alone. At 14 DAT, pyrithiobac plus malathion applied POST resulted in highest cotton injury (13%). At 21 DAT, pyrithiobac plus malathion applied POST injured cotton 6% while all other treatments caused 1% or no injury. Seed cotton yield was not adversely affected by treatments containing pyrithiobac plus malathion compared to pyrithiobac applied alone.

WEED CONTROL IN ULTRA-NARROW ROW ROUNDUP READY™ COTTON. J. T. Fowler, Jr., E. C. Murdock, J. T. Staples, Jr., and J. E. Toler, Clemson University Pee Dee REC, Florence, SC 29501.

ABSTRACT

Weed management programs for Roundup Ready™ cotton seeded in ultra narrow (7.5-inch) and conventional (38-inch) row spacings were evaluated at the Pee Dee Research and Education Center, Florence, SC, in 1997 and 1998. 'Paymaster 1330 RR' and 'Paymaster 1220 BR' were seeded May 22, 1997, and May 21,1998, respectively. Seeding rates were 2 (ultra narrow row spacing) and 4.5 (conventional row spacing) seed/row ft. PRE herbicides evaluated were pendimethalin (1.0 lb ai/ac), fluometuron (1.75 lb ai/ac) and pendimethalin + fluometuron. Glyphosate (0.75 lb ae/ac) was applied POST alone and following each of the PRE treatments. Pendimethalin (1.0 lb ai/ac) + fluometuron (1.75 lb ai/ac) followed by (fb) pyrithiobac (0.625 lb ai/ac) applied POST was included as the standard treatment. Where fluometuron was not applied PRE, glyphosate was applied POST June 16, 1997, when Palmer amaranth, sicklepod, and tall morningglory seedlings were 7.25, 3.5, and 3.0 inches tall, respectively. Cotton was 4 inches tall with two true leaves. Where fluometuron was applied PRE glyphosate was applied POST June 26, 1997. Cotton was 7 inches tall with four true leaves, and Palmer amaranth, sicklepod, and tall morningglory seedlings were 2.5, 3, and 2 inches tall, respectively. In 1998, glyphosate and pyrithiobac were applied POST on June 9 to 5-inch cotton with 4 true leaves. Palmer amaranth, sicklepod, tall morningglory, and goosegrass seedlings were 9, 6, 7, and 2 inches tall, respectively.

Excellent (>90%) control of Palmer amaranth was observed 4 weeks after POST herbicide application (WAT) with all treatments except pendimethalin, which provided 82 and 68% control with ultra narrow and conventional row spacings, respectively. Pendimethalin did not control sicklepod or tall morningglory. All other treatments controlled sicklepod 85 to 93% 4 WAT. Glyphosate applied POST without a soil-applied herbicide and pendimethalin applied PRE fb glyphosate applied POST controlled tall morningglory 76 to 80% 4 WAT, and were less effective than other herbicide treatments. Fluometuron and pendimethalin + fluometuron (PRE) controlled tall morningglory 85 to 86%, and POST application of glyphosate did not improve control with these PRE treatments. Pendimethalin + fluometuron fb pyrithiobac provided 90 to 91% control of tall morningglory.

For each treatment, weed biomass for ultra narrow row and conventional row spacings was similar. The average reduction in total weed biomass 2 WAT was 92 and 87% with ultra narrow and conventional row spacings, respectively. When glyphosate or pyrithiobac were applied following a PRE herbicide, total weed biomass was reduced 99 to 100%. POST applications of glyphosate without a PRE herbicide reduced weed biomass 82 and 91 % with conventional and ultra narrow row spacings, respectively.

Lint yield attained with fluometuron fb glyphosate and pendimethalin + fluometuron fb glyphosate (885 and 873 lb/ac, respectively) in ultra narrow rows were greater than yields attained with all herbicide treatments in the conventional row spacing. In the ultra narrow row spacing, yields produced with pendimethalin + fluometuron and pendimethalin fb glyphosate (679 and 752 lb/ac, respectively) were similar to fluometuron and pendimethalin + fluometuron fb glyphosate. Lint cotton yields were greater in ultra narrow row spacings than conventional row spacings with all treatments except pendimethalin alone, pendimethalin + fluometuron fb pyrithiobac, and the untreated check.

EFFECTS OF MSMA AND SULFUR ON COTTON INJURY AND WEED CONTROL IN ALABAMA. J. Sanders, C. D. Monks, M. G. Patterson, and D. P. Delaney, Alabama Agricultural Experiment Station, Auburn University, Auburn, AL 36849.

ABSTRACT

MSMA has been used as a cotton herbicide since the 1960's. It is effective in controlling a variety of weeds and is relatively safe to cotton when applied early (POT) or as a salvage treatment (PDS). MSMA can cause some cotton injury, including a darkening and slight burning of the foliage and a reddening of the stem and petiole. MSMA may also delay fruiting and maturity and reduce yields. There has been speculation that the addition of sulfur foliar fertilizer in a tank-mix may reduce MSMA-induced injury on cotton. Field trials were conducted to determine the effects of MSMA and sulfur on cotton injury and growth and weed control in Alabama. Objectives of these field trials were to determine if the addition of sulfur reduces MSMA-induced injury and yield suppression of cotton or affects weed control.

Two separate studies, a crop response study (weed free) and a weed control study, were conducted in 1997 and 1998 at the Wiregrass Substation in Headland, AL. 'Deltapine 35B' cotton was planted in mid-April on 36-inch rows.

Treatments included sulfur in the form of Sul-Max 15Ò (Terra Industrial, Inc.) applied at 0, 0.28, and 0.56 lb a.i./A (0, 1.5, and 3.0 pt/A) and MSMA as Bueno 6 SL (Zeneca Ag Products) at 0, 1.0, and 2.0 lb a.i./A (0, 1.3, 2.6 pt/A), and all possible combinations, giving a 3*3 factorial treatment arrangement. A randomized complete block (RCB) design with 3 replications in the weed control study and 4 replications in the crop response study was used. Treatments were applied when the cotton had 5-6 leaves and the weeds had 5-8 leaves. Treatments were applied using a backpack sprayer (15 GPA and 38 PSI) to the center two rows of four- row plots.

Data collected included visual crop injury ratings at 14 DAT, percent bolls open at maturity, yields at harvest, and visual weed control ratings of sicklepod [*Senna obtusifolia* (L.) Irwin & Barneby] and Texas panicum [*Panicum texanum* (L.)] at 14 DAT. The data were then subjected to ANOVA.

Cotton injury (crop response study) varied between 1997 and 1998. Sulfur had no effect on MSMA-induced injury in 1997. However in 1998, sulfur at 0.56 lb/A when added to MSMA at 1.0 lb/A reduced injury from 16 to 5%. Similarly, sulfur at 0.56 lb/A when added to MSMA at 2.0 lb/A reduced injury from 28 to 15%.

The effects on maturity and yields were taken from the crop injury study. Maturity effects were measured by percent open bolls. Open boll data did not vary across years and were pooled. The addition of sulfur had no affect on cotton maturity either year. Untreated plots had 67% open bolls compared to 56% and 53% with MSMA at 1.0 and 2.0 lb/A respectively.

Sicklepod and Texas panicum control varied across years. In 1997, sicklepod control increased from 33% with MSMA at 1.0 lb/A to 63% with the addition of 0.56 lb/A of sulfur. Sicklepod control in 1998 was 45% with MSMA at 1.0 lb/A and the addition of 0.56 lb/A of sulfur improved control to 72%. Also in 1998, the addition of 0.56 lb/A of sulfur to MSMA at 2.0 lb/A increased sicklepod control from 80% to 93%. The level of Texas panicum control was similar to sicklepod control both years. In 1997 and 1998, sulfur at 0.56 lb/A added to MSMA at 1.0 lb/A had approximately 70% control of texas panicum and sicklepod which was similar to control with 2.0 lb/A of MSMA alone.

In summary, the addition of sulfur to MSMA tended to reduce MSMA-induced injury to cotton. However, the response was neither consistent across years nor reflected in yield. Although the addition of sulfur to MSMA increased weed control numerically each year, weed control data could not pooled for both years.

RELATIONSHIP BETWEEN PREEMERGENCE HERBICIDES AND SEEDLING DISEASE IN ROUNDUP READY COTTON. J. H. Pankey, J. L. Griffin, P. D. Colyer, and R. W. Schneider, Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

A field study was conducted in 1998 to evaluate the influence of preemergence (PRE) herbicides and Roundup Ultra on seedling diseases of cotton. The cotton cultivar ‘D&PL 5690 RR’ (Roundup Ready) was planted April 27 in one row plots forty feet in length. A factorial arrangement of treatments in a randomized complete block experimental design with four replications was used. The first factor, PRE herbicides, included Prowl at 0.75 lb ai/A, Staple at 0.5 oz ai/A, and Dual II at 1.5 lb ai/A alone and in combination with Cotoran at 1.2 lb ai/A and a nontreated control. The second factor was Roundup Ultra (0.75 lb ai/A) applied to cotton at the cotyledon and 4-leaf stages, and a no Roundup Ultra control. All herbicides were applied with a CO_2 backpack sprayer calibrated to deliver 15 gallons of water per acre. One week after each Roundup Ultra application, 20 plants per plot were collected and brought to the lab where hypocotyls and roots were rated for disease severity using an index developed by C. S. Rothrock (University of Arkansas). For hypocotyls the disease index scale was: 1= no symptoms; 2 = few pinpoint lesions, diffuse colored areas; 3 = distinct necrotic lesions; 4 = girdling lesions; and 5 = dead seedling. For roots, the disease index scale was: 1 = no symptoms; 2 = 1-10% of root system discolored; 3 = 11-25% discolored; 4 = 26-50% discolored; and 5 = >51% discolored. Data were subjected to analysis of variance, and means were compared using both linear and orthogonal contrasts.

After disease ratings were made, the hypocotyls and roots of randomly selected plants were sterilized in 0.5% NaOCl, placed on water agar plates, and incubated for 48 h at room temperature. Resulting fungi were transferred to potato-carrot agar and identified. Following the application of Roundup Ultra at the cotyledon stage, the majority (85%) of the fungi isolated were *Rhizoctonia solani*. After the 4-leaf application of Roundup Ultra, *R. solani*, *Fusarium* spp., *Curvularia* spp., and *Aspergillus* spp. were recovered.

Based on linear contrasts, disease severity on cotton roots was greater than on hypocotyls for application of Roundup Ultra at the cotyledon stage, but greater on the hypocotyls for application of Roundup Ultra at the 4-leaf stage. For Roundup Ultra applied to cotyledon cotton, disease severity on hypocotyls was 13% less when Staple or Dual II was applied PRE compared with these herbicides in combination with Cotoran. When Roundup Ultra was applied to 4-leaf cotton, disease severity on hypocotyls and roots was at least 16% less when Prowl was applied PRE compared with Prowl plus Cotoran. When Staple plus Cotoran, Dual II plus Cotoran, Staple alone, or Dual II alone was followed by Roundup Ultra at the cotyledon stage, disease severity on cotton roots was 16 to 26% greater than when only Roundup Ultra was applied. Application of Prowl plus Cotoran, Dual II plus Cotoran, or Dual II alone followed by Roundup Ultra at 4-leaf resulted in disease severity on hypocotyls 11 to 39% greater than when only Roundup Ultra was applied. Dual II followed by Roundup Ultra at cotyledon resulted in 15% less disease on hypocotyls when compared with the nontreated control. When Prowl was followed by Roundup Ultra at 4-leaf, disease severity on hypocotyls and roots was 13 and 19% less, respectively, when compared with the nontreated control.

Based on orthogonal contrasts, the co-application of Cotoran with Prowl, Staple, or Dual II PRE followed by Roundup Ultra at cotyledon resulted in 12% greater hypocotyl disease severity when compared with Prowl, Staple, or Dual II applied without Cotoran followed by Roundup Ultra. When Roundup Ultra was applied at the cotyledon stage following Cotoran PRE, root disease severity was 40% greater than when Roundup Ultra was applied at the 4-leaf stage following Cotoran PRE. When comparing all treatments receiving Roundup Ultra, disease severity on hypocotyls was 7% greater when applied at 4-leaf than at cotyledon. In contrast for root ratings, disease severity was 46% greater when Roundup Ultra was applied at cotyledon than at 4-leaf.

Under the conditions that existed in 1998, Cotoran applied PRE appeared to predispose cotton plants to infection by soil-borne plant pathogens. Application of Roundup Ultra at either timing decreased the severity of seedling disease. Disease severity on cotton hypocotyls was less when Roundup Ultra was applied at cotyledon, whereas root disease severity was less following 4-leaf application.

WEED CONTROL SYSTEMS IN BXN COTTON. R. H. Blackley, Jr., D. B. Reynolds, and C. D. Rowland, Jr. Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Field experiments were conducted in 1997 and 1998 at the Black Belt Branch Experiment Station near Brooksville, MS, to evaluate the use of Staple (pyrothiobac) with Buctril (bromoxynil) in BXN cotton (*Gossypium hirsutum* L.). Treatments were arranged as a two factor factorial in a randomized complete block design with four replications. Factor A consisted of preemergence application of 1.5 lb ai/A Meturon (fluometuron) or 1.5 lb Meturon tank-mixed with 0.5 oz ai/A Staple. Factor B consisted of four postemergence treatments: 1.0 oz/A Staple; 1.0 oz Staple followed by (fb) 0.5 lb ai/A Buctril; 0.5 oz/A Staple tank-mixed with 0.5 lb/A Buctril; and 0.75 lb/A Buctril followed by (fb) 0.75 lb/A Buctril. Treatments were evaluated for common cocklebur (*Xanthium strumarium* L.), pitted morningglory (*Ipomoea lacunosa* L.), large crabgrass (*Digitaria sanguinalis* L.), and common purslane (*Portulaca oleracea* L.) control.

Common cocklebur control in 1997 was 85-95% for all POST treatments at the early rating. In 1998 Staple fb Buctril and Buctril fb Buctril provided 94% control while Staple tank-mixed with Buctril and Staple alone provided 76% and 63% control, respectively, regardless of the PRE treatment. Season long control was better with POST treatments containing Buctril. Pitted morningglory control was not different among herbicide treatments, but differed between years, with control in 1997 being 89% and 1998 being 70%. Large crabgrass control did not differ significantly among herbicide treatments at any rating date. Differences were observed between years, with 92% and 40% control in 1997 and 1998, respectively. Common purslane control differed between years, with all treatments providing 95% control in 1997. In 1998, Staple fb Buctril and Buctril fb Buctril provided 94% and 95% common purslane control, respectively, while Staple tank-mixed with Buctril or Staple alone provided 88% control at the early rating date.

LONG-TERM JOHNSONGRASS CONTROL IN ROUNDUP READY COTTON. R. M. Cobill, D. B. Reynolds, H. C. Smith. Dept. of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS, 39762.

ABSTRACT

In 1997 and 1998, field studies were conducted at the Black Belt Branch Experiment Station near Brooksville, MS, to evaluate the efficacy of Roundup Ultra (glyphosate) for long-term johnsongrass [Sorghum halepense (L.) Pers.] control in Roundup Ready cotton (Gossypium hirsutum L.). Treatments were made in a factorial arrangement of treatments in a randomized complete block design with five replications. Experimental units were 12.3 by 40 feet and all applications were applied at 15 gpa. Factor A was cultivation treatments: standard cultivation, no cultivation, and hooded sprayer. Factor B was herbicide combinations: in-season Roundup Ultra (glyphosate) alone at 0.75 lb ai/A, in-season Roundup and a lay-by of Bladex (cyanazine) at 1.0 lb ai/A, in-season Roundup with a lay-by of Bladex and a Roundup defoliation treatment, application of Prowl (pendimethalin) at 1.0 lb ai/A and Cotoran (fluometuron) at 1.5 lb ai/A applied as preemergence and in-season Select (clethodim) at 0.13 lb ai/A and Prowl + Cotoran applied preemergence and in-season Select with a Roundup defoliation treatment. Ratings were taken 7, 14, and 28 days after herbicide application.

Johnsongrass control with standard cultivation (76%) and no cultivation (79%) was significantly better than with hooded sprayer applications (69%) at 28 DAT. Control with Prowl + Cotoran fb Select (86%) and Prowl + Cotoran fb Select fb Roundup (88%) at 28 DAT was greater than from any Roundup treatment (65-74%). In 1998, standard cultivation and no cultivation reduced plant counts (93-94%) over hooded sprayer applications (83%). Plant count reduction from 1997 to 1998 with standard cultivation (90%) and no cultivation (84%) were greater than reductions from hooded sprayer applications (73%). In 1998, all Select treatments and Roundup fb Bladex fb Roundup treatment reduced plant count (92-99%) more than that of Roundup alone (81%). Plant count reductions from 1997 to 1998 were greater with Select treatments (94-96%) than with Roundup fb Bladex fb Roundup (80%), or Roundup alone (74%). Roundup alone increased yields (1213 lb. seed cotton) compared to Select treatments (921-932 lb.) in 1997. In 1998, Roundup fb Bladex and Roundup fb Bladex fb Roundup increased yields (524-541 lb.) compared to Select treatments (236-321 lb.).

WEED MANAGEMENT IN NO-TILL ULTRA NARROW ROW COTTON. R. M. Hayes, S. G. Matthews, P. A. Brawley, and T. C. Mueller. University of Tennessee, Jackson, TN 38301.

ABSTRACT

Weed management is integral to the success of ultra narrow row cotton (UNRC). Our research began in 1995 to compare weed control inputs in UNRC and wide row (40-inch spacing) cotton. This research revealed that a preplant burndown, PRE residual and POST herbicides for monocot and dicots weeds were necessary to optimize lint yields in both systems.

Utilizing Roundup Ready cotton in 1996, we compared Roundup Ultra herbicide to Staple followed by Select. Initial performance was similar on smooth pigweed, pitted morningglory, common cocklebur, and spotted spurge. However, resurgence of weeds occurred and was a serious harvest problem. We concluded that a single application of Roundup was not adequate for POST weed control. Nor did Staple provide season-long control of pitted morningglory.

In 1997, we focused on the multiple applications, timing and rates of Roundup Ultra on Roundup Ready. Sequential applications improved weed control and lint yields were equal to or greater than a single application. There were increased injury and lower yields as rate increased from 0.5 to 1.0 lb. ai/a when the second application was delayed to the 6- or 8-leaf stage. Lower yields were a combination of both cotton injury and weed competition from weed emerging after the initial treatment or escaping control. Lint yield reached 950 lb./a and weed control was >90% with Roundup Ultra at 0.75 and 1.0 lb. ai/a at the 4-leaf stage following an initial application at the 2-leaf stage.

In 1998, research was expanded to evaluate Prowl PRE, Prowl + Cotoran PRE followed by Roundup, and Prowl tank-mixed with Roundup Ultra. Pitted morningglory, goosegrass, and common cocklebur were controlled >88% with Prowl + Cotoran followed by Roundup Ultra at the 4-leaf stage. Similar control was achieved with Roundup Ultra 1.0 lb./a applied at 1-leaf, 4-leaf and 4-nodes above white flower (cutout). Staple as a late POST following Roundup Ultra at the 1- and 4-leaf stages did not control pitted morningglory. Prowl + Roundup Ultra tank mixture injured cotton 50% and failed to provide acceptable weed control.

Roundup Ready cotton affords the greatestopportunity forweed management options. Residual herbicides compliment the Roundup Ultra program, but add significantly to the weed control costs. However, Roundup Ultra after cutout (4-NAWF) may offeran opportunity to control escape weeds and facilitate harvest of UNR Roundup Ready cotton. Several programs controlled weeds, but efforts must be made to achieve the most economical control. Timing is perhaps the most important aspect of successful weed control in no-till UNRC.

WEED MANAGEMENT IN COTTON WITH PREEMERGENCEAND POSTEMERGENCE STAPLE COMBINATIONS. T. S. Osborne, J. W. Keeling, P. A. Dotray, and J. D. Everitt. Tex. Agric. Exp. Stn., Lubbock.

ABSTRACT

Red morningglory (*Ipomoea coccinea*) and devil's-claw (*Proboscidea louisianica*) are continually troublesome weeds in Texas Southern High Plains cotton because standard preplant and preemergence herbicides do not provide acceptable control. The objectives of this research were: 1) to compare preemergence applications of Staple alone or in combination with either Caparol or Karmex to the commercial standards recommended in our area for the control of both devil's-claw and red morningglory, and (2) to evaluate the effectiveness of sequential Staple applications in combination with preemergence applications of Caparol or Karmex for the control of devil's-claw and red morningglory.

Field trials were conducted in 1997 and 1998 at the Texas Agricultural Experiment Station near Lubbock and in Castro county to evaluate control using preemergence and postemergence Staple combinations. All locations received preplant incorporated applications of Treflan at 0.75 lb ai/A over entire test area. Plots, four rows by thirty feet, were sprayed at a volume of ten gallons per acre. Conventional cotton (PM HS26) was used in 1997 while a transgenic variety (PM 2326RR) was planted in 1998. Soil types ranged from sandy loam to clay loam. Staple was applied as a preemergence (PE) treatment alone at 0.032, 0.047, and 0.063 lb/A or at 0.032 lb/A in combination with either Caparol or Karmex at both reduced (0.8 lb ai/A) and full rates (1.2 and 1.0 lb ai/A respectively). All PE Staple treatments were compared to the following regional PE commercial standards: Caparol at 1.2 lb/A, Cotoran at 1.0 lb/A, Karmex at 1.0 lb/A and Caparol at 1.2 lb/A plus Zorial at 0.5 lb/A. PE combinations of Staple at 0.032 lb/A with reduced rates of Caparol and Karmex followed by a PT application of Staple at 0.047 lb/A were evaluated also. All postemergence topical (PT) treatments were applied with crop oil concentrate (1.25 % v/v) to 1-to 3-inch weeds.

Staple applied PE at 0.063 lb/A controlled devil's-claw 30% and red morningglory 40% 30 DAT, but did not improve 1997 or 1998 weed control above any commercial standard. In 1997 Staple plus either Caparol or Karmex applied PE controlled devil's-claw 75% and red morningglory 80% 30 DAT and was more effective than the commercial standards. In 1997 and 1998 Staple applied PT following Staple plus either Caparol or Karmex applied PE controlled devil's-claw 99% and red morningglory 95% 30 DAT and was the most effective treatment evaluated.

CHARACTERIZATION OF NEW VENTURI-TYPE DRIFT REDUCTION NOZZLES. R. E. Etheridge and T. C. Mueller, Department of Plant and Soil Sciences; and A.R. Womac, Department of Agriculture and Biosystems Engineering, The University of Tennessee, Knoxville, TN 37996.

ABSTRACT

Minimizing drift, or the off-target movement, of pesticides is a concern of applicators. The recent introduction of crops tolerant to non-selective herbicides has facilitated wide scale usage of products such as glufosinate and glyphosate. Not only is more area being treated with these products, but they are also being applied later in the growing season thus increasing the potential for drift damage to occur on non-target vegetation. Also in the past few years, applicators have reduced the application volume used to apply herbicide sprays. A common method for reducing carrier volume is to use smaller tip sizes, which often reduces the droplet size of the resulting spray. There is a need to minimize drift potential in these situations.

Laboratory studies were conducted to evaluate the effectiveness of a new technology, venturi nozzles which produce large spray droplets, in reducing the drift potential of commonly used non-selective herbicides at various carrier volumes. Venturi-type drift reduction nozzles consist of a flow metering pre-orifice followed by an air-fluid mixing chamber, or venturi, and finally a flat fan orifice to define the pattern. A Malvern laser drop/particle size analyzer was used to characterize the droplet spectra of four new venturi nozzles: Delavan Raindrop Ultra® (RU), Greenleaf TurboDrop® (TD), Lurmark Lo-Drift® (LM), and Spraying Systems AI Teejet® (AI). A Spraying Systems XR Teejet® (XR) flat

fan nozzle was included as a standard for comparison. Tip sizes of 110015, 11003, and 11004 were evaluated for each nozzle to simulate field application volumes of 50, 100, and 150 L/ha, respectively, at application speeds of 12.0 to 13.5 km/h. Spray solutions of glufosinate (Liberty), glyphosate (Roundup Ultra), and paraquat (Gramoxone Extra) at 0.43, 0.84, and 0.71 kg ai/ha, respectively, were utilized. Paraquat solutions included a non-ionic surfactant at 0.25% v/v. These rates are representative of typical use patterns for in-season applications of glufosinate and glyphosate on their respective genetically engineered crops and for pre-season burndown applications of paraquat. Application pressures of 100, 276, 450, and 625 kPa were also evaluated. The study was conducted as a CRD with 3 replications and a factorial treatment arrangement of 5 nozzles, 3 tip sizes (application volumes), 3 herbicides, and 4 pressures for a total of 540 observations. Data was subjected to an analysis of variance and means compared using Tukey's Honest Significant Difference (2) at the 95% confidence level. Tukey's method was chosen in order to control the experiment-wise error rate since a large number of treatment combinations were being compared.

Spray patterns with a volume median diameter (VMD), or the point where 50% of the spray volume is in smaller droplets, of 650, 470, 465, 440, and 170 :m were produced by the RU, AI, TD, LM, and XR nozzles, respectively, when averaged over all factors. Similarly, the percentage of spray volume containing droplets <205 :m (V205), which contribute significantly to drift potential (3), was less for the venturi nozzles with values of 11, 18, 18.5, 19, and 65% produced by the RU, AI, TD, LM, and XR tips, respectively. The venturi nozzles produced patterns containing larger droplets and fewer small droplets, thus reducing their drift potential relative to the flat fan nozzle. The 110015 tips, which represent a field application volume of 50 L/ha, exhibited more drift potential, as measured by higher V205 values, than the larger tips. Also, glufosinate resulted in a larger percentage of spray volume containing small droplets than either glyphosate or glufosinate across all factors. Variation in droplet size due to herbicide formulation has been noted by others (1). While glufosinate may exhibit the greatest drift potential, utilization of venturi-type drift reduction nozzles may minimize the drift potential of each of these herbicides and provide flexibility with respect to timing and location of their application.

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WEED MANAGEMENT IN CONVENTIONAL- AND STRIP-TILLAGE ROUNDUP READY™ COTTON.
J. T. Fowler, Jr., E. C. Murdock, J. E. Toler, C. E. Curtis, Jr., and J. T. Staples, Jr., Clemson University Pee Dee REC, Florence, SC 29501.

ABSTRACT

Weed control programs in strip-tillage and conventional-tillage cotton production systems were compared in 1997 and 1998 at the Edisto Research and Education Center, Blackville, SC. Treatments were pendimethalin + fluometuron (0.75 + 1.75 lb ai/ac, respectively) and pendimethalin + fomesafen (0.75 + 0.375 lb ai/ac, respectively) applied preemergence (PRE) followed by a postemergence (POST) application of glyphosate @ 0.75 lb ae/ac, and glyphosate @ 0.75 lb ae/ac applied POST with no soil-applied herbicide. PRE treatments were applied broadcast and in an 18-inch band. Paraquat + prometryn (0.47 + 1.2 lb ai/ac) was applied to the entire test area 6 weeks after planting (WAP). Glyphosate (0.75 lb ae/ac) was applied to strip-tillage plots 2 weeks before planting and paraquat (0.47 ai/ac) + surfactant was applied at planting. With residual herbicides, Palmer amaranth (Amaranthus palmeri) was controlled 95 to 100% 6 WAP. Glyphosate applied POST with no PRE herbicide controlled Palmer amaranth 88 to 90% 6 WAP. Southern crabgrass (Digitaria ciliaris) was controlled 98 to 100% 6 WAP when residual herbicides were used. Glyphosate alone controlled southern crabgrass 95 to 99% 6 WAP. Palmer amaranth and southern crabgrass control was similar with broadcast and banded applications. When pendimethalin + fluometuron was broadcast, sicklepod was controlled 92% 6 WAP. With strip-tillage, pendimethalin + fluometuron banded controlled sicklepod 95 and 90% in strip- and conventional-tillage respectively. Pendimethalin + fomesafen did not control sicklepod. Glyphosate applied POST without residual herbicides controlled sicklepod 85 and 91% with strip- and conventional-tillage, respectively. Weed control was generally similar with conventional-tillage compared to strip-tillage. Lint yields in 1998 (excluding the untreated check) averaged 531 and 385 lb/ac with strip- and conventional-tillage, respectively. However, lint yields with strip- and

conventional-tillage were statistically similar for each herbicide treatment. Net income above weed management costs in 1998 averaged $391 and $269 /ac with strip- and conventional-tillage, respectively.

COMPARISON OF DUAL AND FRONTIER FOR YELLOW NUTSDGE (*Cyperus esculentus*) CONTROL, PEANUT INJURY AND YIELD. M. A. Matocha, W. J. Grichar, D. C. Sestak and K. D. Brewer, Texas Agricultural Experiment Station, Yoakum, TX 77995; R. G. Lemon, Texas Agricultural Extension Service, College Station, TX 77843.

ABSTRACT

Field experiments were conducted in 1996 and 1997 at four Texas locations to evaluate Dual and Frontier for yellow nutsedge control, peanut injury and yield. The four locations represented three different peanut growing regions of Texas including south (Lavaca County), central (Comanche County) and west Texas (Dawson County). Frontier and Dual were applied PPI and PRE at rates of 0.6X to 2X of the suggested label rate. The PPI treatments were applied just before planting and were incorporated to a depth of 5 cm. PRE treatments were applied immediately after peanuts were planted. Approximately 50 mm of irrigation was applied within 48 hr of planting to simulate heavy rainfall. Frontier at 0.6X (1.34 kg/ha) and Dual at 0.75X (1.68 kg/ha) are below the suggested use rate but are the rates commonly used by many producers in Texas. The experiment was established as a randomized complete block and the plot size was 1.8m X 9.5 m in length. Prowl was applied over the test areas to reduce competition from annual grasses and broadleaf weeds. Peanut stunting and yellow nutsedge control were rated two and four WAT and at four week intervals thereafter. Peanut yield was determined by digging the pods and harvesting individual plots with a thresher. Early-season yellow nutsedge control with Frontier and Dual was similar in Lavaca County in 1996 but in Comanche (1996) and Lavaca (1997) Dual provided better nutsedge control than Frontier. Late-season yellow nutsedge control at all locations was better with Dual than Frontier. Peanut stunting was slightly higher with Dual than Frontier in two locations when rated 4 or 12 WAT. Peanut yield was variable but under weed-free conditions at Dawson, the untreated check had the highest yield due to herbicide injury to the treated plots. From this study, there does not appear to be any difference between Dual and Frontier in relation to peanut injury or yield. However, Dual provided better season-long yellow nutsedge control than Frontier.

ANNUAL WEED CONTROL IN ROUNDUP READY® COTTON WITH TWO TILLAGE SYSTEMS. H. R. Hurst and G. R. Tupper, Delta Research and Extension Center, Stoneville, MS.

ABSTRACT

Roundup Ready® cotton (Coker 312 in 1996, PM 1244 in 1997, PM 1220BG in 1998) was planted late April to early May on a silt loam to loam soil without irrigation. The experimental design was a split-plot with 5 replications. Main-plot treatments were conventional-till and minimum-till systems. Sub-plot treatments were (1) conventional herbicides PRE followed by (fb) PODIR, (2) Roundup® PRE fb PODIR only, (3) Roundup PRE fb PODIR fb cyanazine lay-by, and (4) no herbicide. The conventional-till treatment was subsoiled before beds were formed, hipped (1 or 2 times) and reduced to planting height with a bed conditioner before planting plus two cultivations in 1996 and 1998 and 3 in 1997. The minimum-till treatment was subsoiled under the drill in 1997 and smoothed with a bed conditioner before planting each year. The area was over-seeded with a mixture of annual weed seeds in early May 1996 and 1997 before planting. Predominate species were pigweed (*Amaranthus* sp.) and crabgrass (*Digitaria sanquinalis)*. Sub-plots were 4, 40-inch rows wide by 90 feet long and data (plant counts, visual control, seed cotton yield) were obtained from the 2 center rows. Roundup was applied pre-plant each year. Weed counts made before the first PODIR in 1996 were not different for main-plot treatments. Sub-plot treatment 1 reduced weeds 93% from the control while treatments 2 and 3 had 44 and 71% reductions. In 1998, the minimum-till main-plot weed count was 93% lower than the conventional-till due to high residue that prevented weed seed germination. When compared with the sub-plot treatment 4, treatments 1, 2, and 3 reduced weed counts 97, 93, and 95%, respectively. Late-season visual weed control in 1996 was 99 to 100% with sub-plot treatments 1-3 and 0% for treatment 4. In 1997 the *Amaranthus* sp. control ratings were 72, 88, and 90% for treatments 1, 2, and 3, respectively; for *Digitaria sanquinalis* respective ratings were 88, 94, and 99%. In 1998, the respective ratings were 74, 84, and 94% and 89, 96, and 100%. Sub-plot treatment 4 was 0 for all ratings. Cotton stand was not different in 1996. In 1997, stand was reduced 50% with minimum-till which was largely influenced by minimum-till sub-plot 4 which was 73% less than treatments 1-3. In 1998 cotton stand was not different among main-plot treatments. Sub-plot treatment 4 had 44% fewer cotton plants than treatments 1-3. Main-plot seed cotton yield was not different in 1996. In 1997 and 1998, yield with minimum-till was 35% (541 lb/A) and 22% (375 lb/A) less than with

conventional-till. Seed cotton yields were not different with sub-plot treatments 1-3 with all greater than treatment 4. In 1997 and 1998 sub-plot treatment 4 did not produce any seed cotton due to the intense weed competition.

ALFALFA PRODUCTION AND STAND LONGEVITY AS INFLUENCED BY WEEDS AND FERTILITY.
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ABSTRACT

A study was initiated to determine the effects of phosphorus fertilization on the competitiveness of alfalfa with weeds. Weed density and level of fertility were evaluated as determinants of alfalfa productivity from establishment through six years of production. Five fertility levels included an untreated check; 200 lb phosphorus/acre (lb P/A) applied as 0-46-0 and 18-46-0 broadcast and 10-34-0 injected, in years 1, 3, and 5 of the study; and 100 lb P/A 18-46-0 applied every year. Two weed density levels included a high weed density with 15 lb/A downy brome (*Bromus tectorum*) over-seeded at planting with no herbicides used during the study; and a low weed density level with no weeds over-seeded at planting and herbicides used as needed in the established stand. Data on alfalfa stem densities, weed dry matter yield, and alfalfa dry matter yield were collected at each harvest for six years.

First-year, first harvest yield of cool-season weeds averaged 1550 lb/A in the high weed density treatments compared to 650 lb/A in the low weed density treatments. For years 2 through 5, there was essentially no cool-season weed production at first harvest. However, by the sixth year, cool-season weeds amounted to 500 lb/A in the high weed density treatments.

Stem densities at the first harvest decreased from 34 stems/sq. ft. in the second year to 17 stems/sq. ft. by the sixth year. No weed production differences were recorded for the second harvest in any year. Low weed production was due to removal of cool-season weeds at first harvest and minimal warm-season weed productivity by second harvest. In the fifth year, warm-season weed yields (*Amaranthus* spp. and *Digitaria* spp.) in the high weed density treatments were above 500 lb/A for the fifth and sixth harvests.

By the sixth year, there was enough weed production to compare differences among fertility treatments. For the first harvest, the annual application of 100 lb P/A (18-46-0) at the high weed density yielded the highest cool-season weed production (1400 lb/A). Differences were also noted in alfalfa yield at first harvest between high and low weed density treatments at both the 100 and 200 lb/A rates of 18-46-0. At the 100 lb P/A annually rate, the low weed density yielded 3100 lb alfalfa/A and the high weed density yielded only 1600 lb alfalfa/A. At the 200 lb P/A rate, the low weed density yielded 2600 lb alfalfa/A and the high weed density yielded only 1900 lb alfalfa/A. The two 18-46-0 treatments at high weed density also recorded the highest warm-season weed yield at third harvest. At the annual 100 lb P/A rate, the low density weed production was 40 lb/A and the high density weed production was 670 lb/A. At the 200 lb P/A rate, the low density weed production was 30 lb/A and the high density weed production was 450 lb/A.

Phosphorus fertilizers increased total forage production. However, there is no evidence that phosphorus fertilization increases the competitiveness of alfalfa with weeds. Both cool-season and warm-season weeds were able to compete with alfalfa by the sixth year of the stand in all treatments. Annual application of 18-46-0 fertilizer at 100 lb P/A resulted in an increase in both cool-season and warm-season weed production. Also, phosphorus fertilizers increased total forage production. These conclusions indicate phosphate fertilizers containing nitrogen (18-46-0 and 10-34-0) may increase weed competitiveness with alfalfa in thinning stands.

PERFORMANCE OF ROUNDUP READY® COTTON CULTIVARS UNDER THREE HERBICIDE SYSTEMS.
O. L. May, USDA-ARS, Florence, SC 29501, E. C. Murdock, J. T. Fowler, Jr. and J. T. Staples, Jr., Clemson University, Florence, SC 29501.

ABSTRACT

Roundup Ready cultivars have expanded grower options for weed control, but have also complicated Official Cultivar Trials. In Official Cultivar Trials it is not feasible to evaluate Roundup Ready cultivars in a Roundup Ultra® herbicide system along with non-transgenic cultivars in a standard herbicide system. Evaluation of Roundup Ready cultivars along with non-transgenic cultivars in a standard herbicide system has raised concerns about the validity of yield data from Official Cultivar Trials. To address this issue, we conducted two trials in 1998 that evaluated early- and later-maturing Roundup Ready cultivars in three herbicide systems. The Roundup Ready cultivars included all those entered into the 1998 South Carolina Official Cultivar Trials. The three herbicide systems were 1) a standard system utilizing soil-applied herbicides, a POST application of Staple®, and a layby treatment of Cotton-Pro®/MSMA; 2) a system using soil-applied herbicides, Roundup Ultra applied POST at the 4-leaf stage, and the layby treatment; 3) a system with no residual herbicides where only Roundup Ultra was used. The treatment design was a strip-plot, with cultivar the horizontal factor and herbicide system the vertical factor. Four replicates were arranged in randomized complete blocks. The herbicide system x cultivar interaction for lint yield was highly non-significant (P>0.5) in the early- and later-maturity trials. There was a highly significant (P<0.01) herbicide system main effect, with the highest yields produced in the Roundup Ultra only herbicide system (636 and 740 lbs/ac early- and late-trials, respectively) and lowest yields in the standard herbicide system (469 and 595 lbs/ac early- and late-trials, respectively). Cultivar main effects were non-significant in both trials. The lack of a herbicide system x cultivar interaction suggests that yield data from Official Cultivar Trials can be used to select a Roundup Ready cotton cultivar.

RESPONSE OF VIRGINIA COLLECTIONS OF DICLOFOP-RESISTANT ITALIAN RYEGRASS (*Lolium multiflorum*) TO PREEMERGENCE AND POSTEMERGENCE HERBICIDES.
I. V. Morozov, E. S. Hagood, and P. L. Hipkins. Virginia Polytechnic Institute & State University, Blacksburg, VA 24061-0331.

ABSTRACT

Italian ryegrass, originally introduced from Europe as a forage crop, has become a competitive weed in small grain crops in the northwestern and southeastern United States. Diclofop resistance in Italian ryegrass was first reported in 1987. Diclofop resistance was initially confirmed in one Virginia biotype from south-central Virginia in 1993. Following the 1997-98 growing season, Italian ryegrass seed was collected from five locations where diclofop applications failed to provide acceptable control. Greenhouse and field studies were conducted to determine the level of diclofop resistance exhibited by each biotype, and to evaluate alternative preemergence and postemergence herbicides for Italian ryegrass control. Field studies were conducted at two locations with suspected diclofop resistance. Varying rates and timings of preemergence herbicides including acetochlor, fluthiamide + metribuzin, metolachlor, and pendemethalin, and postemergence herbicides including CGA-184927, chlorsulfuron, chlorsulfuron + metsulfuron, diclofop, MON-37503, and tralkoxydim were applied to plots arranged in a randomized complete block design with four replications. The same herbicide treatments and timings were evaluated on all five biotypes in the greenhouse. Greenhouse studies demonstrated significant differences in response to diclofop application among the five biotypes. While a 16X rate of diclofop provided complete control of two biotypes, a third biotype exibited no response to this application rate, and the response of the remaining biotypes was intermediate. The safety of preemergence and postemergence treatments was evalutated on wheat and barley. Preemergence treatments of acetochlor in the emulsifiable concentrate formulation and of fluthiamide + metribuzin caused significant injury to small grains, as did postemergence applications of MON-37503. Greenhouse studies using visual ratings showed some reduction of Italian ryegrass vigor in response to higher rates of diclofop, CGA-184297, and tralkoxydim. The other postemergence treatments had no effect on ryegrass vigor. Postemergence treatments in the field did not elicit the same level of ryegrass control as observed in the greenhouse.

EFFECTS OF CULTURAL PRACTICES ON COMMON POKEWEED (*PHYTOLACCA AMERICANA*) CONTROL IN NO-TILL SOYBEAN PRODUCTION. T. L. Bostian, W. W. Witt, and J. D. Green, Department of Agronomy, University of Kentucky, Lexington, KY 40546-0091.

ABSTRACT

Common pokeweed is a deep rooted perennial broadleaf weed that is native to North America and can reach heights of six to eight feet under fertile conditions. It reproduces frombuds on the root or from seeds. Numerous bird species are known to feed upon the berry and disperse the pokeweed seeds over a sizable area and these seeds are viable after passing through the digestive tract of the bird. Common pokeweed has become particularly troublesome in soybeans and corn grown under conservation tillage practices, especially no-tillage. Common pokeweed is easily controlled in tilled fields by the preplant seedbed tillage and by between the row cultivation. Conservation tillage crop production prevents soil erosion and reduces the cost of crop establishment and is desired by farmers, as evidenced by the large decrease in tilled fields over the last decade. Little information is available on the influence of soybean planting date and soybean row spacing on common pokeweed growth and reproduction. The objectives of this project are 1) determine the contribution of shading by soybean to common pokeweed management by decreasing the growth of common pokeweed and reduce the number of berries produced by pokeweed plants and 2) monitor the regrowth of naturally occurring common pokeweed after between row cultivation.

For Objective 1, field plots were established by planting Roundup Ready soybean seeds at row spacings of 19, 38, and 76 cm May 28 (early) and June 24 (late) at a population of approximately 430,000 seed per hectare . For each row spacing and planting date, the following treatments were evaluated: a) no herbicide for pokeweed, b) Roundup Ultra at 1.1 kg ai/ha; and c) free of pokeweed. Data collected were common pokeweed height, number of fruiting racemes per plant, and berries per raceme. Common pokeweed height decreased as the spacing between soybean rows decreased at the early planting date. Common pokeweed in the 19 cm and 39 cm row spacings were similar, and both were shorter than pokeweed plants in the 76 cm rows at the late planting date. The treatment of Roundup Ultra removed all common pokeweed plants fromthe plots. The number of fruiting racemes per common pokeweed plant was increased as the row spacing increased at both planting dates. The number of racemes for pokeweed plants in the 19 inch rows were similar for both planting dates. At the 38 cm row spacing, there were more racemes from plants in the early planting date, but the difference was not large. However, at the 76 cm row spacing, the pokeweed in the early planting were very large, especially one plant. The pokeweed height and fruiting raceme data indicate that soybeans grown in narrow rows resulted in smaller pokeweed plants that produced fewer racemes.

For Objective 2 field plots were established in soybeans planted in mid-May into a field that was in corn in 1997. Roundup Ready soybeans were planted in 75 cm rows at a seeding rate of about 30 seeds per meter of row. Treatments evaluated were: a) no treatment; b) cultivation only; c) Roundup Ultra applied at 1.1 kg ai/ha followed by cultivation 7 days later; and d) pokeweed removed by hand. A John Deere no-tillage cultivator that has one 50 cm sweep per row middle was used as the cultivation tool when soybeans were about 30 cm in height and common pokeweed plants were from 30 to 75 cm in height. Common pokeweed plants occurring between the rows were cut about 4 cm below the soil surface by the cultivator. Generally, those pokeweed plants with a stem diameter greater than 1 cm were easily cut and removed by the cultivator. Five plants were marked immediately after the cultivation to monitor regrowth during the remainder of the growing season. Common pokeweed height 8 weeks after cultivation averaged 1.85 m, 1.32 m, 0 m, and 0 m for treatments a, b, c, and d, respectively. Regrowth from the two cultivated treatments (b and c) averaged <10%. Soybean yield was not reduced by any of treatments. These data show that a single, between the row cultivation will provide about 50% control of the total common pokeweed population. However, a postemergence herbicide is needed to control pokeweed in the crop row.

HERBICIDE PROGRAMS IN DRILLED ROUNDUP READY SOYBEANS. S. A. Payne and L. R. Oliver, Department of Agronomy, University of Arkansas, Fayetteville, AR 72704.

ABSTRACT

A study was conducted in Keiser, Arkansas in 1997 and 1998 on a Sharkey silty clay with 1.7% OM to compare weed control, soybean yield, and net return with applications of Roundup Ultra (glyphosate) alone and with other herbicides in Roundup Ready soybeans (*Glycine max*). Plots were Delta King 5961 RR soybeans drilled in 7.5-inch rows and weed species included barnyardgrass (*Echinochloa crus-galli*), hemp sesbania (*Sesbania exaltata*), pitted morningglory (*Ipomoea lacunosa*), and prickly sida (*Sida spinosa*). The study was arranged as a factorial using two Roundup Ultra rates (0.5 and 0.75 lb ai/A) and 17 herbicide treatments including Roundup Ultra applied alone in single and sequential applications and in combination with soil-applied or other postemergence herbicides. Year was not a significant factor, so all data were pooled over years.

Sequential applications of Roundup Ultra (applied at V2 and V4 soybeans) and Roundup Ultra + Classic (chlorimuron) gave at least 90% control of hemp sesbania. The 0.75 lb/A rate of glyphosate gave significantly higher control when applied alone and after applications of Treflan (trifluralin) + Scepter (imazaquin), or Canopy (chlorimuron + metribuzin). Pitted morningglory control by a single application of Roundup Ultra was 68% at best. Sequential applications of Roundup Ultra, Roundup Ultra following the previously-mentioned soil-applied herbicides or Canopy XL (sulfentrazone + chlorimuron), or Roundup Ultra with either Classic or FirstRate (cloransulam methyl) + Reflex (fomesafen) gave at least 89% control. Follow-up Roundup Ultra applications were generally needed to control pitted morningglory regrowth. Prickly sida control was the highest with sequential applications of Roundup Ultra or Roundup Ultra + Classic or following a soil-applied herbicide. Multiple emergence flushes impeded control by single Roundup Ultra applications. Multiple flushes of barnyardgrass also challenged herbicide programs. Roundup Ultra applications following soil-applied herbicides gave the highest control of at least 85%.

Single applications of Roundup Ultra resulted in 30 and 24 bu/A yields when applied at the V2 and V4 timings, respectively. All other herbicide treatments yielded significantly higher with at least 38 bu/A while the untreated check yielded 10 bu/A. There were no differences in net return among Roundup Ultra in sequential applications, in combination with other postemergence herbicides, or following soil-applied herbicides. Weed control ratings, yield data, and differences in net return support the need for sequential Roundup Ultra applications or the addition of a soil-applied heribicide.

EVALUATION OF AUTHORITY BROADLEAF IN ROUNDUP READY SOYBEAN SYSTEMS. P. A. Clay, J. L. Griffin, and J. M. Ellis, Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

A field study was conducted at Baton Rouge, LA in 1998 to evaluate weed control programs with Authority Broadleaf (sulfentrazone + chlorimuron premix) and Roundup Ultra (glyphosate). Pioneer 95B71 Roundup Ready soybean was planted June 8. Preemergence (PRE) application rates of Authority Broadleaf were 3.5, 4.5, 5.1, 5.8, and 6.4 oz product/A followed by single or sequential postemergence (POST) applications of Roundup Ultra at 1.0 pt/A. Total POST programs included a single application of Roundup Ultra at 1.0, 1.5, 2.0, or 3.0 pt/A or sequential applications at 1.0 pt/A. No activating rainfall was received until 15 d after PRE herbicide application. Herbicide treatments were applied using a CO_2 backpack sprayer calibrated to deliver 15 gallons/A spray volume at 28 psi.

Barnyardgrass [*Echinochloa crus-galli* (L.) Beauv.] control 14 d after POST application was equal and at least 91% for total POST programs of Roundup Ultra at 1.5 pt/A or greater and for PRE/POST combinations. Hemp sesbania [*Sesbania exaltata* (Raf.) Rybd. Ex A. W. Hill] was controlled 88% with Authority Broadleaf at 6.4 oz/A followed by 1.0 pt/A Roundup Ultra, which was equal to Roundup Ultra alone at 3.0 pt/A (81%). Roundup Ultra at 3.0 pt/A was needed for control of pitted (*Ipomoea lacunosa* L.) and entireleaf (*Ipomoea hederacea* var. *integriuscula* Gray) morningglory equal to all PRE/POST combinations (at least 87%). Similarly, Roundup Ultra at 2.0 and 3.0 pt/A was needed to control prickly sida (*Sida spinosa* L.) and redweed (*Melochia corchorifolia* L.) equal to PRE/POST combinations.

At 14 d after sequential applications, barnyardgrass control was at least 92% for total POST programs with a single application of Roundup Ultra at 1.5 pt/A or greater, and equal to sequential applications or PRE/POST combinations.

Control of hemp sesbania was equal for a single application of Roundup Ultra at 1.0 pt/A following Authority Broadleaf compared with sequential applications of Roundup Ultra (total POST or PRE/POST combinations). Only at the 3.5 oz/A rate of Authority Broadleaf was a sequential application of Roundup Ultra (1.0 pt/A followed by 1.0 pt/A) needed to maximize control of pitted and entireleaf morningglory, prickly sida, and redweed.

Soybean yield was equal for all PRE/POST combinations with either one or two applications of Roundup Ultra. Yield was generally lower following total POST programs with a single application or Roundup Ultra at rates of 2.0 pt/A or less.

ASSESSMENT OF EFFICACY AND ECONOMICS IN ROUNDUP READY VERSUS CONVENTIONAL SOYBEAN PROGRAMS. J. C. Arnold, D. R. Shaw, and J. L. Norris, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Studies were conducted in 1997 and 1998 to evaluate the efficacy and economics of Roundup Ready and conventional soybean systems. The three highest yielding Roundup Ready and conventional soybean cultivars were chosen each year for two Mississippi locations: Shelby (irrigated, Sharkey clay soil) and Brooksville (non-irrigated, Black Belt clay soil). Cultivars were selected based on the 1996 and 1997 Mississippi Soybean Variety Trials for these locations and soil types. Treatments within each cultivar herbicide system included untreated, reduced rate (1/2 X), labeled rate (1X), and high level of input (1X with an additional POST application).

Pitted morningglory (*Ipomoea lacunosa* L.) and hemp sesbania [*Sesbania exaltata* (Raf.) Rydb.] were the predominant species at all locations. Hemp sesbania control was different between years at both locations. In 1997, Roundup controlled hemp sesbania more than the comparable conventional system in most instances; however, in 1998, control was higher with conventional herbicides. Within the Roundup Ready system, control was lower with reduced rates compared to labeled or high input levels. Within the conventional system, increased rates did not increase hemp sesbania control in most instances. Pitted morningglory control was greater in most instances when high levels of input were used compared to labeled and reduced rates, regardless of system. At Shelby, reduced rates of conventional herbicides controlled pitted morningglory more than the comparable Roundup Ready system. At labeled rates or high input levels, pitted morningglory control was at least 85%, regardless of the program. Reduced and labeled rates did not control pitted morningglory, regardless of the system involved.

In 1997, there were no differences in mean yields between the two systems at either location. At Shelby, the use of labeled rates or high input levels did not increase yields in comparison to reduced rates, regardless of the system. Within the conventional system, yields were the same or more with reduced rates when compared to labeled rates or high levels of input. In 1998, the conventional system yields were greater than the Roundup Ready system. This was primarily due to lack of late-season hemp sesbania control. Yields were at least 1270 kg/ha more from conventional cultivars/treatments than the comparable Roundup Ready system. Yields did not differ between the two systems at Brooksville, regardless of input level, in most instances. In 1997, high input levels increased yields compared to the labeled or reduced rates for both systems, but in 1998 high input levels did not increase yields.

In 1997, using labeled or high input levels did not increase net returns compared to reduced rates at either location. The reduced rate net returns were more compared to other levels of input within the conventional system at Shelby. Net returns were greater with labeled rate and high input levels of the Roundup Ready system compared to the conventional system at Shelby. In 1998, the conventional system net returns were more than the Roundup Ready system, regardless of input level at Shelby. At Brooksville in 1997, the Roundup Ready system high level of input was greater compared to the conventional system high level of input. In 1998, the labeled rate and high level of input net returns were greater compared to reduced rates within the Roundup Ready system. Within the conventional system, high input levels increased net returns in comparison to reduced rates. However, all net returns were negative in 1998 due to extreme drought conditions.

PERFORMANCE OF TOUCHDOWN 5â ALONE AND TANK MIXED IN “PIONEERâ BRAND” SOYBEANS.
S. Royal, J. N. Lunsford, and C. V. Greeson, ZENECA Ag Products, Girard, GA, Enterprise, AL, and Pikeville, NC.

ABSTRACT

The herbicide, Touchdown 5â (sulfosate) was applied postemergence over the top of Pioneerâ brand glyphosate tolerant soybeans at 0.375, 0.50, 0.75, 1.0, and 1.5 lb ai/A. These same treatments were also applied in tank-mixtures with Flexstarâ 1.88SC (fomesafen) at 0.058, 0.117, 0.156, 0.176, and 0.313 lb ai/A or Reflexâ 2.0SC (fomesafen) at 0.125, 0.188, 0.25, 0.313, and 0.375 lb ai/A. Spray additives used were 0.25% NIS, 1% MSO, and ammonium sulfate at 136 oz/100 gallons of water.

Soybean phytotoxicity ratings were taken 14 days after application. Weed control ratings were taken 20-28 days after application. Touchdown 5â provided excellent control of cocklebur (XANST), bristly starbur (ACHNI), and Florida beggarweed (DEDTO). Touchdown 5â tankmixtures with Flexstarâ or Reflexâ improved control of smallflower (IAQTA), ivyleaf (IPOHE), entireleaf (IPOHG), pitted (IPOLA), and cotton morningglory (IPOTT) by increasing foliar desiccation. Touchdown 5â mixtures with Flexstarâ were slightly more active than mixtures with Reflexâ. Lower rates of 0.117-0.176 lb ai/A of Flexstarâ provided control levels equal to the full rates of 0.313 lb ai/A in the tankmixture.

Touchdown 5â provided excellent control of annual grasses of Texas panicum (PANTE), broadleaf signalgrass (BRAPP), barnyardgrass (ECHCG), and crowfootgrass (DTTAE). Annual grass control was antagonized at Touchdown 5â rates of 0.50 lb ai/A in mixture with fomesafen formulations. When Touchdown 5â rates were increased to 0.75 - 1.0 lb ai/A, annual grass antagonism was overcome. Reducing rates of Flexstarâ to 0.117-0.176 lb ai/A also lowered antagonism. Grasses which tiller fully before jointing, such as Texas panicum, were easier to control with Touchdown 5â. Grasses which joint shortly after the 1st or 2nd tiller, such as crowfootgrass, were more difficult to control. The tank-mix application of Touchdown 5â and Flexstarâ appears to provide a wider range of weed control than either product used alone.

EFFECTS OF SOYBEAN ROW SPACING, POPULATION DENSITY, AND HERBICIDE MANAGEMENT TECHNIQUES ON SICKLEPOD (*Senna obtusifolia*) AND SOYBEAN PRODUCTION.
G. R. Nice, N. W. Buehring, D. R. Shaw, R. Dobbs, G. Jones, and A. Rankins, Jr., Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762, and Northeast Mississippi Branch Experiment Station, Verona, MS 38879.

ABSTRACT

Studies were conducted in 1997 and 1998 at the Northeast Mississippi Research and Extension Center, Verona, MS, to evaluate the effects of combinations of soybean seeding rate, row width, and sicklepod management systems on sicklepod control, sicklepod biomass, and soybean production. Hartz 5088RR, a Roundup Ready® soybean, and Hutcheson were used in separate studies. The weed management systems included no herbicide, a single herbicide application, or a split herbicide application. The herbicide applications for the Hartz 5088RR cultivar were a POST application of 0.8 kg ai/ha glyphosate POST applied once or in a split application. For the Hutcheson cultivar, the herbicide applications were 77 g ai/ha flumetsulam + 2.3 kg ai/ha metolachlor PRE alone or followed by 9 g ai/ha chlorimuron + 0.25% (v/v) nonionic surfactant POST. The POST applications were applied when the majority of sicklepod were at the 2-leaf stage. Row spacings investigated were 19 and 38 cm. Soybean seeding rates of 330000, 660000, and 980000 seed/ha were used with both cultivars to give approximate soybean populations of 270000 (low), 500000 (medium), and 700000 (high) plants/ha for Hartz 5088RR, and 220000, 420000, and 650000 plants/ha for Hutcheson, averaged over years.

Treatments including a single herbicide application increased sicklepod control up to 64 and 68% in 1997 and 1998, respectively, from treatments without herbicides. As soybean population increased, sicklepod population and competitiveness was often lower. High soybean populations often suppressed sicklepod equivalent to treatments that included a herbicide application (up to 86%). Increasing soybean population from low to medium and from medium to high, suppressed sicklepod 59 and 28%, respectively, when no herbicide was applied. In treatments including a herbicide application, sicklepod control generally increased as soybean populations increased from low to medium.

Treatments including a single herbicide application reduced sicklepod biomass up to 77 and 51% in the Hutcheson cultivar in 1997 and 1998, respectively. In the Hartz 5088RR, sicklepod biomass was reduced 67 to 98% following a

single application of glyphosate. Increasing soybean populations within treatment combinations decreased sicklepod biomass when a herbicide was not included.

In the Hutcheson cultivar, each increase in herbicide use increased yield: 1880, 2480, and 2900 kg/ha in 1997; 850, 1330, and 1830 in 1998, averaged over population and row spacing. The Hartz 5088RR yields increased in treatments with a single application of glyphosate. A second POST application of glyphosate increased soybean yield only in the low soybean populations. Increasing soybean population from low to medium increased soybean yield. However increasing from medium to high within treatments generally did not increase yield.

RESPONSE OF GLYPHOSATE TOLERANT AND GLYPHOSATE SUSCEPTIBLE VARIETIES TO POSTEMERGENCE HERBICIDES. J. M. Ewing, J. L. Ralston, and W. W. Witt. University of Kentucky, Lexington.

ABSTRACT

The acres planted to glyphosate tolerant soybeans has grown dramatically since their introduction in 1996. Little is known,however, about the effects of postemergence herbicides other than glyphostate on these soybean varieties. Field experiments were conducted at the University of Kentucky experiment stations in Lexington and Princeton in 1997 and Princeton in 1998 to evaluate injury from postemergnce herbicides in glyphosate tolerant (GT), Asgrow A4401, and glyphosate susceptible (GS) soybeans, Asgrow AG4715. Two times in each soybean variety, herbicides and adjuvants were applied according to label directions. Herbicides evaluated were: chlorimuron (13.4 g ai ha^{-1}), imazethapyr (70.6 g ai ha^{-1}), imazamox (44.8 g ai ha^{-1}), lactofen (0.22 kg ai ha^{-1}), fomesafen (0.39 kg ai ha^{-1}), flumiclorac (60.5 g ai ha^{-1}), bentazon (1.12 kg ai ha^{-1}), and cloransulam (16.8 g ai ha^{-1}). The study was designed as a split-plot with four replications of each treatment. Treatments were evaluated for visual soybean injury at one, two, four, and eight weeks after treatment (WAT). Light interception under the soybean canopy was measured as an indication of canopy closure approximately 10 weeks after planting. At harvest ten consecutive plants were collected from each plot to determine the mean number of pods, beans and nodes per plant. Visual injury ranged from 5 to 26 %, 1 and 2 WAT for each location, however, by 8 WAT injury was slight to none. In 1998, the GS variety showed a slight but significantly higher visual injury 1 and 2 WAT, but by 4 WAT no visible injury was apparent for either variety. Glyphosate tolerant soybeans had more of pods and beans per plant each year at both locations, yet there were no differences between the varieties in the number of nodes per plant. With GS soybeans provided greater light interception and higher yield at both locations in 1997. Light interception and yield for GS was 93% and 3000 kg ha^{-1} and GT was 85% and 2305 kg ha^{-1}, respectively, in Lexington, while in Princeton the light interception and yield for GS was 76% and 2394 kg ha^{-1} and GT was 69% and 2279 kg ha^{-1},respectively. The late treatment reduced light interception and yield for both GS and GT soybeans at Princeton in 1997. Also in Princeton during 1997, soybeans treated with fomesafen, imazamox, and imazethapyr had greater yield and light interception than soybeans treated with the other herbicides with cloransulam having the lowest yield and light interception. At Princeton in 1998, there was no timing, treatment, or varietal effects for light interception. The ALS herbicides showed a greater range of yield differences across both varieties and timings than non-ALS herbicides in 1998. The yield for the non-ALS herbicides was not statistically different for either variety or timings, with yield ranging from 2122 kg ha^{-1} to 1901 kg ha^{-1}, except for the early GS treatment of bentazon which had a lower yield of 1725 kg ha^{-1}. The ALS herbicides had yield ranging from 2123 kg ha^{-1} to 1436 kg ha^{-1}. Glyphosate tolerant soybeans had statistically the same yield for both timings and all ALS herbicides with a range from 2123 kg ha^{-1} to 1868 kg ha^{-1}. The GS soybeans on the other hand had a wide range of yields between treatments and timings with a high of 2001 kg ha-1 and a low of 1436 kg ha-1. The early treatment of chlorimuron and the late treatment of imazamox had statically lower yields than all other treatments, 1436 and 1614 kg ha^{-1} respectively. These data clearly show that the growing environment greatly influenced the response of both soybean cultivars during growing seasons.

DICLOSULAM WEED CONTROL PROGRAMS IN SOYBEAN. M. L. Lovelace, L. R. Oliver, J. W. Barnes Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR 72704.

ABSTRACT

Diclosulam is a broadleaf herbicide pending registration in soybean and peanut. A field study was conducted at Fayetteville, Arkansas, in 1998 to determine the spectrumofcontrolfordiclosulam. The spectrum of control study was a strip plot design. Weeds were planted in linear rows and thinned to ensure a uniform stand. Field studies at Keiser and Pine Tree, Arkansas, were conducted in 1998 to determine the efficacy of diclosulam weed control programs. The efficacy studies were conducted as a randomized complete block design. Before planting, weed seeds were broadcast and incorporated to ensure uniform weed pressure. Individual plots were four 96-cm rows planted to a glyphosate-tolerant soybean cultivar. Treatments in all tests included diclosulam at 18 and 36 g ai/ha applied preemergence (PRE) and trifluralin at 840 g ai/ha applied preplant incorporated (PPI) with diclosulam at 18 g/ha, metribuzin at 280 g ai/ha, and flumetsulam at 60 g ai/ha applied PRE. Treatments in the spectrum of control test also included trifluralin at 840 g/ha applied PPI with diclosulam at 18 g/ha applied PRE and trifluralin applied at 840 g/ha PPI with diclosulam at 18 g/ha and metribuzin at 420 g/ha applied PRE. The efficacy studies had additional treatments of metribuzin at 420 g/ha applied PRE, flumetsulam at 60 g/ha applied pre, diclosulam at 18 g/ha plus metribuzin at 420 g/ha applied PRE, metribuzin at 420 g/ha plus flumetsulam at 60 g/ha applied PRE, diclosulam at 18 g/ha plus metribuzin at 420 g/ha plus flumetsulam at 60 g/ha applied PRE. Sequential treatments in the efficacy studies included diclosulam applied PRE at 18 and 36 g/ha followed by (fb) glyphosate at 1120 g ai/ha or fluazifop + fomesafen at 628 g ai/ha applied to 2- to 6-cm weeds, trifluralin applied PPI at 840 g/ha with diclosulam at 18 g/ha applied PRE fb glyphosate at 1120 g/ha or fluazifop + fomesafen at 628 g/ha to 2- to 6-cm weeds, glyphosate at 1120 g/ha to 2- to 6-cm weeds, and fluazifop + fomesafen at 628 g/ha applied to 2- to 6-cm weeds. Treatments were applied with a CO_2 backpack sprayerat 187 L/ha. Plots were rated for visual control and injury at 2, 4, and 8 weeks after treatment. Yield was obtained at soybean maturity. The data presented were values averaged overall experiments. Data were subjected to analysis ofvariance, and means were separated with the Least Significant Difference Test (LSD) at the 0.05 confidence level.

Diclosulam did not effectively control hemp sesbania (*Sesbania exaltata*) in any test, providing 20 to 68% control. In the spectrum of control test, the addition ofmetribuzin applied PREat 280 g/ha to trifluralin applied PPI at 840 g/ha and diclosulam at 18 g/ha PRE provided 100% control of hemp sesbania and improved control of common cocklebur (*Xanthium strumarium*) and sicklepod (*Senna obtusifolia*) over diclosulam alone to 82 and 97%, respectively. The addition of flumetsulam improved entireleaf morningglory control from 71 to 92% over the reduced rate of diclosulam alone.

In the efficacy study, no PRE treatment controlled hemp sesbania over 56%. The combination of trifluralin with diclosulam, metribuzin,and flumetsulameffectively controlled broadleaf signalgrass,entireleafmorningglory,and pitted morningglory at 99, 94, and 92% control, respectively. Tank-mixes with the diclosulam at 36 g/ha were among the highest yielding PRE treatments. Diclosulam did not prove to be a stand-alone program for Arkansas soybean production.

Sequential programs of diclosulam at 18 g/ha followed by glyphosate at 1120 g/ha increased control of hemp sesbania over glyphosate alone. A labeled rate of diclosulam fb glyphosate yielded better than glyphosate alone at Keiser. All treatments with fluazifop + fomesafen resulted in increased hemp sesbania control over all PRE treatments. The addition of diclosulam to fluazifop + fomesafen increased morningglory control over fluazifop + fomesafen alone. Trifluralin with a reduced rate of diclosulam fb fluazifop + fomesafen increased yield of soybean overfluazifop + fomesafen alone at Keiser. The addition of diclosulam to fluazifop + fomesafen increased yield of soybean over fluazifop + fomesafen alone at Pine Tree. Sequential programs were needed to achieve the highestyields. The higher yields were due to better hemp sesbania control and longerduration ofcontrol. Diclosulam appeared to be a complimentary herbicide to existing sequential herbicide programs.

CULTURAL AND CHEMICAL REDVINE (*BRUNNICHIA OVATA*) CONTROL IN SOYBEAN. T. A. Castillo, L. R. Oliver, and T. C. Keisling; Department of Agronomy, University of Arkansas, Fayetteville, AR 72701.

ABSTRACT

A long-term field study was initiated in the fall of 1996 to evaluate tillage methods and herbicide treatments for redvine control in soybean (*Glycine max*). A split plot design was used, with tillage type as the main plot and herbicide treatment as the subplot. Tillage types included no-till, conventional, hyperbolic subsoiler, and moldboard plow. Subsoiling and plowing operations were conducted in the fall of 1996 only, after which conventional tillage methods were used. Herbicide treatments included no herbicide, glyphosate at 1.1 kg ai/ha applied annually to V2 and V6 soybeans, and dicamba at 2.2 kg ai/ha applied 2 weeks prior to 1996 soybean harvest. Plot size was 15 by 15 m, and the identity of these plots was maintained over years. Aerial photography and Global Positioning System (GPS)/Global Information Systems (GIS) were used to monitor redvine movement. At trial initiation, redvine populations averaged 15 to 25 per m^2 and resulted in 42 to 50% groundcover. When a herbicide was not used, moldboard plowing provided consistently higher control over other tillage methods, resulting in 83 and 63% control at harvest in 1997 and 1998, respectively. Subsoiling increased control over conventional tillage early in 1997, but by harvest there were no differences between the two tillage types. Glyphosate increased control of redvine for all tillage treatments except moldboard plowing, providing 50 to 70% redvine control throughout the course of study. Dicamba provided $96% control, regardless of tillage type, for one year after treatment. Highest control at harvest in 1998 was obtained by moldboard plowing plus dicamba (84%). Control with dicamba in all other tillage types remained greater than 80% for 20 months and resulted in 60 to 70% control 24 months after treatment. Moldboard plowing and dicamba were the only treatments with lower redvine stem counts 24 months after trial initiation. Redvine density did not affect soybean yields in 1997 or 1998.

FACTORS AFFECTING THE PERFORMANCE OF CLOMAZONE FOR WEED CONTROL IN RICE. R. E. Talbert, L. A. Schmidt, J. S. Rutledge, C. C. Wheeler, and E. F. Scherder, Department of Agronomy, University of Arkansas, Fayetteville, AR 72704.

ABSTRACT

Studies were conducted at the Rice Research and Extension Center at Stuttgart, Arkansas, in 1998 to evaluate the performance of clomazone, 'Command 3 ME®' under different rice field moisture regimes. Field studies included clomazone at 0.2 and 0.4 lb/A at three application timings, preplant incorporated (PPI), preemergence (PRE), and delayed preemergence (DPRE), applied 7 days after planting. In conjunction with application timing, performance of clomazone was evaluated under normal flushing compared to no-flushing. These experiments were separate, but in adjacent areas, during a rather dry period following planting, with 0.6 inches of rain at 15 days after planting (DAP) and 1.1 inches at 25 DAP.

The rice cultivar 'Drew' was drilled in 6.5-inch rows in plots 6 by 16 feet on May 11, 1998. The experimental designs were a randomized complete block with four replications. At planting, single rows of propanil-resistant and susceptible barnyardgrass (*Echinochloa crus-galli)* were planted perpendicular to the rows of rice. Clomazone was applied at 0.2 and 0.4 lb/A at PPI, PRE, and DPRE. Quinclorac (Facet 75 DF) at 0.375 lb/A, pendimethalin (Prowl 3.3 EC) at 1.0 lb/A, and thiobencarb (Bolero 8 EC) at 4.0 lb/A were applied DPRE as comparison treatments. The flushed trial was flushed 3, 10, 24, and 29 (DAP) by allowing a shallow flood to stand 3 to 4 hours before draining. Rice chlorosis ratings were taken 7, 14 and 28 days after emergence (DAE). Yields were taken from the four middle rows of each plot and adjusted to 12% moisture.

Clomazone caused chlorosis at all timings for both trials. Clomazone at 0.4 lb/A in the flushed experiment caused chlorosis of 60% applied PPI, 18% applied DPRE, and 3% applied PRE at 7 DAE. Chlorosis was 0 to 2% by 28 DAE for all treatments. In the no-flush experiment, clomazone at 0.4 lb/A caused chlorosis of 55% applied PPI, 13% applied PRE, and 18% applied DPRE at 7 DAE. Chlorosis was reduced to 11% for PPI, and 0% with PRE and DPRE applications 28 DAE.

Clomazone at 0.4 lb/A controlled susceptible barnyardgrass, m95%, regardless of application timing in both the flushed and no-flush experiment. However, clomazone at 0.2 lb/A showed less control at 60 DAE in both studies. In the flushed trial 93% control was achieved PPI, 92% PRE, and 99% DPRE for barnyardgrass. In the no-flush experiment lower control was observed, 76% PPI, 49% PRE, and 99% DPRE.

Standard treatments gave season-long control of m 98% for barnyardgrass in the flushed experiment at 60 DAE. Except for quinclorac (99% control), standard treatments under no-flushed conditions failed to control barnyardgrass, pendimethalin 66% and thiobencarb 69%.

Rice cultivar sensitivity to clomazone was evaluated in the greenhouse at Fayetteville, Arkansas in 1998. Ten cultivars of rice were selected on the percent acreage planted in 1998, and projected acreage in 1999. Clomazone at 0.2 and 0.4 lb ai/A, was applied delayed preemergence to Alan, Bengal, Cypress, Drew, Kaybonnet, Koshihikari, Lagrue, Lemont, Mars, and Priscilla cultivars. Visual ratings and samples of leaf tissue were taken at 7 and 14 DAE for chlorophyll extractions and analysis.

Visual ratings were well correlated with the chlorophyll measurements in the leaf tissue ($\pm$ 12% variance between chlorophyll inhibition and chlorosis ratings). Rate had no significant effect on the amount of chlorosis observed at 7 and 14 DAE. However, rice cultivars did vary in chlorosis, with Mars, Alan, and Kaybonnet showing a significantly less chlorosis (or more tolerance to clomazone) than Bengal, Drew, Koshihikari, Lemont and Priscilla at 14 DAE..

WEED CONTROL PROGRAMS USING PROPANIL SYNERGISTS. J. S. Rutledge, R. E. Talbert, L. A. Schmidt, C. C. Wheeler, and E. F. Scherder, Department of Agronomy, University of Arkansas, Fayetteville, AR 72704.

ABSTRACT

Intensive use of propanil since its introduction in the early 1960's has led to the development of propanil-resistant barnyardgrass (*Echinochloa crus-galli*). Studies were conducted at the Rice Research and Extension Center at Stuttgart in 1997 and 1998 to determine the effectiveness of piperophos, anilofos, and carbaryl as synergists in propanil herbicide programs for the control of resistant barnyardgrass.

Both studies were conducted on a Crowley silt loam in 6- by 16-foot plots with resistant and susceptible barnyardgrass planted in single separate rows across the plots. In 1997, ' Kaybonnet' was drilled in 7.5-inch rows and in 1998 'Drew' was drilled in 6.5-inch rows. Visual ratings for percent injury and control were taken 7, 14, 28, and 56 days after treatment. Yield data were taken from the middle four rows in each plot and adjusted to 12% moisture. Experimental design was a randomized complete block with four replications.

Outstanding synergist treatments in 1997 included anilofos at 0.2 lb/A plus 4 lb/A propanil, piperophos at 0.22 or 0.45 lb/A with either 3 or 4 lb/A of propanil, and carbaryl at 0.1 lb/A plus 3 lb/A of propanil, all at the 2-leaf stage. Treatments at the 4-leaf stage included anilofos at 0.33 or 0.67 lb/A with 3 or 4 lb/A propanil, 0.67 lb/A piperophos with 3 lb/A propanil, and carbaryl at 0.1 lb/A with 4 lb/A of propanil.

Rates of synergists used with propanil were adjusted in 1998 to reduce injury and/or increase weed control. The 1998 treatments included a single application at the 2-leaf stage of 4 lb/A Super Wham (propanil plus carbaryl), 4 lb/A propanil alone and in combination with anilofos at 0.25 lb/A, piperophos at 0.375 lb/A, carbaryl at 0.03 and 0.005 lb/A. Comparison treatments included Arrosolo (propanil plus molinate) at 6 lb/A along with combinations of 4 lb/A propanil plus thiobencarb at 3 lb/A, quinclorac at 0.25 lb/A, and pendimethalin at 1 lb/A. Sequential treatments of 3 lb/A of Super Wham and 3 lb/A of propanil plus the three synergists were also made at the 2-leaf stage and again prior to flooding.

All treatments in 1998 gave good control of resistant barnyardgrass except the single application of propanil. The single and sequential application of propanil plus carbaryl at 0.03 lb/A gave 44 and 45% injury at 7 DAT. This injury significantly affected yields of these treatments, with yield from the sequential propanil plus carbaryl treatment not significantly different from the check. High yields (>7300 lb/A) occurred with both treatment timings of propanil with anilofos, piperophos, and 0.005 lb/A of carbaryl in addition to the sequential application of propanil alone and the comparison treatments of propanil plus pendimethalin and Arrosolo.

Although these synergists gave excellent control of resistant barnyardgrass, both anilofos and piperophos are organophosphate compounds making their registration in the U. S. unlikely because of the recent FQPA legislation. Carbaryl currently has a label and is used in small amounts with propanil in the Super Wham® formulation. It is possible, however, that the use of this compound could lost as it is a carbamate and its registration will be reviewed under the FQPA.

RICE TOLERANCE TO MALEIC HYDRAZIDE USED IN RED RICE SUPPRESSION. R. T. Dunand, Rice Research Station, Louisiana Agricultural Experiment Station, L.S.U. Agricultural Center, Crowley, LA 70527-1429.

ABSTRACT

Maleic hydrazide (MH), a plant growth regulator, is being registered for red rice seedhead suppression in rice. Even though MH will be labeled for use in rice, timing is very growth stage specific and rice fields at susceptible stages, adjacent to treatable rice fields, are considered a non-target crop. Rice is known to be susceptible to the proposed labeled rates of MH during heading, flowering, and very early stages of grain filling. The impact on rice of lower than labeled rates was studied to determine the general tolerance during the growing season of rice to MH.

An early season variety, Cypress, was drill-seeded on 7-inch rows at 100 lb/A. Plot size was 6x30 ft. Standard agricultural chemicals were applied as recommended for insect and disease control and to enhance seedling vigor. Maleic hydrazide (Royal MH-30 SG, Uniroyal Chemical Company, Middlebury, CT) was applied at 1/8 X (0.1875 lb/A), 1/4 X (0.375 lb/A), and 1/2 X (0.75 lb/A) rates using a CO_2 driven back pack sprayer with a delivery rate of 15 gal/A. Applications were made at internode initiation (II), panicle differentiation (PD), mid boot (MB), and 50% heading (HD). Timings corresponded to 63, 76, 86, and 100 days after planting (DAP) and approximate the period when rice would be a non-target crop. Experimental design was a randomized complete block with four replications and 13 experimental units consisting of a single untreated control and 12 foliar treatments (four timings and three rates of MH).

Rice tolerance to MH was primarily rate dependent. At the lowest rate of MH, 0.1875 lb/A, rice was completely tolerant at the II, PD, MB and HD timings. There were no adverse effects on mature plant height, panicle sterility, grain yield, grain moisture (crop maturity indicator), and total and whole milling yields (grain quality factors). At the intermediate rate of MH, 0.375 lb/A, grain quality was affected by the heading application only and resulted in a decrease of 3 percentage points in whole milling yield. All other aspects of plant growth and development were unaffected by the intermediate rate of MH applied at the four timings. At the highest rate of MH, 0.75 lb/A, rice was generally intolerant to MH. The effects were dependent on time of application. Plant height was decreased 3 to 4 cm with the II and PD timings. Panicle sterility was increased 25 to 30% with the PD and HD timings. Grain yield was reduced 700, 1900, 600, and 1600 lb/A with the II, PD, MB, and HD timings, respectively. Total milling yield was decreased 4 percentage points with the HD timing. Whole milling yield was decreased 3 and 13 percentage points with the MB and HD timings, respectively. Only grain moisture was unaffected by the highest rate of MH.

Rice is sensitive to 0.75 lb MH/A applied during the 6 week period prior to complete heading, and shoot growth, panicle development and grain formation are subject to injury by MH. Crop maturity is unaffected by MH. Drift rates of MH (<0.375 lb/A, one-fourth the labeled rate) have no affect on rice. Consequently, the drift potential for MH onto neighboring rice, considered a non-target crop during the application of MH for red rice suppression in rice, is low.

PERFORMANCE OF V-10029 (BISPYRIBAC-SODIUM) IN RICE WEED CONTROL PROGRAMS. L. A. Schmidt, R. E. Talbert, F. L. Baldwin, J. S. Rutledge, E. F. Scherder, and C. C. Wheeler; Department of Crop, Soil and Environmental Science, University of Arkansas, Fayetteville, AR 72704, University of Arkansas Cooperative Extension Service, Little Rock, AR 72203.

ABSTRACT

V-10029 (Bispyribac-sodium) is a new rice herbicide currently under development by the Valent U.S.A. Corporation. The mode of action of bispyribac-sodium is inhibition of the acetolactate synthase (ALS) enzyme. Bispyribac-sodium has demonstrated excellent control of barnyardgrass in rice at broad application timings ranging from the first leaf to the tillering stage.

Field studies were conducted in Arkansas at two locations in 1998 to evaluate bispyribac-sodium alone and in herbicide programs for crop tolerance and weed control in dry-seeded rice. The experimental design was a randomized complete block with four replications at both locations. Propanil-resistant and -susceptible barnyardgrass (*Echinochloa crus-galli*), hemp sesbania (*Sesbania exaltata*), northern jointvetch (*Aeschynomene virginica*) and palmleaf morningglory (*Ipomoea wrightii*) were planted in separate rows perpendicular to the rice at Stuttgart. The Lonoke location contained a natural population of grass and broadleaved weeds of rice.

Single applications of Bispyribac-sodium were applied four- to six-leafrice stage at 20 and 22 g a.i./ha with the nonionic surfactant, Kinetic, added. Bispyribac-sodium at these rates and timing provided good control of resistant and susceptible barnyardgrass, hemp sesbania, and northern jointvetch. However, the control of broadleaf signalgrass (*Brachiaria platyphylla*), palmleaf morningglory, and bearded sprangletop was inadequate. The integration of bispyribac-sodiuminto program approaches such as pendimethalin or thiobencarb followed bispyribac-sodiumapplied either MPOST or Post-flood and thiobencarb + propanil, EPOST followed by bispyribac-sodium + thiobencarb helped in controlling broadleaf signalgrass and bearded sprangletop. The only herbicide programs in this study that were effective in controlling palmleaf morningglory were those where triclopyr was included. Slight discoloration was observed at one week following bispyribac-sodium application, but was not evident following two weeks. No stand reduction or stunting was observed with any treatment tested. The results from this study indicate that bispyribac-sodium has a fit in rice weed control programs in Arkansas. The wide application window for barnyardgrass control as well as the alternative mode of action makes it an excellent alternative for areas in Arkansas containing propanil-resistant barnyardgrass.

BARNYARDGRASS (*ECHINOCHLOA CRUS-GALLI*) CONTROL IN DRY-SEEDED RICE WITH V-10029.
B. J. Williams; Northeast Research Station, St. Joseph, LA, Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

Efficacy of V-10029 (bispyribac-sodium) in controlling barnyardgrass in dry-seeded rice (*Oryza sativa*) was evaluated in 1997 and 1998 at the Northeast Research Station near St. Joseph, LA on a Sharkey clay soil and at the Macon Ridge Research Station near Winnsboro, LA on a Gigger silt loam soil. Rice ‘Cypress' at 140 kg/ha was drill seeded in rows 19 cm apart. Permanent floods were established 4 to 5 weeks after planting each year. Nitrogen, in the form of prilled urea, was applied at 126 kg/ha just before permanent flood. At panicle initiation an 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. Herbicide treatments were arranged in randomized complete blocks with three replications. Weed control ratings, rice injury ratings, and rice yield data were subjected to analysis of variance by year and soil type. Means were separated using Fisher’s Protected LSD at the 5% level. Only data collected in 1998 are discussed, since the results were similar between years.

Barnyardgrass control from middle to late postemergence applications of bispyribac-sodium at 0.02 or 0.023 kg ai/ha was excellent (98 to 100%). Propanil at 3.36 kg ai/ha plus molinate at 3.36 kg ai/ha applied middle to late postemergence only controlled barnyardgrass 70% and 60%, respectively. Post flood applications of bispyribac-sodium controlled barnyardgrass (93%) better than molinate (82%). When applied late post flood (3 barnyardgrass tillers) 0.023 kg ai/ha bispyribac-sodium controlled barnyardgrass 70%. Bispyribac-sodium at 0.02 kg ai/ha plus 2.24 kg ai/ha propanil or 3.36 kg ai/ha thiobencarb following thiobencarb applied delayed preemergence or early postemergence maximized barnyardgrass control and rice yields. Following thiobencarb with propanil plus molinate resulted in less barnyardgrass control and lower rice yield. Barnyardgrass control was not affected when bispyribac-sodium was tank mixed with carfentrazone, bensulfuron, or fenoxaprop. Barnyardgrass control was reduced from 92% to 80% when bispyribac-sodium was mixed with acifluorfen or bentazon. Early season control of hemp sesbania (*Sesbania exaltata*) was slightly reduced when bispyribac-sodium was mixed with bensulfuron, bentazon or fenoxaprop, but late season control was not affected. Bispyribac-sodium alone or mixed with carfentrazone or halosulfuron following clomazone resulted in excellent barnyardgrass, Amazon sprangletop (*Leptochloa panicoides*), and hemp sesbania control.

Bispyribac-sodium at 0.02 and 0.023 kg ai/ha controlled barnyardgrass 20 to 40 cm tall, demonstrating its' potential as a salvage tool. In 1998, bispyribac-sodium also worked well in programs with thiobencarb and clomazone controlling both barnyardgrass and hemp sesbania, demonstrating an excellent potential to be used in planned weed management programs. However, preliminary research in 1998 also suggested that bispyribac-sodium may be antagonized by acifluorfen and bentazon.

A COMPARISON OF CONVENTIONAL TO SITE SPECIFIC WEED MANAGEMENT TECHNOLOGY. J. A. Tredaway, R. M. Hayes, T. C. Mueller, W. E. Hart, and J. E. Wilkerson, 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, and 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(*Xanthiumstrumarium*),broadleafsignalgrass (*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 1xrate 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 1x (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 1 m^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. 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 CONTROL IN ROUNDUP READY SOYBEANS WITH ROUNDUP ULTRA/REFLEX COMBINATIONS. C. B. Corkern, J. L. Griffin, P. R. Vidrine, D. K. Miller, J. M. Ellis, and P. A. Clay, Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

Field studies were conducted in 1998 at Alexandria, Baton Rouge, and St. Joseph, LA to evaluate grass and broadleaf weed control, and crop injury with Roundup Ultra alone and in combination with reduced rates of Reflex. The experimental design at each location was a randomized complete block with 4 replications. Treatments included Roundup Ultra at 1.0, 1.5, and 2.0 pt/A applied alone and in combination with Reflex at 0.25, 0.50, and 0.75 pt/A. Included for comparison was Reflex alone at 0.75 pt/A plus nonionic surfactant (0.25% v/v), Reflex at 1.5 pt/A plus Fusion at 0.63 pt/A plus crop oil concentrate (1% v/v), and a nontreated control. >Asgrow 5901RR= soybean was

planted May 18 and June 8 at Alexandria and Baton Rouge, respectively. At St. Joseph, >DP&L 5960RR= soybean was planted June 9. Weeds evaluated were barnyardgrass (*Echinochloa crus-galli* (L.) Beauv.), johnsongrass (*Sorghum halepense* (L.) Pers.), hemp sesbania (*Sesbania exaltata* (Raf.) Rybd ex A. W. Hill), and prickly sida (*Sida spinosa* L.). At time of application, barnyardgrass was 1 to 6 inches tall at all locations and hemp sesbania was 1 to 6 inches tall at Baton Rouge and St. Joseph. Prickly sida at St. Joseph was 2 to 4 inches tall and johnsongrass at Alexandria was 6 to 12 inches at application. Herbicide treatments were applied June 9, July 16, and July 2 at Alexandria, Baton Rouge, and St. Joseph, respectively. All treatments were applied in 15 gallons of water per acre. Weed control ratings were made 14 or 28 d after treatment.

At all locations, Roundup Ultra alone provided at least 87% control of barnyardgrass regardless of rate. The addition of Reflex to Roundup Ultra did not antagonize barnyardgrass control when compared with Roundup Ultra alone. Johnsongrass control was at least 91% for Roundup Ultra applied alone or in combination with Reflex and no antagonism was observed with the mixtures. Reflex plus Fusion controlled barnyardgrass and johnsongrass at least 89%. For hemp sesbania at Baton Rouge, control with Roundup Ultra alone was no more than 71% and increasing the rate from 1.5 to 2.0 pt/A did not improve control. Hemp sesbania control with Reflex plus Roundup Ultra ranged from 88 to 93% regardless of the Reflex rate. At St. Joseph, hemp sesbania control was no more than 50% when Roundup Ultra was applied alone at 1.0 or 1.5 pt/A and addition of Reflex increased control to as high as 85%. Although not significantly different, control with Roundup Ultra alone at 2.0 pt/A at St. Joseph was only 67%, while control with Reflex at 0.50 or 0.75 pt/A plus Roundup Ultra was at least 82%. At both Baton Rouge and St. Joseph, increasing the Reflex rate from 0.25 to 0.75 pt/A when in combination with Roundup Ultra did not improve hemp sesbania control. Prickly sida control with Roundup Ultra alone was no more than 60% with no difference in control among rates. The addition of Reflex to Roundup Ultra at 1.5 or 2.0 pt/A increased control to 78 to 88%. Reflex alone or in combination with Fusion controlled prickly sida no more than 33%. At Baton Rouge, soybean injury with Roundup Ultra alone was negligible. The addition of Reflex to Roundup Ultra injured soybean 5 to 14%. No injury was observed for any of the treatments at Alexandria. At Baton Rouge, improvement in hemp sesbania control with Reflex/Roundup Ultra combinations was reflected in increased soybean yields of at least 11%. Differences in hemp sesbania and prickly sida control were reflected in yields at St. Joseph.

Tank-mixing Reflex at 0.25, 0.50, or 0.75 pt/A with Roundup Ultra did not antagonize barnyardgrass or johnsongrass control. Addition of Reflex at 0.25 pt/A to Roundup Ultra at 1.5 or 2.0 pt/A improved control of hemp sesbania and prickly sida when compared with Roundup Ultra alone. Increased weed control was reflected in higher yields.

PERFORMANCE OF TOUCHDOWN 5 AND ROUNDUP ULTRA APPLIED OVERTOP IN GLYPHOSATE TOLERANT SOYBEANS. G. N. Rhodes, Jr., T. C. Mueller, and W. T. Flinchum, University of Tennessee, Knoxville, TN 37901; J. A. Kendig, University of Missouri Delta Center, Portageville, MO 63873.

ABSTRACT

Herbicide tolerant crops (HTC's) are rapidly becoming integral components of weed management programs in corn, cotton and soybeans. Enhanced weed control spectrum, less need for tank mix partners, reductions in number of spray applications, ease of use, and better crop rotational flexibility are reasons for the relatively rapid grower acceptance of HTC-based weed management programs. Of all the HTC options, glyphosate tolerant soybeans have made the greatest progress in market penetration. Estimates for the Midsouth in 1998 range roughly from 30 to 60% of the acreage, depending upon the state. Forecasts for the future show a continued increase. Roundup Ultra has performed very well as an overtop soybean herbicide on troublesome weeds such as common cocklebur, sicklepod, hophornbeam copperleaf, pigweeds, rhizome johnsongrass and several annual grasses. Producer satisfaction with this system has largely been excellent.

From experience with using Touchdown 5 as a burndown herbicide in no-till corn and soybeans, producers are aware of the similarities between Touchdown 5 and Roundup Ultra. Many are also aware of the possibility of a future registration for overtop use of Touchdown 5 in glyphosate tolerant soybeans. Due to numerous questions we have received from producers over the past few years and the scarcity of information regarding performance of Touchdown 5 applied overtop, this research was initiated in 1998 to evaluate the performance of Touchdown 5 applied overtop in glyphosate tolerant soybeans.

The research was conducted at Knoxville, Tellico Plains, Spring Hill and Jackson, TN, and at Portageville, MO. 'Pioneer 9492' soybeans were planted at all locations. Row spacing was 30 in. at all locations except for Knoxville where 7.5

in. rows were used. Herbicides were applied in spray volumes of 15 to 20 gpa, utilizing a tractor, backpack or four-wheeler CO2 sprayer. Treatments were replicated 3 or 4 times in a randomized complete block experimental design. Data collected included visual estimates of weed control and crop injury, and soybean yield at all locations except Jackson.

Overall performance of Touchdown 5 was similar to the Roundup Ultra standard included in the trials, and similar to results of previous experiments with Roundup Ultra applied overtop. The greatest difference was initial crop response at 2 of the 5 locations. At Tellico Plains and Spring Hill, phytotoxicity, best described as mottling or flecking, appeared shortly following application of Touchdown 5 (5 and 6% for 0.625 lb. a.i./A; 12 and 13% for 1 lb. a.i./A, respectively). This injury was short lived and new leaves showed none of the symptoms. Flecking occurred also, but was less noticeable, at Knoxville and Jackson. No flecking was caused by Roundup Ultra (1 lb. a.i./A) at any of the locations.

Weeds which were easily controlled by Touchdown 5 included common cocklebur, sicklepod, smooth pigweed, spotted spurge, and velvetleaf. As has been the case with Roundup Ultra, pitted morningglory and entireleaf morningglory were more difficult to control. Sequential applications (0.625 lb. a.i. applied twice) were particularly beneficial for control of rhizome johnsongrass, large crabgrass and goosegrass. The addition of Reflex (0.188 lb. a.i./A) to Touchdown 5 tended to improve entireleaf morningglory control. Residual herbicides, which varied across locations, did not consistently improve weed control. The greatest benefit appeared to be on annual grasses and entireleaf morningglory.

Yields of soybeans treated with one application of Touchdown 5 at 1 lb. a.i./A were no different from those treated with one application of Roundup Ultra at the same rate at Knoxville, Tellico Plains, Spring Hill and Portageville. Likewise, at Tellico Plains and Spring Hill where sequential applications (0.625 lb. a.i. applied twice) of Touchdown 5 and Roundup Ultra were compared, yields did not differ. The addition of Reflex to Touchdown 5, or the use of residual herbicides, increased yield at one location.

INFLUENCE OF ROW SPACING AND RESIDUAL HERBICIDES ON WEED CONTROL IN ROUNDUP READY AND LIBERTY LINK SOYBEAN. J. L. Norris, D. R. Shaw, C. E. Snipes, and D. S. Akin, 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 at Stoneville, 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, PRE 840 g ai/ha pendimethalin plus PRE 140 g ai/ha imazaquin, PRE 840 g/ha pendimethalin plus PRE 140 g/ha imazaquin followed by 840 g/ha glyphosate, PRE 420 g/ha pendimethalin plus PRE 70 g/ha imazaquin followed by 487 g/ha glyphosate, PRE 840 g/ha pendimethalin plus PRE 140 g/ha imazaquin 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, PRE 840 g/ha pendimethalin plus PRE 140 g/ha imazaquin, PRE 840 pendimethalin plus PRE 140 g/ha imazaquin followed by 420 g/ha glufosinate, PRE 420 g/ha pendimethalin plus PRE 70 g/ha imazaquin followed by 280 g/ha glufosinate, PRE 840 g/ha pendimethalin plus PRE 140 g/ha imazaquin followed by 279 g/ha bentazon plus 560 g/ha acifluoren . Row spacing of 38 and 76 cm were used with both cultivars.

Sicklepod [*Senna obtusifolia* (L.) Irwin and Barneby], pitted morningglory (*Ipomoea lacunosa* L.), and hemp sesbania [*Sesbania exltata* (Raf.) Rydb. ex A.W. Hill] were the predominant species throughout the study. Pendimethalin plus imazaquin followed by glyphosate controlled pitted morningglory more than glyphosate alone in both 38 and 76 cm rows 8 weeks after planting (WAP). Pendimethalin plus imazaquin followed by glufosinate did not increase pitted morningglory control compared to glufosinate alone in either row spacing. Pendimethalin plus imazaquin followed by glufosinate controlled sicklepod more than any glufosinate treatments alone. Glyphosate at 840 g/ha followed by 560 g/ha controlled more sicklepod than any of the pendimethalin plus imazaquin followed by glyphosate treatments. Hemp sesbania was controlled more with onventional herbicide treatments compared to the glyphosate treatments. Glufosinate at 420 g/ha followed by 420 g/ha glufosinate controlled hemp sesbania more than the conventional herbicide treatment. There was no difference in yield among any treatment.

EFFICACY OF ALS-INHIBITING BROADLEAF HERBICIDES TANK-MIXED WITH ROUNDUP ULTRA IN ROUNDUP READY SOYBEAN. D. S. Akin, D. R. Shaw, and J. L. Norris, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Since the development and introduction of glyphosate resistant soybean, producers can now use glyphosate during the growing season to control various weeds. Although a broad spectrum, non-selective herbicide, glyphosate does not control all weeds equally well. Weeds such as prickly sida (Sida spinosa L.), hemp sesbania (Sesbania exaltata [Raf.] Rybd. ex A. W. Hill), and morningglory (Ipomoea) species are subject only to suppression, at best, and sometimes several sequential applications of glyphosate must be used in order to achieve adequate control.

Several postemergence ALS-inhibiting herbicides are more effective than glyphosate for controlling morningglories. Tank-mixing an ALS-inhibitor with glyphosate could reduce the number of applications needed and improve efficacy, compared to glyphosate used alone. Studies to evaluate these combinations were conducted at Brown Loam Experiment Station near Raymond, MS. The experiment was designed as a randomized complete block with a factorial arrangement of treatments. Factors evaluated were ALS herbicide, ALS herbicide rate, and glyphosate rate. ALS herbicides evaluated were imazaquin, imazamox, cloransulam-methyl, cloransulam-methyl + flumetsulam, chlorimuron, and CGA-277476. All were used at full and ½X rates. Rates used for ALS herbicides are as follows: 0.07 and 0.14 kg ai/ha for imazaquin, 0.04 and 0.07 kg/ha for imazamox, 0.009 and 0.018 kg/ha for cloransulam-methyl, 0.012 and 0.025kg/ha for cloransulam-methyl+flumetsulam, 0.0044 and 0.0088 kg/ha for chlorimuron, and 0.039 and 0.078 kg/ha for CGA-277476. Glyphosate was used at rates of 0.0, 0.42, and 0.84 kg/ha. Comparison treatments of a single application of glyphosate at 0.42 or 0.84 kg/ha and a sequential application of glyphosate at 0.84 kg/ha followed by 0.42 kg/ha were also included. All postemergence applications were made at 3 weeks after planting (WAP), and the sequential glyphosate application was made at 5 WAP. Visual ratings were conducted to determine weed control at 2 and 6 weeks after postemergence treatment (WAT). Weeds evaluated were pitted morningglory (Ipomoea lacunosa L.) and entireleaf morningglory (Ipomoea hederacea var. integriuscula Gray).

Upon examination of main effects, increasing ALS herbicide rate or glyphosate rate had little effect on pitted morningglory control at both evaluation timings. Entireleaf morningglory control was also not effected by the increase of ALS herbicide rate or glyphosate rate at 6 WAT, but at 2 WAT, both factors effected control as well as the specific ALS herbicide used.

At 6 WAT, glyphosate applied at 0.42 lb/A controlled pitted morningglory 55% and entireleaf morningglory 57%. Glyphosate applied at 0.84 lb/A controlled pitted morningglory 66% and entireleaf morningglory 63%. The sequential application of glyphosate controlled pitted and entireleaf morningglory 85% and 87%, respectively. Control of pitted morningglory with all ALS herbicides was significantly different at the 0.05 alpha level, with control ranging from 82% with cloransulam-methyl to 68% with chlorimuron. Entireleaf morningglory control also differed significantly with the ALS herbicides, with control ranging from 82% with cloransulam-methyl + flumetsulam to 67% with chlorimuron.

UTILIZATION OF FIRST RATE AND PYTHON IN ROUNDUP READY SOYBEANS. J. A. Tredaway and T. C. Mueller, University of Tennessee, Knoxville, TN 37901.

ABSTRACT

Field experiments were conducted at Knoxville, TN in 1998 to evaluate First Rate and Python for broadleaf signalgrass (*Brachiaria platyphylla*) and pitted morningglory (*Ipomoea lacunosa*) control in Roundup Ready soybeans. Soybeans were planted in May 1998. The experimental design was a randomized complete block and treatments were replicated four times. Pre-plant incorporated treatments included Python (0.063 lb ai/A) and Treflan (0.75 lb ai/A) + Strongarm (0.031 lb ai/A). Preemergence treatments included Dual II (2.0 lb ai/A) + Python (0.063 lb ai/A) + Strongarm (0.008 lb ai/A), Dual II (2.0 lb ai/A) + Python (0.063 lb ai/A), and Strongarm (0.024 lb ai/A). Preemergence and postemergence treatment combinations included Dual II (2.0 lb ai/A) + Python (0.063 lb ai/A) + FirstRate (0.016 lb/A), Python (0.063 lb ai/A) + Roundup Ultra (0.75 lb ai/A), Dual II (2.0 lb ai/A) + Python (0.063 lb ai/A) + Strongarm (0.008 lb ai/A) + FirstRate (0.016 lb ai/A), Python (0.063 lb ai/A) + Strongarm (0.008 lb ai/A) + Roundup Ultra (0.5 lb ai/A), Python (0.063 lb ai/A) + FirstRate (0.016 lb ai/A) + Roundup Ultra (0.5 lb ai/A), Strongarm (0.024 lb ai/A) + Roundup Ultra (0.75 lb ai/A), Broadstrike + Treflan (0.91 lb ai/A) + FirstRate (0.016 lb ai/A), Dual II (2 lb ai/A) + FirstRate (0.0.031 lb ai/A), and Dual II (2 lb ai/A) + Frontrow: Python (0.006 lb ai/A) + FirstRate (0.016 lb ai/A) + Blazer (0.25 lb ai/A).

Total postemergence treatments included FirstRate (0.016 lb ai/A) + Select (0.125 lb ai/A) + Blazer (0.38 lb ai/A), and Frontrow + Roundup Ultra (0.5 lb ai/A). All treatments containing FirstRate contained COC (1.2%v/v). Treatments were applied in Knoxville with a CO_2 backpack sprayer delivering 18 GPA of water carrier. Data collected included pitted morningglory and broadleaf signalgrass control at 1 week after treatment (WAT) of preemergence applications, 1 and 4 WAT of postemergence applications, and soybean yields (bu/A).

All PPI treatments provided > 70% control of pitted morningglory at 1 WAT except Strongarm and Python (<20% control). Preemergence treatments at 1 WAT provided > 95% control of pitted morningglory except Dual II + Python (80%), Python + Strongarm (80%), and Treflan + Strongarm (40%). Broadleaf signalgrass was controlled 95% with all preemergence treatments at 1 WAT and this was maintained throughout the season. All treatments provided >95% control of pitted morningglory at 1 WAT of postemergence applications except Python applied alone and Dual II + Python + Strongarm. At 4 WAT, pitted morningglory control was maintained at 95% for all treatments except the PPI treatments of Strongarm and Python. Soybean yields were highest with Python + FirstRate + Roundup Ultra. Yields were lowest in treatments of Python alone (PPI) and Dual II + Python + Strongarm (PRE).

EFFECT OF RESIDUAL HERBICIDE AND EARLY SEASON WEED CONTROL ON SOYBEAN YIELD IN ROUNDUP READY SOYBEAN. C. A. Ashburn and T. C. Mueller, University of Tennessee, Knoxville, TN 37996 and G. S. Stapleton, American Cyanamid, Dyersburg, TN 38024.

ABSTRACT

The critical weed free period for a given crop is dependent upon several factors including environment conditions and weed density. Residual herbicides may be useful when growing seasons are lengthy, providing multiple weed flushes. The use of residual herbicides are often considered unnecessary in late planted Roundup Ready soybeans. However, competition from high weed populations early in the growing season is still possible.

Roundup Ready Soybean (Asgrow 5601RR) was planted in 30 inch centers in a tilled seed bed. Plots were 10' X 25'. Two planting dates were implemented in the study. The study used a split-plot design with planting date as the whole plot and treatment as the sub-plot. In study one, beans were planted early on May 16, 1998 and late on June 8, 1998. Treatments included applications of Roundup Ultra at various timing. Initial Roundup applications were made 7, 11, 19, and 27 days after planting (DAP) and maintained weed free with Roundup. Squadron (0.875 lb ai/A) followed by Roundup Ultra (1.0 lb ai/A) was included as the residual herbicide treatment. In study two, soybeans were planted early on May 29 and late on June 19. Treatments consisted of Squadron preplant incorporated (0.875 lb ai/A) followed by Roundup Ultra (1.0 lb ai/A), Roundup Ultra (1.0 lb ai/A) early, mid and late post when soybeans were 1-4", 6-8", and 10-14", respectively.

In study one, broadleaf signalgrass (*Brachiaria platyphylla*), common cocklebur (*Xanthium strumarium*), and pitted morningglory (*Ipomoea lacunosa*) control were evaluated. In evaluations taken after all initial applications had been made, all control was >95% with the exception of pitted morningglory in the 27 DAP treatment.

Both planting dates in study one were harvested on November 2. Yield in the early planted soybean were >40 bu/A and no treatment differed. Late planted soybean yields were lower than early yields due to decreased growing season length. Yields from treatments applied 7 and 19 DAP were 30 bu/A and differed from yield of 40 bu/A in treatments applied 11 and 27 DAP and Squadron fb Roundup 19 DAP.

In study two, yield was 40 bu/A with Squadron followed by Roundup. Use of residual herbicide eliminated competition in early soybean resulting in greater yields versus weed removal timings. The same was true for late planted soybean with the exception of the 1-3" removal timing. Yield in late planted soybean were half those of early planted beans.

Residual herbicides may be necessary to provide optimum yields, and their utility will be determined by weed species present, intensity of infestation and soil and environmental conditions.

THE BENEFITS OF AN IMAZAQUIN-BASED SOIL-APPLIED HERBICIDE FOLLOWED BY GLYPHOSATE VERSUS TOTAL POSTEMERGENCE GLYPHOSATE SYSTEMS AS RELATED TO APPLICATION TIMINGS, NUMBER OF APPLICATIONS, AND SOYBEAN YIELD. G. S. Stapleton, American Cyanamid Co., Dyersburg, TN 38024 and J. A. Kendig, Delta Center, University of Missouri, Portageville, MO 63873.

ABSTRACT

With the adoption of herbicide-resistant crop technology, weed competition has resurfaced as a significant issue. Early-season competition or the time prior to weed removal can expose soybean to yield-robbing influences. This is particularly evident if initial postemergence applications are delayed due to weather and crop management constraints. Additional issues which may interact directly or indirectly with weed competition are now being emphasized and have served to solidify the benefits of soil-applied residual followed by postemerge (PRE/POST) systems versus total postemergence (total POST) non-residual weed control programs.

Two weed removal timing experiments were conducted in 1998. The objectives of these studies were: 1) to evaluate the effects of weed removal timing on soybean yield and 2) to evaluate the need for a soil-applied herbicide in Roundup Ready soybean versus total POST systems. One was conducted in Portageville, Missouri at the University of Missouri – Delta Center (MO) and the other at the Agricenter International in Memphis, Tennessee (TN). Asgrow 5601 Roundup Ready soybean was planted on June 11 in a conventional-tilled sandy loam soil at the MO location and FFR556 Roundup Ready soybean was no-till planted into a silt loam soil on June 3 at the TN site. In MO study, SQUADRON @ .875 lb ai/A PRE followed by (fb) Roundup Ultra @ 1.0 lb ai/A POST was factorially compared to Roundup Ultra alone @ 1.0 lb ai/A POST. Initial POST treatments were applied 2 through 6 weeks after planting (WAP) on a weekly time interval. An additional POST treatment was applied to maintain plots weed-free. At the TN location, SQUADRON fb Roundup Ultra applied when weeds were 4-6 inches, Roundup Ultra alone with weeds 1-3 inches, 4-6 inches, 11-13 inches, and 14-16 inches were the treatments evaluated. Additional Roundup Ultra applications were made as necessary to maintain plots weed-free. Untreated checks were also incorporated into both trials to evaluate the effects of season-long competition.

At the MO location, no yield differences were recorded between any of the SQUADRON fb Roundup Ultra treatments averaging 44 bu/A. A 3 bushel advantage was recorded with this PRE/POST system over the Roundup Ultra 2 WAP and 4 WAP treatments. If weeds were allowed to compete 1 and 2 more weeks before removal, yield was reduced to 35 and 30 bushels, respectively. At the TN site similar trends in yield loss were observed. The PRE/POST program yielded 35 bu/A with comparative yield reductions of 3, 8, and 13 bu/A when POST alone treatments were applied at weed heights of 4-6 inches, 11-13 inches, or 14-16 inches. Additionally, as many as 5 Roundup Ultra applications were needed because severe drought conditions prevailed mid-season. Weeds became less actively growing at certain application timings, the crop was less competitive, and later flushes due to the lack of residual severely compromised Roundup Ultra performance. Yields were reduced 60% and 89% compared to the SQUADRON fb Roundup Ultra (PRE/POST) when weeds were allowed to compete full-season in MO and TN, respectively.

Residual soil-applied fb POST herbicide systems in Roundup Ready soybean offer weed control and subsequent yield advantages as well as many intangible benefits that total POST non-residual programs may not. Soil-applied herbicides help to manage the risks by buying time and providing insurance for the diverse southern farmer.

WEED MANAGEMENT SYSTEMS IN LIBERTY LINK AND ROUNDUP READY SOYBEAN *(GLYCINE MAX*). A. S. Culpepper, A. C. York, R. B. Batts, and K. M. Jennings. Crop Science Department, North Carolina State University, Raleigh, NC 27695-7620.

ABSTRACT

Transgenic, herbicide-tolerant soybean cultivars give growers new options to manage weeds. An experiment was conducted at Rosewood and Goldsboro, NC in 1997 and at Clayton and Goldsboro, NC in 1998 to compare weed control, soybean yields, and net returns from various management systems in non-transgenic soybean, glufosinate-tolerant soybean, and glyphosate-tolerant soybean. Clayton had a moderate to severe infestation of goosegrass (*Eleusine indica*), smooth pigweed (*Amaranthus hybridus*), and tall morningglory (*Ipomoea purpurea*) . In both years, Goldsboro had a moderate infestation of goosegrass, prickly sida (*Sida spinosa*), smooth pigweed, and sicklepod (*Senna obtusifolia*). Moderate weed infestations at Rosewood consisted of johnsongrass (*Sorghum halapense*), sicklepod, smooth pigweed,

and tall morningglory. All herbicides were applied broadcast at either preemergence (PRE), early POST (EPOST) at two- to three-trifoliate soybean, or late POST (LPOST) at seven- to eight-trifoliate soybean.

The prepackaged mixture of imazaquin + dimethenamid (0.13 + 0.9 lb ai/A) PRE controlled johnsongrass, sicklepod, and tall morningglory 32, 53, and 54%, respectively, by late-season. Other species were controlled at least 95%. The PRE herbicide plus glufosinate (0.35 lb ai/A) EPOST in glufosinate-tolerant soybean or glyphosate (0.75 lb ai/A) EPOST in glyphosate-tolerant soybean controlled all weeds at least 93%.

Total postemergence glufosinate programs in glufosinate-tolerant soybean included glufosinate at 0.26 or 0.35 lb/A alone or mixed with fomesafen (0.25 lb ai/A) EPOST. A system of glufosinate (0.35 lb/A) EPOST followed by glufosinate (0.26 lb/A) LPOST also was included. Glufosinate (0.26 lb/A) controlled johnsongrass, goosegrass, smooth pigweed, prickly sida, tall morningglory, and sicklepod 72, 67, 81, 84, 87, and 94%, respectively. Increasing the rate of glufosinate to 0.35 lb/A increased control of johnsongrass, goosegrass, and smooth pigweed 17, 15, and 8%, respectively. Fomesafen mixed with glufosinate at 0.26 lb/A increased control of goosegrass, prickly sida, and smooth pigweed 9 to 13% but was of little benefit when mixed with glufosinate at 0.35 lb/A. Sequential applications of glufosinate controlled smooth pigweed, prickly sida, and tall morningglory better than a single application. Except for smooth pigweed, all species were controlled as well with sequential glufosinate applications as with imazaquin + dimethenamid followed by glufosinate. No differences in yields or net returns among glufosinate systems were noted in 1997. However, in 1998, yields with a single application of glufosinate at 0.26 lb/A were less than those of other glufosinate systems.

Total postemergence glyphosate programs in glyphosate-tolerant soybean included glyphosate at 0.5 or 0.75 lb/A alone or mixed with fomesafen at EPOST. Glyphosate (0.75 lb/A) EPOST followed by glyphosate (0.5 lb/A) LPOST also was included. Glyphosate (0.5 lb/A) controlled johnsongrass, goosegrass, smooth pigweed, prickly sida, tall morningglory, and sicklepod 97, 92, 95, 85, 59, and 93%, respectively. Increasing the rate of glyphosate to 0.75 lb/A increased control of prickly sida and morningglory by 8 and 16%, respectively. Fomesafen mixed with glyphosate at 0.5 lb/A increased morningglory control 7% but reduced smooth pigweed control 6%. Loss of smooth pigweed control was alleviated by increasing the rate of glyphosate in mixture to 0.75 lb/A. Sequential applications of glyphosate controlled only morningglory more than a single application. However, imazaquin + dimethenamid followed by glyphosate EPOST controlled morningglory 7% more than sequential glyphosate applications. Similar to glufosinate systems, differences in 1997 yields and net returns were minimal. In 1998, yields with a single application of glyphosate at 0.5 lb/A were less than systems with soil-applied or sequential herbicide applications.

Imazaquin + dimethenamid followed by EPOST treatments of chlorimuron, glufosinate, or glyphosate in respective cultivars controlled goosegrass, smooth pigweed, and prickly sida similarly. Following soil-applied herbicides, glyphosate controlled johnsongrass 6 and 65% more than glufosinate or chlorimuron, respectively, and controlled sicklepod 6% more than chlorimuron. In contrast, tall morningglory was controlled most effectively by glufosinate, intermediately by chlorimuron, and least by glyphosate when following soil-applied herbicides. Although weed control differences were noted, yields and net returns were similar among these systems.

FLORIDA PUSLEY (*Richardia scabra*) CONTROL IN ROUNDUP READY™ SOYBEANS. E. C. Murdock, Clemson University Pee Dee REC, Florence, SC 29501, and S. Sherrick, Monsanto.

ABSTRACT

Two field experiments were conducted at an on-farm site in 1998 to evaluate Florida pusley control in Roundup Ready™ soybeans with Roundup Ultra. Single and sequential applications of Roundup Ultra at 1 to 2 pt/ac controlled Florida pusley 88 to 100% 3 and 6 weeks after POST herbicide application (WAT). Control was similar with and without ammonium sulfate (AMS) or Quest. Almost complete control was observed where the soil was not compacted by the tractor tires and Florida pusley seedlings were 1 to 2 inches tall. However, control was notably less in the tire tracks where Florida pusley seedlings emerged earlier and were 2 to 3 inches tall when POST herbicides were applied. Single and sequential applications of Roundup Ultra at 2 pt/ac controlled yellow nutsedge 67 to 82% and 78% 3 and 6 WAT respectively. The addition of AMS or Quest did not enhance control. Roundup Ultra at 1 pt/ac controlled yellow nutsedge 45 and 43% 3 and 6 WAT, respectively, and was less effective than the 1.5 and 2 pt/ac rates. Control with 1.5 and 2.0 pt/ac was similar, and ranged from 60 to 67% and 65 to 78% 3 and 6 WAT, respectively. Southern crabgrass was controlled 98 to 100% with all treatments, including Prowl PRE followed by Classic and surfactant at 2.4 pt and 0.5oz + o.25% v/v, respectively. Complete season-long sicklepod and Florida beggarweed control was attained with

all herbicide treatments. Tropic croton was controlled 98 to 100% with all Roundup Ultra treatments; whereas Prowl PRE followed by Classic POST did not control tropic croton.

SOIL –APPLIED PROGRAMS IN A ROUNDUP READY SYSTEM. S. G. Flint, J. C. Holloway, D. R. Shaw, and M. C. Smith, Department of Plant and Soil Sciences, Mississippi State University, MS 39762, and Novartis Crop Protection Corp., Greenville, MS 38701.

ABSTRACT

Field studies were conducted in the summer of 1998 at the Novartis Research Station Greenville, MS, the Coastal Plain Branch Experiment Station, Newton, MS, and the Brown Loam Experiment Station, Raymond, MS, to evaluate the effectiveness of soil-applied herbicides in a Roundup Ready system. Residual herbicides evaluated at Newton and Raymond included flumetsulam + metolachlor, pendimethalin, metribuzin + chlorimuron + pendimethalin, imazaquin + pendimethalin, and sulfentrazone + chlorimuron + pendimethalin. Labeled rates were used according to soil type. The soil treatments were applied alone or followed with single application of 0.56 or 0.84 kg ai/ha glyphosate 5 weeks after planting. All treatments were compared to sequential applications of 0.84 followed by 0.56 kg ai/ha glyphosate. Three weeks after the late glyphosate application, all treatments containing a soil-applied herbicide followed by a single or sequential application of glyphosate controlled pitted morningglory (Ipomoea lacunosa L.) at least 80% except Prowl followed by glyphosate (61%). Chlorimuron + pendimethalin + sulfentrazone followed by glyphosate controlled pitted morningglory at least 94%, regardless of timing and rate. Metribuzin +chlorimuron + pendimethalin and imazaquin + pendimethalin followed by glyphosate at 0.84 kg/ha controlled pitted morningglory 84 to 87%. At Newton, all soil-applied treatments followed by glyphosate at 0.56 kg/ha or sequential applications of glyphosate controlled sicklepod [Senna obtusifolia (L.) Irwin and Barnaby] 70 to 90%. Sulfentrazone + chlorimuron + pendimethalin followed by glyphosate controlled pitted morningglory at least 81%, compared to less than 76% with the other treatments containing glyphosate. Broadleaf signalgrass [Brachiaria platyphylla (Griseb.) Nash] control was at least 90% with all treatments containing glyphosate, compared to 83% with the conventional standard. Flumetsulam + metolachlor followed by glyphosate controlled sicklepod at least 80%, which was equal to the sequential glyphosate treatment. At 8 weeks after the late glyphosate applications, only sequential glyphosate applications controlled hemp sesbania [Sesbania exaltata (Raf.) Rydb. ex. A. W. Hill], pitted and entireleaf morningglory (Ipomoea hederacea var. integriuscula Gray) at least 90%. Soil-applied herbicides did not increase broadleaf signalgrass, sicklepod, or hemp sesbania control compared to the sequential glyphosate standard. Soybean treated with sequential glyphosate applications yielded 1400 kg/ha. Yields were equivalent with all soil-applied treatments followed by glyphosate except treatments using the conventional standard, which yielded 560 kg/ha. The conventional standard yield was comparable to each soil-applied herbicide treatment without glyphosate.

Experiments at Greenville evaluated PRE herbicides alone and followed by glyphosate POST at 4 timings. The residual herbicides evaluated were flumetsulam + metolachlor and metribuzin + metolachlor. The weeds evaluated were entireleaf morningglory, pitted morningglory, and common cocklebur (Xanthium strumarium L.). Glyphosate was applied at .54 kg/ha 4, 5, 6, and 7 weeks after planting. Three weeks after the early postemerge (EPOST) (4WAP) application, flumetsulam + metolachlor and metribuzin + metolachlor alone controlled pitted morningglory 63 to 66%. Glyphosate controlled pitted morningglory and entireleaf morningglory more than 86%. Glyphosate applied 6WAP following flumetsulam + metolachlor PRE controlled pitted morningglory 66 to 77%. Glyphosate applied 5, 6, and 7 WAP controlled horse purslane 98 to 100% following either PRE treatment. Flumetsulam + metolachlor and metribuzin + metolachlor followed by glyphosate 5, 6, and 7 WAP controlled common cocklebur 88 to 96%. Yields were variable when PRE herbicides were applied followed by an application of glyphosate at different timings. Soybean treated with flumetsulam + metolachlor PRE and glyphosate 4WAP yielded 1792 kg/ha, while the glyphosate was applied 7WAP yielded 3385 kg/ha. Similar results were noted with metribuzin + metolachlor.

EFFICACY OF DIPHENYLETHER HERBICIDES TANK-MIXED WITH GLYPHOSATE. A. C. Bennett, D. R. Shaw, and D. S. Akin, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

With the increasing use of glyphosate-tolerant soybean, there is interest in tank-mixing conventional herbicides with glyphosate to reduce the number of applications required and improve efficacy on weeds difficult to control with glyphosate alone. The diphenylether herbicides are good candidates for tank-mixture with glyphosate, as they provide excellent control of weeds such as morningglory species (Ipomoea spp). and hemp sesbania [Sesbania exaltata (Raf.) Rydb. ex A.W. Hill] which are not always effectively controlled with glyphosate. The objective of this research was to evaluate the efficacy of tank-mixtures of diphenylether herbicides and glyphosate. Studies were conducted at the Plant Science Research Center near Starkville, MS, and at the Brown Loam Experiment Station near Raymond, MS. The studies were designed as randomized complete blocks with a three-factor factorial arrangement of treatments. Factors were diphenylether herbicide, diphenylether herbicide rate, and glyphosate rate. Diphenylether herbicides evaluated were fomesafen, acifluorfen, and lactofen. The diphenylether herbicides were applied at full and 1/2X rates, which were 0.42 and 0.21 kg/ha, respectively, for fomesafen and acifluorfen, and 0.22 and 0.11 kg/ha, respectively, for lactofen. Glyphosate rates were 0.0, 0.42, and 0.84 kg/ha. Comparison treatments of a single application of glyphosate at 0.42 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, and the glyphosate sequential also received a second application 5 weeks after planting. Evaluations included weed control 2 and 6 weeks after the postemergence treatment (WAT), and yield. Weeds evaluated were pitted morningglory (Ipomoea lacunosa L.), entireleaf morningglory (Ipomoea hederacea var. integriuscula Gray), sicklepod [Senna obtusifolia (L.) Irwin and Barneby], common cocklebur (Xanthium strumarium L.), broadleaf signalgrass [Brachiaria platyphylla (Griseb.) Nash], browntop millet [Brachiaria ramosa (L.) Stapf], and barnyardgrass [Echinochloa crus-galli (L.) Beauv.].

Examination of main effects showed increasing the diphenylether herbicide rate, or increasing glyphosate rate from 0.42 kg/ha to 0.84 kg/ha had little effect. The diphenylether herbicide used did affect control in several instances, so comparisons were made between the three diphenylether herbicides in tank-mixture with 0.42 kg/ha glyphosate. Pitted morningglory control with fomesafen and acifluorfen tank-mixtures was equivalent to single or sequential glyphosate treatments at both evaluation timings, but control with lactofen tank-mixed with glyphosate was less than the other treatments late-season. Entireleaf morningglory control 2 WAT was better with fomesafen or acifluorfen tank-mixtures than with any other treatments at Raymond, but did not differ at Starkville. Control with fomesafen in tank-mixture with glyphosate was better than the single glyphosate treatment, and equivalent to the sequential glyphosate treatment 6 WAT at Raymond, but no diphenylether tank-mixture was as effective as the sequential glyphosate treatment for entireleaf morningglory control. Sicklepod control with fomesafen or acifluorfen tank-mixtures was equivalent to single or sequential glyphosate treatments 2 and 6 WAT, but control with lactofen tank-mixed with glyphosate was less than with the sequential glyphosate treatment. Broadleaf signalgrass control was reduced when lactofen was tank-mixed with glyphosate compared to all other treatments 2 WAT, and was less effective than the sequential glyphosate treatment 6 WAT. There were few differences in common cocklebur, browntop millet, or barnyardgrass control with any treatment at either evaluation timing. Yields following fomesafen tank-mixed with glyphosate were higher than when following a single glyphosate treatment at Raymond, while yield following a sequential glyphosate treatment was higher than following all other treatments at Starkville.

WEED CONTROL IN ROUNDUP READY SOYBEAN WITH AND WITHOUT SOIL APPLIED HERBICIDES. J. M. Ellis, J. L. Griffin, and E. P. Webster, Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

Field experiments were conducted in 1998 at the Ben Hur Research Farm near Baton Rouge, LA to evaluate possible benefits of using preemergence (PRE) herbicides in a Roundup Ready soybean system. The experimental design was a randomized complete block with four replications. 'Asgrow 5901RR' soybean was planted June 2. Full and half rates of Squadron (3 and 1.0 pt/A), Prowl (2.4 and 1.2 pt/A), Dual II (1.5 and 0.75 pt/A), Detail (2 and 1 pt/A), Canopy XL (6.4 and 3.2 oz/A), and Canopy (8 and 4 oz/A) were applied PRE on June 4. To ensure herbicide activation the experimental area was irrigated with 0.75 inches of water using an overhead sprinkler system two days after planting. Irrigation was continued as needed throughout the growing season. Weed height, leaf number, and density of hemp sesbania [*Sesbania exaltata* (Raf.) Rydb. Ex A. W. Hill], ivyleaf morningglory [*Ipomoea hederacea* (L.) Jacq.], and

barnyardgrsss [*Echinochloa crus-galli* (L.) Beauv.] were determined from three-1ft^2 areas 12 d after PRE (DAPRE) treatments were applied. Weed size was monitored to determine the number of days needed to reach 3 to 4 inches at which time Roundup Ultra was applied at 1.0 qt/A. If needed, sequential Roundup Ultra applications were made. Weed control was evaluated 14 d after Roundup Ultra application.

The PRE herbicides extended the Roundup Ultra "application window" an extra 3 to 5 days. Squadron, Prowl, and Dual II allowed an extra 3 days between planting and Roundup Ultra application, whereas Detail, Canopy XL, and Canopy allowed an extra 5 days. There were no differences between the full and half rates of the PRE herbicides in respect to timing of Roundup Ultra application. Use of PRE herbicides eliminated the need for a sequential Roundup Ultra application. When PRE herbicides were not used, a second Roundup Ultra application was made 10 days after the first application.

Hemp sesbania density was increased when only Squadron was applied at a half rate compared with a full rate. Barnyardgrass density was increased when only Canopy XL was applied at a half rate compared with a full rate. Reducing the rate of the PRE herbicides did not affect ivyleaf morningglory densities. Based on total weed density 12 d after PRE herbicides were applied, weed control with full rates was 78% (Squadron), 68% (Prowl), 76% (Dual II), 86% (Detail), 85% (Canopy XL), and 94% (Canopy). For only Canopy XL was reduction in total weed density less when half rates were used. Hemp sesbania was taller 12 d after Squadron or Canopy XL application at half rates compared with full rates. Ivyleaf morningglory and barnyardgrass height was not affected when PRE herbicide rates were reduced.

When Roundup Ultra followed Canopy PRE, hemp sesbania control was greater than when Roundup Ultra was applied twice without a PRE herbicide. Irregardless, half rates or full rates of PRE herbicides followed by Roundup Ultra or sequential applications of Roundup Ultra did not control hemp sesbania. Blazer was applied at 1.0 pt/A to the experimental area to control hemp sesbania and facilitate harvest. Fourteen days after Roundup Ultra application, ivyleaf morningglory and barnyardgrass control was equivalent for all herbicide treatments averaging 84 and 100%, respectively. Soybean yields were not different for half rates or full rates of PRE herbicides followed by Roundup Ultra and for two applications of Roundup Ultra with no PRE.

In conclusion, none of the PRE herbicides evaluated (Squadron, Prowl, Dual II, Detail, Canopy XL, or Canopy) provided complete weed control and a postemergence follow up application was necessary. In a Roundup Ready system, use of the PRE herbicides extended application window for Roundup Ultra 3 to 5 days depending on herbicide. Use of PRE herbicides at half rates eliminated need for a second Roundup Ultra application. Based on weed control and soybean yield, the Roundup only program of two applications was as effective as when PRE herbicides at either half or full rates were followed by a single application of Roundup. Hemp sesbania was not controlled with any of the weed control programs evaluated.

INTERACTIONS OF AMMONIUM SULFATE OR PELARGONIC ACID WITH GLUFOSINATE OR GLYPHOSATE ON TWO PERENNIAL AND THREE ANNUAL WEED SPECIES. W. A. Pline, K. K. Hatzios. Virginia Polytechnic Institute & State University, Blacksburg, VA 24061-0330.

ABSTRACT

The influence of ammonium sulfate (AMS) or pelargonic acid (PA) on the efficacy of glufosinate or glyphosate on perennial and annual weed species was investigated using greenhouse studies. Two perennial weeds, common milkweed (*Asclepias syriaca*) and horsenettle (*Solanum carolinense*), as well as three annual weed species, common lambsquarters (*Chenopodium album*), giant foxtail (*Setaria faberi*), and sicklepod (*Cassia obtusifolia*) were used in efficacy studies. PA alone dose response studies on seedling annual weeds were conducted using 0, 1, 2, or 3 % v/v PA delivered at 237 L/ha. PA treatments showed differential sensitivity among the three annual weeds, as well as a considerable level of herbicidal activity, causing a 50-70% reduction in fresh weight in 7 cm annuals at 3% v/v. Sicklepod showed the highest tolerance to pelargonic acid, followed by common lambsquarters, and giant foxtail showing the least tolerance. For AMS and PA synergism studies, annual and perennial weeds were treated with 0, 62.5, 125, 250 g/ha glufosinate or glyphosate alone, or in combinations with 2% w/v AMS or 3% v/v PA. Greenhouse studies showed that AMS-glufosinate combinations decreased fresh weight over an equivalent rate of glufosinate alone in the perennial weeds horsenettle and common milkweed, but had either no effect or an antagonistic effect on the annual weeds common lambsquarters, sicklepod, giant foxtail. PA-glufosinate combinations were more effective than glufosinate alone treatments in all weeds except sicklepod. AMS-glyphosate treatments increased glyphosate efficacy in giant foxtail, horsenettle, and common

lambsquarters. PA-glyphosate treatments significantly reduced the rate of glyphosate needed to achieve an equal amount of fresh weight reduction versus glyphosate alone treatments in all weeds. Re-growth of the perennial weeds, horsenettle and common milkweed was significantly less with glyphosate treatments versus glufosinate treatments. The synergists AMS and PA only effected the amount of re-growth compared to glufosinate or glyphosate treatments alone, at the 0.5 kg/ha rate. The addition of 2% w/v AMS to glufosinate decreased the growth of common milkweed versus glufosinate alone. The addition of AMS and PA to glyphosate at 0.5 kg/ha significantly reduced the amount of common milkweed growth versus an equal rate of glyphosate alone. The synergists AMS and PA had no effect on the amount of horsenettle re-growth.

WEED CONTROL WITH AC 299,263 IN IMI[a] WHEAT. J. R. Roberts, J. P. Kelley, and T. F. Peeper, Graduate Research Assistant, Senior Agriculturist, and Professor, Department of Plant and Soil Sciences, Oklahoma State University, Stillwater, OK 74078.

ABSTRACT

Field research was conducted in North Central Oklahoma during the 1997 - 1998 growing season to evaluate AC299,263 (imazamox) for grassy weed control in winter wheat. Each location was seeded to Fidel IMI[a] wheat at 60 lb/ac. Imazamox was applied at 0.024, 0.032, 0.04, and 0.048 lb ai/ac in the fall and/or spring, and MON37503 was applied at 0.032 lb ai/ac in the fall or spring. Rye control was 70 to 100% with imazamox, and 3 to 25% with MON37503 depending on rate, timing, and location. Cheat control was 100% with imazamox and MON37503. Italian ryegrass control was 74 to 99% with imazamox, and 78 to 80% with MON37503 depending on rate, timing, and location. Jointed goatgrass control was 80 to 100% with imazamox, and 0 to 9 % with MON37503. The tolerance of Fidel IMI[a] wheat to imazamox has also been evaluated. Research is being repeated during the 1998 - 1999 growing season.

ITALIAN RYEGRASS AND WINTER ANNUAL BROADLEAF WEED CONTROL WITH PROWL HERBICIDE IN WHEAT. R. C. Scott and N. M. French, II, American Cyanamid Company, Jonesboro, AR 72404 and Little Rock, AR 72211, F. L. Baldwin and T. Dillon, University of Arkansas, Cooperative Extension Service, Little Rock, AR 72203.

ABSTRACT

In the spring of 1996, a wheat (*Triticum aestivum*) field in central Arkansas was determined to be infested with a population of Italian ryegrass (*Loliummultiflorum*) resistant to the herbicide Hoelon. This population of Italian ryegrass was later shown to be resistant to Hoelon at rates as high as 20 pt/A. In the fall of 1996, research was conducted by the University of Arkansas to evaluate several new herbicides and some labeled herbicides for the control of Hoelon resistant ryegrass in Arkansas wheat. One of the herbicides evaluated was Prowl. Results from that study were very positive; however, further research was needed to evaluate the potential of Prowl as a broad-spectrum herbicide for wheat.

In the fall of 1997, 4 trials were conducted in Arkansas and 1 was conducted in Tennessee to evaluate Prowl for control of Italian ryegrass in wheat. All studies were conducted as randomized complete blocks with 3 or 4 replications. Treatments were applied in 10 to 15 gallons of water per acre. Treatments varied depending on location, but included the following: Prowl at 2.4 and 4.8 pt/A applied preemergence (PE), delayed preemergence (DP), and early-postemergence (EP); Hoelon at 1.33 and 2.67 pt/A applied EP either alone, tank mixed with Prowl or following Prowl DP; and Achieve at 0.188 and 0.25 lb ai/A applied EP either alone, tank mixed with Prowl or following Prowl DP. DP treatments were applied after the wheat had germinated, but before it emerged (approximately 5 days after planting). Wheat stand counts were taken after emergence at 3 locations. Crop response and weed control were visually evaluated both early and late in the growing season. Wheat yield was obtained.

No stand loss of wheat was observed from 2.4 pt/A of Prowl applied DP at any location. This is the appropriate rate for the soil types evaluated at these locations. Stand loss from PE treatments of Prowl at 2.4 and 4.8 pt/A ranged from 0 to 40% at the 3 locations evaluated. Stand loss from the PE treatments is probably dependent on how soon after planting a significant rainfall occurs and planting depth. Visual crop response ratings ranged from 0 to 26% for Prowl PE and DP at 2.4 pt/A, 28 days after treatment (DAT). By 90 DAT, crop response was less than 10% for all treatments, except at one location that had a lighter soil type where crop response ranged from 14 to 18%.

Prowl at 2.4 pt/A applied PE and DP controlled Italian ryegrass 84 and 74%, respectively, when averaged over 5 locations. Italian ryegrass control with 4.8 pt/A of Prowl applied PE and DP was 86-87%, over 5 locations. Tank mix and sequential treatments were averaged across two locations. Tank mixtures of 2.4 pt/A Prowl with the low rates of either Hoelon or Achieve applied EP controlled ryegrass 92% or more and provided better control than full rates of either herbicide applied alone. Sequential treatments of Prowl followed by the lower rates of Hoelon or Achieve controlled ryegrass over 93%, which was 5 to 11% better than the full rates of Hoelon or Achieve applied alone. Prowl also controlled several species of winter annual broadleaf weeds 93% or more including: henbit (*Lamium amplexicaule*), shepherd's-purse (*Capsella bursa-pastoris*), and mouseear chickweed (*Cerastium vulgatum*).

Prowl applied at 2.4 or 4.8 pt/A either PE or DP alone increased wheat yield an average of 12 bu/A or 45% across 5 locations compared to the untreated check. When averaged across 2 locations, tank mixing or applying Prowl as a sequential with Hoelon or Achieve improved wheat yield 20 and 70%, respectively, over Hoelon and Achieve applied alone. The data from these studies suggests that Prowl herbicide may provide wheat growers with a tool for controlling Hoelon resistant ryegrass. Also, Prowl controls a broad-spectrum of broadleaf wheat weeds, with acceptable crop safety. However, activity and crop safety are strongly tied to proper application timing and timely rainfall.

ITALIAN RYEGRASS *(Lolium multiflorum)* CONTROL IN WHEAT WITH MKH 6562 AND OTHER NEW HERBICIDES. M. A. Barnes, J. P. Kelley, and T. F. Peeper, Oklahoma State University, Stillwater, OK 74078.

ABSTRACT

Italian ryegrass is a competitive winter annual weed and has become a significant problem in winter wheat production in Oklahoma. Current herbicide treatments may not provide satisfactory control of Italian ryegrass. Also, winter wheat is often used as forage for cattle prior to jointing, which precludes use of diclofop because it has a full season grazing restriction. Also, resistance to diclofop and sulfonylurea herbicides has been reported.

Research was conducted to compare MKH 6562 and FOE 5043 + metribuzin with standard treatments for Italian ryegrass control. MKH 6562 at 0.027 lb/ac controlled Italian ryegrass 53 to 98% and injured wheat 0 to 13%. FOE 5043 + metribuzin at 0.250 lb/ac plus 0.094 lb/ac controlled Italian ryegrass 78 to 97% and injured wheat 0 to 10%. FOE 5043 + metribuzin at 0.250 lb/ac plus 0.125 lb/ac controlled Italian ryegrass 59 to 100% and injured wheat 0 to 75%. Diclofop at 0.5 lb/ac controlled Italian ryegrass 43 to 99% and injured wheat 1 to 9%. Controlling Italian ryegrass typically increased wheat yield. Research is currently in progress to confirm these results.

WHEAT CULTIVAR CHARACTERISTICS AFFECT COMPETITIVE ABILITY WITH GRASSY WEEDS. J. P. Kelley, T. F. Peeper, and E. G. Krenzer, Department of Plant and Soil Sciences, Oklahoma State University, Stillwater, OK 74078.

ABSTRACT

Jointed goatgrass (*Aegilops cylindrica*) and cheat (*Bromus secalinus*) are troublesome winter annual grass weeds in Oklahoma wheat. Various cultural practices have been investigated and found to reduce the impact of these weeds on wheat, but no practices have been identified that adequately suppress either species. One potential cultural control method that has not been fully investigated is the use of competitive wheat cultivars to reduce competition fromweeds.

Eight hard red winter wheat cultivars were chosen based on their different growth characteristics, (i.e. forage production potential, juvenile growth habit, and plant height). All cultivars were planted at 60 lbs/acre with six-inch row spacing. Each cultivar was planted alone or with 30 lbs/acre of jointed goatgrass spikelets or cheat seed mixed with the wheat (60 lbs wheat + 30 lbs weed seed). Experiments with jointed goatgrass were conducted near Perkins for three years, near Altus, Lahoma, and Orlando for two years, and near Chickasha for one year. Experiments with cheat were conducted near Perkins for two years and near Altus, Chickasha, Perkins, and Orlando for one year.

In the ten experiments with jointed goatgrass, the cultivars 2180 or TAM 107 contained the highest amount of jointed goatgrass in the harvested grain in seven experiments, while Jagger had less than most cultivars in each experiment. In the six experiments on cheat, 2180 or TAM 107 had the highest percent dockage due to cheat in all six experiments, while Jagger had less dockage than other cultivars at one experiment. Mature plant height and wheat yield were more often negatively correlated with jointed goatgrass and cheat seed production than other plant characteristics.

EFFECT OF MON 37500 ON EMERGENCY RECROP OPTIONS. A. E. Stone, T. F. Peeper, and J. P. Kelley, Department of Plant and Soil Science, Oklahoma State University, Stillwater, Oklahoma 74078.

ABSTRACT

When winter wheat is destroyed by wind, hail, freeze, weeds, pest infestation, or drought after a herbicide such as MON37503 has been applied, wheat producers often plant a warm season crop. To determine the effect of MON37503 on crops seeded in such conditions, experiments were conducted in 1997 and 1998 on a silt loam soil with 2 % organic matter content and 4.7 pH. There was not a need to simulate wheat destruction the first year, since it did not establish a stand. The second year the wheat planted in the experimental area was treated with glyphosate to simulate destruction. In 1997 three rates of MON37503 were used, the label rate (0.031 lb ai/ac), 0.016 lb ai/ac, and 0.023 lb ai/ac. MON37503 was sprayed on April 15 and three days later corn and IR corn were planted. Grain sorghum and soybeans were planted two weeks later. During the summer, stands were counted and plant heights were measured. Crops were harvested at maturity and grain yield corrected for moisture content.

In 1998, an experiment was conducted at the same location, with two rates of MON37503, the labeled rate of 0.031 lb ai/ac and 0.062 lb ai/ac rate, which were sprayed on March 28. The corn and IR corn were planted two weeks later. A month and a half later the grain sorghum, soybeans, STS soybeans, and pearl millet were planted. Throughout the summer stands were counted and plant heights were measured. In the fall, the crops were harvested and yields were recorded. The labeled rate of MON37503 did not reduce yield of IR corn either year, and reduced corn yield only in 1997 (14%). Soybean yields were not reduced either year. Grain sorghum yield was reduced 55% in 1997, but not reduced in 1998.

ECLIPTA (*ECLIPTA PROSTRATA* L.) CONTROL PROGRAMS IN PEANUT. J. R. Sholar and J. N. Nickels; Department of Plant and Soil Sciences, Oklahoma State University, Stillwater, OK 74078.

ABSTRACT

Eclipta, (*Eclipta prostrata* L.), is a major weed problem in irrigated peanut, (*Arachis hypogaea* L.), fields in Oklahoma. This summer annual weed prefers moist conditions and is an even greater problem in wet years. Dinitroanaline herbicides provide unacceptable control of eclipta. Postemergence herbicides must be used when eclipta is very small and growers achieve erratic control with these treatments. Acetamide herbicides can be used as preemergence treatments with some success but growers are reluctant to use these herbicides over concern about injury when the crop is germinating and emerging. Field experiments were conducted in 1998 to evaluate eclipta and peanut response to new, soil-applied herbicide treatments as compared to currently available herbicides . Soil-applied Strongarm (diclosulam) and Authority (sulfentrazone) provided season-long control of eclipta with no detectable crop injury. Basagran (bentazon) and Pursuit + Dual (imazathapyr + metolachlor) also provided season-long control (90-100%) control of eclipta. All herbicides increased peanut pod yields and gross returns over the check. Herbicide treatments did not affect pod quality as measured by Total Sound Mature Kernels. Additional research is needed to confirm these results in wetter years.

INTERACTIONS OF SETHOXYDIM AND CLETHODIM WITH SELECTED AGRICHEMICALS IN PEANUT. D. L. Jordan, A. S. Culpepper, P. D. Johnson, and A. C. York, Crop Science Department, North Carolina State University, Raleigh, NC 27695.

ABSTRACT

Timing of application of graminicides often coincides with application timings for other herbicides, fungicides, insecticides, plant growth regulators, and foliar fertilizers used in peanut (*Arachis hypogaea*). Determining how clethodim and sethoxydim interact with other agrichemicals would be advantageous when formulating weed management strategies. Research was conducted in 1997 and 1998 to evaluate potential interactions of these graminicides when applied in a tank mixture with a variety of agrichemicals. In one group of experiments sethoxydim was applied alone or with dimethenamid or metolachlor at use rates equivalent to 1, 0.5, and 0.25 times the suggested use rate to large crabgrass (*Digitaria sanguinalis*) and broadleaf signalgrass (*Brachiaria platyphylla*). In additional studies, clethodim was applied alone or with the suggested use rate of chlorothalonil (Bravo Weather Stick), tebuconizole (Folicur),

iprodione (Rovral), Tenn-cop, fluazinam, Early Harvest, 2,4-DB (Butyrac 200), acifluorfen + bentazon (Storm), metolachlor (Dual), or dimethenamid (Frontier) to large crabgrass in the three to five-leaf stage. A crop oil concentrate at 1.0% v/v was included with all treatments. Percent grass control was determined 3 weeks after application using a scale of 0 (no control) to 100 (complete control). Data were subjected to analysis of variance and means were separated using Fisher's Protected LSD test at P = 0.05.

Dimethenamid or metolachlor did not affect large crabgrass or broadleaf signalgrass control by clethodim or sethoxydim, suggesting that dimethenamid or metolachlor can be applied with these graminicides to control emerged grasses and provide residual control of annual grasses and small-seeded broadleaf weeds. Chlorothalonil, Tenn-cop, and acifluorfen + bentazon reduced efficacy of clethodim compared to efficacy of clethodim alone. However, Tenn-cop and acifluorfen + bentazon were greater antagonists than chlorothalonil. Other chlorothalonil-containing formulations are used routinely to control leafspots (*Cercospera* spp.) in peanut. Additional research is needed to determine if the antagonism occurs when other chlorothalonil formulations are used. Tenn-cop is a copper-containing fungicide applied for leafspot control in peanut and is used on limited acreage. Other research has shown antagonism of clethodim and sethoxydim by acifluorfen + bentazon. These data also suggest that tebuconizole, iprodione, fluazinam, Early Harvest, and 2,4-DB can be applied with clethodim without reducing annual grass control. Previous research indicated that 2,4-DB antagonized clethodim under certain conditions. Additional research on other grass species and with other formulations of agrichemicals is needed to further define potential interactions.

INFLUENCE OF APPLICATION TIMING AND METHOD ON DICLOSULAM EFFICACY IN WEST TEXAS PEANUT. P. A. Dotray, J. W. Keeling, and T. S. Osborne, Texas Agricultural Extension Service and Texas Agricultural Experiment Station, Lubbock, TX 79401-9757 and Texas Tech University, Lubbock, TX 79409-2122.

ABSTRACT

Peanut (*Arachis hypogaea*) acreage in a sixteen county area in the Texas Southern High Plains has increased from less than 20,000 acres to over 130,000 acres from 1987 to 1997. Acreage planted in 1998 has been estimated at 198,000 acres. Current cotton (*Gossypium hirsutum*) and corn (*Zea mays*) prices and the presence of the boll weevil in the Texas High Plains may continue to favor the increased peanut production. Imazethapyr and imazapic, two commonly used herbicides in peanut because they control a broad spectrum of annual broadleaf weeds and have good activity on yellow (*Cyperus esculentus*) and purple (*C. rotundus*) nutsedge, are limited in use because cotton has an 18 month rotation restriction following application. Diclosulam is a new triazolopyrimidine sulfonanilide herbicide for use in peanut and soybeans (*Glycine max*). Diclosulam applied preplant incorporated (PPI) and preemergence (PE) has been reported to have excellent activity on Florida beggarweed *(Desmodium tortuosum*), common cocklebur *(Xanthium strumarium*), tropic croton (*Croton glandulosus* var. *septentrionalis*), eclipta (*Eclipta prostrata*), common lambsquarter (*Chenopodium album*), morningglory (*Ipomoea* spp.), pigweed (*Amaranthus* spp.), common ragweed (*Ambrosia artemisiifolia*) , giant ragweed (*Ambrosia trifida*), and prickly sida (*Sida spinosa*). The objectives of this research were to examine the influence of application timing and method on diclosulam activity and examine the efficacy of diclosulam on various weeds of West Texas. Field experiments were conducted in 1998 at the Texas Agricultural Experiment Station near Lubbock on an Amarillo sandy clay loam soil. In one test, diclosulam at 0.024 lb ai/A was applied PPI, PE, and EPOST. Weed size was 1-4 inches at EPOST. In a second test, diclosulam at 0.024 lb/A was applied 60, 30, 14, and 0 days before planting (DBP). Applications 60 and 30 DBP were made to flat ground and incorporated 2-3 inches using a spring tooth harrow. Applications 14 DBP were made to bedded ground and incorporated 1-2 inches using a rolling cultivator and the 0 DBP application was applied PE. A third test examined diclosulam at 0.016 and 0.024 lb/A applied PPI with and without ethalfluralin at 0.75 lb/A. AT 120 peanuts were planted May 1. Peanut injury and Palmer amaranth (*Amaranthus palmeri*) and devil's-claw (*Proboscidea louisianica*) control were evaluated throughout the growing season. No visual injury was observed following any diclosulam application. Diclosulam at 0.024 lb/A applied PPI or PRE controlled Palmer amaranth 85-93% and devil's-claw 83-97% at the end of the growing season. Diclosulam applied EPOST was less effective. Diclosulam applied 60 and 30 DBP controlled Palmer amaranth 85-93% and devil's-claw 96-100% at the end of the growing season. Diclosulam applied PE was less effective. Diclosulam plus ethalfluralin applied PPI was more effective at controlling Palmer amaranth than diclosulam applied alone; however, diclosulam applied alone controlled devil's-claw as effectively as diclosulam plus ethalfluralim. Diclosulam will be an excellent tool for peanut growers in 2000.

COMPARISON OF S-METOLACHLOR WITH METOLACHLOR FOR YELLOW NUTSEDGE (CYPERUS ESCULENTUS) CONTROL AND PEANUT INJURY AND YIELD. B. A. Besler, W. J. Grichar, R. G. Lemon, K. D. Brewer, and T. A. Hoelewyn. Texas Agricultural Experiment Station, Yoakum, TX 77995 and Texas Agricultural Extension Service, College Station, Texas 77843.

ABSTRACT

S-metolachlor was compared with metolachlor at four field locations in Texas during the 1996 and 1997 growing seasons for yellow nutsedge control, peanut injury, and peanut yield. The locations included south Texas (Lavaca County), central Texas (Comanche County) and the south plains region (Dawson County). Metolachlor use rates were 1.68, 2.24, and 4.48 kg/ha and S-metolachlor use rates were 1.11, 1.48 and 2.22 kg/ha. Both herbicides were applied preplant incorporated (PPI) and preemergence (PRE).

S-metolachlor caused peanut injury comparable to metolachlor when either herbicide was applied PPI or PRE. Yellow nutsedge control was similar with both herbicides, although S-metolachlor was applied 1/2 to 2/3 of the metolachlor rate. At the Lavaca County location in 1996, metolachlor at all three rates applied PPI and PRE controlled yellow nutsedge > 70% and in 1997 > 74%. S-metolachlor applied PPI and PRE at the lower rates controlled yellow nutsedge 58% to 85% in 1996 and 78% to 90% in 1997. At the Comanche County location in 1996, metolachlor at all three rates applied PPI and PRE controlled yellow nutsedge 68% to 85% while S-metolachlor at all three rates applied PPI and PRE controlled yellow nutsedge 71% to 90%.

All metolachlor and S-metolachlor treatments in 1996 at the Comanche County location, and in 1997 at the Lavaca County location, substantially increased yields over the untreated check. However, in Dawson county where yellow nutsedge failed to develop, the untreated check produced the highest yield.

CONTROL OF CITRONMELON (*CITRULLUS LANATUS*) IN PEANUT. W. J. Grichar, K. D. Brewer, and B. A. Besler. Texas Agricultural Experiment Station, Yoakum, TX 77995.

ABSTRACT

Field studies were conducted from 1995 through 1998 to evaluate citronmelon control in peanut (*Arachis hypogaea*) with soil-applied and postemergence (POST) herbicides. Pendimethalin, metolachlor or dimethenamid alone or pendimethalin in combination with imazethapyr, metolachlor or dimethenamid failed to provide citronmelon control (< 70%). Flumioxazen alone or pendimethalin + lactofen provided ≥ 70% early season control. Pendimethalin + lactofen provided ≥ 75% citronmelon control late season. No other soil-applied herbicides provided > 70% control.

With POST herbicides, imazapic early postemergence (EPOST) at 0.07 kg/ha controlled ≥ 90% citronmelon while imazapic late postemergence (LPOST) controlled ≥ 74% when rated early season. Imazapic at 0.04 applied EPOST + LPOST controlled ≥ 93% citronmelon. Imazethapyr control was inconsistent. Lactofen applied EPOST controlled ≥ 82% citronmelon while LPOST applications controlled ≥ 95% early season. Acifluorfen LPOST controlled ≥ 89% citronmelon. EPOST or LPOST applications of imazapic controlled ≥ 85% citronmelon late season. Lactofen EPOST or LPOST controlled 23 to 95% citronmelon late season while acifluorfen controlled 53 to 95% citronmelon late season.

SULFENTRAZONE PERFORMANCE ON KEY WEEDS IN PEANUTS. H. G. Hancock, FMC AgProducts Group, Hamilton, GA 31811.

ABSTRACT

The PPO inhibitor sulfentrazone (F6285), a member of the aryl triazolinone family, was first field tested in 1988. Among other crops, sulfentrazone's field testing in peanuts (*Arachis hypogaea* L.) spans the past ten years. This period encompasses the very early stages of sulfentrazone's development where numerous formulations, application methods and rates, as great as 1 lb ai/a, were evaluated as a function of soil type and organic matter (OM). The greatest proportion of this research examined sulfentrazone rates in the range of 0.25 to 0.375 lb ai/a in >60 replicated field trials across the peanut growing regions of the US. However, more recent research efforts have focused on rates £ 0.25 lb ai/a, PPI and PRE.

Sulfentrazone's activity, across the reduced rate range, was considered using the current (1998) Southern Weed Science Society's Southern States Peanut Weed Survey as a benchmark. The predominant weeds reported in this survey were the nutsedges, morningglories, and pigweeds. Other key weeds in various states and regions included prickly sida (*Sida spinosa* L.), sicklepod (*Senna obtusifolia* L.), Florida beggarweed (*Desmodium tortuosum* (Swartz) DC) and eclipta (*Eclipta prostrata* L.) among others.

Among the pigweeds, sulfentrazone produced >90% control of Palmer amaranth (*Amaranthus palmeri* S. Wats.), redroot pigweed (*A. retroflexus* L.), and waterhemp (*A. rudis* L.) at 0.125 lb ai/a. Spleen amaranth (*A. rudis* L.) control was 91% at 0.063 lb ai/a. Excellent control (90%) of ivyleaf morningglory (*Ipomoea hederacea* (L.) Jacq.) was obtained at 0.125 lb ai/a. The high levels of control (99 and 94%, respectively) for entireleaf (*I. hederacea* var. *integriuscaula*) and pitted (*I. lacunosa* L.) morningglories, at 0.25 lb ai/a, suggests that further rate reductions may be possible for these species as well. Current results for Florida beggarweed, prickly sida and cocklebur (*Xanthium strumarium* L.) indicates that the optimum sulfentrazone use rate may be in the 0.1875 to 0.25 lb ai/a range. Good to excellent control of lambsquarters (*Chenopodium album* L.), tropic croton (*Croton glandulosus* var. *septentrionalis* Muell. Arg.), eclipta and prostrate spurge (*Euphorbia humistrata* L.) was reported at 0.125 lb ai/a, the lowest rate tested on these species. The high level of control (94%) for yellow nutsedge (*Cyperus esculentus* L.) at 0.25 lb ai/a suggests that sulfentrazone rate may be reduced here as well. Sulfentrazone's performance on these and other key weeds either met or exceeded that observed for imazapic (0.063 lb ai/a, Post), diclosulam (0.024 lb ai/a, PPI or PRE) and flumioxazin (>0.063 lb ai/a, PPI).

Since the majority of all sulfentrazone peanut research has been recorded in coarse soils with £ 1.5% organic matter (typical of peanut areas), the use of these soil parameters as determinants of sulfentrazone application rate has been diminished. Instead, the current approach, if successful, will allow rate selection based on weed spectrum. This will certainly give the grower greater flexibility in controlling key peanut weeds.

WEED CONTROL IN PEANUT WITH DICLOSULAM AND FLUMIOXAZIN. W. A. Bailey, J. W. Wilcut, S. D. Askew, and G. H. Scott, Crop Science Department, North Carolina State University, Raleigh, NC 27695-7620.

ABSTRACT

Field studies were conducted in Rocky Mount and Lewiston, NC in 1998 to evaluate and compare diclosulam (Strongarm) and flumioxazin (Valor) systems for weed control, peanut tolerance, and peanut yield. Peanut cultivars used were 'NC 7' and 'NC 10C.' Dual II was applied PPI at 1.27 lb ai/A to all plots. Strongarm and Valor were applied PRE at 0.024 lb ai/A and 0.078 lb ai/A, respectively, and were followed by (fb): 1) nothing, 2) Storm (0.75 lb ai/A) POST, or 3) Starfire (0.13 lb ai/A) plus Basagran (0.25 lb ai/A) EPOST fb Storm (0.75 lb/A) POST. POST-only systems included: 1) nothing, 2) Storm POST, or 3) Starfire plus Basagran EPOST fb Storm POST. All POST herbicides were applied with NIS at 0.25% (v/v) in a volume of 15 GPA at 18 psi.

Dual II alone controlled yellow nutsedge (*Cyperus esculentus*) as well or better than all other systems but did not provide adequate control of other evaluated weed species. Since Dual II provided good control of yellow nutsedge and was applied to all plots, control of this weed was generally similar for Strongarm and Valor systems. Starfire plus Basagran EPOST fb Storm POST controlled spurred anoda (*Anoda cristata*), prickly sida (*Sida spinosa*), entireleaf morningglory (*Ipomoea hederacea* var. *integriuscula*), and common lambsquarters (*Chenopodium album*) as well as all Strongarm and Valor systems. Dual II plus Valor alone controlled spurred anoda 70% compared to 42% control with Dual II plus Strongarm alone. Strongarm and Valor systems provided equivalent control of prickly sida and common ragweed (*Ambrosia artemisiifolia*). Dual II plus Valor controlled common lambsquarters 100% compared to 83% control with Dual II plus Strongarm. Dual II plus Valor controlled entireleaf morningglory 82% compared to 70% control with Dual II plus Strongarm.

Peanut injury from all herbicide systems was minor (<12%). All systems provided yields that were higher than Dual PPI alone (2090 lb/A). All Strongarm and Valor systems provided higher yields than systems that did not include a preemergence herbicide. Peanut yields were similar for Strongarm and Valor systems.

INFLUENCE OF IN-FURROW THRIPS INSECTICIDES ON RESPONSE OF PEANUT TO BENTAZON AND ACIFLUORFEN. C. W. Swann and D. A. Herbert, Jr., Tidewater Agric. Res. and Ext, Center, Suffolk, VA 23437.

ABSTRACT

NC-V 11 peanut grown with and without in-furrow (IF) insecticide application were treated with postemergence (PO) herbicides. In-furrow insecticide treatments were: none, aldicarb, phorate, disulfoton, and acephate at 0, 1.18, 1.13, 1.13 and 0.63 kg ai per ha, respectively. Postemergence herbicide treatments were: none, bentazone (0.84 kg ai per ha) 31 and 42 days after planting (DAP) and acifluorfen (0.28 kg ai per ha) or acifluorfen + bentazon (0.28 kg + 0.56 kg per ha) 31 and 49 DAP. A crop oil concentrate at 2.33 L per ha was applied with all herbicide treatments. All plots were maintained weed-free by hand weeding. Peanut growth was visually evaluated 50, 60 and 80 DAP as percent growth relative to plots receiving aldicarb IF and no PO herbicide. Across all PO herbicide treatments, significant peanut growth reduction occurred in plots with no IF insecticide treatment and for phorate, disulfoton and acephate treated plots relative to aldicarb treated plots. Yield of peanut across all PO herbicide treatments was significantly lower for plots without IF insecticide treatment than for plots treated with any of the IF insecticides. Yield of peanut across all IF insecticide treatments was significantly lower for plots treated with sequential PO applications of acifluorfen and acifluorfen + bentazon than for plots without PO herbicide treatment for plots treated with sequential applications of bentazon. These data indicates that recommendations for use of sequential pesticide application to peanut may require revision to avoid deleterious impact on yield.

EVALUATION OF PEANUT HERB IN NORTH CAROLINA. J. W. Wilcut, G. H. Scott, and S. D. Askew, North Carolina State University, Raleigh, NC 27695-7620.

ABSTRACT

Experiments were initiated at Lewiston and Rocky Mount, NC to evaluate weed control, peanut response, and yield to weed management systems that used only soil-applied herbicides, postemergence herbicides, or a combination of soil and postemergence herbicides. Furthermore, the study evaluated standard postemergence herbicide treatments versus postemergence herbicide treatments selected by Peanut HERB, a decision aid program developed by the University of Georgia, the University of Florida, and North Carolina State University.

The experimental design was a randomized complete block with a factorial arrangement of soil-applied herbicide options and postemergence herbicide options providing a total of 21 weed management systems. The soil-applied options included 1) none, 2) metolachlor preplant incorporated (PPI) at 1.27 lb ai/ac, 3) ethalfluralin PPI at 0.75 lb ai/ac, 4) metolachlor PPI followed by (fb) flumioxazin preemergence (PRE) at 0.078 lb ai/ac, 5) metolachlor PPI fb diclosulam at 0.024 lb ai/ac PRE, 6) ethalfluralin PPI fb diclosulam PRE, or 7) ethalfluralin PPI fb flumioxazin PRE. The postemergence options included 1) none, 2) paraquat at 0.125 lb ai/ac plus bentazon at 0.25 lb ai/ac early postemergence (EPOST) fb a prepackaged mixture of acifluorfen at 0.25 lb ai/ac plus bentazon at 0.5 lb/ac applied postemergence (POST), or 3) a postemergence program selected by Peanut HERB. The EPOST treatment was applied 7 to 10 days before POST treatments were made. All postemergence treatments included a non-ionic surfactant at 0.25% (v/v). All postemergence treatments selected by Peanut HERB used either a non-ionic surfactant or crop oil concentrate at 1.0% (v/v) as required on the respective herbicide labels.

Peanut injury was less than 10% early season from all soil-applied herbicide programs. Metolachlor based systems provided better yellow nutsedge control than ethalfluralin based systems. Yellow nutsedge control with metolachlor was not further improved with PRE or postemergence herbicides. Ethalfluralin controlled common lambsquarters 100% compared to 71% control with metolachlor at Rocky Mount. The additions of flumioxazin PRE or diclosulam PRE to metolachlor PPI or ethalfluralin PPI improved control of common ragweed, ivyleaf morningglory, spurred anoda, prickly sida, and entireleaf morningglory. For the most part, weed control between the sequential standard postemergence system of paraquat plus bentazon EPOST fb acifluorfen plus bentazon POST was comparable to that obtained with Peanut HERB. When only metolachlor or ethalfluralin were applied PPI, Peanut HERB tended to outperform the standard postemergence system. Metolachlor PPI or ethalfluralin PPI alone failed to provide high peanut yields. However, the addition of diclosulam PRE or flumioxazin PRE to either herbicide provided high peanut yields, which were not further improved with any additional postemergence input. When no soil applied herbicides were used, peanut yields were higher with a total postemergence system selected by Peanut HERB than with paraquat plus bentazon EPOST fb acifluorfen plus bentazon POST.

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

Common bermudagrass is the most serious weed for Southern U.S. sod producers. A study was conducted to evaluate the effectiveness of Envoy 0.94EC (clethodim) for bermudagrass control and centipedegrass tolerance. The investigaton occurred on a commercial sod operation in Neeses, South Carolina. Eight separate treatments were applied to 10 x 10 ft strips of centipedegrass naturally infested with bermudagrass. Four 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. Plots were rated bi-weekly beginning two weeks after the initial application. Treatments with Vantage (sethoxydim) alone, Envoy (with Dash surfactant), Envoy (with Optima surfactant), were applied to the randomized plots at different rates and application times. Treatments were applied using a CO_2 backpack sprayer calibrated at 20 gal/ac and fitted with 8003 flat fan tips. Two applications were made, the first on June 10, 1998, the second on July 10, 1998.

Two weeks after the initial treatments, there was minimal turf injury (<8%) with best bermudagrass control (70%) for Envoy at 68.0 oz/ac. Vantage at 2.25 pt/ac controlled approximately 15% of the bermudagrass with <5% injury to the centipedegrass. Envoy had no injury to centipedegrass at either 17.0 oz/ac rate or at 34.0 oz/ac plus Optima surfactant. Minor injury (< 8%) was observed for all other applications of Envoy. Bermudagrass control was significantly higher at this time using Envoy with either surfactant as compared to the industry standard Vantage.

At four weeks after the first application (July 10), no visible injury to the centipedegrass existed for any treatment. Vantage provided 35% control, 17.0 oz/ac Envoy with Optima or Dash provided 40-50% control, 34.0 oz/ac Envoy + Optima 43% control, 34.0 oz/ac Envoy + Dash 85% control, 68.0 oz/ac Envoy + Optima 59% control, and 68.0 oz/ac Envoy + Dash 74% control.

At six weeks after initial application, each treatment averaged 25% increase in bermudagrass control while centipedegrass injury remained low (<13%). Best treatment was 34.0 oz/ac of Envoy + Dash, with >90% control of bermuda and <5% injury to centipede. Envoy + Dash at 68 oz/ac had 90% control and 13% turf injury. Vantage provided 76% control and <2% injury at this time.

By eight weeks after initial application, centipedegrass injury was minimal for all treatments. Bermudagrass control at this time for 17oz/ac Envoy + Optima was at 44% control. Vantage, 17 oz/ac Envoy + Dash, and 34 oz/ac Envoy + Optima was at 80-90% control; 34 oz/ac Envoy + Dash, 68 oz/ac Envoy + Optima, and 68 oz/ac Envoy + Dash was at >95% control.

In conclusion, Envoy treatments using two different adjuvants, were effective for bermudagrass control and centipedegrass tolerance. Overall best treatments were two applications of Envoy (with Dash surfactant) at rates of 34.0 oz/ac or 68.0 oz/ac each. Although the 68 oz/ac rate did experience minor centipede injury, the turf recovered within 4 weeks. Envoy proved to be slightly more effective than Vantage at 2.25 pt/ac, which had previously been the industry standard for bermudagrass control.

Future experimentation includes a cost analysis for the most effective and economical application rates of Envoy, and best Envoy + Adjuvant ratio to obtain best bermudagrass control with least centipedegrass injury.

REGULATION OF 'TIFWAY' BERMUDAGRASS GROWTH AND DEVELOPMENT WITH TRINEXAPAC-ETHYL AND PACLOBUTRAZOL. M. J. Fagerness and F. H. Yelverton, Crop Science Department, North Carolina State University, Raleigh, NC 27695-7620.

ABSTRACT

Trinexapac-ethyl (TE) and paclobutrazol (PB) are common gibberellin-inhibiting plant growth regulators (PGRs) which may be used for bermudagrass growth management. While the effects of these compounds on biomass production and turfgrass quality have been investigated, little is known about their impact on lateral development of aggressive species such as bermudagrasses. This new information, therefore, may prove useful to turfgrass managers who use PGRs, especially during bermudagrass establishment. An experiment was established in the summer of 1998 in the greenhouse

to investigate the impact of TE and PB on lateral development of ‘Tifway’ bermudagrass. 79 cm^2 cores of mature ‘Tifway’ sod were imported from the field and established in 415 cm^2 pots. Turf was maintained at a 2 cm cutting height, received 12 kg N/ha/week, and was subirrigated throughout the experiment. Treatments included TE 1 EC and PB 2 SC (0.11 kg a.i./ha and 0.56 kg a.i./ha, respectively), applied once, twice or three times during the course of the experiment. Sequential applications were made at four week intervals. Measured growth parameters included biomass production, shoot density, stolon number, stolon length, and core area and were measured weekly for twelve weeks following initial PGR applications. Additionally, root and stolon biomass were measured at the conclusion of the experiment. The experiment was a randomized complete block design with four replications. PB, in five of six weeks where differences between PGRs were detected, was more inhibitory to biomass production than was TE. Beyond five weeks after initial treatment (WAIT), biomass production in turf treated with sequential applications of either PGR was inhibited to a greater extent than that treated with only a single application. Shoot density was enhanced, as much as 50%, by either PGR for the duration of the experiment. Detectable differences between PGR or application frequency effects on shoot density were only evident 8 WAIT or later, suggesting positive long-term effects of continuous PGR use, especially with PB. Stolon length was reduced by PB but the persistence of this effect was dependent on sequential applications; TE had little effect on stolon length. Stolon length, as affected by continuous PB use, was reduced by 70% 12 WAIT. Three applications of PB resulted in increased stolon counts (~60%) 7 WAIT but these stolon counts declined rapidly beyond 7 WAIT as stolons became incorporated into the turfgrass canopy; stolon counts were 50% of those for the nontreated by 12 WAIT. TE had little impact on stolon counts throughout the experiment. The impact of stolons incorporating into the turfgrass canopy beyond 7 WAIT with continuous PB use was reflected by increased core area over the same time frame. By the time the experiment concluded, two or three applications of PB resulted in cores that covered 60% and 75% of the pot area, respectively, while nontreated or TE-treated cores covered 50% or less of the same area. Assessment of root and stolon biomass at the conclusion of the experiment showed no impact of PGRs on these growth parameters. Results suggested that multiple applications of PB dramatically impact lateral development of ‘Tifway’ bermudagrass, to the point where this PGR may be a useful tool during bermudagrass establishment. TE had a lesser impact on lateral growth and development than did PB.

WEED CONTROL IN WARM-SEASON TURFGRASS WITH QUINCLORAC. S. T. Kelly and G. E. Coats. Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Field experiments were conducted in 1997 and 1998 to evaluate quinclorac for weed control in warm-season turfgrass. These experiments included: evaluating the effect of additives on efficacy of quinclorac on southern crabgrass [*Digitaria ciliaris* (Retz.) Koel.], the effect of tank-mixing quinclorac with BAS 635 00H, PRE control of southern crabgrass, or POST control of southern crabgrass with dithiopyr + quinclorac combinations.

Quiclorac (0.5 lb ai/A) was evaluated in combination with: BAS 0902S, BAS 904 07S, BAS 904 08S, BAS 904 09S, Sunit II, Frigate, Dyne-Amic, or Tween 80. These treatments were compared to a split application of MSMA (1.5 lb ai/A followed by 1.5 lb/A 7 days after the initial treatment [DAIT]). Data collected at 21 DAIT indicated that all additives had a similar effect on quinclorac efficacy on southern crabgrass. Southern crabgrass control at 35 DAIT was 18 to 43% with quinclorac while the MSMA standard controlled crabgrass 68%.

BAS 635 00H (0.036, 0.044, or 0.054 lb ai/A) was evaluated in combination with quinclorac (0.5 lb/A) or 2,4-D (1.0 lb ae/A) on dandelion (*Taraxacum officinale* Weber in Wiggers), Virginia buttonweed (*Diodia virginiana* L.) and lawn burweed [*Soliva pterosperma* (Juss.) Less.]. BAS 635 00H alone controlled dandelion less than 60% at 33 days after treatment (DAT). Both quinclorac and 2,4-D controlled dandelion at least 85%. Virginia buttonweed control was less than 15% with BAS 635 00H alone, 53% with quinclorac alone and 80% with 2,4-D. Lawn burweed control was 25% or less with any herbicide or combination except 0.054 lb/A BAS 635 00H (60%). Combining BAS 635 00H with quinclorac or 2,4-D did not increase control of these weed species over either herbicide alone.

A combination of 0.38 lb ai/A dithiopyr + 1.5 lb/A quinclorac on a fertilizer granule (18-2-7, N-P-K) was applied to southern crabgrass at 2 to 3-leaf or 2 to 4-tiller growth stages and compared to 0.38 lb/A dithiopyr on fertilizer carrier (40-0-0, N-P-K) or a split application of MSMA as mentioned previously. When applied to 2 to 3-leaf southern crabgrass, dithiopyr alone or two applications of MSMA provided at least 80% control. However, if applied to 2 to 4-tiller southern crabgrass, the dithiopyr + quinclorac combination controlled southern crabgrass equivalent to two applications of MSMA.

Two formulations of quiclorac (75 DF or 0.57 G) were evaluated for PRE efficacy on southern crabgrass. Both formulations were evaluated at 0.5 or 0.75 lb/A and compared to 1.5 lb ai/A pendimethalin. Treatments were applied prior to southern crabgrass emergence and evaluated through mid September. From 77 to 160 DAT, either formulation of quinclorac controlled southern crabgrass equivalent to the pendimethalin standard.

ANNUAL BLUEGRASS (*Poa annua*) CONTROL AND OVERSEEDED GRASS ESTABLISHMENT FOLLOWING PESTICIDE USE. B. T. Bunnell, F. C. Waltz, J. K. Higingbottom, and L. B. McCarty. Clemson University, Department of Horticulture, Clemson, SC. 29634-0375.

ABSTRACT

Annual bluegrass (*Poa annua*) control in overseeded turf poses a long-term challenge to turfgrass managers. It's tufted growth habit, non-uniform color and noxious seedhead production reduces the overall quality of highly maintained turfgrass arenas such as golf greens. Traditionally, selectively controlling Poa annua in other cool-season grasses has been elusive. The objective of this research was to provide control of *Poa annua* while allowing establishment of overseeded grasses following a variety of pesticide applications at various rates and timings.

Three studies were performed in 1996, 1997, and 1998 in central SC on overseeded 'Tifdwarf' bermudagrass (*Cynodon dactylon x transvaalensis 'Tifdwarf'*) golf greens. The 1996 and 1997 studies determined the efficacy of pre and postemergence applications for season long control of *Poa annua* and establishment of perennial ryegrass (*Lolium perenne*). Herbicide treatments included Kerb 50 WP (pronamide), Rubigan 1 AS and Patchwork 0.008 G (fenarimol), Ronstar 2G (oxidiazon), Prograss 1 EC (ethofumesate), Turf Enhancer 2 SC (paclobutrozol), Primo 1 EC (trinexapac-ethyl), and Dimension 1 EC (dithiopyr) with varying rates and application times. The 1998 study observed the effect of DMI (Demethylation Inhibitors) or sterol-inhibiting fungicides on germination and establishment of rough bluegrass (*Poa trivialis*). Treatments included Rubigan 1AS, Eagle 40 WSP (myclobutanil), Banner 1.1 EC (propiconazole), Sentinel 40 WG (cyproconazole), and combinations of Turf Enhancer with Sentinel and Eagle at varying rates and timings.

Visual ratings were taken monthly except in 1998, when two ratings were taken in early and late December. *Poa annua* control and overseeded grass cover and injury was rated on a 0-100% scale with 0%=worst and 100%=best. Minimum acceptable *Poa annua* control and overseeded grass cover was 70%, and maximum acceptable overseeded grass injury was 30%.

The 1996 study showed best (>90%) long-term *Poa annua* control through April with Ronstar 2G (2.0 lbs ai/A) applied 45 DBO (Days Before Overseeding) and sequential applications of Prograss (1.5 lbs ai/A) in November and December. Prograss showed unacceptable (>30%) perennial ryegrass injury in February, however full recovery occurred by April. No significant turf injury was seen with other treatments.

Best control (>90%) in 1997 followed Rubigan (0.375 lbs ai/A) applied 30, 15 DBO plus December (0.125 lbs ai/A), sequential applications of Prograss (1.5 lbs ai/A) in November plus December, and Dimension (0.25 lbs ai/A) applied 60, 30, 15 DBO, plus February. Good control (80-90%) followed applications of Ronstar 2G (2.0 lbs ai/A) 45 DBO, Patchwork 30, 15 DBO (1.75 lbs ai/A), plus December (0.70 lbs ai/A), and sequential applications of Dimension (0.5 lbs ai/A) 50 DBO plus February. Turf Enhancer (0.25 lbs ai/A) applied monthly from December through March provided good (. 80%) control in February, but only 30% control in April. Acceptable (>70%) perennial ryegrass cover followed December ratings of Rubigan, Kerb, Turf Enhancer, Primo, sequential applications of Dimension, and Patchwork.

The 1998 DMI study showed acceptable (>70%) *Poa trivialis* cover with Rubigan and Banner applied at 0.375 lbs ai/A 45, 30 DBO, plus December at 0.125 lbs ai/A. Eagle provided acceptable cover in the second December rating. Tank mixes of Sentinel and Eagle with Turf Enhancer provided poor (<40%) *Poa trivialis* cover in both December ratings. No differences were seen in *Poa trivialis* germination. Ratings will continue through spring 1999.

Research will continue on long-term *Poa annua* control with varying pesticide combinations, timings, and rates. DMI fungicides and sulfonylurea herbicides may potentially open new avenues of *Poa annua* control in overseeded turf. Additionally, improvements in establishment of overseeded turf species are necessary by adjusting seeding rates and dates.

TANK MIXING ENVOY (CLETHODIM) AND REWARD (DIQUAT) FOR POSTEMERGENCE ANNUAL BLUEGRASS (*Poa annua)* CONTROL. J. K. Higingbottom, L. B. McCarty, and B. T. Bunnell; Clemson University, Horticulture Department, Clemson SC.

ABSTRACT

Annual bluegrass (*Poa annua)* is one of the most common winter annual, grass weeds in dormant bermudagrass (*Cynodon dactylon)*. It predominately germinates in the fall and produces undesirable seedheads throughout the winter and spring months. The objective of our research was to determine the efficacy of different herbicides and tank mixes in controlling established *Poa annua* in dormant bermudagrass.

Research was conducted on a dormant common bermudagrass rough infested in mature, annual bluegrass located in Pendleton, SC. Treatments were applied with a CO_2 backpack sprayer calibrated at 30 GPA with 8003 flat fan tips. Plots were 5 ft. by 10 ft. using a randomized complete block experimental design replicated 3 times. All treatments were applied on February 5, 1998. *Poa annua* was rated for percent burn for the first week and percent control for subsequent weeks on a 0-100% scale while bermudagrass was rated for percent green-up.

Singular treatments included atrazine (1.0 lb ai/A), diquat (2.0 pt/A) + Optima surfactant (0.25 % v/v), clethodim (34.0 oz/A) + Dash crop oil (1.0 % v/v), clethodim (34.0) + Optima surfactant (0.25), glyphosate (0.5 lb ai/A), and glufosinate (6.0 qt/A). Tank mix treatments were clethodim (34.0) + diquat (0.5); glyphosate (0.5) + diquat (0.5), glyphosate (0.5) + clethodim (34.0), glyphosate (0.5) + glufosinate (6.0), and glufosinate (6.0) + clethodim (34.0). Clethodim tank mixes contained Optima surfactant at 0.25 % v/v except for those with glyphosate .

Diquat treatments provided quick burn-down (60%) within three days after treatment. At 1 WAT (week after treatment), diquat plus clethodim had 83% burn followed by diquat alone and diquat + glyphosate at . 72% burn. Excellent control (95%) followed the application of diquat + clethodim at 3 WAT. Additionally at 3 WAT, the glufosinate treatments provided significant control (. 70%). By 5 WAT, treatments containing glufosinate and diquat + clethodim showed 95% control while diquat and diquat + glyphosate started declining in control.

Excellent residual control ($98%) followed diquat + clethodim and all glufosinate treatments at 7 WAT. Clethodim alone provided . 70% control. Glyphosate and glyphosate + clethodim first exhibited acceptable control (. 80%) at 7 WAT. Clethodim alone, diquat + clethodim, and all treatments with glufosinate all had 100% control by 9 WAT. Glyphosate provided 82% control at 9 WAT, which was considerably, less than the treatments listed above.

Significant differences in green-up at 9 WAT were not noted except for the clethodim + Dash treatment which had 13% green-up compared to 20% for the untreated. By 12 WAT green-up was unaffected among any treatments.

For quick and long lasting *Poa annua* control, the diquat + clethodim tank mix had the best overall results followed by the glufosinate treatments, which showed similar control but took slightly longer to achieve. Atrazine, a standard product, never attained greater than 58% control.

ROOTING OF CREEPING BENTGRASS IN RESPONSE TO PLANT GROWTH REGULATORS AND PREEMERGENCE HERBICIDES. H. D. Cummings, F. H. Yelverton, And T. W. Rufty Jr., 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. Preemergence (PRE) herbicides like dithiopyr and bensulide + oxadiazon may be applied in the spring to control goosegrass (*Eleusine indica*) and crabgrass (*Digitaria sp.*). Plant growth regulators (PGRs) like paclobutrazol and paclobutrazol + cyproconazole (fungicide with PGR properties) may be applied in the spring and fall to control annual bluegrass (*Poa annua ssp. annua*). Trinexapac-ethyl is a PGR which may be applied in the spring and fall for creeping bentgrass growth management. Using PRE herbicides, which inhibit cell division at the growing points, or PGRs, which inhibit cell division and cell elongation, may impact creeping bentgrass rooting during its maximum growth 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 PGRs and PRE herbicides on root biomass production and lateral recovery of creeping bentgrass and to determine if these treatments affect the ability of creeping bentgrass to survive the stress of summer in NC. The experiment was conducted using a randomized complete block design with 4 replications on established ‘Penncross’ creeping bentgrass, maintained at 4 mm at the Sandhills Research Station near Pinehurst, NC. The PRE herbicides were applied using a shaker can on April 8, 1998 at the following rates: dithiopyr (1 EC) at 0.56 kg ai/ha and bensulide + oxadiazon (6.56 G) at 6.7 and 1.7 kg ai/ha, respectively. PGRs were applied using a CO_2 backpack sprayer once a month beginning on April 8, 1998 at the following rates: trinexapac-ethyl (1 EC) at 0.06 kg ai/ha or at 0.12 kg ai/ha, paclobutrazol (2 SC) at 0.28 kg ai/ha, and paclobutrazol (2 SC) + cyproconazole (40 WG) at 0.28 kg ai/ha + 1.0 kg ai/ha, respectively. Cyproconazole was applied two weeks after paclobutrazol. Every month, two soil cores (10 cm in diameter x 15 cm in length) were collected from each plot using a standard golf cup cutter. The soil was washed away using a sift, and the roots were dried in a drying oven. The root dry weights were determined, and the samples were placed in a muffle furnace for 12 hours at 500 °C. The organic weight of the roots was determined by subtracting the ash weight from the dry weight. Lateral growth of the creeping bentgrass into each cup cutting was measured every two weeks until complete closure with a 15 cm ruler. Diameter measurements were made in three directions from crown to crown (growing point to growing point). The results of the root biomass measurements indicated that neither preemergence herbicides nor plant growth regulators inhibited the ability of ‘Penncross’ creeping bentgrass to produce root biomass. The results of lateral recovery measurements indicated that while neither preemergence herbicides nor trinexapac-ethyl inhibited the ability of ‘Penncross’ creeping bentgrass to spread laterally during the summer months, paclobutrazol + cyproconazole did inhibit this form of growth. Paclobutrazol, compared to trinexapac-ethyl at 0.12 kg ai/ha, also inhibited the ability of ‘Penncross’ creeping bentgrass to spread laterally during the summer months; however, neither of these treatments were significantly different from the non-treated.

NEW APPROACHES TO MANAGEMENT OF ANNUAL BLUEGRASS IN BENTGRASS PUTTING GREENS.
F. H. Yelverton, J. Isgrigg III, and J. Hinton, Crop Science Department, North Carolina State University, Raleigh, NC 27695-7620.

ABSTRACT

Perennial and annual biotypes of annual bluegrass (*Poa annua ssp. reptans & annua*) continues to be the most troublesome weed in bentgrass putting greens in the US. Management strategies to remove or reduce this weed in putting greens have been only marginally successful. This is due to poor control or unacceptable bentgrass turf quality. Plant growth regulators (PGRs) that cause a temporary inhibition of the gibberellin biosynthesis pathway have been shown to reduce the perennial biotypes of annual bluegrass if used repeatedly overtime. Research on the effects of these PGRs on the annual biotypes has not been sufficiently studied. Research trials were initiated on several golf course putting greens in NC with high populations of the annual biotypes of annual bluegrass. PGRs utilized include paclobutrazol, flurprimidol, and trinexapac-ethyl. Also included were the herbicides dithiopyr and ethofumesate. Rates of paclobutrazol ranged from 0.28 to 0.56 kg ai/ha. Flurprimidol was tested at 0.28 kg ai/ha and trinexapac-ethyl was utilized at 0.05 to 0.1 kg ai/ha. PRG applications were initiated in mid-October and applied at 4 wk intervals until bentgrass growth slowed in the winter months. Treatments were re-initiated in late February to early March when bentgrass began actively growing and were repeated at 4 wk intervals and ceased in late April to early May. All totaled, PGR applications numbered 4 to 6 applications for fall + spring. Dithiopyr was applied in mid-October only at 0.56 kg ai/ha. Ethofumesate were applied at 0.56 kg ai/ha in mid-October and again 3 wk later. Paclobutrazol was the most effective treatment in reducing annual bluegrass. Control ranged from 50% with 0.28 kg ai/ha to > 85% with 0.56 kg ai/ha. Flurprimidol was less effective with control ranging from approximately 10% to 40%. Trinexapac-ethyl was not effective in reducing annual bluegrass at any of the sites. Acceptable turf quality was obtained with all PGR applications; however, the 0.56 kg ai/ha rate of paclobutrazol resulted in lower turf quality than other treatments. Dithopyr or ethofumesate were also ineffective in reducing annual bluegrass populations in these studies . Greenhouse studies were also conducted to determine the effects of paclobutrazol or flurprimidol on germination and growth of annual bluegrass and bentgrass when applied 3, 2, and 1 wk prior to planting, at planting, and 1, 2, and 3 wk after planting of both species. As was observed in field studies, paclobutrazol was the most phytotoxic to annual bluegrass seedlings. Paclobutrazol also inhibited bentgrass growth when applied 2 wk or less prior to seeding or less than 2 wk after seeding. This indicates that an application interval of at least 2 wk should be observed when overseeding of bentgrass into existing putting greens. This was not observed with trinexapac-ethyl

EVALUATION OF A SUSPECTED DNA RESISTANT BIOTYPE OF ANNUAL BLUEGRASS *(POA ANNUA L.).* J. Isgrigg III and F. H. Yelverton, Crop Science Department, North Carolina State University, Raleigh, NC 27695.

ABSTRACT

Growth chamber studies were conducted in 1998 to evaluate suspected resistance of an annual bluegrass biotype to dinitroaniline (DNA) herbicides. After a 21 day period of growth, suspected resistant and known susceptible annual bluegrass biotypes were evaluated for root and shoot growth as affected by treatment with solutions containing varying concentrations of prodiamine, pendimethalin, oxadiazon, and pronamide.

Seed was counted at 20 each and placed in 65 x15 mm round petri dishes between 2 discs of Watmann #1 filter paper. Herbicide solutions were prepared using deionized water and concentrations ranged from 1:M to 0.1M and 20 ml of this solution was pipetted onto the filter paper containing the seed. The prepared petri dishes were placed into a growth chamber maintained at 20ºC with a 14 hour light period. The filter paper was kept moist with the addition of 2.5 ml deionized water twice weekly. Seed was allowed to grow for 21 days then roots and shoots were separated and measured. Treatments were arranged as a factorial with checks and 4 replications. The experiment was repeated. Observed I_{80} values were calculated subjected to ANOVA using the General Linear Model procedure. Means were separated using the Fishers' Protected LSD procedure. Predicted dose-response curves were developed using non-linear regression with shoot data being fitted to a Gompertz model while root data were fitted to a Logistic model.

Biotype response to oxadiazon concentration was similar for shoot growth inhibition with an I_{80} R/S ratio of 1. Root growth response indicates the resistant biotype is more sensitive to oxadiazon compared to the susceptible biotype with an I_{80} R/S ratio of 0.6. Pronamide inhibited growth parameters of both species >90% at any rate tested. The resistant biotype was less sensitive to pendimethalin with I_{80} R/S ratios of 2.3 for shoot growth and 2.7 for root growth. Resistance to DNA herbicides was more pronounced with respect to prodiamine sensitivity with I_{80} R/S ratios for shoot and root growth at 105 and 12.7 respectively. Predicted dose-response curves were consistent with other research on DNA resistant goosegrass [*Eleusine indica* (L.) Gaertin.] with > than a two fold tolerance to DNA herbicides with increased sensitivity to herbicides with other modes of action. R^2 values were significant for all fitted dose-response curves.

These data indicate pronamide and oxadiazon can be effectively used in weed management programs for control of DNA resistant populations of annual bluegrass.

TEMPERATURE, LIGHT AND NITRATE INFLUENCE SEED GERMINATION OF GREEN KYLLINGA (*KYLLINGA BREVIFOLIA*), COCK'S COMB KYLLINGA (*K. SQUAMULATA*) AND TUFTED KYLLINGA (*K. PUMILA*). D. B. Lowe, T. Whitwell and L. B. McCarty, Department of Horticulture, Clemson University, Clemson, SC 29634-0375.

ABSTRACT

Kyllinga species are becoming increasingly prevalent in turfgrass sites throughout North America. Developing effective, long-term weed management strategies requires knowledge of the weed's biology; therefore, parameters affecting weed seed germination should be studied. Three separate studies were performed to determine the effects of nitrate, temperature and light on green kyllinga, cock's-comb kyllinga and tufted kyllinga seed germination.

Seeds were collected locally and surface sterilized (20% chlorox) for 10 minutes, rinsed, dried and stored at 24 C. For all studies, 50 seeds of each species were placed into 50 mm petri dishes and irrigated with 2 ml of deionized water. Pads were kept moist throughout the 8-week studies. Germination was counted weekly and seedlings discarded upon radicle emergence. Experimental design for each study was a randomized complete block using 4 repetitions. ANOVA was utilized and means separated using LSD (*P*=0.05).

Nitrate studies were performed in growth chambers maintained at constant temperature (25 C) and low light levels (12 hours/day at 12 :mol m^2 sec^{-1}). Nitrate concentrations (0, 50, 200 and 400 mg L^{-1}) were derived using potassium nitrate and deionized water. Temperature studies were performed in growth chambers maintained at 200 :mol m^2 sec^{-1} light. Temperatures alternated daily and treatments included 33/24, 25/17, 19 C day/11 C night temperatures. A subsequent temperature study was performed based upon results from the first study. The effects of constant temperature (25 C) versus diurnally alternating temperatures (25 C day/15 C night) were evaluated. The influence of light on *Kyllinga* seed germination was also investigated in growth chambers (12 hours/day at 12 :mol m^2 sec^{-1}). Seed dishes were either left

uncovered or covered with aluminum foil for 4 weeks. Foil was removed at 4 weeks and dishes remained in the growth chamber for an additional 2 weeks for subsequent rating.

Nitrate did not influence *Kyllinga* seed germination but seedlings treated with nitrate were larger and greener at each rating than those placed in deionized water alone. Maximum green kyllinga germination (95%) occurred at 2 weeks but cock's-comb kyllinga seeds required 5 weeks for 95% seed germination. Minimal (<10%) tufted kyllinga seed germination occurred throughout the study.

Increasing temperature promoted *Kyllinga* germination percentage and rate. More than 90% green kyllinga seeds germinated in all temperatures; however, maximum germination occurred at 2, 3 and 5 weeks in 33/24, 25/17 and 19 C day/ 11 C night temperatures, respectively. Tufted kyllinga germination was statistically similar to green kyllinga in 33/24 C (89%) and 25/17 C (88%) but only 60% tufted kyllinga seeds germinated in 19/11 C by 8 weeks. Cock's-comb kyllinga germination was also similar to green kyllinga and tufted kyllinga in 33/24 C (87%), but was less than the other species in 25/17 C (74%) and 19/11 C (38%) by 8 weeks. Furthermore, cock's-comb kyllinga seeds did not initiate germination until 4 weeks in 19/11 C. In the second temperature study, alternating temperatures did not influence green kyllinga or cock's-comb kyllinga seed germination as >90% germination occurred for both species by 5 weeks. Tufted kyllinga, meanwhile, responded favorably to alternating temperatures as 87% seeds germinated in 25/15 C while only 7% seeds germinated in constant 25 C. Temperatures fluctuate less in dense turfgrass than in weakened areas and tufted kyllinga may be a less competitive turfgrass weed than green kyllinga or cock's-comb kyllinga.

Light was required for germination by each *Kyllinga* species. Green kyllinga, cock's-comb kyllinga and tufted kyllinga seeds in light germinated by 4 weeks (99, 97 and 35%, respectively); while those previously covered with aluminum did not germinate. Previously covered seeds resumed germination once they were placed in light so that similar germination percentages occurred for both treatments by 6 weeks. This is an important pest management strategy as a dense, uniform turf stand would minimize *Kyllinga* seed germination since minimum light penetration to the soil would occur.

PREEMERGENCE CRABGRASS CONTROL IN BERMUDAGRASS. M. R. Toubakaris, J. K. Higingbottom, B. T. Bunnell, and L. B. McCarty. Department of Horticulture, Clemson University, Clemson, SC 29632-0375.

ABSTRACT

A field study was performed in bermudagrass (*Cynodon dactylon*) in 1998 to determine best preemergence control of crabgrass (*Digitaria* sp.). The trial was conducted in bermudagrass rough on a public golf course near Clemson University. Crabgrass is an aggressive summer annual that remains a consistent pest to golf course superintendents each year. The most accepted method for controlling crabgrass today is preemergence herbicides. These herbicides have the ability to persist in the soil for long periods of time providing effective control through most of the summer. The objectives of the study were to provide effective control of crabgrass, to identify a superior rate, and to research new products.

The preemergence trial contained 22 treatments, replicated 4 times. Initial applications were made on March 10, 1998. Sequential applications were 8 weeks after the initial. Treatments included various combinations, timings, and rates of Surflan (oryzalin), Team Pro (trifluralin + benefin), Dimension (dithiopyr), Ronstar (oxadiazon), Barricade (prodiamine), Pendimethalin, and a fertilizer blank.

The trial was rated monthly for percentage control on a 0-100% scale. A minimum threshold was set at 70% control for crabgrass. The first rating was taken on April 24 and the ratings continued through the summer until September 9.

Best preemergence control (80-100%) from April to September 1998 followed sequential applications of Surflan at 1.5 lbs ai/A, Team Pro at 2.0 lbs ai/A followed by Surflan at 1.5 lbs ai/A, and Dimension at 0.38 lb ai/A. Team Pro at 2.0 lbs ai/A, Dimension 0.25 lb ai/A, Pendimethalin at 2.5 lbs ai/A, and Dithiopyr XF98-013 (experimental) at 0.38 lb ai/A treatments maintained control >70% for most of the summer. Pendimethalin also showed (70-80%) control levels.

Research on preemergence herbicides for the control of crabgrass will continue. This weed continues to be a undesirable, expensive, and constant pest to golf courses in the southeast.

MAPPING SPATIAL VARIABILITY OF WEED CONTROL GROUND COVER USING A WEED-ACTIVATED SPRAYER. W. J. Parks and D. C. Bridges, University of Georgia, Griffin, GA 30223.

ABSTRACT

Most weed management strategies assume random and uniform weed distributions, and decisions are based on a limited number of observations. However, weeds are not randomly distributed, which results in inaccurate herbicide applications. A weed-activated sprayer was used to predict ground cover in three fields in Griffin, GA. The fields were divided into equal transects. In the experiments, ground cover was estimated by making visual estimations of the weeds in a one meter square quadrants and by taking a digital photograph of the quadrant. Image analyses were made using SigmaScan Pro software on a personal computer. Results indicated a high correlation between visual estimates and actual ground cover from the images. Each transect in the fields was sprayed with a Patchen™ WeedSeeker sprayer, which was modified with additional electronic equipment including a differentially corrected Global Positioning System to record and map spray instances. Volume measurements were taken after each transect to validate actual spray volumes. Analysis showed a high correlation between the volume measured by the data logging system and actual spray volume. Analyses of the spray and visual data showed poor correlation between them, suggesting that although visual estimates of ground cover were precise, they were not representative of the actual ground cover of the field. Using a modified weed-activated sprayer to map a field is a much better indicator of the actual ground cover than traditional measurement techniques.

TUFTED LOVEGRASS CONTROL IN MEYER ZOYSIAGRASS. J. W. Boyd and B. N. Rodgers. University of Arkansas, Little Rock, AR 72204.

ABSTRACT

Tufted lovegrass (*Eragrostis pectinacea*) is a summer annual that blooms from July to October. It is a problem weed in 'Meyer' zoysiagrass (*Zoysia japonica* 'Meyer') sod production in Arkansas, western Tennessee and northern Mississippi. MSMA tolerance is the primary reason for the success of tufted lovegrass as a weedy invader. Another contributing factor is the relatively slow re-growth of zoysiagrass after sod harvest. The soil surface in a harvested field is bare for several months creating an ideal environment for the establishment of a competitive stand of this weed.

Two studies were conducted at Winrock sod farm in central Arkansas during 1997 and 1998 to evaluate several herbicides for preemergence and postemergence control of tufted lovegrass. Both sites are located on silt loam soil that has been in zoysiagrass production for more than 20 years.

In 1997, postemergence herbicides were applied to a blooming, well-established stand of lovegrass on August 6. Fluazifop-butyl, sethoxydim, clethodim, nicosulfuron, primisulfuron, atrazine, quinclorac, asulox and pronamide were ineffective for lovegrass control. At 29 days after treatment (DAT), fenoxaprop at 0.25 lb ai/a and glyphosate at 0.38 lb ai/a, glyphosate controlled 70% control of the lovegrass and caused 30% zoysiagrass injury. On the same evaluation date, glyphosate at 0.5 lb ai/a and glufosinate at 0.75 lb ai/a controlled 100% of the lovegrass and resulted in 60% zoysiagrass injury. On April 30, 1998 and injury ratings for glufosinate and the higher rate of glyphosate were 40 and 80%, respectively.

Atrazine, applied preemergence on April 2, 1998, at 1.5 lb ai/a and followed by the same rate on May 18 provided >95% control of lovegrass at 138 DAT. Two applications of oxadiazon at 2.0 lb ai/a (April 2 and June 16) resulted in 65% lovegrass control at 138 DAT. Treatments consisting of two applications of simazine at 1.5 lb ai/a (April 2 and May 18) or two applications of metolachlor at 1.0 lb ai/a (April 2 and June 16) were ineffective for lovegrass control. Two applications (April 2 and June 16) of simazine + oxadiazon, atrazine + oxadiazon and atrazine + metolachlor at the previously listed rates provided >95% lovegrass control at 138 DAT. Simazine + metolachlor controlled 60% of the lovegrass at 138 DAT.

Glyphosate, applied July 7, 1998, at 0.19, 0.25 and 0.31 lb ai/a provided 0, 47 and 100% control of lovegrass at 40 DAT. Glyphosate at 0.031 lb ai/ac produced 10% zoysiagrass injury at 40 DAT. No injury was evident for the lower rates of glyphosate at 40 DAT.

EFFECT OF TROPICAL SODA APPLE DENSITY ON BAHIAGRASS PRODUCTION. J. J. Mullahey, F. Roka, M. D. Fanning, and R. Akanda, Southwest Florida Research and Education Center, Immokalee, FL 34142; and California Polytechnic St Univ., San Luis Obispo, CA 93405.

ABSTRACT

Tropical soda apple (*Solanum viarum* Dunal) is a non-native invasive plant that threatens agricultural land and natural systems in Florida. This plant displaces desirable vegetation resulting in lower agricultural production and reduced biodiversity in natural areas. Extensive research has focused on chemical control, weed biology and ecology, and integrated management strategies. Information is lacking on the effects of tropical soda apple (SOLVI) on bahiagrass production in pasture systems. Tropical soda apple plants shade the bahiagrass resulting in lower forage production. Also, SOLVI plants have prickles that can restrict cattle grazing.

A competition experiment between bahiagrass and SOLVI was conducted in 1995 and 1998. Plots (11' X 11') were arranged in a randomized complete block design and replicated four times. Plant density was established as 0, 6, 12, and 20 SOLVI plants per plot. All plots had a good stand of bahiagrass prior to planting the SOLVI plants. SOLVI transplants were grown in the greenhouse and planted in the field in early March of both years. Plots were fertilized biweekly and irrigated as needed. In August of both years, the SOLVI plants (leaves, stems, roots) and the bahiagrass were harvested and oven-dried (140 F) for 3 days to determine dry matter yield. All fruit on the harvested SOLVI plants was collected, sorted and counted by size (diameter) of fruit. Based on fruit size, the number of SOLVI seed was estimated. Bahiagrass yield, SOLVI fruit and seed data were analyzed using regression analysis. From the bahiagrass yield data, an economic analysis determined the cost of supplemental forage (hay) to replace the lost bahiagrass, and the lost revenue associated with lower bahiagrass production.

Results indicated that as SOLVI density increased, bahiagrass declined. With a significant ($p<0.05$) year x treatment interaction, each year was analyzed separately. In 1995, there was a significant linear decline in yield ($Y= 12845.5 - 506.9x$; $r^2=.91$) compared to a quadratic response in 1998 ($Y= 8766.5 -474.9x + 13.7x^2$; $r^2=.76$). Based on bahiagrass yield, grazing days were highest for the control (378 days) and declined to only 131 days for the high SOLVI density. SOLVI seed production had a linear increase ($Y=23323.1 + 33412.3x$; $r^2=.98$) with an increase in SOLVI density.

To compensate for the lower bahiagrass production per acre associated with each SOLVI density, a rancher would have to purchase $101, $213, or $318 in hay for the low, medium, and high SOLVI densities, respectively. From the loss in bahiagrass production, revenue per acre was calculated based on stocking rate. As SOLVI density increased, revenue declined $16, $33, and $49 per acre compared to the control (no SOLVI). This loss in revenue for each density level is higher than the cost of controlling SOLVI.

TRANSITION OF POA ANNUA SSP. REPTANS INFESTED BENTGRASS PUTTING GREENS TO MONOCULTURE BENTGRASS USING PLANT GROWTH REGULATORS AND FUNGICIDES . J. Isgrigg III and F. H. Yelverton, Crop Science Department, North Carolina State University, Raleigh, NC 27695.

ABSTRACT

A field trial was conducted at the Sandhills Research Station in Jackson Springs, North Carolina, over 1997-98 to evaluate the usefulness of plant growth regulators and fungicides in a program to control existing stands of a perennial biotype of annual bluegrass in creeping bentgrass (*Agrostis palustris* L.) putting greens.

Treatments consisted of paclobutrazol a 0.3 kg ai ha alone or in combination with fenarimol at 0.6 kg ai as a tankmix, propiconazole at 1.5 kg ai tankmixed, cyproconazole at 1 kg ai tankmixed or as a 1 or 2 week sequential, or as a continuous 6 week treatment during PGR applications, paclobutrazol alone at 0.4 or 0.6 kg ai, trinexapac-ethyl at 0.1 or 0.2 kg ai ha alone, and flurprimidol at 0.3 kg ai ha alone. A nontreated check was included for comparison. Treatments were applied twice each in the spring and fall when bentgrass growth commenced. Treatments were arranged in a randomized complete block design with four replications. Data collected were visual ratings of % annual bluegrass, phytotoxicity, and turf quality. Data were subjected to ANOVA, means were separated using the Fishers' Protected LSD procedure. Sod strips containing >90% perennial annual bluegrass were cut from a nearby golf course green and laid into the plots. Chlorothalonil was applied as a disease preventative measure. Plots were mowed 3X weekly at 5 mm and clippings were removed. The site was irrigated as needed and core airification was conducted spring and fall of both years with vertical mowing conducted in May of each year.

All treatments containing paclobutrazol or flurprimidol reduced annual bluegrass most with > 40% by the end of year 1 with the same treatments resulting in annual bluegrass stand reductions of at least 80% by the end of year 2. Annual bluegrass reductions for trinexapac-ethyl were at least 10% and 40% for years 1 and 2 respectively which was comparable to nontreated.

Phytotoxicity was highest for paclobutrazol alone at the 0.6 kg rate or at the 0.3 kg rate tankmixed with either cyproconazole or propiconazole or combined with the continuous cyproconazole program. Treatments containing paclobutrazol at 0.3 or 0.4 kg alone or the 0.3 kg rate tankmixed with fenarimol, followed by a 2 week cyproconazole sequential, or with flurprimidol or trinexapac-ethyl had phytotoxicity levels similar to nontreated.

Turf quality was reduced when paclobutrazol was tankmixed with either propiconazole or cyproconazole. The continuous cyproconazole treatment resulted in turf quality below minimally acceptable levels. Treatments with flurprimidol, and paclobutrazol alone, or trinexapac-ethyl at 0.1 kg were similar to nontreated while the treatment containing trinexapac-ethyl at 0.2 kg ai ha resulted in late season turf quality enhancement in year two.

Treatments of paclobutrazol alone at 0.3 or 0.4 kg, paclobutrazol tankmixed with fenarimol, paclobutrazol followed by a 2 week sequential of cyproconazole, or flurprimidol at 0.3 kg ai ha resulted in the highest levels of annual bluegrass reduction with acceptable levels of phytotoxicity and no differences in turf quality compared to nontreated. Trinexapac-ethyl treatments did not significantly reduce annual bluegrass populations but the 0.2 kg ai ha rate did result in enhanced late-season turf quality indicating it is a useful tool for management of mixed stand annual bluegrass/creeping bentgrass putting greens.

ECONOMICAL APPROACH TO ANALYZATION OF WEED CONTROL DATA. S. H. Futch and M. Singh, University of Florida, Citrus Research and Education Center, Lake Alfred, FL 33850.

ABSTRACT

Field study data from citrus sites were analyzed to determine the most cost effective weed control on a cost per percent weed control for annualized data. The seven PRE herbicides used in the field studies were bromacil, diuron, norflurazon, simazine oxyfluorfen, oryzalin and thiazopyr. These herbicides were used individually and in combinations to develop 20 treatments. A POST only herbicide treatment of glyphosate was included in the study. For the products which had greater than 80% weed control on an annualized basis, the cost per percent weed control ranged from $2.09 to $3.68 at Lake Garfield and $2.95 to $4.55 at Indiantown. The Indiantown study site had higher herbicide rates applied due to greater weed pressure which resulted in slightly higher cost per percent weed control. The use of an economical approach to weed control provides the growers with an additional tool when developing herbicide programs which provide acceptable weed control in a cost-effective manner.

HERBICIDE ACTIVITY OF METHAM, METHYL IODIDE, AND METHYL BROMIDE APPLIED THROUGH IRRIGATION SYSTEMS. C. C. Dowler, USDA, ARS, Coastal Plain Experiment Station, Tifton, GA 31793.

ABSTRACT

With the imminent cancellation of methyl bromide for agricultural uses in the United States, alternatives have to be developed. Extensive research, specifically Florida and California, are in progress to evaluate chemical and cultural alternatives to methyl bromide use in crop production. The research reported herein focused on irrigation application technology for applying metham, methyl iodide, and methyl bromide for controlling weeds in several high value crops.

Metham was applied in a liquid phase at 35 or 50 gal/A in sprinkler or drip irrigation systems under plastic mulch culture. Methyl iodide and methyl bromide was applied in a gaseous phase at 150 or 392 lbs/A in drip irrigation systems under plastic mulch only. Irrigation application rates for sprinkler systems was 0.3 or 0.4 in/A. The drip irrigation tape used had emitter output capacities of 0.24, 0.36, or 0.6 GPH spaced 12 inches apart. Infrared transmitting (IRT) versus black plastic mulch culture was compared in two experiments. All experiments were conducted on a Tifton or Leefield loamy sand soil.

All treatments containing paclobutrazol or flurprimidol reduced annual bluegrass most with > 40% by the end of year 1 with the same treatments resulting in annual bluegrass stand reductions of at least 80% by the end of year 2. Annual bluegrass reductions for trinexapac-ethyl were at least 10% and 40% for years 1 and 2 respectively which was comparable to nontreated.

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Yellow or purple nutsedge was present in all experiments. Depending on time of the year, other weeds present included Texas panicum, crabgrass, Florida beggarweed, Florida pusley, Palmer amaranth, and smallflower morningglory. Crops included in the research were pepper, cucumber, squash, cantaloupe, and onion.

Metham applied through sprinkler irrigation temporarily suppressed but did not control yellow and purple nutsedge. This suppression lasted about 10 days. Approximately one month after application, nutsedge control was zero. Control of previously mentioned weed species generally ranged between 80 and 100%. Covering the metham treated areas after application with a plastic mulch or maintaining the treated area moist for 10 days increased herbicidal activity on the previously mentioned weeds to 90% or more. Metham applied through drip irrigation systems under a plastic mulch cover controlled all of the above mentioned weeds and also reduced nutsedge penetration through plastic mulch 80 to 90% in a 9" band on either side of the drip irrigation tape. The application rate of 35 or 50 GPA, the amount of irrigation water applied through sprinkler irrigation, or the flow rate through drip irrigation emitters did not affect herbicidal activity of metham.

Methyl iodide and methyl bromide did not control purple or yellow nutsedge. When applied through drip tape under plastic mulch there was no difference in the number of nutsedge plants penetrating plastic mulch or number of nutsedge plants germinating under plastic mulch following either methyl bromide or methyl iodide treatments as compared to untreated checks. Yellow and purple nutsedge were the only species that penetrated plastic mulch. All other weeds were controlled with the exception of some random emergence through holes in the plastic mulch covers.

Although a fumigant treatment did not affect the emergence of nutsedge species through plastic mulch, IRT plastic mulch did suppress penetration of both yellow and purple nutsedge when compared to black plastic mulch.

These results indicate that metham and methyl iodide may be viable alternatives to methyl bromide when applied through irrigation systems. With the exception of nutsedge species, metham controlled a broad spectrum of annual weeds commonly found in horticultural crops when applied through irrigation systems. Metham applied through irrigation in combination with other cultural practices, such as stale seedbed, may be feasible for controlling a broad weed spectrum in many horticultural crops. The results also indicate that methyl bromide and methyl iodide can be applied through drip irrigation systems under plastic mulch culture, but the plastic mulch was the major factor in weed control.

PROGRESS IN THE DEVELOPMENT OF GLYPHOSATE-RESISTANT SPINACH. J. Wells and R. E. Talbert, Department of Agronomy, University of Arkansas, Fayetteville, AR; and T. Morelock and J. Al-Khayri, Department of Horticulture, University of Arkansas, Fayetteville, AR.

ABSTRACT

Spinach (*spinacia oleracea*) is a dioecious, cool season vegetable crop grown in nearly every state. In Arkansas, there are three cropping seasons per year, a fall crop, overwintered crop, and a spring crop. Spinach is grown in Arkansas for canning, freezing, and fresh market. Weed control is one of the most significant problems for spinach growers. Due to a lack of a viable weed removal system during processing, the spinach is often rendered unusable if weeds are present in the product. At this time, there are only three herbicides labeled for the control of annual weeds in spinach. These include sethoxydim (Poast), cycloate (Ro-Neet) and phenmedipham (Spin-Aid). In addition, metolachlor (Dual) is registered under a Section 18 label. These herbicides used alone or in combination are inconsistent in providing adequate weed control. Therefore, the need for a new type of weed control program is obvious. An excellent potential alternative weed control technology is to use spinach that is genetically altered for glyphosate resistance.

The cultivar ‘High Pack’ is being used because of its tissue culture characteristics. Three types of explants were used. These include leaf discs, hypocotyls, and cotyledons. For leaf discs, plants were grown in the growth chamber for 6 weeks, disinfected and cut into 5-mm discs and used for the transformation. In addition, seeds were sterilized and grown in-vitro on a hormone-free, half-strength MS medium (Murashige and Skoog, 1962). At two weeks, the hypocotyls and cotyledons were cut into 5-mm sections for use in transformation.

Five vectors were obtained from Monsanto (700 Chesterfield Parkway North, St. Louis, MO). The vectors all harbor the glyphosate and kanamycin resistant genes, and each differ in their promoter and /or leader sequence. The genes were contained in *Agrobacterium tumefaciens* strain ABI (C58).

The spinach leaf discs, hypocotyls, and cotyledons were co-cultured with *A. tumefaciens* containing the glyphosate resistant gene. The explants were then transferred to solid MS callus induction mediumcontaining kanamycin to screen for transformed plants. Of the explants, hypocotyls formed the most potentially transformed callus with a transformation rate of 40%, followed by leaf discs and cotyledons, with transformation rates of 20 and 17% respectively. The callus tissue was then transferred to shoot regeneration mediumcontaining kanamycin and glyphosate for selection purposes. Presently, the callus tissue is on this medium. The control plants have begun to regenerate shoots. We hypothesize that the treated plant tissue is approximately 4 to 6 weeks behind the controls.

Future plans are to transfer the shoots to rooting mediumcontaining kanamycin. When roots are established the plants will be moved to pots containing Sunshine Mix and placed in the greenhouse. These plants will be screened for the presence of the glyphosate resistant gene. The potentially transformed plants will be screened by isolating genomic DNA from each plant and using polymerase chain reaction (PCR) amplification. Primers will be designed by sequence data provided from Monsanto. The presence of amplified fragments will be confirmed using electrophoresis and ethidium bromide staining. Finally, Southern and Western blot analysis will be performed on shoot tissue to further confirm the presence and expression of the gene.

WEED MANAGEMENT USING MILESTONE AND VISOR HERBICIDES IN BLUEBERRY AND GRAPE.
D. W. Monks, R. J. Mills, W. E. Mitchem, Department of Horticultural Science, N. C. State University, and S. K. Rick, E. I. DuPont, Raleigh, NC 27695.

ABSTRACT

Studies were conducted in North Carolina to evaluate Milestone (azafenidin) and Visor (thiazopyr) herbicides for weed control and crop safety in Reveille blueberry, and Muscat and Cabernet Sauvignon grape. Milestone at 0.38, 0.5 and 1.0 pound a.i., Visor at 0.38, 0.5 and 0.75 pound a.i., and Velpar (hexazinone) at 1 pound a.i. per acre were evaluated in blueberry. Milestone at 0.25, 0.38, 0.50, 0.75 pound a.i., Visor at 0.38 and 0.75 pound a.i. and Surflan (oryzalin) plus Princep (simazine) at 2 plus 2 pounds a.i. per acre were evaluated in grape. At 8 wk after treatment in December, Milestone or Visor with glufosinate gave excellent control of red sorrel in blueberry. Horsweed control in blueberry was over 90% for Milestone at all rates, and at 0.5 pound a.i. or higher of Visor, and at 1.0 pound a.i. per acre of Velpar. Spring treatment with Milestone or Visor did not appear as effective as fall application. In grape, Milestone, Visor or Surflan plus Princep gave over 85% control of common lambsquarters. In these studies, Visor at 0.38 pound per acre gave only 67% control of large crabgrass at 12 wk after treatment while the other treatments gave over 95% control of this weed. Fall panicum control was excellent from Milestone and Visor. However, fall panicum was not controlled at 6 months after application by Surflan plus Princep. Significant (over 10%) injury was not observed in blueberry or grape.

IN-ROW PALMER AMARANTH (*Amaranthus palmeri*) INTERFERENCE IN PLASTICULTURE TOMATO.
P. V. Garvey and D. W. Monks, Department of Horticultural Science, North Carolina State University, Raleigh, NC 27695.

ABSTRACT

Fresh market tomato (*Lycopersicon esculentum*) is considered a high value crop. Average gross economic returns for the U. S. was nearly \$20,000 ha^{-1} in 1996. To achieve earlier harvest and increase yields of high quality fruit, many producers have adopted the plasticulture production system. The plasticulture production system provides optimum water and nutrients for crop growth. Though the use of black plastic mulch blocks sunlight and prevents most weed germination and growth, weeds emerging from holes where tomato transplants grow in plasticulture production are in close proximity to the crop thus increasing weed/crop competition. In addition to disease control, the use of methyl bromide fumigation in plasticulture systems provides broad spectrumweed control. However, methyl bromide is slated for phase out by 2005, and current alterntive herbicidal replacements are not as broad spectrum. This loss could increase the level of management needed for plasticulture weed control in the future.

The objectives of this study were to: 1) evaluate the effect of Palmer amaranth grown in close proximity with fresh market cultivar, Mt. Spring tomato in a plasticulture production system, and 2) determine the critical weed-free period for Palmer amaranth interference based on the findings.

Field studies were conducted at the Horticultural Crops Research Station near Clinton, North Carolina from 1996 through 1998. Plasticulture production practices and drip fertigation schedules followed those recommended by North Carolina Cooperative Service. The additive series experiment included: 1) Palmer amaranth maintained at a density of either 1 or 3 weeds per tomato plant, and 2) seven establishment (EST) dates plus seven removal (REM) dates. Palmer amaranth EST treatments were hand-seeded within 5 cm ofthe base of tomato plants at 0, 1, 2, 3, 4, 5 and 6 weeks after transplanting (WAT). Conversely, for Palmer amaranth REM treatments, plots were hand-seeded at tomato transplanting for removal at 0, 2, 3, 4, 6, 8 and 10 WAT. Harvested vine-ripened tomato fruit was sized, weighed and counted. Tomato vegetative biomass dry weights were recorded.

Tomato vegetative dry weight decreased when Palmer amaranth EST was before 6 WAT or Palmer amaranth REM was later than 4 WAT. Cull grade tomato fruit weight increased when Palmer amaranth EST was before 2 WAT or Palmer amaranth REM was later than 6 WAT. The proportion of medium and large grade tomato fruit weight increased when Palmer amaranth EST was before 2 WAT or Palmer amaranth REM was later than 6 WAT. Jumbo grade tomato fruit made up 50% of the weed-free yield. Jumbo grade tomato fruit decreased when Palmer amaranth EST was before 3 WAT or Palmer amaranth REM was later than 6 WAT. Nonlinear regression of yield on EST and REM treatments determined the critical weed-free period to be between 30 and 35 days.

This research concludes Palmer amaranth grown in close proximity to tomato adversely affects tomato fruit yield and quality. However, the critical weed-free period was narrow in time and indicates tomato grown in a plasticulture production system is a competitive crop. Through this research, tomato growers utilizing plasticulture production systems can have a better understanding of weed/crop relationships to aid in weed management decisions.

WHITE CLOVER *(TRIFOLIUM REPENS)* FLOWER SUPPRESSION AND CONTROL IN APPLE ORCHARDS WITH CLOPYRALID AND 2,4-D. W. E. Mitchem, A. W. MacRae, and D. W. Monks, Department of Horticultural Science, N. C. State University, Raleigh, NC 27695.

ABSTRACT

White clover is native to the mountain and piedmont regions of North Carolina and is commonly found in apple orchards. White clover competes with apple trees and desirable ground cover in orchards for water and nutrients, and creates a desirable habitat for voles. More importantly is the attraction of managed and feral bee colonies to white clover flowers on the orchard floor. Flowering white clover attracts foraging bees into the orchard during the summer when protective insecticides, known to be toxic to bees, are applied to manage insect pests. Between 1995 and 1997, in Henderson county, NC 10% of the managed bee hives were killed and 50% of the remaining hives were adversely affected by insecticides commonly used in commercial apple orchards.

Studies were conducted in 1997 and 1998 to evaluate Stinger (clopyralid) for eliminating white clover and white clover flowers from apple orchards. Stinger alone at 4 and 8 oz/acre or at 1 and 2 oz/acre plus 2,4-D at 1 qt/acre was applied as a single application 2 weeks before (2 WBB) or 2 weeks after (2 WAB) apple tree bloom. 2,4-D at 1 qt/acre was applied at the same application times as a commercial standard. White clover control relative to a non-treated check was estimated visually and white clover flowers were counted at two sites within each plot to determine flower density.

In 1997 white clover control in July with 2,4-D applied 2 WBB or 2 WAB was 16 and 25%, respectively, and suppressed white clover flowers only through mid-May. Stinger at 1 oz/acre plus 2,4-D at both application times provided no better control than the 2,4-D standard. White clover control in July with Stinger at 2 oz/acre plus 2,4-D, or Stinger at 4 or 8 oz/acre 2 WBB or 2 WAB ranged from 64 to 100%. However only Stinger at 8 oz/acre 2 WBB or 2 WAB provided 100% white clover control and complete flower suppression into July.

In 1998 white clover control in July with 2, 4-D at 2 WBB or 2 WAB was 35 and 15%, respectively, and suppressed flowers through mid-May. All treatments containing Stinger provide better white clover control than the 2,4-D standard. Stinger at 1 oz/acre plus 2,4-D 2 WBB or 2 WAB provided 66 and 60% white clover control, respectively. White clover control ranged from 91 to 100% when treated with Stinger at 2 oz/acre plus 2,4-D 2 WAB, or Stinger at 4 or 8 oz/acre 2 WBB or 2 WAB. However, Stinger at 4 or 8 oz/acre 2 WBB or 2 WAB completely eliminate white clover flowers into July.

POSTEMERGENCE WEED CONTROL IN APPLE ORCHARDS WITH SULFOSATE AND GLYPHOSATE.
A. W. MacRae, W. E. Mitchem and D. W. Monks. Department of Horticultural Science, North Carolina State University. Raleigh, NC 27695-7609.

ABSTRACT

In 1998, sulfosate and glyphosate efficacy studies were conducted on apple (*Malus domestica*) in Henderson and Cleveland Counties of North Carolina. Treatments consisted of sulfosate at 0.5, 1.0, and 1.5 lb ai/A plus non-ionic surfactant at 0.25%v/v, or glyphosate at 0.5, 1.0, and 1.5 lb ai/A. Herbicides were applied as a directed spray underneath apple trees on April 6, and June 17, 1998 in Henderson County and Cleveland County, respectively. Application was made with a CO_2 back pack sprayer calibrated to deliver 10 GPA of spray solution at 40 psi.

Efficacy ratings at 4 weeks after treatment (WAT) showed a similar level of control by sulfosate and glyphosate for perspective weed species. Sulfosate and glyphosate, at 1.0 and 1.5 lb ai/acre provided similar control of *Taraxacum officinale*, *Cerastium vulgatum*, *Descurainia spp*., *Geranium carolinianum*, *Trifolium repens*, *Conyza canadensis*, *Ambrosia artemisiifolia*, and *Solanum carolinense*. Sulfosate and glyphosate, at 0.5 lb ai/acre provided similar control of *Taraxacum officinale*, *Cerastium vulgatum*, *Descurainia spp*., *Geranium carolinianum*, *Ambrosia artemisiifolia*, and *Solanum carolinense*. Glyphosate at 0.5 lb ai/acre provided better control of *Trifolium repens* and *Conyza canadensis*.

MILESTONE EFFICACY IN APPLES – A THREE YEAR SUMMARY IN NORTH CAROLINA. S. K. Rick, W. E. Mitchem, D. W. Monks, and C. S. Morton. DuPont Agricultural Products, Raleigh and North Carolina State University, Raleigh, NC 27606.

ABSTRACT

Milestone herbicide, common name azafenidin, represents a new family of chemistry to be used for weed control in apples (Malus domestica Borkh), stone fruit, citrus and other speciality crops. Milestone was tested under the code DPX-R6447. The mode of action of Milestone is the inhibition of the porphyrin biosynthetic pathway resulting in cell membrane disruption. It has a low acute oral and dermal toxicity and a favorable environmental profile. Milestone is a selective herbicide with preemergence and limited postemergence activity. Milestone is formulated as an 80% water dispersible granule which is both compatible with fertilizers and other tank mix partners. No adverse effects in thirteen tests conducted over three years and across five apple varieties at rates up to 32 ozai/a Milestone were observed. The timing of herbicide application did not affect the overall level of control achieved but higher rates gave acceptable control over a longer time frame. Four to 12 ozai/a gave control of grass and broadleaf weeds equal to or superior to the current standards. Split applications of low rates of Milestone provided better season long control of later germinating weeds and several perennial weed species than a single application of higher rates. Split applications also provided better control of the more difficult to control species. Few differences in weed control were observed among the burndown herbicides tank mixed with Milestone. Applications made to emerged weeds should contain a burndown herbicide to broaden the postemergence spectrum. Little to no benefit was observed when tank mixing 8 to 12 ozai/a Milestone with currently registered herbicides. Control of a few more difficult to control species may benefit by applying a split application as a fall/spring vs. a spring/summer treatment. Based on these studies, Milestone herbicide will fit well into Apple weed control programs in North Carolina.

EVALUATION OF NEW HERBICIDES IN NEWLY PLANTED STRAWBERRY. K. D. Starke, D. W. Monks and R. J. Mills. Department of Horticultural Science, North Carolina State University, Raleigh, NC 27695-7609.

ABSTRACT

In 1998 a study was conducted at the Horticultural Crops Research Station, Clinton, NC to evaluate new herbicides on newly planted Allstar, Apollo, Delmarva, Earliglo, Jewel and Sweet Charlie perennial strawberry. Nine herbicides evaluated for weed control and crop safety were oxyfluorfen at 0.3 and 0.4 kg/ha, napropamide at 1.1, 1.7 and 2.2 kg/ha, bensulide at 5.6 and 6.7 kg/ha, pendimethalin at 0.6 and 0.8 kg/ha, naptalam at 2.2 and 4.5 kg/ha , norflurazon at 0.8 and 1.1 kg/ha, thiazopyr at 0.3, 0.4 and 0.6 kg/ha, azafenidin at 0.1, 0.3 and 0.4 kg/ha and terbacil at 0.1 and 0.2 kg/ha. In the first study napropamide, bensulide, pendimethalin, naptalam, norflurazon were evaluated as preplant incorporated (PPI) treatments. Oxyfluorfen was evaluated as a pre-transplant (PRE-T) treatment in the first study. In the second study

oxyfluorfen, napropamide, bensulide, pendimethalin, naptalam, norflurazon, terbacil, thiazopyr and azafenidin were evaluated as preemergence (PRE) treatments.

A nontreated, weed-free check was included for comparison in both studies. In the first study the following ratings were observed two weeks after treatment: oxyfluorfen applied PRE-T at 0.3 and 0.4 kg/ha caused 18% to 40% and 20% to 50% injury and napropamide applied PPI at 2.2 kg/ha caused 10% injury, respectively. Six weeks after treatment oxyfluorfen applied PRE-T at 0.3 and 0.4 kg/ha caused 18% and 22% to 32% injury, respectively. Napropamide applied PPI at 2.2 kg/ha caused 17% to 22% injury six weeks after treatment. Norflurazon applied PPI at 0.8 and 1.1 kg/ha caused 20% and 18% to 25% injury, respectively, six weeks after treatment. In the second study oxyfluorfen applied PRE at 0.3 and 0.4 kg/ha caused 25% to 47% and 30% to 47% injury, respectively, two weeks after treatment. Norflurazon applied PRE at 0.8 kg/ha caused 12% injury two weeks after treatment. Azafenidin applied PRE at 0.4 kg/ha caused 13% to 22% injury two weeks after treatment . Oxyfluorfen applied PRE at 0.4 kg/ha caused 18% injury six weeks after treatment. Norflurazon applied at 0.8 and 1.1 kg/ha caused 17% and 40% injury six weeks after treatment. Azafenidin applied at 0.3 and 0.4 kg/ha caused 25% to 53% and 32% to 77% injury, respectively, six weeks after treatment. Two and six weeks after treatment terbacil applied PRE at 0.1 and 0.2 kg/ha caused 10% or less injury and thiazopyr applied PRE at 0.3, 0.4 and 0.6 kg/ha caused 13% or less injury. Only azafenidin applied at 0.3 and 0.4 kg/ha reduced strawberry runners.

MULBERRY WEED (*FATOUA VILLOSA*): A NEW WEED IN LANDSCAPES AND CONTAINER NURSERY CROPS. G. M. Penny and J. C. Neal, N.C. State University, Raleigh NC.

ABSTRACT

Two greenhouse studies were conducted to evaluate the efficacy of 10 granular preemergent herbicides on mulberry weed (*Fatoua villosa*). 6" azalea pots were filled with a bark: sand substrate (6:1 by vol.). These pots were sown with mulberry weed (*Fatoua villosa*) seeds and herbicide treatments applied. The herbicides used in the study were OH II (oxyfluorfen + pendimethalin)3.0 lb. ai/A, Rout (oxyfluorfen + oryzalin) 3.0 lb. ai /A, Regal O-O (oxyfluorfen + oxadiazon) 3.0 lb. ai/A, RegalKade (prodiamine) 1.5 lb. ai/A, Snapshot TG (isoxaben +trifluralin) 5.0 lb. ai/A, Ronstar (oxadiazon) 4.0 lb. ai/A, Pennant (metolachlor) 4.0 lb. ai/A, Pre-Pair (napropamide + oxadiazon) 6.0 lb. ai/A, Pendulum (pendimethalin) 2.0 lb. ai/A, Pendulum 4.0 lb. ai/A, Preen (trifluralin) 2.0 lb. ai/A, Preen 4.0 lb. ai/A, XL (benefin + oryzalin) 4.0 lb. ai/A, XL 6.0 lb. ai/A. Test system design was a RCB with 6 replications. Emerged weeds were counted weekly, and percent control was visually evaluated biweekly relative to a non-treated check. It was found that products containing oxyfluorfen and/or oxadiazon provided good mulberry weed control. The dinitroanilines differed in effectiveness, XL 6.0 lb. ai/A>prodiamine ≥ pendimethalin ≥ XL 4.0 lb. ai/A > trifluralin. Snapshot TG and metolachlor provided poor control.

YELLOW NUTSEDGE CONTROL AND TOMATO INJURY AS AFFECTED BY THE INTERACTION OF VAPAM AND THE HERBICIDES EPTAM, TILLAM, AND MATRIX. C. L. Stiles, D. L. Coffey, and T. C. Mueller; University of Tennessee, Knoxville.

ABSTRACT

Yellow nutsedge (*Cyperus esculentus* L.) is a major problem when plastic is used in tomato and other vegetable crops, because it can break through the overlying plastic. This allows yellow nutsedge to be competitive with tomato crops. Young tomato plants are poor competitors with weeds therefore heavy infestations can reduce yield. Yellow nutsedge competition is reduced by the soil fumigant methyl bromide, but due to the environmental problems caused it is being phased out.

Field experiments were conducted in 1998 at the University of Tennessee Experiment station in Knoxville. The experiment was designed to evaluate the control of yellow nutsedge in tomatoes and crop injury as influenced by the interaction between plastic, Vapam and Matrix, Eptam, and Tillam. The experiment utilized a split block design with main plots as Vapam (110 or 0 kg ai/ha) and the sub-plots as herbicide treatment (rimsulfuron .03 kg ai ha^{-1}, Eptam 3.43 kg ai ha^{-1}, Tillam 6.72 kg ai ha^{-1}, and no herbicide). Vapam was used as an alternative to methyl bromide for soil fumigation. Vapam and the three herbicides were applied on May 26 and immediately incorporated. The plastic was then laid over all plots to prevent volatilization. Plot size was 2.6 m wide by 6.1 m long. Tomatoes were transplanted June 18. Tomatoes were grown using drip irrigation with standard commercial practices, including stakes, tying, and

fungicide and insecticide application. Yellow nutsedge and tomato injury were visually evaluated. Fruit was harvested by hand at the typical mature green stage of development. Fruit were graded by quality and size after harvest. Throughout the growing season there was no difference in yellow nutsedge control. All treated plots had greater than 90% control. Vapam plus Eptam resulted in greater tomato injury.

TOLERANCE OF BELL PEPPER TO RIMSULFURON AND HALOSULFURON. W. M. Stall. Horrticultural Sciences Dept. University of Florida, Gainesville, FL 32611-0690.

ABSTRACT

Bell pepper is produced on 21,000 polyethylene mulched, methyl bromide treated acres in Florida. The value of the crop in Florida is $231 million. Methyl bromide use is to be phased out over the next 5 years with total loss occurring January 1, 2005. Due to a lack of effective herbicides, yield losses due to nutsedges and several broadleaf weeds growing in the plant holes are anticipated. Rimsulfuron is labeled on tomato and potato in Florida for both preemergence and postemergence control of many broadleaf weeds. Halosulfuran controls many weeds preemergence and controls yellow and purple nutsedge postemergence. Tomato has shown a degree of POST tolerance to halosulfuron as do cucurbit crops. Trials were carried out in 1997-1998 to evaluate bell pepper tolerance to rimsulfuron and halosulfuron both as pretransplant applications and as POST applications. In the pretransplant trials, rimsulfuron was applied as a surface treatment at 0,18, 27, 45, 90, 180 and 360 g/ha in 1997 and at 0, 4, 18, 27, 35 and 70 g/ha in 1998. Halosulfuron was applied at 0, 18, 36, 70, and 140 g/ha in 1997 and at 0, 18,27, 36, 45, 54 and 70 g/ha in 1998. After application, the beds were fumigated with methyl bromide and polyethylene mulch was applied to reduce weed competition as a factor. Pepper transplants were planted 3 (1997) and 7 (1998) days after application. The POST herbicide rates applied were the same as the PRE treatment rates. These were made to plants 1 month after transplanting into mulched, methyl bromide treated beds. In 1997, the experiment was a factorial design with 3 cultivars of 'Capistranio', 'Lancelot' and 'Camelot'. In 1998 only 'Camelot' was grown. Phytotoxicity, vigor and yield ratings were made.

There were no interactions of yield by cultivar in the 1997 trials and the data was combined. Treatment yields were compared to the check plots by orthoginal comparisons and also converted to percent of the check and regressed.

Pepper yields were reduced linearly as pretransplant rimsulfuron applied rates increased. Yields were significantly lower than the non-treated plots beyond 27 g/ha. The primary phytotoxicity seen in the rimsulfuron pretransplant tests were stunting. When rimsulfuron was applied POST, yellowing and stunting occured in all treatments. Yield reductions of 80% was evident at the 4 g/ha rate. Peppers have no tolerance to rimsulfuron applied POST.

There was an interaction by year among the pretransplant halosulfuron treatments. In 1997 the pepper yield from the 18 g/ha halosulfuron treatment was not significantly lower than the non-treated check, while in 1998, all treatment rates caused significantly more yield loss. There were no interactions by year nor cultivar among the POST applied halosulfuron treatments. There was a linear response to rate with the 18 g/ha rate not being significantly lower than the non-treated check. These trials indicate that pepper have a degree of tolerance to low rates of halosulfuron. Tomatoes have a much greater tolerance to both herbicides.

WEED MANAGEMENT CONSIDERATIONS IN CUCURBIT CROPS TRANSPLANTED ON PLASTIC COVERED BEDS. W. C. Johnson, III. USDA-ARS, Coastal Plain Experiment Station, Tifton, GA 31793.

ABSTRACT

Studies were conducted in 1998 at the Coastal Plain Experiment Station in Tifton, GA on weed management systems in transplanted cantaloupe and watermelon grown on plastic covered beds. The trials were a split-plot design using three preplant soil fumigants and six herbicide systems. Soil fumigants were metam-sodium (748 l/ha), metam-sodium (374 l/ha) followed by 1,3-dichloropropene (1,3-D) plus chloropicrin (159 l/ha), and a nonfumigated control. All metam-sodium applications were sprayed in a 61 cm band and incorporated with a power tiller. The combination of 1,3-D plus chloropicrin was injected in a 1.2 m band, 30 cm deep. Herbicide treatments were ethalfluralin (0.8 kg ai/ha) PRE, ethalfluralin PRE followed by glyphosate (1.1 kg ai/ha) applied with a hooded sprayer, glyphosate alone, bensulide (5.6 kg ai/ha) plus naptalam (3.4 kg ai/ha) PRE, bensulide plus napalm PRE followed by glyphosate, and a nontreated control.

Fumigants were applied in early April before transplanting and sealed into the soil with overhead irrigation. After an aeration period of three weeks, plastic film (1- mil thick and 60 cm wide) was spread, producing a covered seedbed 30 cm wide. Holes were cut in the plastic film in late April, and four week old 'Cordele' cantaloupe and 'Stargazer' watermelon seedlings transplanted through the plastic. PRE herbicides were applied to row middles not covered in plastic, with none contacting cucurbit seedlings and minimal contact with the plastic film. PRE herbicides were activated with overhead irrigation immediately after application. Glyphosate was applied to row middles using a hooded sprayer, just prior to vine running. Sprayer hoods were adjusted to apply glyphosate to the edge of the plastic film, minimizing incidental contact with cantaloupe and watermelon plants.

Weed control and yield was not improved with soil fumigation in either cantaloupe or watermelon. The fields in these trials were not infested with high levels of plant parasitic nematodes or soil-borne pathogens, thus there was no measurable benefit from the soil fumigants on these pest complexes. Based on these preliminary studies, it appears that there may be minimal benefit in either cantaloupe or watermelon production from preplant soil-fumigation for weed control. This may not be the case in multiple cropping systems where several vegetable crops are grown on the same plastic covered seedbed throughout the growing season.

Control of southern crabgrass, crowfootgrass, redroot pigweed, and Florida pusley was adequate with any of the PRE herbicides evaluated in these trials. Herbicide systems that included glyphosate applied with a hooded sprayer improved weed control and yield by controlling large-seeded weeds such as smallflower morningglory and sicklepod. The use of plastic covered seedbeds and semi-directed applications of PRE herbicides offered cucurbit seedlings protection from injury from PRE herbicides, particularly ethalfluralin. It is clear that the consistency and seedling vigor of transplanted cucurbits, protection from herbicide injury provided by plastic film, and ability to safely apply glyphosate with a hooded sprayer gives cantaloupe and watermelon growers more options for effective weed management than in direct-seeded systems

ON-FARM EVALUATION OF WEED CONTROL OPTIONS FOR WATERMELON. J. W. Shrefler, W. B. Bigger, S. C. Jones, B. W. Roberts, Wes Watkins Agric. Res. and Ext. Center, Lane, OK 74555.

ABSTRACT

Research and Extension programs are underway to improve weed control technology for watermelon producers. Studies conducted at Lane, Okla. during the period 1995 to 1997 indicated that herbicides currently labeled for use in watermelon may not provide adequate weed control unless used in combination with mechanical weed removal. In these studies, herbicide efficacy was found to be weed species dependent, suggesting that weed species should be considered when planning weed control programs for watermelon. Watermelon production fields in Okla. are often infested with several weed species that were not studied in trials conducted at Lane. These weeds include some species that growers find especially difficult to control. In particular, several species of the genus Amaranthus are often present. In order to evaluate the efficacy of approved weed control treatments in commercial watermelon production, small-plot trials were conducted in 1998 on two commercial farms, Non and Bennington and at the Wes Watkins Agricultural Research and Extension Center at Lane. Soils at the study sites Non, Bennington, and Lane were sand, sandy loam and loam, respectively. Trials were established at each site using the following set of treatments: 1. a tank mix of bensulide and naptalam applied preplant, 2. ethalfluralin applied preemergence (PRE), 3. bensulide applied preplant and ethalfluralin applied PRE, 4. cultivation close to the crop row and hand hoeing, 5. naptalam applied postemergence (POST) and cultivated as in treatment 7, 6. cultivation close to the crop row and hand hoeing combined with an application of trifluralin prior to the final cultivation (lay-by), and 7. delayed cultivation, which served as an untreated check plot and was cultivated only at lay-by. All treatments received some cultivation. However, treatments 4 and 6 were hoed to obtain more thorough early weed removal. Preplant treatments were incorporated to 2 inches deep with rotary tillers at Bennington and Lane. Treatments 1, 2, 4, and 6 received a POST application of sethoxydim as needed. Herbicide application rates were 5 lb ai acre^{-1} for bensulide, 3 lb ai acre^{-1} for naptalam applied preplant, 1.125 lb ai acre^{-1} for ethalfluralin, 4 lb ai acre^{-1} for naptalam applied POST, and 0.5 lb ai acre^{-1} for trifluralin. Treatments were applied with a CO_2 pressurized sprayer with a hand-held spray boom. Water was used as the spray carrier using 30 gal per acre for treatments applied at planting and 20 to 30 gallons per acre for POST treatments. At each site, treatments were replicated 4 times in randomized complete blocks. Data were analyzed using Analysis of Variance and LSD or Duncan's means separation tests. Watermelons were direct seeded using the cultivars Black Diamond, Orangeglo, and Allsweet , at Non, Bennington, and Lane, respectively. Plots consisted of a single row of watermelon 40 feet long. The effect of treatments 1, 2, and 3 on crop stunting and weed control was evaluated at 4 weeks after planting using a scale of 0 to 100 such that 0 indicated no stunting and no weed control. Conversely, 100% indicated no crop growth or complete weed control.

At Non, minor stunting (7 to 15%) was observed as compared to untreated plots, and treated plots did not differ from one another. At Bennington, only treatment 1 caused minor stunting (12.5%). Treatments 1, 2, and 3 gave 90% or greater control of large crabgrass (DIGSA) at Non and Bennington, except for treatment 1at Non that gave 79% control. Control of Palmer amaranth (AMAPA) at Non ranged from 78 to 95% and no differences were detected between treatments. Treatments 2 and 3 at Non gave complete control of carpetweed (MOLVE) and treatment 1 gave 52% control. Treatment 1, 2, and 3 gave 95% or greater control of tumble pigweed (AMAAL) at Bennington and no greater than 75% control of hophornbeam copperleaf (ACCOS). Each of treatments 2 and 3 gave only 30% control of ACCOS. Subjective evaluations of weediness were made at harvest on a 1 to 10 scale such that 1 indicated no weeds and 10 indicated a large weed infestation. At Non, evaluations for AMAPA ranged from 4 to 8.5, indicating that no treatment resulted in complete control until harvest. Treatments 1, 2, 3, and 4 were significantly less weedy than treatment 7 for AMAPA. At Non, treatments 1, 2, 3, and 6 were free of DIGSA at harvest and the remaining treatments were ranked from 2-3 in weediness. Similar results were obtained at Bennington for DIGSA. At Bennington, weediness for Amaranthus spp. AMAAL and tall waterhemp (AMATU) was classified 5 for treatment 7 and the remaining treatments were significantly less weedy. Weed populations at Lane were nearly non existent. Watermelon yields at Lane ranged from 6 to 11.6 tons acre-1 of marketable fruit and no differences were detected between treatments.

CONTROL OF MELINA (GMELINA ARBOREA) SEEDLING AND COPPICE REGROWTH IN HARVESTED COSTA RICAN PLANTATIONS PRIOR TO REGENERATION WITH IMPROVED MELINA SEEDLINGS. N. S. Yoho, 618 Southern Way, Spanish Fort, Alabama 36527 and R. Murillo, W. Barrantes, and D. Zeaser, Ston Forestal S.A. , Apdo, 6265-1000 San Jose, Costa Rica.

ABSTRACT

Melina (*Gmelina arborea*) is a tropical hardwood characterized by rapid growth and excellent wood properties. In Costa Rica Ston Forestal S.A. is replanting improved melina seedlings as plantations are harvested. Successful establishment of improved seedlings is threatened by natural regeneration of melina. Screening trials were applied to examine viability of broadcast treatments in controlling melina germinants and sprouts. Products used included Garlon 48 EC, Roundup 35,6SL, Seracsa 2,4-D Amine (Acid 48.1%), 2,4-D/dicamba(3:1) (Dicamba 10.3%/2,4-D 31.0%), and Arsenal 24SL (Acid 22.2%) applied at 1X and 2X rates. Kill of 80 percent or more of melina germinates was achieved by all products at one or both rates, providing several effective operational options. By a month after application, significant numbers of newly emerged germinates were established following application of all products except dicamba/2,4-D(1:3) and Imazapyr. Imazapyr killed or damaged or killed 13 of 30 seedlings test planted at one and two weeks post application. Damage to melina seedlings planted after application of other products was 10 percent or less.

No tested broadcast treatment controlled more than a third of coppicing melina stumps. Previous screening demonstrated that cut stump treatment was operationally inviable so basal application was studied.
Regression indicates that sprout height is the factor most influencing basal application control. However, consequences of sprout height vary with different herbicides and herbicide rates. Tested herbicide rates affect performance of 2,4-D ester and 2,4-D/dicamba(3:1) but not Triclopyr which controls 84-91% of sprouting stumps regardless of sprout height or tested herbicide rate. 2,4-D ester (50% product) is superior for killing small sprouts (nearly 100% at 25-50 cm). Dicamba/2,4-D(1:3) best controls large sprouts (±95% at 50-100 cm). Application of 2,4-D ester or dicamba/2,4-D(1:3) to sprouts of inappropriate size produces unacceptable results. Post application coppicing was absent four months following all treatments.

Currently, germinants are killed by broadcast application of 2,4-D. Soon after sprout emergence, basal application of stumps and escaped germinates is made with 2,4-D ester (25% product). Residuals are controlled with dicamba/2,4-D(1:3)(40% product).

INTRODUCTION

Melina (*Gmelina arborea*) is a tropical Asian hardwood characterized by rapid growth and excellent pulp and timber properties. The species has been commercially planted across the tropics. Smurfit-Stone Container Corporation, through its fully Costa Rican subsidiary, Ston Forestal S.A., initiated plantations on abandoned agricultural lands in southwest Costa Rica in 1989. Trees are planted on a 10 X 10 ft. spacing, 450 trees/acre. Plantations are located across 14,000 hectares (32,000 acres) of leased lands. The tropical climate with 10-16 feet of yearly rainfall supports growth limited only by intermittent soil water deficit in less fertile sites during December-May. Depending upon soil depth and quality, At Non, minor stunting (7 to 15%) was observed as compared to untreated plots, and treated plots did not differ from one another. At Bennington, only treatment 1 caused minor stunting (12.5%). Treatments 1, 2, and 3 gave 90% or greater control of large crabgrass (DIGSA) at Non and Bennington, except for treatment 1at Non that gave 79% control. Control of Palmer amaranth (AMAPA) at Non ranged from 78 to 95% and no differences were detected between treatments. Treatments 2 and 3 at Non gave complete control of carpetweed (MOLVE) and treatment 1 gave 52% control. Treatment 1, 2, and 3 gave 95% or greater control of tumble pigweed (AMAAL) at Bennington and no greater than 75% control of hophornbeam copperleaf (ACCOS). Each of treatments 2 and 3 gave only 30% control of ACCOS. Subjective evaluations of weediness were made at harvest on a 1 to 10 scale such that 1 indicated no weeds and 10 indicated a large weed infestation. At Non, evaluations for AMAPA ranged from 4 to 8.5, indicating that no treatment resulted in complete control until harvest. Treatments 1, 2, 3, and 4 were significantly less weedy than treatment 7 for AMAPA. At Non, treatments 1, 2, 3, and 6 were free of DIGSA at harvest and the remaining treatments were ranked from 2-3 in weediness. Similar results were obtained at Bennington for DIGSA. At Bennington, weediness for Amaranthus spp. AMAAL and tall waterhemp (AMATU) was classified 5 for treatment 7 and the remaining treatments were significantly less weedy. Weed populations at Lane were nearly non existent. Watermelon yields at Lane ranged from 6 to 11.6 tons acre-1 of marketable fruit and no differences were detected between treatments.

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Sexual maturity at age three permits rapid genetic improvement. Ston Forestal is planting fromits genetically improved seed orchard, and operationally testing vegetatively propogated selections. Successful establishment of improved seedlings after harvest is threatened most by herbaceous competition and natural regeneration of melina; competing woody species are virtually absent in plantations establishedon the previously pastured or cultivated land. Grasses and herbaceous broadleaves are controlled using sspot applications of glyphosate tank mixes with either oxyfluorofen or atrazine + metoachlor.

Seed production by melina begins at age three and by age seven plantation soils contain 35,000 viable seeds per acre. Coppicing fromthe root collar upward is prolific when melina is cut. Regeneration is abundant within weeks of harvest. The strategy for establishing plantations with improved trees involves clearing the site of unwanted melina regeneration after harvesting and immediately planting the site, before additional regeneration reestablishes.

Ston Forestal began trials to control melina coppicing in 1995. Triclopyr, dicamba, 2,4-D, and glyphosate (7% product in oil) provided 100, 98, 94 and 93 percent control respectively when applied to freshly cut stumps during thinning. Cut stump treatment with Triclopyr (20% product v/v) was successful on freshly cut 5 and 6 year old trees, but only if application was made as stumps were severed. Performance declined rapidly; the treatment was ineffective within a few hours, an operationally inviable limitation when harvesting is mechanized. Additional research was initiated to develop cost effective herbicidal control of natural melina regeneration a month or more after harvest.

METHODS

Broadcast screening trials were established in October 1997. Ten treatment plots (500 sq. m) each in two adjacent locations were identified, measured, and staked in preparation for tractor application with a mounted boom. Two five hectare plots were established for helicopter application. Products used included Garlon 48 EC, Roundup 35,6SL, Seracsa 2,4-D Amine (Acid 48.1%), 2,4-D/dicamba(3:1) (Dicamba 10.3%/2,4-D 31.0%), and Arsenal 24SL (Acid 22.2%). Herbicides and rates (1X and 2X) were selected based on observed or assumed vulnerability of melina. Herbicides of principal soil activity were avoided due to high and variable levels of soil organic matter, and to avoid potential damage when planting melina soon after application.

Broadcast screening trials involved five herbicide products applied at two rates each by tractor on Oct. 14-16 and Oct. 23-24, 1997 on two series of plots (Table 1). Glyphosate and Triclopyr were each applied at an intermediate rate by helicopter on October 16. All trials included non-ionic pH buffer/surfactant at 0.25 percent by volume. Total applied mix in tractor treatments was 500 liters/hectare (214 gallons/acre). Tractor applications were made between 8:30-11:30 AM, and stopped for the day when rain threatened. Application by helicopter was 10 gallons/hectare (4 gallons/acre) during 6:00 to 7:00 AM.

Melina control was measured at 2, 4, 6 and 8 weeks. The condition of all sprouts and germinates were recorded. After several weeks, decay of killed germinates and development of post application germinates introduced possible errors in measurements. Development ofpost application coppicing and germination were monitored. Fifteen (15) seedlings were planted in treated plots at weekly intervals in the month following treatment. Death or injury at two months after application were recorded.

A basal application study was established near Salama, Costa Rica July 23-24, 1998. Five variables suspected of affecting control were studied including (1) three products: Triclopyr, 2,4-D ester and dicamba/2,4-D(1:3) (2) rate: 1X and 2X (Table 1), (3) trace inclusion of Imazapyr: 0.025 percent by volume, (4) height of sprouts when treated: 25, 50 and 100 cm, and (5) performance across time. Thirty treatments were replicated in sixty random plots. In each plot 25 stumps were selected by sprout height and treated. Death or injury was recorded at 2, 4 and 8 weeks. Results were analysed using multiple regression.

RESULTS & DISCUSSION

Control of 80 percent or more of melina germinates was achieved by all products at one or more tested broadcast rate (Table 1), providing several effective operational options. Cost effectiveness of 2,4-D is attractive. Success of Imazapyr in controlling germinates became apparent after measurements were suspended.

Monitoring control after several weeks became difficult due to rapid deterioration of killed succulent germinates, and continued germination after application (Table 1). Within a month, significant numbers of newly emerged germinates were established following application of all products except dicamba/2,4-D(1:3) and Imazapyr (Table 1).

Pre-emergent control by dicamba/2,4-D(1:3) and Imazapyr offers significant operational advantage in timing of subsequent replanting. Rapid repopulation of germinates otherwise necessitates planting soon after site preparation to successfully establish improved melina seedlings.

Imazapyr killed or damaged or killed 13 of 30 of 15 seedlings test planted at one and two weeks post application, eliminating the product from possible operational broadcast use. Damage to melina seedlings planted after application of other products was 10 percent or less.

No treatment controlled more than a third of melina sprouts st two months after treatment (Table 2). Poor coppice control extinguished hope for a single pass broadcast chemical site preparation treatment. Control of coppicing is critical; surviving stump sprouts are probable dominants in a new stand. Pursuing adequate control through increased broadcast rates of candidate herbicides was unpromising and economically inviable. Operations would involve broadcast control of germinates, followed by mechanical or chemical control of individual stumps and escaped germinates. The strategy indicated focus on cost effectiveness of broadcast treatments.

Pursuit of coppice control using basal treatment was based in part on an unusual physiological feature of melina. The species develops a thick corky bark, apparent at lignification when stems are about an inch in diameter. However, meristematic tissue encases the thick bark, reminiscent of a ripening canteloupe rind. The green exterior of small stems fades as outer bark forms, but the meristem remains near the surface.

A 1/2 hectare basal treatment trial was established on melina stump sprouts with triclopyr (20 % v/v) in oil October 1, 1997. By October 16 most sprouts were dead and the remainder dying. An interim operational site preparation strategy was established. However, four subsequent operations across ±30 hectares produced inconsistent control. Research moved toward understanding variables affecting basal treatment.

The selected study area offered conditions associated with reduced control. These included stumps of older trees, larger stumps, buttressed stumps, and flat ground. Five variables (thirty treatments) also suspected to affect performance were studied including (1) product, (2) rate (1X and 2X), (3) trace inclusion of imazapyr, (4) height of sprouts (25, 50 and 100cm), and (5) performance across time. In each plot 25 stumps were selected by sprout height.

Regression indicates that sprout height is the factor most influencing basal application performance (Table 3). However, consequences of sprout height vary with different herbicides and herbicide rates.

Tested herbicide rates affect performance of 2,4-D ester and 2,4-D/dicamba(3:1) but not Triclopyr (Table 5). Triclopyr controlled 84-91% of sprouts regardless of sprout height or herbicide rate. 2,4-D ester (50% product) is superior for killing small sprouts (nearly 100% at 25-50 cm). The 2X rate of 2,4-D/dicamba(3:1) (40% product) is superior in killing stumps supporting taller sprouts (91-94% at 50-100 cm). Application of 2,4-D ester or dicamba/2,4-D(1:3) treatments to sprouts of inappropriate size produced unacceptable results (Table 4&5).

Indicated success of treatments at two weeks, two months, and four months is not significantly different. This is operationally important. Remedial actions can follow field evaluations at two weeks.

Inclusion of trace quantities of Imazapyr (0.25% by volume) to retard recovery of damaged stumps was unnecessary. Average control in treatments with Imazapyr was 79.5 percent, without Imazapyr 76.5 percent. Resprouting was absent four months following all treatments (Table 2).

Melina coppicing occured within a month of harvesting (Table 2). Operational considerations favor control of stump sprouts soon after development. Treating sites while sprouts are small is faster, easier and requires reduced quantities of less expensive herbicide. This strategy enables control approaching 100 percent and improves cost effectiveness compared to treating sprouts of 1 meter or taller.

This experiment provided the remaining technology to predictably and cost effectively kill unwanted melina reproduction whether from seed or from root collar sprout at all stages of development. Currently, germinants are killed by broadcast application of 2,4-D (1 lb ae/ac). Soon after sprout emergence, basal application of stumps and escaped germinates is made with 2,4-D (25% product). Dicamba/2,4-D(1:3) (40% product) is used to kill residuals.

Table 1. Effectiveness of broadcast herbicide treatments on melina germinates, Puntarenas, Costa Rica, 1997.

			INJURY TO TREATED GERMINATES (PERCENT)*					
HERBICIDE	RATE (LB AE/AC)	MONTHS AFTER APPL.	DEAD OR SEVERELY INJURED	NONE	SLIGHT	SEVERE	DEAD	POST APPLICATION GERMINATS
2,4-D	0.9	1	65	0	35	12	54	22
		2	84	6	10	25	59	
	1.5	1	92	1	8	26	66	8
		2	80	14	7	0	80	
Dicamba/2,4-D	0.1/0.4	1	58	4	69	36	23	0
		2	33	0	87	4	29	
	0.4/1.2	1	66	1	33	8	58	0
		2	87	7	7	27	60	
Triclopyr	0.7	1	69	0	32	11	58	39
		2	69	16	15	6	63	
	1.5	1	76	0	24	18	58	4
		2	72	14	14	36	36	
Glyphosate	0.8	1	87	3	11	28	59	25
		2	62	10	28	7	5	
	1.4	1	97	0	3	37	60	63
		2	100	0	0	25	75	

* Numbers of germinates in plots ranged from 39 to 428.

Table 2. Effectiveness of broadcast herbicide treatments on melina sprouts, Puntarenas, Costa Rica, 1997.

			INJURY TO TREATED GERMINATES (PERCENT)*					
HERBICIDE	RATE (LB AE/AC)	MONTHS AFTER APPL.	DEAD OR SEVERELY INJURED	NONE	SLIGHT	SEVERE	DEAD	POST APPLICATION GERMINATS
2,4-D	0.9	1	7	28	66	7	0	0
		2	33	67	0	33	0	
	1.5	1	7	40	54	7	0	0
		2	0	50	50	0	0	
Dicamba/2,4-D	0.1/0.4	1	8	26	66	8	0	0
		2	34	17	50	17	17	
	0.4/1.2	1	34	26	40	30	5	0
		2	25	0	75	0	25	
Triclopyr	0.7	1	5	50	40	5	0	0
		2	0	100	0	0	0	
	1.5	1	24	67	9	0	24	0
		2	0	67	33	0	0	
Glyphosate	0.6	1	0	100	0	0	0	0
		2	0	60	40	0	0	

* Numbers of sprouting stumps in plots ranged from 14 to 44.

Table 3. ANOVA of variables studied for effect on control by basal treatment of sprouting melina stumps, Salama Farm, Costa Rica, 1998.

VARIABLE	d.f.	SS	MS	F ratio	Probability
Sprout height	2	16849.715	8424.857	16.534	0.000
Herbicide rate	1	5535.324	5535.324	10.863	0.001
Product	2	6510.708	3255.354	6.389	0.002
Imazypyr	1	0598.681	0598.681	1.175	0.280
Evaluation date	2	0733.496	0366.748	0.720	0.488
Error	159	81019.976	509.560		

Table 4. Percent mortality of 50 sprouting melina stumps per treatment two months after basal treatment, Salama Farm, Costa Rica, 1998.*

		PERCENT MORTALITY BY SPROUT HEIGHT		
		25 CM	50 CM	100 CM
2,4-D Ester	50 %	**98**	**100**	43
	25 %	91	38	4
Dicamba/2,4-D(1:3)	10%+30%	25	**94**	**91**
	5%+15%	93	65	21
Triclopyr	20%	83	77	69
	10%	82	65	70

*The least significant range (LSR) in this study is statistically determined at ±10.5 %, Values must differ from each other by 10.5 % or more to be clearly important.

Table 5. Percent control (Mortality + Severe Damage)* of 50 sprouting melina stumps per treatment at two weeks, one month and two months after basal treatment, Salama, Costa Rica, 1998.

		PERCENT CONTROL BY SPROUT HEIGHT								
		25 CM			50 CM			100 CM		
HERBICIDE	PRODUCT QUANTITY	2wk	1mo	2mo	2wk	1mo	2mo	2wk	1mo	2 mo
2,4-D ester	50 %	95	95	98	100	100	100	56	45	65
	25 %	93	97	93	71	55	52	6	4	8
Dicamba/2,4-D	10%+30%	54	33	30	98	93	94	98	94	96
	5%+15%	86	94	99	73	75	73	42	19	44
Triclopyr	20%	81	90	87	71	84	88	73	90	90
	10%	85	93	91	75	70	87	67	77	84

*The least significant range (LSR) in this study is statistically determined at ±10.5 %, Values must differ from each other by 10.5 % or more to be clearly important.

PINE RESPONSE AND VEGETATION CONTROL FOLLOWING MECHANICAL BEDDING AND CHEMICAL SITE-PREPARATION METHODS. D. K. Lauer and B. R. Zutter. School of Forestry, Auburn University, AL 36849-5418.

ABSTRACT

An experiment was installed near St. Augustine, FL to compare slash pine (*Pinus elliottii* Englem.) response to five different site-preparation treatments with and without first-year herbaceous weed control (HC). The soil on the study site is characterized as a somewhat poorly drained spodosol of the Myakka series. The entire area was tandem-chopped followed by a year layover due to wet soil conditions. The five site-preparation treatments were 1) early single bed, 2) early single bed + banded pre-plant (PP) herbicide application, 3) early bed +late bed (double bed), 4) late single bed, and 5) early single bed + broadcast PP herbicide application. Bedding was done with a Rome bedding plow with the early pass occurring on May 23, 1995 and late pass on August 27, 1995. The PP herbicide applications were made on November 14, 1995 and consisted of 0.25 lb ae/ac imazapyr (Arsenal AC®) + 2 lb ae/ac triclopyr (Garlon 4®) + 1.2 oz ai/ac metsulfuron (Escort®) + 0.1% Kinetic® surfactant. The entire study was machine planted February 9, 1996. The first-year HC treatment was an over-the-top application of 0.18 lb ae/ac imazapyr (Arsenal AC®) made on April 24, 1996.

Second-year pine height differed by site-preparation treatment. The early single bed treatment was the poorest performer at 3.1 ft, the late bed and double bed treatments were comparable at 4.0 ft, and the pre-plant treatments were the best performers at 5.0 ft. Second-year height response to HC was negligible for PP treatments, 0.6 ft for the late bed and double bed treatments, and 0.3 ft for the early bed treatments. Double bedding improved pine survival over other treatments (99% vs. 95%) due to improved planting quality.

Pine response was correlated with treatment efficacy. Pine response and first-year vegetation cover was comparable on both the late bed and double bed treatments. PP treatments improved control of redroot (*Lachnanthes tinctoria* (Walt.) Ell.), bracken fern (*Pteridium aquilinum* (L.) Kuhn.), low panic grass (*Dichanthelium* spp.), gallberry (*Ilex glabra* (L.) A. Gray), and saw palmetto (*Serenoa repens* (Batr.) Small) over that achieved by single or double bedding alone. Response to HC combined with single or double bedding was primarily due to control of low panic grass with HC. Combining HC with PP generally did not improve control of first-year herbaceous vegetation because PP treatments already provided good control of herbaceous vegetation. However, the banded PP treatment did not control first-year herbaceous vegetation as well as broadcast PP due to late colonization of bluestem grasses (*Andropogon* spp.) concentrated on bed edges. Lack of response to HC following either banded or broadcast PP suggests that this late colonizing vegetation on bed edges had little effect on early pine response. These results suggest that if HC treatments are applied following PP applications they should be applied later in the first year or early in the second year with the objective of improving second year control of herbaceous vegetation.

COMPARISON OF VARIOUS GLYPHOSATE FORMULATIONS AND TANK MIXTURES FOR SITE PREPARATION. L. R. Nelson, A. W. Ezell and J. L. Yeiser. Clemson University, Clemson, SC; Mississippi State University, Starkville; and Stephen F. Austin State University, Nacogdoches, TX.

ABSTRACT

Herbicide treatments were installed at three locations to evaluate the efficacy of high rates of glyphosate formulated as MON 78300 for forest site preparation. Product was tested alone, in mixtures with imazapyr (Arsenal Applicators Concentrate[7]) and metsulfuron (Escort[7]) and was compared to treatments of glyphosate in Accord7 and MON 52276. Treatments were tested on a Piedmont site in South Carolina and on upper coastal plain sites in Mississippi and Arkansas. Dominant species were water oak, black cherry, hackberry and privet in South Carolina; cherrybark oak, post oak, water oak, willow oak, red maple and sweetgum in Mississippi; and water oak, post oak, sweetgum and loblolly pine in Arkansas. Treatments were applied in late August, 1997 with a CO_2 backpack, pole sprayer to simulate aerial application. Treatments were arranged in a randomized complete block experimental design with three replications. Evaluations included percent foliar brownout of dominant hardwood species eight weeks after treatment and percent reduction in number of hardwood stems twelve months after treatment.

In Mississippi, 8 qt of MON 78300 alone or mixed with one oz product/ac of metsulfuron provided 80% or more initial brownout of all species except red maple at 50%. Mon 78300 was slightly more effective than 8 qts/ac of MON 52276

and provided significantly more brownout than 8 qt/ac of glyphosate in Accord. MON 78300 at 4 qt + imazapyr at 12 oz and MON 78300 at 2 qts + 20 oz product/ac of imazapyr provided less than 45% brownup of all species.

Foliar brownout with MON 78300 at 8 qt and in mixtures with one and two oz/ac of metsulfuron was 100%, more than 90% and 53% or less on black cherry, hackberry and water oak respectively, in South Carolina. Accord at 8 qt product/ac, MON 78300 + imazapyr at 4 qt + 12 oz and MON 78300 + imazapyr at 2 qt + 20 oz product/ac provided significantly less brownout (40% or less) than 8 qt of MON 78300 alone or in mixture with metsulfuron. Percent brownout from treatments in Arkansas followed the same ranking as those in South Carolina.

MON 78300 tank mixtures with imazapyr, MON 78300 at 8 qt alone or tank mixed with 1 oz metsulfuron, and 8 qt MON 52276 provided more than 90% reduction in the number of hardwood stems per acre in Mississippi. Percent stem reduction was significantly less (77%) with 8 qt of Accord. Similar results occurred in Arkansas. In South Carolina MON 78300 tank mixtures with imazaypr provided the lowest percent hardwood stem reduction. Imazapyr resistant species such as elm and hackberry comprised a significant portion of the hardwood stem count.

BROWNOUT RESPONSE TO TANK MIXTURES USING ACCORD AND MON 78300. A. W. Ezell, Department of Forestry, Mississippi State University, Mississippi State, MS 39762, J. L. Yeiser, Arkansas Forest Resources Center, Monticello, AR 71656, and L. R. Nelson, Department of Forestry, Clemson University, Clemson, SC 29634.

ABSTRACT

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.

A total of 11 herbicide treatments were applied and an untreated check treatment was included as a basis of comparison. Each treatment was replicated three times on linear plots 25ft x 100ft. All spray applications were completed with a CO_2-powered backpack sprayer with a pole extension and KLC9 nozzle. Spray volume was 10 gpa.

The treatments were applied to recently-harvested clearcut 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 10ft x 80ft evaluation area centered with the spray treatment plot. Stems were tallied by species and height class. Principal woody species occurring on the study areas include 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. Overall brownout was excellent and site prep burning would be easily accomplished following these treatments. Best results were obtained in treatments 2, 6, 7, 9, and 10, all of which had 90 percent or greater brownout on grasses, broadleaves, and woody vegetation. While slightly lower in woody brownout, treatments 3, 4, and 11 all had brownout response of over 90 percent in herbaceous and over 80 percent in woody stems. While treatments 5, 8, and 12 had less brownout, response was still greater than 70 percent in all categories and is considered acceptable.

A final evaluation of woody stem control will be conducted after the 1999 growing season. Results from all study sites will be analyzed individually and combined for a final report.

List of treatments in 1998 Monsanto field trials.

Treatment No.	Products - Rate/Acre
1	Untreated check
2	MON 78300 + Arsenal AC - (6qts + 2oz)
3	MON 78300 + Arsenal AC - (6qts + 4oz)
4	MON 78300 + Arsenal AC - (6qts + 6oz)
5	MON 78300 - (4qts)
6	MON 78300 - (6qts)
7	MON 78300 - (8qts)
8	Accord + MON 59120 - (4qts + 2.5%)
9	Accord + MON 59120 - (6qts + 2.5%)
10	Accord + MON 59120 - (8qts + 2.5%)
11	MON 78300 + Arsenal AC - (4qts + 12oz)
12	MON 78300 + Escort - (4qts + 1oz)

EARLY-SEASON FOREST SITE PREPARATION WITH IMAZAPYR AND COMBINATIONS OF IMAZAPYR AND GLYPHOSATE OR TRICLOPYR IN OIL EMULSION CARRIER: SECOND-YEAR RESPONSE FOR PLANTED PINES AND ACCOSIATED WOODY AND HERBACEOUS VEGETATION. P. J. Minogue, American Cyanamid, W. Robins, GA and H. E. Quicke, American Cyanamid, Auburn, AL.

ABSTRACT

Operationalscale helicopterapplications were made at fourstudy locations in the southeastern United States to testthree rates of imazapyr alone and combinations of imazapyr plus glyphosate or triclopyr in oil emulsion carrierin comparison to imazapyr in water based carrier plus surfactant. Imazapyr alone at 0.75 lb ae/A in oil emulsion performed well in terms of control of tree forming hardwood, shrub control, and pine response. There was a large improvement in control of tree forming hardwood, shrub control, and pine response for an increase in imazapyr rate from 0.5 to 0.75 lb ae/A. Adding 0.75 lb ae/A glyphosate to 0.75 lb imazapyr improved control of tree forming hardwood, shrub control, and pine response over 0.75 lb imazapyr alone in oil emulsion. Adding 0.38 lb ae/A triclopyr to 0.75 lb imazapyr improved the level of shrub control over 0.75 lb imazapyr alone. Reducing the imazapyr rate to 0.50 lb and increasing the rate of glyphosate or triclopyr in the mix resulted in a decrease in competition control compared to 0.75 lb imazapyr alone. Treatment with 0.5 lb imazapyr plus 1.5 lb ae/A glyphosate resulted in over two-fold more shrub competition than 0.75 lb imazapyr alone and three-fold more shrub competition than for 0.75 lb imazapyr and 0.75 lb glyphosate. There is strong evidence of antagonism for combinations of imazapyr and high rates triclopyr. When applied in oil emulsion, 0.5 lb imazapyr plus 1 lb ae/A triclopyr resulted in over two-fold more tree forming hardwood than with 0.5 lb imazapyr alone and over five-fold more tree forming hardwood than with 0.75 lb imazapyr. Although 0.75 lb ae/A imazapyr in water carrier resulted in good shrub control, this treatment was not as good as 0.75 lb imazapyr applied in oil emulsion carrier in terms of weed free area after one year, control of tree forming hardwood after two years, and pine response.

INTRODUCTION

CHOPPER herbicide is an emulsifiable concentrate formulation of imazapyr. Chopper contains 2 pounds acid equivalent (ae) imazapyr per gallon plus emulsifier. Chopper is formulated to be applied in oil, oil and water emulsion, or water carrier. Chopper applied in oil emulsion carrier increases initial vegetation brownout, particularly for grasses, vines, seedling pines and hardwoods, which may be desired for improving fuel for site preparation burning (2, 3, 8). For low-volume applications (5 gallons per acre, gpa) using oil in water emulsions, the best performance for initial brownout is obtained with oil proportions between 25 and 50 percent of the total carrier volume, depending on oil type (2, 3). A study examining emulsion proportions at 5, 10, 20, and 40 percent of 10 gpa total spray volume applied by mechanized ground sprayer indicated brownout of grasses, broadleaf weeds and vines was not related to oil proportion, whereas brownout of hardwoods increased from 27 to 48% as oil proportion increased (10). Operational experience indicates that for aerial applications at 10 gpa, at least 12 and preferably 25% oil:water should be used where brownout for burning is desired.

Use of oil emulsion carrier improves herbicide absorption by the target vegetation (12) and has been shown to enhance imazapyr performance for control of grasses, trees and shrubs (5, 9). Emulsion carrier improves efficacy for the control of species with thick cuticles such as gallberry and waxmyrtle (6) as well as species which normally require a high imazapyr rate such as hickory and yellow-poplar (5). Emulsion carrier improves imazapyr absorption by reducing surface tension which increases contact area on the leaf, by increasing drying time on the leaf surface fostering greater initial diffusion into the cuticle, by reducing droplet bounce due to greater affinity of oil to the wax, cutin and suberin of the leaf cuticle, and by solvent action to these oil soluble constituents of the cuticle (11). Emulsions improve herbicide dose response, facilitating imazapyr performance in the early-season (full leaf to July) but also improving efficacy in late-season applications (August-September) when application timing is optimum (9).

Oil emulsions also provide application advantages. Oil emulsions provide greater spray deposition efficiency because they have lower rates of evaporation than water carriers. With water carrier, typical evaporation rates in the southeastern United States range from 20 to as much as 50% of the volume applied, whereas with emulsions evaporative losses are typically between 10 and 20% (11). Differences in evaporation potential also effects droplet size. As droplets move toward the target vegetation the mean droplet diameter (MDD) is reduced due to evaporation. Small droplets (<200 micron MDD) are prone to drift away from the target area. Emulsion carrier coupled with the use of controlled droplet application equipment provides greater control of droplet size, reducing the potential for drift.

The objectives of this research were to examine rate response for Chopper and performance of Chopper tank mixtures with glyphosate and triclopyr in oil emulsion carrier during the early-season application period, relative to water based sprays with Arsenal AC. Initial vegetation brownout and first-year results were previously reported in these proceedings (6, 7).

METHODS AND MATERIALS

Operational scale helicopter applications were made at four study locations in the southeastern United States (Table 1). Treatments included three rates of imazapyr as Chopper® (0.5, 0.75 and 1.0 lb ae/A), two imazapyr/glyphosate tank mixes (0.5 lb imazapyr + 1.5 lb ae/A glyphosate, 0.75 lb imazapyr + 0.75 lb ae/A glyphosate), and two imazapyr/triclopyr tank mixes (0.5 lb imazapyr + 1.0 lb ae/A triclopyr, 0.75 lb imazapyr + 0.5 lb ae/A triclopyr). These treatments were applied in 25% oil emulsion carrier using Sun-It II®[1] methylated seed oil. Each study site also included 0.75 lb ae/A imazapyr as Arsenal® Applicators Concentrate applied in water carrier plus 1% (v:v) glycol surfactant.

All applications were made between May 13 and 23, 1995 using controlled droplet booms and nozzles to apply 5 gallons per acre of total spray emulsion. Treatment plots were between 5 and 10 acres, and at least 5 swaths wide. Five permanent 1/40-acre subplots were installed on line transects 2 chains apart in the middle of the center swath. Loblolly pine seedlings were operationally planted across the entire study area in the dormant season following application.

Evaluations included: cover by grasses, broadleaf weeds, vines, *Rubus* and weed free area after one year; a tally of all hardwood, shrub and non-crop pines over 1.5 ft tall by species and height at treatment and one and two years after treatment; pine groundline diameter and height after planting and one and two growing seasons after planting.

Treatment means were compared using planned contrasts to test for: linear or quadratic responses to increasing rates of straight imazapyr; differences between imazapyr/glyphosate and imazapyr/triclopyr tank mixes; and an interaction between imazapyr rate and the tank mix partner. Pine response was analyzed using covariance analysis. Covariates for pine height and groundline diameter two growing seasons after planting were pine height and groundline diameter at planting, respectively.

RESULTS

Weed Cover After One Year

None of the sites received herbaceous weed control treatments following planting. This means that differences in vegetation cover one year after the applications can be ascribed to the site preparation treatments. The largest differences in herbaceous cover were observed in *Rubus* cover (Table 2). Average *Rubus* cover on the treatments with straight imazapyr at 0.5 or 0.75 lb was 13% compared to 4% on the tank mix treatments. However, at a imazapyr rate of 1.0 lb

[1] Registered trademark of AGSCO, Inc.

ae/A, *Rubus* cover was reduced to 6%. There was no overall difference between imazapyr/glyphosate and imzapry/triclopyr tank mixes. *Rubus* cover on the tank mix treatment with 1.0 lb ae/A triclopyr was less than half that on the tank mix treatment with 0.5 lb triclopyr (3% vs. 7%). The average weed free area on the treatments with straight imazapyr at 0.5 or 0.75 lb ae/A was 34% compared to 41% on the tank mix treatments. The tank mix combination of 0.75 lb imazapyr plus 0.75 lb ae/A glyphosate had the most weed free area at 48%.

Table 1. Study locations, physiographic region, and dominant pre-treatment competitors in order of decreasing abundance.

		Dominant pre-treatment competitors	
Location	Region	Arborescent hardwood	Non-arborescent hardwood
Calhoun, Georgia	Piedmont	Sassafras	Sumac
		Black tupelo	Vaccinium
		Persimmon	
		Black cherry	
		Hickory	
		Red oaks	
Great Falls, S. Carolina	Piedmont	Sassafras	Vaccinium
		Yellow-poplar	Sumac
		Red maple	
		Black tupelo	
Bartow, Georgia	Coastal Plain	Sweetgum	Vaccinium
		Red oaks	Sumac
		Black cherry	
		Persimmon	
		Sassafras	
Curtis, Arkansas	Coastal Plain	White oaks	Vaccinium
		Hickory	Sumac
		Red oaks	
		Sweetgum	
		Winged elm	

Arborescent Hardwood Control

The variable used to describe the level of tree forming hardwoods after two years is the sum of the live heights of arborescent hardwood stems over 1.5 ft tall. This variable accounts for hardwood mortality, terminal dieback, resprouting and stunting and has been shown to correlate well with longer term pine growth. Table 2 also provides the number of hardwood stems per acre.

There was a marked improvement in hardwood control as the imazapyr rate increased from 0.5 to 0.75 lb ae/A, with a smaller improvement in hardwood control for a further increase in the imazapyr rate to 1.0 lb (Table 2 and Figure 1).

For the tank mixes there was an interaction between imazapyr rate and the tank mix partner (p=0.049). There was very strong evidence of antagonism between low imazapyr rates and high triclopyr rates. Adding 1.0 lb ae/A triclopyr to 0.5 lb imazapyr resulted in a marked decrease in hardwood control over 0.5 lb ae/A imazapyr alone. Treatment with 0.5 lb imazapyr + 1.0 lb ae/A triclopyr resulted in over two-fold more hardwood than straight imazapyr at 0.5 lb ae/A and over five-fold more hardwood than 0.75 lb imazapyr. Straight imazapyr at 0.75 lb ae/A oz resulted in the same level of hardwood control as 0.75 lb imazapyr + 0.5 lb triclopyr. Species resprouting on the treatment with 0.5 lb imazapyr + 1.0 lb triclopyr included black cherry, dogwood, sweetgum, hickory and red oak. Differences between the imazapyr/glyphosate tank mixes were not as dramatic as those between the imazapyr/triclopyr tank mixes. For the imazapyr/glyphosate tank mixes there was also an improvement in control as the imazapyr rate increased from 0.5 to 0.75 lb ae/A.

Non-Arborescent Hardwood Control

Trends for non-arborescent hardwood levels (shrubs) demonstrate a strong imazapyr rate response (p=0.050). There was a marked improvement in control as the imazapyr rate increased from 0.5 to 0.75 lb ae/A, with a smaller improvement in control with a further increase in the imazapyr rate to 1.0 lb (Table 2 and Figure 2).

There was no interaction between imazapyr rate and the tank mix partner (p=0.704). For both glyphosate and triclopyr tank mixes there was an improvement in shrub control as the imazapyr rate increased from 0.5 to 0.75 lb (p=0.152). Overall, the imazapyr/triclopyr tank mixes provided better shrub control than the imazapyr/glyphosate tank mixes. Noticeable is the excellent shrub control from 0.75 lb imazapyr plus 0.5 lb triclopyr and the poor control on 0.5 lb imazapyr + 1.5 lb ae/A glyphosate. The treatment of 0.5 lb imazapyr + 1.5 lb ae/A glyphosate resulted in two-fold more shrub competition than straight imazapyr at 0.75 lb and three-fold more shrub competition than 0.75 lb imazapyr plus 0.75 lb ae/A glyphosate.

Non-crop pine control

The study was not specifically designed to look at non-crop pine control. The authors suggest that studies of non-crop pine control should consider sampling methods which account for the patchy distribution of natural pine regeneration. The Calhoun site had virtually no non-crop pines present at the initial assessment and two years later. Prior to treatment, the Great Falls site had much higher levels of non-crop pines on plots that ended up being treated with straight Chopper. On the Bartow site, the range in pre-treatment non-crop pine densities was 40 to 680 stems per acre. On the Curtis site the range in pre-treatment non-crop pine densities was 8 to 1080 stems per acre, with the highest densities occurring on plots that ended up being treated with imazapyr/triclopyr tank mixes. Because of the pre-treatment variability, these data could not be used to interpret treatment efficacy in terms of non-crop pine control.

The effect of the non-crop pine on crop pine response was investigated by adding the level of non-crop pine two years after treatment as a covariate in the pine response analysis. The covariate was not significant and resulted in no meaningful differences in the ranking of treatments. While the non-crop pine did not appear to impact crop pine growth after two years, they will certainly have some effect on diameter growth in future years.

Crop Pine Response: Age Two

Site preparation treatments control woody competitors and may also change herbaceous components in the years following treatment . The full impact on pine growth will not be evident for many years because herbaceous competition has a greater impact on pine growth in the early years, while woody competition becomes more important at later ages (13). The treatment effect on pine growth in terms of height and diameter was not significant (p>0.24). However, 0.75 lb imazapyr + 0.75 lb ae/A glyphosate stands out above the rest in terms of pine growth (Table 2). This treatment had the largest weed free area at the start of the first growing season, explaining the early growth response. Because of the excellent shrub and arborescent hardwood control, this treatment is expected to remain a good long-term performer. There was also no treatment effect on pine survival. Survival ranged from 63% to 70%.

Comparison of Chopper to Arsenal Applicators Concentrate

All study sites included a comparison of Chopper in 25% oil emulsion carrier to the standard 0.75 lb ae/A imazapyr as Arsenal® herbicide Applicators Concentrate (Arsenal AC) applied in a water based spray with a glycol surfactant at the rate of 1% of the total spray solution volume. Total spray volume for the Arsenal AC treatment was 15 gallons per acre (Calhoun and Curtis) or 5 gallons per acre (Great Falls and Bartow). Arsenal AC is an aqueous solution containing the isopropylamine salt of imazapyr with 4 lb acid equivalent per gallon. Arsenal AC contains no emulsifiers or surfactants and is formulated to be applied in water based sprays.

Herbaceous components after one year differed between the Arsenal and Chopper treatments. The Arsenal treatment had the most broadleaf, vine and *Rubus* cover of any treatment. Weed free area was 28% compared to a range of 33% to 48% for the Chopper treatments (Table 2). The Arsenal AC treatment also had a higher level of arborescent hardwood competitors compared to straight Chopper at 48 oz or any of the Chopper tank mixes, with the exception of 32 oz Chopper + 1.0 lb ae/A triclopyr. Non-arborecent control on the Arsenal AC treatment was better than straight Chopper at 48 oz and better than any Chopper tank mix, with the exception of 48 oz Chopper + 0.5 lb ae/A triclopyr. This may be due to the higher application volumes, resulting in better penetration of the spray mix through the canopy to the shrub component. Another possibility is that there was better fuel availability with Chopper and Chopper combinations with glyphosate and triclopyr, as burning promotes shrub development (1).

Pine growth on the Arsenal AC treatment was less than that on any of the Chopper treatments. These initial growth differences can be explained by the higher levels of weed free area on the Chopper treatments at the beginning of the first growing season.

CONCLUSION

Imazapyr at 0.75 lb ae/A applied in 25% oil emulsion carrier performed well in terms of control of tree forming hardwood, shrub control and pine response. Adding 0.75 lb ae/A glyphosate to 0.75 lb imazapyr improved control of tree forming hardwood, shrub control and pine response over 0.75 lb ae/A imazapyr alone. Adding 0.5 lb ae/A triclopyr to 0.75 lb imazapyr improved the level of shrub control over straight imazapyr at 0.75 lb ae/A.

Reducing the imazapyr rate to 0.5 lb and increasing the rate of glyphosate or triclopyr in the mix, resulted in a decrease in competition control over tank mixes with 0.75 lb imazapyr. In particular, 0.5 lb imazapyr + 1.5 lb ae/A glyphosate resulted in poor shrub control and 0.5 lb imazapyr + 1.0 lb ae/A triclopyr resulted in poor control of tree forming hardwood. There was strong evidence of antagonism between high triclopyr rates and imazapyr. The hardwood recovery on the 0.5 lb imazapyr + 1.0 lb ae/A triclopyr treatment was not readily apparent one year after treatment. It is, therefore, very important to consider longer term performance when evaluating different treatments.

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Table 2. Control of vegetation components and pine size after two growing seasons.

Treatment	Weed cover after one year		Arborecent hardwood level[1]		Non-arborecent hardwood level[1]		Pine response[2]	
	Rubus	Weed free area	Sum of heights per acre	Stems per acre	Sum of heights per acre	Number per acre	Height[3]	Ground-line diameter[4]
	%	%	*ft*		*ft*		*ft*	*inches*
Chopper® in Oil Emulsion Carrier								
0.50 lb imazapyr	10	35	1151	356	1461	570	3.0	0.79
0.75 lb imazapyr	17	33	482	170	498	218	3.2	0.86
1.00 lb imazapyr	6	39	302	112	408	190	3.0	0.81
0.50 lb imazapyr + 1.50 lb glyphosate	5	40	537	144	1014	434	3.2	0.86
0.75 lb imazapyr + 0.75 lb glyphosate	3	48	374	134	350	156	3.4	0.95
0.50 lb imazapyr + 1.0 lb triclopyr	3	37	2658	680	454	210	3.3	0.86
0.75 lb imazapyr + 0.5 lb triclopyr	7	40	508	172	64	26	3.2	0.83
Arsenal® AC in water carrier								
0.75 lb imazapyr	21	28	690	260	113	48	3.0	0.76

1 Two years after treatment.
2 Two growing seasons after planting.
3 Adjusted by covariance analysis for height at planting.
4 Adjusted by covariance analysis for groundline diameter at planting.

HIGH IMAZAPYR RATES AND TANK MIXES FOR EARLY SEASON FORESTRY SITE PREPARATION.
H. E. Quicke and P. J. Minogue, American Cyanamid Company, Auburn, AL and Warner Robins, GA.

ABSTRACT

Operational experience and formal research efforts indicate that the optimum application timing for control of woody brush with imazapyr improves as we progress through the growing season from May to September. An important factor limiting the efficacy of imazapyr early in the year is epicuticular wax on the leaf. This wax is a significant barrier to absorption of water soluble (polar) herbicides such as imazapyr. In the spring and early summer, the newly formed epicuticular wax of deciduous woody plants provides a continuous covering on the leaf surface. Later, weathering causes the wax covering to break facilitating the absorption of water soluble herbicides. There are several advantages to spring applications: enhancement of fuels for site preparation burns, better availability of applicators, and reduced risk of work being missed at the end of the season. The objectives of this study were to test if early season applications of high rates of imazapyr or tank mixes with glyphosate or triclopyr could compensate for the timing effects.

Operational scale site preparation applications were made at five study locations in the southeastern United States. Treatments included three rates of imazapyr (0.6, 0.9 and 1.2 lb ae/A), two imazapyr/glyphosate tank mixes (0.6 lb imazapyr + 1.125 lb ae/A glyphosate, 0.75 lb imazapyr + 0.75 lb glyphosate), and two imazapyr/triclopyr tank mixes (0.6 or 0.75 lb imazapyr + 1 lb ae/A triclopyr). Imazapyr was formulated as Arsenal® herbicide Applicators Concentrate. Herbicides were mixed with water and applied in 10 gallons total spray solution per acre by helicopter. All applications were made between 5/13/93 and 6/02/93. Treatment plots were between 4 and 10 acres and were at least 5 swaths wide. Five permanent 1/40-acre subplots were installed on line transects 2 to 3 chains apart in the middle of the center swath. Loblolly pine seedlings were operationally planted across the entire study area in the dormant season following application. Evaluations included: cover by grasses and sedges, broadleaf weeds, vines, *Rubus* and weed free area after one year and a tally of all hardwoods over 1.5 ft tall by species and height at treatment and one and two years after treatment. Treatment means were compared using planned contrasts.

For arborescent hardwood control there was no rate effect for straight imazapyr at one and two years after treatment ($p>0.766$). Variability in initial hardwood levels may be responsible. After two years the reduction in sum of hardwood heights per acre expressed as a percentage of initial hardwood levels was 56% for 0.6 lb imazapyr and over 75% for the higher imazapyr rates. At both one and two years after treatment, increasing the rate of Arsenal AC in the tank mix treatments improved hardwood control ($p<0.076$). Imazapyr + glyphosate provided better overall hardwood control than imazapyr + triclopyr ($p<0.062$). Two years after treatment sum of hardwood heights averaged 2,052 ft/A for imazapyr + glyphosate and 3,099 ft/A for imazapyr + triclopyr. Adding 1 lb triclopyr to 0.6 or 0.75 lb imazapyr did not improve control over 0.6 lb straight imazapyr. Adding glyphosate to 0.6 or 0.75 lb imazapyr improved hardwood control over 0.6 lb straight imazapyr, but 0.9 lb straight imazapyr gave the best control with a sum of hardwood heights after two years of 1740 ft/A (78% reduction in hardwood levels relative to pretreatment conditions). Imazapyr + triclopyr was more effective than imazapyr + glyphosate for controlling *Rubus* spp. After two years *Rubus* cover averaged 20% for straight imazapyr, 16% for glyphosate tank mixes and 9 % for triclopyr tank mixes.

After two years, the sum of hardwood heights for all treatments included in this study was over 1,740 ft/A. Even imazapyr rates of 1.2 lb and tank mixes with glyphosate or triclopyr were not sufficient to provide exceptional control of arborescent hardwoods for these May or very early June applications. In contrast, May applications of imazapyr formulated as Chopper® herbicide and applied in an oil emulsion carrier provided very effective hardwood control across four study sites (see Minogue and Quicke in this proceedings). In the early season Chopper study the sum of hardwood heights after two years for the standard Chopper rate of 0.75 lb ae/A applied with 5 qts of oil per acre was 482 ft/A. This is 3.6 fold less hardwood than the best treatment (0.9 lb imazapyr) in the early season Arsenal AC study.

WOODY STEM CONTROL USING SITE PREPARPATION TANK MIXTURES OF DICAMBA. J. L. Yeiser, Stephen F. Austin State Univ., Nacogdoches, TX 75962; L. R. Nelson, Clemson Univ., Clemson, SC 29634 and A. W. Ezell, Mississippi State Univ., Starkville, MS 39762.

ABSTRACT

Timberlands must be managed more intensively if societal demand for wood fiber is to be met. The objective of this study was to screen selected Vanquish treatments in combination with Accord, Arsenal, and Garlon 4 for rapid brownout and reduction of unwanted woody stems on pine sites. A site in each of Arkansas, Mississippi, and South Carolina were tested. A backpack, CO_2 aerial simulator was used to treat unwanted woody stems in 100 ft X 20 ft plots. Species were visually evaluated for percent brownout six weeks after treatment and stem reduction two growing seasons after treatment. Best total reduction of sweetgum, pine and oak in Arkansas resulted from treatments of Accord (6qt) and Vanquish+Garlon 4 (2qt+1qt). Best total reduction of cherrybark oak, water oak and red maple in Mississippi was achieved with Arsenal+Accord (8oz+3qt), Arsenal (24oz), and Vanquish+Arsenal (2qt+12oz). In South Carolina, no differences were detected for water oak. Stem reduction for black cherry and Japanese privet was similar for most treatments with statistical differences occurring between extremes.

INTRODUCTION

Societal demands for more wood fiber continue to increase. If these demands are to be met, timberlands must be more intensively managed than ever before. Research has shown low levels of early competition (<100 hardwood stems per acre at age 3), once thought negligible, to significantly impact pine basal area at age 27. Currently, fire plus herbicidal site preparation is commonly used to provide the low levels of early hardwood competition needed for maximum growth.

Use of fire as a vegetation management tool is decreasing due to societal pressure. Consequently, more information is needed on herbicidal stem reduction, without fire, when preparing sites for planting with genetically improved pine.

OBEJCTIVE

The objective of this study was to screen selected Vanquish treatments in combination with Accord, Arsenal, and Garlon 4 for rapid brownout and reduction of unwanted woody stems on pine sites.

METHODS

A site in each of Arkansas, Mississippi and South Carolina was tested. The test site in Arkansas was in the upper Coastal Plain near Monticello. It supported a natural pine-hardwood stand that was harvested during the summer of 1995. Sweetgum(*Liquidambar styraciflua* L.), mixed red oak (*Quercus nigra* L., *Q. phellos* L., *Q. falcata* Michx.), and natural pine (*Pinus taeda* L.) were the major undesired species occupying the site. At the time early and late treatments were applied, the Wilcox silt loam soil was moderately moist. The Mississippi site was in the upper Coastal Plain approximately seven miles NW of Starkville. The natural pine-hardwood stand was harvested in September of 1996. The major residual undesired woody species were mixed red oaks (*Q. nigra* L., *Q. phellos* L. and cherrybark oak (*Q. pagoda* Raf.)), and red maple (*Acer rubrum* L.). The Adaton silt loam exhibited moderate moisture at the time early and late treatments were applied. The third study area was an upland Piedmont site near Pendleton, South Carolina; it was harvested during the winter of 1995. Black cherry (*Prunus serotina* Ehrh.), Japanese privet (*Ligustrum japonica*) and water oak were the major test species bordering a right-of-way and a mature hardwood stand. At the time early and late treatments were applied, the Cecil sandy loam soil was moist.

A list of test treatments and early and late application dates are presented in Table 1. A CO_2 backpack sprayer was used to apply aerially-simulated, broadcast test treatments. The sprayer supported a single, KLC9 flood nozzle above a 15-ft boom. Test treatments were applied with a single pass across plots. Treatment plots were 100 ft X 30' ft with an internal measurement plot of 80 ft X 10 ft. For all test sites and treatments the surfactant was Timberland 90.

Vegetation cover was classed as grass, broadleaf, hardwood, or pine, and visually evaluated in each plot for percent brownout relative to untreated checks six weeks after treatment. Estimates of brownout ranged from 0% to 100% such that 0% indicated no browning and 100% total browning. Results from brownout evaluations were previously reported (1). Since brownout may or may not indicate total vegetation control, total stem counts for each species within measurement plots were tallied at study initiation. Two growing seasons following treatment, surviving stems were tallied on October 7, September 30 and October 7, 1998 in Arkansas, Mississippi, and South Carolina, respectively.

Twelve plots in Arkansas and Mississippi and thirteen plots in S. Carolina were established in each of three blocks with treatments assigned to plots according to a completely randomized block design. Percent stem reduction was analyzed using analysis of variance with means separated using Duncan's New Multiple Range test. All tests were conducted at the p=0.05 level.

RESULTS AND DISCUSSION

Two growing seasons after treatment, stems of sweetgum in Arkansas were reduced the most when treated with Arsenal (24 oz), Vanquish+Arsenal (2qt+12oz), or Accord (6qt) (Table 2). Percent stem reduction was the least for Vanquish+Garlon 4 (2qt+1qt), Vanquish+Accord (2qt+3qt), Garlon 4 (2qt), Vanquish (2qt), Vanquish+Arsenal (2qt+8oz) or check treatments. Intermediate stem reduction resulted from a treatment of Vanquish+Accord (2qt+4qt). Best reduction of oak stems resulted from treatments of Arsenal (24 oz), Arsenal+Accord (8oz+3qt), Vanquish+Garlon 4 (2qt+1qt), Vanquish+Arsenal (2qt+12oz). Least control resulted from treatments of Accord (6 qt), Vanquish (2qt), Vanquish+Accord (2qt+3qt; 2qt+4qt), Vanquish+Arsenal (2qt+4oz; 2qt+8oz) and the check. Pine stems were reduced the best by Accord (6qt). Pine stem reduction was minimal for several treatments: Arsenal+Accord (8oz+3qt), Vanquish (2qt), Vanquish+Accord (2qt+3qt) Vanquish+Arsenal (2qt+4oz; 2qt+8oz; 2qt+12oz), Garlon 4 (2qt), Arsenal 24oz, and check. Vanquish+Garlon 4 (2qt+1qt) and Vanquish+Accord (2qt+4qt) provided intermediate reduction of pine.

Mixtures of Vanquish with Arsenal or Accord provided greater stem reduction than Vanquish alone (Table 2). For example, Vanquish (2qt) did not reduce sweetgum (0%) or oak (16%) stems below that of the untreated check. First, the addition of Arsenal to the tank with Vanquish (2qt) did little to reduce sweetgum and oak stems until the Arsenal rate of 12 oz was achieved. Second, the addition of Accord to the tank with Vanquish (2qt) enhanced stem reduction of sweetgum at the Accord rate of 4qt. but failed to increase oak stem reduction beyond that of the check. Best total reduction of sweetgum, pine and oak in Arkansas resulted from treatments of Accord (6qt) and Vanquish+Garlon 4 (2qt+1qt).

In Mississippi, cherrybark oak stems were reduced the best with an application of Arsenal (24 oz) and water oak the best with Arsenal+Accord (8oz+3qt) (Table 3). Four treatments provided best stem reduction for red maple (Arsenal+Accord (8oz+3qt), Arsenal (24oz), Vanquish+Arsenal (2qt+12oz), and Vanquish+Garlon 4 (2qt+1qt). Red maple stems were reduced the least by Accord (6qt) and Vanquish (2qt). For Vanquish+Accord mixtures (2qt+0qt, 2qt+3qt, or 2qt+4qt or 0qt+6qt), as the rate of Accord increased, cherrybark oak, water oak and red maple stem reduction increased to intermediate levels of 60%, 63%, and 50% respectively. A rate trend for Vanquish+Arsenal (2qt+0oz, 2qt+4oz, 2qt+8oz, 2qt+12oz, 0qt+24oz) was observed for water oak and red maple with inconsistentcy for cherrybark oak. Best total reductio n of cherrybark oak, water oak and red maple in Mississippi was achieved with Arsenal+Accord (8oz+3qt), Arsenal (24oz), and Vanquish+Arsenal (2qt+12oz).

In South Carolina, no differences in stem reduction were detected for water oak. Differences for black cherry and Japanese privet occurred between extremes levels in stem reduction (Table 4).

In conclusion, no one treatment provided best stem reduction for all test species. Across test sites, Arsenal (24 oz) provided excellent control of oaks, red maple and sweetgum. Pine and privet were best controlled with Accord at 6 qt or 3 qt, respectively.

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Table 1. A listing of the treatments and application dates in Arkansas, Mississippi, and S. Carolina.

			Application Date			
Treatment	Rate (product)	Timing		AR	MS	SC
1) Vanquish	2 qt	early	Jul	7	21	23
2) Vanquish + Accord	2 qt + 3 qt	late	Aug	21	19	20
3) Vanquish + Accord	2 qt + 4 qt	late	Aug	21	19	20
4) Accord	6 qt	late	Aug	21	19	20
5) Vanquish + Arsenal	2 qt + 4 oz	late	Aug	21	19	20
6) Vanquish + Arsenal	2 qt + 8 oz	late	Aug	21	19	20
7) Vanquish + Arsenal	2 qt + 12 oz	late	Aug	21	19	20
8) Arsenal	24 oz	late	Aug	21	19	20
9) Garlon 4	2 qt	early	Jul	7	21	23
10) Vanquish + Garlon 4	2 qt + 1 qt	early	Jul	7	21	23
11) Arsenal + Accord	8 oz + 3 qt	late	Aug	21	19	--
12) Arsenal	8 oz	late	Aug	--	--	20
13) Accord	3 qt	late	Aug	--	--	20
14) Check	----					

[1] For all treatments, total application volume was 10 gallons per acre; the surfactant was Timberland 90.

Table 2. Mean percent woody stem reduction in Arkansas two growing seasons following application. Treatments are ranked according to mean percent total woody stem reduction.

Treatment		Sweetgum	Pine	Oak	Total
Vanquish +Garlon 4	2qt + 1qt	32cdef	29b	48abc	37ab
Arsenal + Accord	8oz + 3qt	66ab	16bcd	53ab	25bc
Vanquish + Arsenal	2qt + 12oz	58abc	8bcd	46abc	25bc
Vanquish + Accord	2qt + 4qt	39bcde	20bc	17cde	24bc
Vanquish + Accord	2qt + 3qt	26cdef	13bcd	24bcde	17bcd
Garlon 4	2qt	22def	15bcd	36bcd	23bcd
Arsenal AC	24oz	73a	+3cd	75a	13cde
Vanquish	2qt	0f	6bcd	16cde	6cde
Vanquish + Arsenal	2qt + 4oz	0f	9bcd	15cde	9cde
Vanquish + Arsenal	2qt + 8oz	8ef	+2cd	6de	2de
CHECK		0f	+11cd	0e	+6e

[1] Plus signs indicate an increase in stems.

[2] Values within a column sharing the same letter are not significantly different (Duncan's New Multiple Range Test p=0.05).

Table 3. Mean percent reduction for woody stems in Mississippi treated with herbicides. Treatments are ranked according to mean percent total woody stem reduction.

Arsenal	24oz	100a	*	100a	85a
Vanquish + Arsenal	2qt + 12oz	38d	73b	100a	76ab
Vanquish + Arsenal	2qt + 8oz	81b	55cd	75b	67b
Vanquish + Accord	2qt + 4qt	48cd	26de	50c	41c
Accord	6qt	60c	63bc	0e	37c
Vanquish + Garlon 4	2qt + 1qt	6e	+11f	100a	20d
Vanquish + Arsenal	2qt + 4oz	12e	33d	50c	17de
Vanquish	2qt	+80g	8e	0e	9ef
Garlon 4	2qt	+33fg	33d	66bc	3fg
Vanquish + Accord	2qt + 3qt	17e	+20f	33d	+3fg
CHECK		+380h	+125g	31d	58h

[1] Plus signs indicate an increase in stems.

[2] Values within a column sharing the same letter are not significantly different (Duncan's New Multiple Range Test p=0.05).

* Species did not occur in treatment plots.

Table 4. Mean percent reduction for South Carolina woody stems treated with herbicides. Means are ranked according to mean percent total woody stem reduction.

Treatment		Mean Stem Reduction[1,2](%)			
		Black Cherry	Water Oak	Privet	Total
Arsenal	24oz	89a	85a	0ab	68a
Vanquish + Accord	2qt + 3qt	90a	55a	+28ab	60a
Vanquish + Accord	2qt + 4qt	83a	61a	69ab	60a
Vanquish + Arsenal	2qt + 12oz	100a	78a	31ab	58a
Accord	3qt	72a	42a	100a	55a
Accord	6qt	25ab	64a	39ab	50a
Vanquish	2qt	78a	33a	+72ab	47a
Vanquish + Arsenal	2qt + 4oz	78a	38a	38ab	43a
Arsenal	8oz	69a	50a	41ab	42a
Vanquish + Arsenal	2qt + 8oz	56a	65a	+136ab	20a
Garlon 4	2qt	17ab	49a	+78ab	7ab
Vanquish + Garlon 4	2qt + 1qt	100a	+11a	+117ab	+26ab
CHECK		+38b	+5a	+165b	+78b

[1] Plus signs indicate an increase in stems.

[2] Values within a column sharing the same letter are not significantly different (Duncan's New Multiple Range Test, p=0.05).

EFFECTS OF APPLICATION TIMING ON BROWN OUT AND FIRST-YEAR WOODY STEM CONTROL USING DICAMBA TANK MIXTURES. L. R. Nelson, A. W. Ezell and J. L. Yieser. Clemson University, Clemson, SC; Mississippi State University, Starkville; and Stephen F. Austin State University, Nacogdoches, TX.

ABSTRACT

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®) tank mixed with imazapyr (Arsenal Applicators Concentrate®), glyphosate(Accord®) and triclopyr(Garlon®). Study sites included a piedmont site near Starr, SC and an upper coastal plain site near Starkeville, MS. Treatments included dicamba @ 2 qt + glyphosate @ 3 qt product/ac, dicamba @ 2 qt + triclopyr @ 2 qt product/ac and dicamba @ 2qt + 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, water oak and sweetgum in South Carolina and red maple, red oak spp. and sweetgum in Mississippi. Evaluations included percent foliar brownout of pines, hardwoods, grasses and forbs at 8 WAT and percent reduction in number of woody stems/ac at 12 MAT.

Significant herbicide treatment and timing effects occurred on hardwoods and grasses in Mississippi. Dicamba mixed with either triclopyr or glyphosate averaged better than 60% brownout on hardwoods compared to the imazapyr tank mix at 30%. Dicamba + glyphosate was the only effective treatment on grasses providing 65% brownout compared to 15 and 18 % for triclopy and imazapyr, respectively. August applications resulted in slightly better brownout of hardwoods than other application dates. July and August treatments provided the best brownout on grasses.

In South Carolina dicamba + triclopyr provided the most effective brownout of black cherry, water oak, and loblolly pine. Significant timing effects showed that June applications to water oak and loblolly pine were more effective than those in July and August. Dicamba + glyphosate was the only treatment with significant activity on grasses.

SITE PREP APPLICATIONS OF DICAMBA MIXED WITH GLYPHOSATE, IMAZAPYR, TRICLOPYR, GLUFOSINATE, AND FOSAMINE - BROWNOUT RESULTS. A. W. Ezell, Department of Forestry, Mississippi State University, Mississippi State, MS 39762 and L. R. Nelson, Department of Forestry, Clemson University, Clemson, SC 29634.

ABSTRACT

In a continuing effort to evaluate the use of dicamba in forestry site prep work, various tank mixtures of Vanquish and other forestry herbicides were applied to a recently-harvested area. Both woody stem control and brownout response will be evaluated.

A total of ten treatments were utilized in the study (Table 1). Plot installation was in RCB design. Plot layout was a 25ft x 100ft linear plot marked with metal rebar center posts. Nylon string was stretched between the rebar, and the sample area of 10ft x 80ft was centered in the treatment. All treatments were replicated three times.

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 will be evaluated in 1999 to determine woody stem control.

The study was installed on land owned by The Timber Company in Mississippi. The site is representative of upper coastal plain, and the previous stand had been mixed pine hardwoods. In South Carolina, the study was installed on land owned by Bowater with the site being representative of the Piedmont.

Overall, only Treatment 6 (Vanquish + Arsenal + Accord) gave good brownout on the grasses in Mississippi. This is partially due to the species present and coverage afforded by taller vegetation (especially broadleaf herbaceous). All treatments work very well on broadleaves but Treatment 6 was best. In woody stems, Treatment 6 was best and Treatment 3 (Vanquish + Garlon 4), Treatment 5 (Vanquish + Arsenal + Garlon), and Treatment 7 (Vanquish + Arsenal + Finale) gave good brownout on the oaks, red maple, and sweetgum.

In South Carolina, both Treatments 6 and 7 resulted in good brownout on grasses. For the hardwoods on that site, Treatments 3, 5, and 7 resulted in the best brownout on black cherry, sweetgum, and plum. Treatment 7 and Treatment 8 (Vanquish + Krenite) gave best brownout on pine. Overall, Treatment 7 gave the best brownout on woody.

In summary, brownout may vary by species present, but overall it appears that the mixtures of Vanquish + Arsenal + Accord (Treatment 6) or Vanquish + Arsenal + Finale (Treatment 7) offer the best results.

Table 1. List of treatments in 1998 Novartis forestry site prep field trials - Mississippi.

Treatment No.	Herbicide Product and Rate/A
1	Vanquish (2qts) + Arsenal (16oz)
2	Vanquish (2qts) + Arsenal (10oz)
3	Vanquish (2qts) + Garlon 4 (2qts)
4	Vanquish (2qts) + Accord (3qts)
5	Vanquish (2qts) + Arsonal (10oz) + Garlon 4 (1qt)
6	Vanquish (2qts) + Arsenal (10oz) + Accord (2qts)
7	Vanquish (2qts) + Arsenal (10oz) + Finale (1qt)
8	Vanquish (2qts) + Krenite (3qts)
9	Vanquish (2qts) + Arsenal (10oz) + Krenite (2qts)
10	Untreated check

TWO-YEAR RESPONSE OF HARDWOODS TO MIDROTATION VEGETATION CONTROL AND FERTILIZATION IN THE ALABAMA PIEDMONT. B. R. Zutter, School of Forestry, Auburn University, Auburn, AL 36849-5418.

ABSTRACT

In 1995, the Auburn University Silvicultural Herbicide Cooperative (AUSHC) and the North Carolina State University Forest Nutrition Cooperative (NCSFNC) developed a study to examine the response of southern pine stands to operational midrotation vegetation control and fertilization across a wide variety of sites and levels of competing vegetation. Two-year response of hardwoods to these treatments is summarized herein and pine response reported by Albaugh (same volume) from the first of eleven study sites established across the South through 1998.

The study site is located in the Piedmont of Alabama in Tallapoosa County. Soils are classified a Pacolet sandy loam (eroded). Loblolly pine (*Pinus taeda* L.) had been hand planted on the study site in 1986 following chop and burn site preparation of a harvested natural mixed-pine hardwood stand. At study initiation the loblolly pine stand was 10-years-old. Hardwood basal area averaged 12 ft^2 ac^{-1}, about 15% of the total stand basal area. Sweetgum (*Liquidambar styraciflua* L.) and water oak (*Quercus nigra* L.) comprised over 75% of the hardwood basal area.

Two levels of vegetation control (none, treated) and two levels of fertilization (none, treated) were established in a randomized complete block design with three blocks. Vegetation control consisted of an application of 0.50 lb ae ac^{-1} imazapyr (16 oz ac^{-1} Arsenal AC) plus 0.6 oz ac^{-1} sulfometuron (1 oz. ac^{-1} Escort) in water by helicopter at 15 GPA on September 19, 1995. Fertilizer was applied by hand at a rate of 200 lb ac^{-1} elemental N and 50 lb ac^{-1} elemental P (urea and DAP) in April, 1996. Hardwood rootstocks were assessed prior to treatment and two growing seasons after treatment. Species, height class (1 ft) and dbh class (0.5 in) of each stem greater than 4.5 ft in height were noted for each living rootstock. All stems in a rootstock 12 ft or greater in height were tagged with a numbered metal tag.

No interaction was noted between vegetation control and fertilization on hardwood two growing seasons after treatment. Vegetation control significantly reduced hardwood competition. Stem density, stand basal area, and stand volume index were 74%, 77%, and 82% lower, respectively, with vegetation control. Hardwoods surviving the vegetation control treatment were nearly 4 ft shorter in height.

The magnitude of differences due to fertilization (in the absence of vegetation control) were small compared to those noted for vegetation control and usually not statistically significant. Positive trends in height, dbh, stem basal area, and stem volume were observed for tagged hardwoods (12 ft or greater at the time of treatment) with fertilization. The magnitude of response to fertilization appeared to increase with increasing initial hardwood size.

TWO-YEAR RESPONSE OF LOBLOLLY PINE TO MIDROTATION VEGETATION CONTROL AND FERTILIZATION IN THE ALABAMA PEIDMONT. T. J. Albaugh, College of Forest Resources, North Carolina State University, Raleigh, NC 27695-8008.

ABSTRACT

The desire for improved productivity in mid-rotation pine plantations has focused interest on understanding the growth limiting resources (light, moisture, nutrient) of these stands and in developing silvicultural tools which may be used to ameliorate these limitations. We wanted to quantify the magnitude and duration of pine and competing vegetation response to vegetation control and fertilization on a wide variety of sites and competing vegetation conditions. To accomplish this goal three replicates of a two by two factorial design experiment with vegetation control (none and operational vegetation control) and fertilization (none and operational fertilizer application) as the main effects were installed in a 10 year-old loblolly pine (*Pinus taeda*) stand in the Piedmont of Alabama. The operational vegetation control was 0.50 lb ai/ac imazapyr (16 oz/ac Arsenal AC) with 0.60 oz ai/ac sulfometuron (1 oz/ac Escort) applied by helicopter September 19, 1995 at a rate of 15 gpa. The operational fertilization was 200 lbs/ac of elemental nitrogen and 50 lbs/ac of elemental phosphorus applied by hand in April, 1996 as urea and diammonium phosphate.

Treatment response was assessed for foliar nutrition one and two years after treatment and for four growth parameters two years after treatment. The foliar N concentration response relative to the untreated check one year after treatment was –2%, 19%, and 19% for vegetation control (VC), fertilization (F), and vegetation control plus fertilization treatments (VC+F), respectively. Foliar N concentration response relative to the untreated check was 1%, 5% and 8% in VC, F, and VC+F treatments, respectively, after two years. Foliar P concentration response to treatment increased through time so that at the end of the second year after treatment imposition foliar P concentrations were 7%, 17%, and 12% greater in the VC, F, and VC+F treatments, respectively, when compared to the untreated check. At the end of the second year following treatment, the concentrations of calcium and magnesium in the foliage were reduced relative to the untreated check in the F (-19%, -7%, respectively) and VC+F (-25% and –17%, respectively) treatments. In the VC treatment calcium and magnesium foliar concentrations were increased relative to the untreated check by 14% and 5%, respectively. Two years after treatment imposition, diameter response relative to the untreated check was 1%, 14% and 37% in VC, F, and VC+F, respectively. Average height response relative to the untreated check for the same time period was -9%, 8% and -2% in VC, F, and VC+F treatments, respectively. Basal area growth response relative to the untreated check was –7%, 9%, and 29% in the VC, F, and VC+F treatments, respectively. Volume growth response relative to the untreated check was –12%, 9%, and 13% in the VC, F, and VC+F treatments, respectively.

Foliar nutrient responses follow the patterns observed in previous studies. Fertilization alone had a positive impact on all the growth parameters we examined. The negative height response to vegetation control was statistically significant but should be considered in light of other evidence. Previous studies have found that treatment response is dependent upon the time elapsed since treatment. Height growth in the vegetation control treatment may increase relative to the untreated check in later years. Also, changes in the timing (apply fertilizer before vegetation control) and application method (under the canopy rather than over the top) may reduce the negative effects of vegetation control. Finally, since the combination of fertilization and vegetation control resulted in a positive synergistic effect for diameter, basal area and volume, vegetation control may be an important part of a silvicultural *system* used to improve growth in mid-rotation stands. Possible mechanisms for the synergistic effect when combining the two treatments include improved fertilizer use efficiency and greater nutrient availability in the pines. These results indicate that nutrition may be the factor limiting stand growth in mid-rotation plantations.

IMPACT OF FERTILIZATION AND VEGETATION CONTROL ON UNDERSTORY HARDWOOD GROWTH IN A MID-ROTATION LOBLOLLY PINE PLANTATION IN SOUTHWEST ARKANSAS. F. G. Fallis, Weyerhaeuser Company, DeQueen, AR 71832.

ABSTRACT

Understory hardwood growth, density and species change were measured for five years following operational fertilization and vegetation control treatments in a mid-rotation loblolly pine plantation. The study was located in seventeen-year-old loblolly pine plantation near Dierks, AR that had been commercially thinned. Objectives of the study were 1) to measure the impact of operational fertilization and vegetation control treatments applied alone and in combination on loblolly pine and understory hardwood growth, 2) track over time the change in hardwood species, density and growth and 3) evaluate application timing of vegetation control treatments following commercial thinning.

Five growing seasons after treatment hardwood basal area had increased 66 and 52% while hardwood stems/acre increased 24 and 32% on the fertilization and control treatments respectively. When vegetation control treatments were applied alone or with fertilization, hardwood basal area decreased 38-64% and hardwood stems/acre decreased 18-52% over the five-year period. Vegetation control applied two growing seasons after thinning resulted in better hardwood control than applications made one growing season after thinning

RESPONSE OF A MIDROTATION PINE STAND TO APPLICATION OF HEXAZINONE. B. R. Zutter, School of Forestry, Auburn University, Auburn, AL 36849-5418.

ABSTRACT

Most pine stands receiving midrotation vegetation control are presently treated using imazapyr. With proper prescription, hexazinone may also be effective in reducing woody competition in such stands. In 1980, a study was installed in a 12-year-old slash pine stand on an excessively drained site in Chesterfield County, South Carolina to examine the effectiveness of hexazinone in reducing woody competition and pine growth in response to decreased woody competition.

Treatments included three pelleted formulations of hexazinone (Velpar Gridball): 2cc, 1cc, and ½ cc pellets (20% ai), and an untreated check. A rate of 1.4 lb ai ac^{-1} of hexazinone was prescribed for the site based on the loamy sand texture of the surface soil. Pellets were applied on a grid spacing with the spacing adjusted by pellet size in order to yield the prescribed rate of hexazinone. Treatments were replicated four times in a randomized complete block design. Survival, height, and dbh of pines were assessed pre-treatment and four growing seasons after treatment. Shrubs and hardwoods were assessed pre-treatment (groundline diameter, rootstock height, density), one growing season after treatment (crown reduction), and four growing seasons later (dbh, stem height (hardwoods), rootstock height (shrubs), density). Turkey oak (Quercus laevis L.) and Vacciniumspp. were the only hardwood and shrub competitors observed on the study plots.

No significant differences were noted among the hexazinone formulations in effects on hardwood or pine response. First-year crown reduction of turkey oak averaged over 90% with hexazinone treatment. No significant crown reduction of *Vaccinium* spp was noted. Average stem density and basal area of turkey oak with hexazinone treatment were 35% and 20%, respectively, of that on the untreated check four growing seasons after treatment. Abundance of *Vaccinium* spp. did not differ by treatment. Hexazinone treatment had no effect on four-year pine height growth. However, pine mean dbh, stand basal area, and stand volume increased significantly with hexazinone treatment. The increase in stand volume increase was approximately 1/3 cord ac^{-1} yr-^{1} over the four-year response period.

PINE RESPONSE AND HARDWOOD DEVELOPMENT AFTER BRUSHSAWING AND MANUAL HERBICIDE RELEASE OF LOBLOLLY PINE. R. L. Muir Jr., D. K. Lauer, G. R. Glover, School of Forestry, Auburn University, AL, and J. H. Miller, Southern Research Station, USDA Forest Service, Auburn, AL.

ABSTRACT

Treatment plots were 0.2 ac in size and included two 8 x 50 ft competition measurement plots (CMP) and a 0.1 ac pine measurement plot (PMP). Pines, which were 3 years old when the study was installed, were measured on PMP's initially and 1, 2, 3, 5 and 9 growing seasons after treatment (GSAT). A 100 percent hardwood tally was done on the PMP's for rootstocks taller than 4.5 ft at 2, 5, and 9 GSAT.

Treatments consisted of herbicide applications, the use of a brushcutter to cut down hardwoods, and an untreated check. The herbicide treatments compared two backpack application methods (directed foliar vs. streamline basal) and two herbicides (imazapyr vs. triclopyr) for a total of four different herbicide treatments. The two brushcutter treatments compared cutting the hardwoods with or without a wick application of herbicide (2, 4-D + picloram) to the cut surface. Only woody competition greater than 2 ft in height was treated or cut. The brushcutter treatments used a Shindaiwa B-45 Brush Cutter fitted with a P.J. Brush Blade equipped with chain-saw teeth. Hardwoods were cut at approximately 1 ft above the ground to aid in location by the herbicide applicator or at 6 in. when cutting alone was used.

A sub-sample of hardwood rootstocks > 2 ft in height were measured initially and 2 years after treatment for efficacy determination. Only the herbicide treatments increased percent control compared to the check. Negative percent control values are possible because the number of hardwood rootstocks can increase through time from ingrowth of seedlings or sprouts. Percent control averaged 27, -12, and -57 percent from herbicide, brushcut, and check main effects, respectively. There was a significant interaction between method and type of herbicide application (p=0.051) because

triclopyr was best applied to basal bark and imazapyr performed best applied as a foliar spray. These two treatments provided the best control of all treatments with an average percent control of 53.

Although treatment efficacy varied, the number of rootstocks taller than 4.5 ft 2 GSAT was less than the check for all treatments and of similar magnitude for herbicide and brushcut treatments. Number of rootstocks following brushcutting did not differ from the check 5 GSAT. Herbicide treatments had less rootstocks than the check and the imazapyr foliar and triclopyr bark treatments had the least rootstocks of all treatments 5 GSAT. Although the trends remain, number of rootstocks did not differ 9 GSAT because rootstocks decreased on the brushcut and check treatments, and increased on the herbicide treatments between years 5 and 9.

Hardwood basal area differed from the check but was similar among all treatments 2 and 5 GSAT. Although rootstock numbers were high following brushcutting, hardwood sprouts were short and accounted for little basal area. Hardwood basal area continued to increase with age for all treatments and only the herbicide treatments reduced hardwood basal area 9 GSAT.

Analysis of covariance was used to reduce variation due to differences in initial number and height of pines. Pine dbh, stand basal area, and stand volume were increased by all hardwood control treatments. Response through age 12 (9 GSAT) was of similar magnitude for the two brushcutter treatments and the 4 herbicide treatments. Increases in age 12 pine basal area were 13.9 and 10.9 ft^2 ac^{-1} greater than the check (check=70.6 ft^2 ac^{-1}) for the average of the 4 herbicide and 2 brushcut treatments, respectively. There were no significant differences in response between application method (foliar vs. bark) or herbicide used (imazapyr vs. triclopyr). Use of a herbicide stump treatment following brushcutting did not improve response over brushcutting alone. There was no response in average height of dominant and co-dominant pine trees from any treatment.

Pine volume did not differ among the treated plots at age 12. Age 12 pine volume increases were 263 and 233 ft^3 ac^{-1} greater than the check (check=1220 ft^3 ac^{-1}) for the average of the 4 herbicide and 2 brushcut treatments, respectively. Pine response, which was comparable among all treatments, was better correlated with hardwood basal area (size) than with number of rootstocks. However, hardwood basal area began to diverge among treatments between age 9 and 12, and this may impact pine volume at future ages.

CHEMICAL CROP TREE RELEASE IN CENTRAL WEST VIRGINIA. J. D. Kochenderfer, S. M. Zedaker, J. E. Johnson, D. W. Smith, and G. W. Miller, Department of Forestry, Virginia Polytechnic Institute and State University, Blacksburg, VA and Northeastern Forest Experiment Station USDA Forest Service Parsons, WV.

ABSTRACT

Repeated partial cutting in the Appalachian hardwood region has often favored the development of tolerant species like American beech (<u>Fagus</u> <u>grandifolia</u> Ehrh.) and stands with a high proportion of cull trees. Crop tree release is a widely recommended practice to improve species composition and growth rates in these unevenaged structured stands. Chemical control offers some distinct advantages from the standpoint of safety and residual stand damage, over mechanical methods. Control of American beech was the primary focus of this study. Beech is a low value timber tree, normally considered difficult to control, that is a major competitor to more valuable trees, especially on better sites in the Appalachians.

Research plots were established in hardwood stands at three locations in central West Virginia to evaluate the effectiveness of glyphosate (Accord), imazapyr (Arsenal AC and Chopper), and triclopyr (Garlon 3A and Garlon 4) using the hack-and -squirt application method and low volume basal spray treatments. In the injection treatments 1.5 ml of solution was used per inch of diameter (dbh). Three ml of solution were used per inch of diameter in the basal spray treatments. The following concentrations were used: Accord (65.2%), Arsenal AC (7.5%), Garlon 3A (50%), Garlon 4 (26.25%), and Chopper (6.25%). These concentrations were determined by using the highest costing injection and basal treatment at the lowest recommended labeled rate as standards, Garlon 3A and Chopper respectively. Eighteen 0.1 acre plots were systematically located at each study site where crop trees were present and to maximize the number of American beech on each plot. Crop trees, mostly black cherry (<u>Prunus</u> <u>serotina</u> Ehrh.) were chosen on a 0.025 acre

subplot established at each plot center. All beech two inches and larger on the 0.1 acre plots and competing trees touching crop trees were treated in June 1998. The treatments were evaluated in September of 1998. A numerical rating system ranging from 1-7, (0-100% crown affected), which utilized visual symptoms, was used to evaluate the efficacy of each treatment. Trees receiving a rating of 5 (75 % crown control) or greater were considered controlled. The relationship between the kinds of herbicide, application method, and numerical rating were analyzed by means of one-way analysis of variance with a incomplete random factorial design.

The most effective treatments were the Accord and Garlon 3A injection treatments. Average beech crown control ranged from 94-99% for Accord to 95-98% for Garlon 3A across all study sites. The basal spray treatments were not effective, with average crown control ranging from 1-9%, across all study sites. No adverse treatment effects were observed on any crop trees. The cost effectiveness based on treatment costs and the amount of basal area (BA) controlled were averaged for all study sites. The average treatment costs expressed in dollars/ft^2 BA controlled were as follows: Accord ($1.09), Garlon 3A ($1.15), Arsenal AC ($1.81), Garlon 4 ($19.43), and Chopper ($83.72). Final evaluation of the treatments will be made in June 1999.

JAPANESE HONEYSUCKLE CONTROL IN A MINOR HARDWOOD BOTTOM OF SOUTHWEST ARKANSAS. J. L. Yeiser, College of Forestry, Stephen F. Austin State Univ., Nacogdoches, TX 75962.

ABSTRACT

When hardwood canopies on well drained bottomland sites are removed, Japanese honeysuckle (Lonicera japonica Thunberg.) aggressively responds to release, pulling over and over-toping hardwood reproduction. Once overtaken, oak seedlings require several years to recover from suppression. The objective of this study was to assess efficacy of June-applied foliar treatments of selected herbicides on honeysuckle and oak reproduction growing under a full, mixed hardwood canopy and in a young hardwood clearcut in the Little Missouri River bottoms of SW Arkansas. For honeysuckle and perennial weed control in a four-year-old clearcut, the 0.5 oz/a rate of Escort provided the best combination of high weed control and low damage to oak reproduction. For treatment of honeysuckle in a 40-year-old bottomland hardwood stand, Accord (1.5% vol/vol) and Escort (0.5, 0.75, 1.5 oz/a) appear promising.

INTRODUCTION

Oaks represent a large and important component of major and minor bottomland forests throughout the eastern deciduous forest. Japanese honeysuckle (honeysuckle) is a common understory associate with cherrybark, Shumard and water oaks (Quercus pagoda Raf., Q. shumardii Buckl., Q. nigra L.), especially on better-drained, more productive bottoms. There, Japanese honeysuckle poses little problem until harvests thin or remove the canopy. Japanese honeysuckle aggressively responds to release, pulling over and overtopping hardwood seedlings. Once overtaken, oak seedlings require several years to recover from suppression. In extreme cases, oak density is reduced or lost with soft hardwoods invading the site.

Japanese honeysuckle is a noxious, exotic plant of major proportions throughout the Southeast (2), including pine stands (1,2,3,4). Some current recommendations for honeysuckle control include 2 oz ai/a of metsulfuron (Escort) in May in Georgia with pine tolerance (2) or 1.5% v/v foliar sprays of glyphosate (Accord) in Delaware (5). Recommendations for oak seedling release from Japanese honeysuckle are unavailable and needed.

The objective of this study was to assess efficacy of June-applied foliar treatments of selected herbicides on (1) Japanese honeysuckle growing under a full hardwood canopy (no oak reproduction), and (2) Japanese honeysuckle and oak reproduction in a four-year-old hardwood clearcut, both in the Little Missouri River bottoms of SW Arkansas.

METHODS AND MATERIALS

The study was established on a minor hardwood bottom in Clark County in SW AR near Arkadelphia. Site one was clearcut during the summer of 1992. The site was direct seeded with cherrybark oak acorns in the winter of 1993 with a germination rate of 300 seedlings per acre in the summer of 1993. However, other species of volunteer red oak made up most of the woody species present. Site two was located adjacent to site one and supported a full canopy of 35-40 year old mixed hardwoods including oak, hickory (Carya spp.) and ash (Fraxinus spp.) species. No oak reproduction was present on site two.

The study layout was a randomized complete block design with three blocks on each site. Each block on site one contained seven treatment plots and site two contained eight treatment plots. Each treatment plot was 40' X 20' and contained an internal 20' X 10' measure plot. Two randomly placed subplots were located within each measurement plot. A 10' buffer was established and maintained between each treatment plot.

A CO_2-pressurized hand-held backpack sprayer was used to apply all herbicide treatments. Herbicides were mixed with water until the total volume was 30 gal/ac and applied to each plot using a gunjet with a 4020 nozzle at 20 psi. All treatments were applied on June 24, 1996 as a foliar application with no effort to avoid spraying oak reproduction. Test treatments and their cost are presented in Table 1.

Treatment plots were visually evaluated at 6 weeks after treatment (WAT) and 12 WAT for percent total herbaceous ground cover and percent Japanese honeysuckle cover with results previously reported (1). Visual evaluations of percent total herbaceous ground cover and percent Japanese honeysuckle cover were also recorded after two and three growing seasons. Visual evaluations were recorded in 10% intervals where 0 equaled exposed ground and 100 equaled totally covered ground. Herbaceous vegetation common to plots in the clearcut included rushes (Juncus effusus L., J. coriaceus Mack.), goldenrod (Solidago spp.), caric sedges (Carex spp.), asters (Aster spp.), bog hemp (Boehmeria cylindrica (L.) Sw.), sugarcane plumegrass (Erianthus giganteus (Walt.) Muhl.) and blackberry (Rubus spp.). Under the full canopy, common herbaceous plants were broad beech fern (Phegopteris hexagonoptera (Michx.) Fee), and wood nettle (Laportea canadensis (L.) Wedd.). Honeysuckle was also evaluated by counting the number of foliated strands inside two, 2' X 2' squares randomly located in each measurement plot.

Twelve WAT oaks on the clearcut site were visually assessed for herbicide tolerance with damage expressed as percent crown brown-out. These results were previously reported (1). Oaks within each measurement plot were measured for total height and ground line diameter at study onset and after one, two and three growing seasons.

Data were analyzed using an analysis of variance procedure of SAS with means separated according to Duncan's New Multiple Range test (3). All tests were conducted at the p=0.05 level.

RESULTS AND DISCUSSION

In the clearcut, percent honeysuckle cover was greatest in the untreated check and it increased each study year (Table 2). Of the treated plots, Transline had the highest numerical level of honeysuckle each study year, although 1996, 1997, and 1998 levels were statistically similar for several treatments. After three growing seasons, only Escort (1.5oz) significantly reduced percent honeysuckle cover below that of the untreated check. Percent strands of honeysuckle increased on each treatment plot for each study year. For 1996 and 1997, honeysuckle strands were greatest on plots of the untreated check, followed by Transline (1.3 pt), and then by all other treatments. Significant recovery occurred during the third growing season. Honeysuckle strands approached 50% of the pretreatment levels on Escort 0.5oz and Tordon K+Garlon 3A (1pt+1qt, 1pt+1pt) treated plots and approximately 40% for Escort (0.75, 1.5oz) treated plots.

Differences were detected for oak survival and height growth (Table 3). Oak survival was least on plots treated with Tordon K+Garlon 3A (1pt+1pt, 1pt+1qt). Survival on Transline (1.3pt) and Escort (.5, .75. 1.5oz) treated plots was similar to that of the untreated check. Numerically, height growth decreased as the rate of Escort or Garlon 3A increased although Escort (.5, .75), Transline and the untreated check were statistically similar (Table 3). Oaks growing on plots treated with Tordon K+Garlon or Escort (1.5oz) were shorted in height after three growing seasons than when the study started.

Under the full hardwood canopy, all treatments reduced the percent honeysuckle cover to low levels for the duration of the study (Table 4). Percent strands of honeysuckle were also reduced during 1996, but then increased in number during the second and third growing seasons. Discrepancies in these parameters probably result from the low physiological activity and the litter coverage of the honeysuckle that makes visual plot assessments difficult. Strand data suggests a network of honeysuckle remains and thus the original potential threat to reproduction remains as well.

In conclusion, treatments for Japanese honeysuckle on the clearcut site provided oak release for two growing seasons before significant recovery occurred. Oak survival and height growth were best for Transline (1.3 pt) and Escort (0.5, 0.75) plots. When a full canopy was present, all test treatments provided excellent visible reduction of honeysuckle cover. Honeysuckle strands hidden by leaf litter, were present throughout the study. This suggests the potential for honeysuckle expansion following a harvest remains. More work is needed to find a more efficacious treatment with greater oak tolerance.

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Table 1. 1996 Cost per treated acre of herbicide treatments.

Treatment	Cost per Treated Acre[1]
Escort 0.5 oz/a	$8.38
Escort 0.75 oz/a	$12.56
Escort 1.5 oz/a	$25.13
Tordon K 1.0 pt/a + Garlon 3A 1.0 pt/a	$18.06
Tordon K 1.0 pt/a + Garlon 3A 1.0 qt/a	$25.81
Transline 1.3 pt/a	$45.71
Accord 1.5% vol/vol[2]	$22.05

[1]Costs for Escort were figured from the retail price for 8X8 ounce containers and all others from 2X2.5 gallon containers.
[2]Only on site two, under the full hardwood canopy.

Table 2. Development of Japanese honeysuckle one (1996), two (1997), and three (1998) growing seasons after treatment in a four-year-old clearcut along a minor river bottom in SW Arkansas. Initial levels were recorded on June 24, 1996. Japanese honeysuckle strands are expressed as a percent of initial pretreatment levels.

Treatment[1,2]		Percent Honeysuckle Strands			Treatment[1,2]		Percent Honeysuckle Cover		
		1996	1997	1998			1996	1997	1998
Check	35	114a	136a	163a	Check	22	27a	37a	47a
Transline 1.3 pt	49	29b	40b	83b	Transline 1.3 pt	30	15ab	3b	30ab
Escort 1.5 oz	33	7c	5c	39c	Escort 1.5 oz	20	0c	0b	12b
Escort 0.5 oz	47	7c	8c	51bc	Escort 0.5 oz	47	3bc	1b	18ab
K+3A 1 pt 1qt	31	2c	8c	50bc	K+3A 1 pt 1qt	30	2bc	2b	20ab
K+3A 1 pt 1pt	36	1c	7c	54bc	K+3A 1 pt 1pt	40	1c	3b	20ab
Escort 0.75 oz	33	0c	1c	37c	Escort 0.75 oz	35	1c	1b	17ab

[1] Total application volume was 30 GPA. K=Tordon K; 3A=Garlon 3A.
[2] Means within a column sharing a letter are not significantly different (Duncan's New Multiple Range Test, p=0.05).

Table 3. Survival (%) and height (ft) growth three growing seasons after treatment of a four-year-old clearcut along a minor river bottom in SW Arkansas for Japanese honeysuckle.

Treatment	Survival	Height Growth
Transline 1.3 pt	89a	3.9a
Check	84a	4.2a
Escort .5 oz	78a	1.7ab
Escort .75 oz	67ab	1.5ab
Escort 1.5	44ab	-1.1b
Tordon K+Garlon 3A 1pt+1qt	41bc	-0.5b
Tordon K+Garlon 3A 1pt+1pt	33c	-0.4b

[1] Total application volume was 30 GPA.
[2] Means within a column sharing a letter are not significantly different (Duncan's New Multiple Range Test, p=0.05).

Table 4. Japanese honeysuckle development one (1996), two (1997), and three (1998) growing seasons after treatment under the full canopy of a 35-40 year-old bottomland hardwood stand along a minor river bottom in SW Arkansas. Initial levels were recorded on June 24, 1996. Mean percent foliated Japanese honeysuckle strands are expressed as a percent of initial pretreatment levels.

	Percent Honeysuckle Strands					Percent Honeysuckle Cover			
Treatment[1,2]	Initial	1996	1997	1998	Treatment[1,2]	Initial	1996	1997	1998
Check	12	98a	109a	115a	Check	67	22a	20a	25a
Transline 1.3 pt	8	56ab	91ab	114a	Transline 1.3 pt	48	1b	1a	4a
Escort 1.5 oz	8	5b	5c	8b	Escort 1.5 oz	37	1b	1a	2a
Escort 0.5 oz	11	6b	9bc	35ab	Escort 0.5 oz	43	1b	1a	4a
K+3A 1 pt 1qt	8	23b	56abc	107a	K+3A 1 pt 1qt	40	1b	12a	17a
K+3A 1 pt 1pt	16	6b	87abc	113a	K+3A 1 pt 1pt	58	1b	1a	5a
Escort 0.75 oz	13	10b	20bc	44ab	Escort .75 oz	47	0b	1a	1a
Accord 1.5%	22	41ab	53abc	53ab	Accord 1.5%	70	1b	0a	0a

[1] Total application volume was 30 GPA. K=Tordon K; 3A=Garlon 3A.
[2] Means within a column sharing a letter are not significantly different (Duncan's New Multiple Range Test, p=0.05).

SOIL NITROGEN RESPONSE TO VEGETATION CONTROL AND FERTILIZATION IN A MIDROTATION LOBLOLLY PINE STAND. S. Hanna, G. R. Glover, B. G. Lockaby, B. R. Zutter, Auburn University, Auburn, AL 36849, and J. Torbert, Mead Coated Board, Phenix City, AL 36867.

ABSTRACT

Soil available and microbial nitrogen was monitored periodically throughout the year from September 1997 to October 1998 in order to compare effects of vegetation control and fertilization treatments on two different levels of hardwood vegetation in a loblolly pine (*Pinus taeda* L.) stand. In 1997 twenty-four plots were located in a 12-year-old stand of machine planted loblolly pine in southeast Alabama with similar site and stand characteristics. Treatments were then applied by ground, using a 2^3 factorial design, consisting of vegetation control (none and Arsenal (imazapyr) plus Accord (glyphosate) herbicides), fertilizer (none and 200N + 25P (DAP)), and hardwood level (6% and 13%of total basal area) with three replications.

Soil nitrate levels showed a significant positive response to fertilization during the months of May and June. Nitrate levels peaked sharply at 7 mg/kg (or 12 lb/ac.) Vs 2.5 mg/kg (or 4 lb/ac) for the unfertilized plots at the end of a steep decline in ammonium in May three months after fertilization. Soil ammonium peaked sharply at 132 mg/kg (or 224 lb/ac) Vs 20 mg/kg (or 34 lb/ac) for the unfertilized plots two months after fertilization showing a significant positive response and accounting for much of the applied fertilizer from March to August (6 months).

Response of ammonium, the major component of available N, to different hardwood levels and herbicide treatment was significant on certain sampling dates indicating that the sites with higher levels of hardwood may be taking up more ammonium (and available N). The upper 14 cm of soil in plots with low hardwood contained 65 % more ammonium N than the plots with high hardwood with 46 mg/kg (78 lb /ac) Vs 28 mg/kg (48 lb/ac) on the May 14, 1998 date. Controlling vegetation on plots with a high hardwood level Vs a low hardwood level resulted in a 34% increase in available N on the Oct 1998 sampling date with 5.1 mg/kg (9 lb/ac) Vs 3.8 mg/kg (6lb/ac). Applying N fertilizers to plots with a low hardwood level Vs a high hardwood level results in a 43% increase in available N with 119 mg/kg (202 lb/ac) Vs 83 mg/kg (141 lb/ac) on the April 4, 1998 sampling date. Although this was significant at only one sampling date, the trend was apparent on other dates as well (May 14, 1998, P=0.078).

A three-way interaction with fertilizer, herbicide, and hardwood levels (P=0.138 for available N and P=0.114 for NH_4 on the May 14, 1998 sampling date), although not significant at the P=0.05 level, was consistent with the above results of hardwood levels for main effects and two-way interactions. Applying N fertilizers on plots with a low hardwood level

results in a 100% or more increase in available N with or without controlling hardwood vegetation. In contrast, fertilizing sites with a high hardwood level is apparently effective only if the vegetation is controlled. On these site, vegetation control using herbicides resulted in a 56% increase over no vegetation control with 50 mg/kg N (85 lb/ac) Vs 32 mg/kg N (54 lb/ac).

Microbial N in the upper 14 cm of soil in plots with high hardwood levels was 58% higher (P=0.010) than the plots with low hardwood with 19 mg/kg (32 lb /ac) Vs 12 mg/kg (20 lb/ac) on the Aug 4, 1998 date. Higher levels of hardwood provide a greater amount of sweetgumand other hardwood litter with a higher concentration of N (approximately twice the % N based on fall foliar analysis on these sites). The greater amount of carbon combined with the reduced C:N ratio could result in a higher amount of microbial N. This also may indicate that less N would be available for crop tree growth at this time, with more tied up in soil microorganisms. Incorporation of N by soil microbes may also be related to the difference in ammonium response between the two hardwood levels.

Trends, patterns, and statistically significant data in these first year results support the initial hypothesis that higher hardwood levels do interact with fertilization and vegetation control treatments. It appears higher hardwood levels, as opposed to lower hardwood levels, influence a soil environment with differences in microbial activity, temperatures, moisture, and nutrients that result in a lower amount of available N for crop tree growth.

SCREENING FOR PINE SEED AND SEEDLING SUSCEPTIBILITY TO HERBICIDE TREATMENTS. J. L. Yeiser, College of Forestry, Stephen F. Austin State Univ., Nacogdoches, TX 75962.

ABSTRACT

Controlling unwanted natural pines on sites targeted for intensive culture is a major challenge for managers.
Three protocols were tested that focus on controlling unwanted natural pine. Velpar+Hyvar (4+4qt, 3+3qt) provided the best brownout two months after treatment Numerous treatments provided excellent seedling mortality by September 22 when assessments were made (Velpar+Hyvar (4+4qt, 3+3qt, 2+2qt), Hyvar XL (2qt, 3qt, 4qt), Sinbar (40 oz), and Vanquish (4qt)). Liquid formulations of these materials could be used in tank mixes during site preparation to aid with the control of sheltered pine seedlings that presently escape herbicidal prescriptions without fire. The soil activity of numerous testherbicides was adequate to control germinating loblolly pine seed but not pine seedlings. Thus, a granular formulation of test material has the potential to control natural seeding without damage to newly planted pine seedlings.

INTRODUCTION

Managers are decreasing the size of harvesting blocks and leaving more stream size management zones as part of their commitment to responsible, sustainable forest management. These practices create more opportunity for neighboring reproductively mature trees to seed over-the-top of newly planted pine plantations. Furthermore, herbicides commonly used during site preparation and targeted for unwanted natural pine are soil inactive. Thus, sheltered pine seedlings commonly survival chemical site preparation unless fire is part of the prescription. For public safety and concern reasons, use of fire is declining. Thus, controlling unwanted natural pines on sites targeted for intensive culture is a major challenge for managers.

The objective of this study was to screen a list of prospective herbicides as agents for controlling unwanted pine germinants and seedlings during the preparation of sites for planting with genetically improved pine.

METHODS

Shortleaf Pine Seedlings
Three protocols were tested. The first protocol was a study of shortleaf pine (Pinus echinata Mill.) seedling tolerance to foliar applications of selected herbicides and rates. In a commercial forest tree nursery near Bluff City, AR, two beds of surplus shortleaf pine seedlings were selected for testing. Seedlings were residuals fromthe previous years crop and were growing at a density of 25/ft^2. Seedlings received no supplemental watering or fertilizer.

Loblolly Pine Seed

The second protocol was a study of germinating loblolly pine (Pinus taeda L.) seeds. Seeds were sown at a density of 25/ft^2 on April 12, 1998 in a commercial forest tree nursery near Bluff City, AR. Seeds received standard nursery care excluding the application of fungicides. Eight days after sowing, herbicides were applied. Artificial watering and fertilizing followed standard nursery operations.

Loblolly Pine Seedling

The third protocol was a study of loblolly pine seedlings planted on 8 ft X 10 ft spacing near Sheridan, AR. Directed applications of 30 herbicide treatments were sprayed in 5 ft bands around planted loblolly pine seedlings to assess damage by root uptake. Seedlings were covered with plastic bags prior to applications.

All study layouts were randomized complete block designs. The shortleaf seedling, loblolly seed, and loblolly seedling study each had four, three, and three blocks, respectively. Each block contained the number of treatments listed in Table 1. Shortleaf pine treatment plots were 12 ft X 4 ft with an internal 10 X 4 ft evaluation plot leaving a 1 ft buffer at the beginning and end of each plot. Loblolly seed treatment plots were 10 ft X 4 ft with an internal 8 X 4 ft evaluation plot leaving a 1 ft buffer at the beginning and end of each plot. The loblolly pine seedling study had paired seedlings as a plot with two seedling buffers on each treatment plot end.

A CO_2-pressurized backpack sprayer and hand-held boom supporting four, 8002 nozzles was used to apply all herbicide treatments. Herbicides were mixed with water until the total volume was 10 GPA, and applied in 5-foot bands. For the shortleaf seedling and the loblolly seed studies, bands were centered over the top of nursery beds. For the loblolly seedling study, bands were positioned slightly at the side of covered seedlings to provide continuous soil coverage around the seedling but avoiding drenching of the seedling. Application dates are presented in Table 1. Test treatments for the shortleaf seedling study are provided in Table 2, the loblolly pine seed study are in Table 3 and the loblolly seedling study are the same as the loblolly pine seed study (Table 2).

Evaluation dates are summarized in Table 1. Percent brownout was a visual evaluation in 10% intervals with 0% meaning no brownout and 100% meaning total browning of foliage. Seedling percent mortality was determined by snipping 10 seedlings from plot centers and inspecting cut ends for moisture and green tissues. Seedlings with moist or green tissues were tallied alive and others as dead. Seed germination was determined by counting the number of germinants and expressing germination as a percent based on 25 sown seeds per sq. ft. of bed. Loblolly pine seedlings were visually evaluated for brown foliage using the same procedures as for the shortleaf pine seedlings.

RESULTS AND DISCUSSION

For the shortleaf pine seedling study, Finale treatments (2 qt, 3 qt, 4qt) provided rapid brownout (Table 1). Seedlings subsequently flushed and resumed growth. Velpar+Hyvar (4+4qt, 3+3qt) provided the best brownout two months after treatment. Intermediate brownout was recorded for Hyvar XL (4qt), Velpar+Hyvar (2+2qt), and Vanquish (4qt). By 90 DAT, Velpar+Hyvar (4+4qt, 3+3qt), Hyvar XL (3qt, 4qt), and Velpar+Hyvar (2+2qt) provided greatest brownout. The list of best treatments at 120 DAT included those of 90 DAT plus Vanquish (4qt) and Sinbar (40 oz). Accord (3qt, 4qt, 5qt) treatments performed poorly. However, Accord treatments are seldom used in spring for woody plant control. Late treatments were applied during a drought that lasted beyond the last evaluation date. Consequently, data will not be presented here. These treatments should be tested again when seedlings are physiological active.

Seedling mortality was highest for treatments of Velpar+Hyvar (4+4qt, 3+3qt, 2+2qt), Hyvar XL (2qt, 3qt, 4qt), Sinbar (40 oz), and Vanquish (4qt). Only Vanquish is used today for pine control.

Loblolly pine seed germination was greatest for the untreated check plots and those receiving rates of Evik (10oz, 20oz, 30oz, 40oz) (Table 3). Numerous treatments significantly reduced seed germination to less than 1% survival at 30, 60 and 90 DAT. Consequently, numerous options are available.

The same treatments applied to seed were also tested for root uptake and damage to loblolly pine seedlings. No visible damage was observed for any test treatment.

In conclusion, through foliar and root uptake of herbicides, several test treatments (Velpar+Hyvar (4+4qt, 3+3qt, 2+2qt), Hyvar XL (2qt, 3qt, 4qt), Sinbar (40 oz), and Vanquish (4qt)) provided efficacious control of shortleaf pine seedlings. Since shortleaf pine is generally thought to be more tolerant of herbicides than loblolly pine, effective rates here should also extend to loblolly pine. Liquid formulations of these materials could be used in tank mixes during site preparation to aid with the control of sheltered pine seedlings that presently escape herbicidal prescriptions without fire. The soil activity of numerous test herbicides was adequate to control germinating loblolly pine seed but not pine seedlings. Thus, a granular formulation of test material has the potential to control natural seeding over-the-top of neighboring newly, planted pine seedlings without damage.

Table 1. A summary of application dates, evaluation intervals and number of treatments three protocols screening for pine susceptibility to selected herbicides.

Event	Applicatoin Date	Evaluation DAT	Number of Treatments
Shortleaft Pine Seedling Study—early treatments	April 13	30, 60, 90, 120	37
Shortleaft Pine Seedling Study—late treatments	July 22	30, 60[1]	12[2]
Loblolly Pine Seed Study	April 20	30, 60, 90	29
Loblolly Pine Seedling Study	April 27	30, 60, 90, 120	29

[1]Seedling mortality was evaluated on September 22, 1998.
[2] An untreated check was also included.

Table 2. Percent brownout and mortality for shortleaf pine seedlings growing in a nursery bed near Bluff City, AR. Herbicides were applied to seedlings on April 13. Seedling mortality was recorded on September 22, 1998.

			Days After Treatment[2]				
Treatment[1]	Rate	Timing[3]	30	60	120	Mortality	Percent Seedling Mortality
Finale	4qt	Early	91a	50bc	38de	15efgh	23fghij
Finale	3qt	Early	87a	40cd	40d	13efgh	16ghij
Finale	2qt	Early	63b	33d	23efgh	8fgh	23fghij
Vel+Hyvar	4qt+4qt	Early	33c	73a	100a	100a	100a
Vel+Hyvar	3qt+3qt	Early	30c	73a	100a	100a	100a
Hyvar XL	4qt	Early	28c	60b	98a	100a	100a
Vel+Hyvar	2qt+2qt	Early	20d	50bc	90ab	97ab	98a
Hyvar XL	3qt	Early	20d	38d	88ab	95abc	93a
Hyvar XL	2qt	Early	13e	25ef	64c	77c	78ab
Sinbar	40oz	Early	11ef	30de	82b	94abc	95a
Accord	4qt	Early	10ef	20efg	15fghij	13efgh	6ij
Accord	3qt	Early	8efg	23ef	13ghij	11efgh	28efghi
Accord	5qt	Early	8efg	20efg	15fghij	11efgh	10ij
Vanquish	4qt	Early	5fgh	60b	80b	92abc	85ab
Krenite	4qt	Early	5fgh	15fgh	30def	78bc	41def
Vanquish	2qt	Early	3gh	15fgh	18fghi	23efg	50cde
Vanquish	3qt	Early	3gh	30de	38de	48d	55cd
Velpar L	3qt	Early	2gh	2i	1j	0h	0j
Krovar IDF	20oz	Early	2gh	9ghi	7ij	32de	38defgh
Krovar IDF	30oz	Early	2gh	3hi	33de	28ef	68ab
Krenite	3qt	Early	2gh	9ghi	13ghi	18efgh	26fghi
Velpar L	4qt	Early	2gh	2hi	0j	0h	0j
Krovar IDF	40oz	Early	2gh	4hi	28defg	30de	45def
Karmex DF	30oz	Early	1h	2i	1j	1h	10ij
Sinbar	30oz	Early	1h	5hi	16fghij	14efgh	40defg
Evik	40oz	Early	1h	1i	0j	0h	0j
Krenite	2qt	Early	0h	5hi	1ohij	13efgh	23fghij
Goal	3qt	Early	0h	0j	0j	0h	0j
Goal	4qt	Early	0h	0j	0j	0h	0j
Evik	30oz	Early	0h	2j	0j	0h	0j
Goal	2qt	Early	0h	0j	0j	0h	0j
Velpar L	2qt	Early	0h	1i	0j	0h	0j
Karmex DF	20oz	Early	0h	0j	0j	0h	0j
Sinbar	20oz	Early	0h	2ij	3ij	3gh	25fghij
Karmex DF	40oz	Early	0h	1ij	3ij	3gh	10ij
Check		Early	0h	0j	0j	0h	8ij
Evik	20oz	Early	0h	0j	0j	0h	0j

[1]Total application volume was 10 GPA. Herbicides are in units of product per treated acre

[2] Means within a column sharing the same letter are not significantly different (Duncan's Multiple Range Test, p=0.05).

[3] Late treatments were applied during a drought that lasted beyond the last evaluation date. Consequently, data will not be presented here

Table 3. Percent germination for loblolly pine seeds receiving a pre-emergence application of herbicides on April 20, 1998. Seeds were not treated with fungicide prior to sowing on April 12 in a nursery bed near Bluff City, AR. Seeds were watered and fertilized using standard nursery practices.

		Days After Treatment[2]		
Treatment[1]	Rate	30	60	90
Evik	10 oz	35.5a	35.2a	34.8a
Check		32.0ab	31.0ab	30.3ab
Evik	30oz	25.2bc	24.8bc	25.1bc
Evik	20 oz	19.2cd	18.8cd	17.5cd
Evik	40 oz	14.5d	13.4d	11.9d
Karmex DF	10 oz	4.8e	1.9e	0.9e
R6447	5 oz	2.8e	1.9e	3.1e
Hyvar XL	1 qt	1.1e	0.9e	0.9e
Karmex DF	20 oz	0.6e	0.0e	0.0e
Velpar+Hyvar	1+1pt	0.6e	0.5e	0.3e
Sinbar	10 oz	0.5e	0.4e	0.4e
Hyvar XL	2 qt	0.4e	0.2e	0.0e
Velpar+Hyvar	2+2 pt	0.4e	0.1e	0.0e
Velpar+Hyvar	4+4 pt	0.3e	0.2e	0.0e
Krovar IDF	20 oz	0.3e	0.1e	0.0e
Sinbar	30 oz	0.3e	0.1e	0.0e
Karmex DF	30 oz	0.3e	0.1e	0.0e
Krovar IDF	30 oz	0.2e	0.0e	0.0e
Krovar IDF	10 oz	0.2e	0.0e	0.0e
R6447	10 oz	0.2e	0.1e	0.1e
Hyvar XL	4 qt	0.1e	0.1e	0.0e
Sinbar	40 oz	0.1e	0.1e	0.0e
Sinbar	20 oz	0.1e	0.1e	0.1e
R6447	15 oz	0.1e	0.0e	0.0e
Karmex DF	40 oz	0.1e	0.0e	0.0e
Hyvar XL	3 qt	0.1e	0.1e	0.0e
Velpar+Hyvar	3+3 pt	0.1e	0.1e	0.0e
Krovar IDF	40 oz	0.0e	0.0e	0.0e
R6447	20 oz	0.0e	0.0e	0.0e

[1]Total application volume was 10 GPA. Herbicides are in units of product per treated acre.
[2] Means within a column sharing the same letter are not significantly different (Duncan's Multiple Range Test, p=0.05).

AN INTEGRATED PEST MANAGEMENT RESEARCH PROGRAM FOR KUDZU *(PUERARIA LOBATA)* AT THE SAVANNAH RIVER SITE, SOUTH CAROLINA. L. T. Rader[2], T. B. Harrington, Y. C. Berisford, P. B. Bush, University of Georgia, Athens, GA 30602, D. B. Orr, North Carolina State University, Raleigh, NC 27695, and J. W. Taylor, USDA Forest Service, Forest Health, Atlanta, GA 30367.

ABSTRACT

Kudzu (*Pueraria lobata*) is an exotic weed with extensive abilities to compete with and dominate temperate forests of the southern U.S. The Integrated Pest Management (IPM) research program combines biological, chemical, and cultural control methods in two experiments on infested sites at the Savannah River Site, a National Environmental Research Park. The biological control study focuses on a parasitized soybean looper (*Pseudoplusia includens*) which is augmentatively released on infested sites. The second study focuses on herbicide effects and induced competition, combining chemical and cultural approaches. This study includes environmental fate studies of the herbicides applied to control growth.

In 1998, parasitized soybean loopers were released at a rate of 266 larvae m^{-2} on two sites. These releases were during the last three months of the growing season and included only the 4^{th} and 5^{th} instar *Pseudoplusia includens.* Observations included a 43% average minimum level of defoliation. In release plots, percentage of new leaves increased by 67%. However, the size of each new trifoliate leaf decreased 55% and the density increased 23% which indicates plant stress due to looper feeding. Carbohydrate storage in roots was 14% less in the release plots.

The herbicide/induced competition and herbicide fate studies were performed on four different soil sites. Each site was divided evenly into six plots. Five herbicides, clopyralid, metsulfuron methyl, picloram, tebuthiuron, and triclopyr, were broadcast sprayed in July, 1997 and spot sprayed in July, 1998. Induced competition was stimulated by planting high density stands of pine in a split plot design on these plots.

The herbicide fate study was initiated to determine the persistence of residues. Lysimeter readings were collected 20 times between 10 July 97 and 14 September 98 at soil depths of 60-90 cm. Picloram and tebuthiuron were detected through the first year at levels below USEPA drinking water standards. The highest peak of picloram was 15 ppb after a heavy (6 cm) rain one month after spot application. Tebuthiuron was detected at 10-40 ppb during the first year of study. Triclopyr was detected only on soil with low organic matter (0.80-0.98 ppb). Metsulfuron methyl was intermittently detected in small quantities (0.15 to 0.5 ppb).

The efficacy of the treatments (herbicide and induced competition) was determined by percent cover, biomass and leaf area index (LAI). In August 1998, all herbicide plots had significantly less kudzu biomass (9 to 16 g m^{-2}) than the untreated check (228 g m^{-2}). After the initial herbicide spray (1997), predicted LAI of kudzu in clopyralid, metsulfuron methyl, picloram, and triclopyr significantly decreased to 0.1 m^2 m^{-2}. Kudzu LAI in tebuthiuron plots (0.6 m^2 m^{-2}) was significantly greater than the other herbicides but less than the check plot (3.4 m^2 m^{-2}). In 1998, LAI in tebuthiuron plots (0.1 m^2 m^{-2}) decreased to the LAI values of the other herbicide treatments (0 to 0.1 m^2 m^{-2}). Competition effects of pine on kudzu have not been detected thus far in the study.

The kudzu IPM study will continue to monitor treatment efficacy until 2001. By combining novel approaches, such as these being tested here, a feasible and cost effective method may be developed for managing kudzu infestations.

[2] The authors would like to thank the USDA Forest Service and the Savannah River Site, a National Environmental Research Park.

INTENSIVE VEGETATION MANAGEMENT IMPACTS UNDERSTORY DEVELOPMENT IN MATURING LOBLOLLY PINE PLANTATIONS. T. R. Clason, Hill Farm Research Station, Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center, Homer, LA 71040.

ABSTRACT

A vegetation management study was initiated following a regeneration harvest of a natural loblolly pine stand. The study objectives were to evaluate the ground application methods for use on non-industrial private forestlands, and to determine the impact of sequential vegetation management treatments on the growth and development of artificially regenerated loblolly pine plantations. Experimental design was a randomized complete block, split-split plot design having three main plot treatments, four split-plot treatments, and two split-split plot treatments. Main plot treatments were three ground site preparation applications, single tree injection with hexazinone (INJ); ground mobile tank mix with triclopyr and hexazinone (TRI-HEX); and ground mobile with hexazinone (HEX). Split-plot treatments were four post-planting hexazinone spotgun grid applications, no post-planting application (CHK); 0 year after planting (0YAP); 1 year after planting (1YAP); and 2 years after planting (2YAP). Split-split plot treatments were age 5 imazapyr pine release backpack applications, no release (NR); and release (R). Herbicide application rates included INJ, 1 ml hexazinone per 8 cm of stem circumference; TRI-HEX, triclopyr 1.12 kg ae and hexazinone 2.24 kg ai per ha; HEX, hexazinone 4.48 kg per ha; all YAPs, hexazinone 1.7 kg per ha (m x m grid); and R, imazapyr 0.7 kg per ha (backpack). Treatment plots were 40 m x 100 m (0.4 ha) in size and were replicated 9 times. Each split-split plot combination was 10 m x 20 m in size. The study area was commercially planted with loblolly pine at a spacing of (2.4 m x 2.4 m) and pine density was adjusted to 741 trees per ha at age 4 to account for treatment survival variability. Pine growth data included annual seedling survival, ground line diameter, and total height through age 4; and periodic dbh and total height at ages 5, 10 and 15. Herbaceous weed cover and woody vegetation (arborescent and nonarborescent) were inventoried at ages 3, 5, 7, 10, and 15.

At age 15, main treatment plot mean merchantable volume (152 m^3 per ha) did not differ among treatments, with INJ, TRI-HEX, and HEX averaging 147, 152, and 156 m^3 per ha, respectively. Merchantable volume for the YAP treatments averaged 151 m^3 per ha and differed among treatments. Merchantable volume for the 0YAP treatment averaged 157 m^3 per ha, exceeding the CHK, 1YAP, and 2YAP treatments by 8, 6, and 9 m^3 per ha. Release treatment volume averaged 153 m^3 per ha and did not differ between treatments. Volume comparisons among the CHK and 0YAP post-planting treatments reflect the impact of sequential vegetation management on plantation growth. Merchantable volumes for the CHK and 0YAP split-split plot combinations averaged 149, 159, 160, 165 m^3 per ha for the CHK, 0YAP, CHK+R, and 0YAP+R treatments. Largest merchantable volume differential at age 15 was between the (INJ CHK NR) treatment and the (HEX 0YAP R) treatment, which averaged 149 and 174 m^3 per ha, respectively.

Woody arborescent vegetation density for all treatments averaged 3,000 stems per ha at age 15 and differed among main plot treatments. Arborescent density on the INJ treatment averaged 3,645 stems per ha, exceeding the TRI-HEX and HEX treatments by 800 and 1,200 stems per ha. However, the density of the arborescent overstory did not vary among main plot treatments, averaging 630 stems per ha, with a mean basal area of 1.5 m^2 per ha. A comparison of the arborescent woody vegetation on the two vegetation management extremes [(INJ CHK NR) vs. (HEX 0YAP R)] shows that management intensity significantly reduced understory and overstory density. At age 15, management intensity did not impact understory diversity, number of species, Margalef richness index, Simpson abundance-based diversity index for the respective treatments were 10 and 12 species, 1.27 and 1.76, and 0.14 and 0.21. Intensity level did impact overstory diversity. Low management intensity overstory values for species numbers, Margalef index, Simpson index were 7, 1.18, and 0.19, while high management intensity respective values were 1, 0, and 1.

Sequential vegetation management affected the woody arborescent overstory. A chemical site preparation, a post-planting application before the first growing season, and a pine release application at age 5 significantly altered species composition and reduced stem density. Management intensity had no detectable affect on the woody arborescent understory. Enhancing arborescent overstory diversity reduced pine basal area and merchantable volume in a 15-year-old plantation by 8 and 13 percent. In addition, wood product volumes, chip-n-sawlog and sawtimber, were decreased by 8 and 35 percent.

COMPARTIVE ANALYSIS OF LONGLEAF AND LOBLOLLY PINE RESPONSE TO HERBACEOUS VEGETATION. C. S. Bales, D. H. Gjerstad, B. R. Zutter, M. D. MacKenzie, School of Forestry, Auburn University, AL 36849.

ABSTRACT

A study was established in the coastal plain of south central Alabama comparing longleaf pine (*Pinus palustris* Miller) and loblolly pine (*Pinus taeda* L.) response to herbaceous vegetation. Presently, various incentive programs favor longleaf establishment over loblolly. For this reason, many landowners are planting longleaf pine, but to date little information is available comparing the growth and development of the two species under similar conditions. This long term study has three main objectives: 1) compare the impact of herbaceous vegetation on loblolly and longleaf pine growth and survival, 2) determine the impact of herbaceous vegetation on longleaf pine height initiation, and 3) compare the impact of herbaceous vegetation on loblolly and longleaf pine biomass and biomass partitioning.

Longleaf pine has been shown to be the straightest, most disease resistant, most fire resistant, most diverse habitat, and the most valuable timber species of the southern pine species. Poor survival and a perception of slower growth have discouraged land-managers from artificially regenerating longleaf pine. However, through current technology, many of the problems related to artificial regeneration have been overcome and landowners are able to successfully establish longleaf plantations. This raised questions regarding if longleaf and loblolly respond similarly to vegetation management.

The cut over site was site-prepped by shearing, raking, piling, and bedding prior to hand planting. The site has minimal slope and is very wet in the rainy season. The soil profile is classified as Lynchburg sandy loam. Four plant communities were established: 1) longleaf pine only, 2) longleaf pine and herbaceous, 3) loblolly pine only, 4) loblolly pine and herbaceous. Treatments were replicated four times in each of two blocks. The treatments were maintained with chemical herbicide applications through Year 3.

Tree heights were taken on all trees at end of Year 2, while tree heights and GLD (ground-line diameter) were taken at Year 3. Survival has been monitored since planting. Herbaceous control increased tree height for both species significantly in Years 2 and 3. Longleaf tree height increased from 80 cm at Year 3 to 153 cm with herbaceous control. GLD was also increased significantly at Year 3. It was found that longleaf and loblolly pine responded similarly to herbaceous control. In this study, survival was not influenced by herbaceous control likely because of the intensity of site preparation, reduced herbaceous weed competition on the beds, and higher soil water availability on this site. Survival was excellent for both species (84% longleaf and 96% for loblolly).

Herbaceous control reduced the grass stage for longleaf pine. With herbaceous control, over 90% of longleaf pine were out of the grass stage the first year.

Forty-eight trees were destructively sampled for biomass partitioning in September of Year 3. Trees were separated into stem, current-year foliage, previous-year foliage, current-year branches and previous-year branches for dry weight. Loblolly pine was found to be significantly larger than longleaf pine in each category of biomass. Herbaceous control increased current-year foliage, previous year foliage, and stem dry weight. Total biomass per tree was also increased by herbaceous control. Total biomass per tree (aboveground) increased from 0.36 kilogram dry weight to 1.03 kilograms for longleaf at Year 3. Herbaceous control affected total biomass per tree and biomass partitioning similarly for both species.

IMAZAPYR INJECTION IN BOTTOMLAND HARDWOOD STANDS TO RELEASE OAK REGENERATION. A. W. Ezell, Department of Forestry, Mississippi State University, Mississippi State, MS 39762, J. W. Lowery, Gulf States Paper Company, Tuscaloosa, AL 35405, P. J. Minogue, American Cyanamid Company, Warner Robins, GA 31088, and H. E. Quicke, American Cyanamid Company, Auburn, AL 36830.

ABSTRACT

Regenerating desirable species of oaks in bottomland hardwood stands has been a major concern with land managers for many years. While many of these species will produce regular adequate crops of seed for establishment of a new stand, the vast majority of any seedlings produced never develop into viable stems for future growth and production. The problem is a lack of light on the forest floor due to midstory and understory vegetation.

This research was undertaken to evaluate the use of imazapyr in hardwood stands for controlling undesirable stems in the midstory and understory. Two concentrations of Chopper® in aqueous solutions were utilized in the study. Undesirable stems were injected with either 20% or 40% Chopper solutions on a wide spacing format with one injection per three inches diameter breast height. One milliliter of the herbicide solution was applied in each injection. All injections were completed with either a hatchet or Swedish brush-axe and an Accu-gun herbicide applicator. In addition to the herbicide plots, untreated check areas were established for comparison. All treatments were replicated three times.

Two separate studies are included under the auspices of this research. One study was installed as a release operation to evaluate treatment effects on established oak seedlings and overstory crop trees. The second study was considered as a timber stand improvement application, and the recruitment and development of oak seedlings in these plots will be monitored.

In the release study, the herbicide was applied during the dormant season. By comparison, injection on the TSI project was completed in the early part of the growing season after full leaf expansion. This will allow a comparison application timing. The principal target species in both projects were American hornbeam, sweetgum, hickory, and red maple.

Target stems were tagged, flagged, and had their dbh recorded for later comparisons.

In addition to target stems, oak seedlings were tagged and measured in subplots within treatment areas in order to monitor survival, growth, and/or establishment. For each tagged seedling, total height and root collar diameter were measured.

At the end of the growing season following injection, all target stems were evaluated for percent crown reduction. Crop species had been monitored throughout the growing season for any sign of herbicide impact.

Dormant season injection resulted in excellent control of the species targeted in the study. Similar results were obtained for both herbicide concentrations. The early growing season injection worked well on maple, sweetgum, and hickory, but response was marginal on larger diameter hornbeam, and the 40% solution was more effective.

Oak seedlings in the injected plots had higher survival and height growth. There were no statistically significant differences among the treatments after one year, but cherrybark oak exhibits slow seedling growth and differences are expected to become greater with time as seedlings become better able to utilize the extra resources provided by the injection.

At no time was any herbicide damage observed on any crop species. Injection with imazapyr with this application format is considered to be totally safe in hardwood stands and would be preferable to use in these situations. The treatments were highly effacacious, less labor intensive, and environmentally friendly. The projects will be evaluated in future years to fully evaluate the response by oak regeneration.

EFFECTS OF MID-ROTATION RELEASE ON FOREST STRUCTURE: IMPLICATIONS FOR WILDLIFE HABITAT AND PINE YIELD. K. I. Cheynet, S. M. Zedaker, R. L. Amateis, D. F. Stauffer, College of Forestry and Wildlife, Virginia Tech, Blacksburg VA, 24061.

ABSTRACT

Increases in demand, land use shifts, and harvest restrictions in the Pacific Northwest have placed the Southern US under increasing pressure to produce softwood lumber. In addition, environmental awareness is at an all time high, mandating the consideration of non-timber resources. If the demand for wood products is to be met within the constraints of sustainable forestry, further investigations into the trade-offs between intensive pine culture and ecosystem functions are necessary. This study examined the effects of mid-rotation chemical release on wildlife habitat and pine yield in thinned, fertilized, loblolly pine (*Pinus taeda*) plantations.

Nine sites with three release dates, 1995, 1996, and 1997 were sampled. These sites were located on thinned loblolly plantations which had been operationally released by aerial application of Arsenal AC at a rate of 10 oz per acre plus 0.25% TS-90 and fertilized with 200 lb/ac nitrogen.

Four 16.4 ft x 65.5 ft check plots and four paired treatment plots were installed at each replicate site. Within the plots pine volume, overstory composition, and cavity resource information was collected. A 65.5 ft line along the center of the plot was used for point-intercept sampling of habitat variables relevant to selected Wildlife Habitat Suitability Models (HSI models) chosen to assess ground stratum, shrub stratum, and canopy resources. Paired t-tests were used to test for significant differences in pine volume and Wilcoxon signed rank tests were used to analyze HSI and diversity values.

Hardwood Basal area was reduced from an average of 14 ft^2 to 2 ft^2 per acre in released areas and hardwoods were completely eliminated from the upper third of the canopy. Density of woody and semi-woody stems was also significantly reduced ($p < .01$) from 7500 stems per acre to 2800 stems per acre. Snags were significantly increased ($p = .04$) on treated sites from an average of 7 per acre to 28 per acre. No significant change in herbaceous vegetation was noted between the treated and check areas, however, there was a trend for increasing cover as years since spray increased from one to three. Overstory and understory woody diversity (Simpson and Shannon-Wiener) decreased on the treated areas. Diversity levels remained fairly constant across all three release dates.

Responses to these structural changes were noted in both pine volume and wildlife habitat suitability indices. Average tree volume was significantly increased on treated sites ($p = 0.03$), 2.9 ft^3 and 3.7 ft^3 the second and third year after release respectively. There was a significant increase in habitat suitability for the black-capped chickadee *(Parus atricapillus)* within the treated areas ($p = 0.04$) due to an increase in snags ≥ 4 in DBH.

The habitat suitability index for the pine warbler *(Dendroica pinus)* increased in the treated areas due to the reduction of canopy hardwoods, however, the initial hardwood density was not high enough to result in a significant improvement. The removal of canopy hardwoods also did not significantly affect suitability for the scarlet tanager *(Piranga olivacea)* which is highly dependent on canopy closure. Habitat suitability for the brown thrasher (*Toxostoma rufum)* and cover suitability for the bobwhite quail *(Colinus virginianus)* was well below the control 1 year after treatment, but there was no significant change overall because the suitability in treated areas approximated the check level within three years. No significant changes in the cottontail *(Sylvilagus floridanus)* or turkey *(Meleagris gallopavo sylvestris)* summer food/brood components were found, although the turkey model did reveal a slight trend for increasing habitat quality with age since treatment. The downy woodpecker *(Picoides pubescens)* model did not increase in suitability within the treated areas due mainly to the absence of snags ≥ 6 in DBH.

RELATING STAND LEVEL PINE RESPONSE TO SHRUB AND HERBACEOUS VEGETATION FOLLOWING VEGETATION CONTROL TREATMENTS. D. K. Lauer and G. R. Glover. School of Forestry, Auburn University, AL 36849-5418.

ABSTRACT

Results from four locations of a vegetation control study that included herbicide treatments to control woody shrub and herbaceous vegetation were combined using a modeling approach. These studies are located in the coastal plain region of the Southeastern U.S. Major woody shrub species consisted of gallberry (*Ilex glabra* (L.) A. Gray), lyonias (*Lyonia* spp.), blueberries (Vaccinium spp.), and saw palmetto (*Serenoa repens* (Batr.) Small). Major herbaceous species consisted of panic grasses (*Dichanthelium* spp.), bluestem grasses (*Andropogon* spp.), and bracken fern (*Pteridium aquilinum* (L.) Kuhn.). The study treatments included three levels of woody control (none, first year, and repeated) and two levels of herbaceous control (none, first year).

The objective of this approach was to relate pine response to treatment induced changes in vegetation levels. The relationship between age 5 pine height and vegetation cover was estimated for loblolly pine (*Pinus taeda* L.) and slash pine (*Pinus elliottii* Englem.) stands using regression analysis. Age 5 average dominant height was predicted from first year herbaceous cover, untreated first year shrub cover, and fifth year shrub cover. Dominant height increased 0.4, 0.5, and 0.6 ft for each decrease of about 10% in first year herbaceous cover, untreated first year shrub cover, or fifth year shrub cover, respectively. Lack of any vegetation control on beds, where vegetation was allowed to re-colonize before planting, reduced dominant height an additional 1.5 feet. A competition index was constructed that estimates the decrease in age 5 pine height from less than complete vegetation control. The relationship between pine response and this competition index was similar across the four locations.

A stand level model was developed to link age 5 pine height and occupancy of competing vegetation to quadratic mean dbh or stand basal area. The effects of interspecific competition on stand basal area could be accounted for by the effect of competing vegetation on dominant height except for treatments that did not control woody shrubs at time of

establishment. The presence of woody shrubs at establishment resulted in further decreases in stand basal area and the magnitude of this decrease was related to first-year shrub cover.

DEVELOPMENT OF LOBLOLLY PINE STAND STRUCTURE AS INFLUENCED BY VEGETATION MANAGEMENT. D. M. Carpenter[1], G. R. Glover[1], B. R. Zutter[1], and J. H. Miller[2], [1]School of Forestry, Auburn, AL 36849 and [2]USDA Forest Service , Auburn, AL.

ABSTRACT

There have been numerous studies on the effects of herbaceous and woody competition on pine species. As the demand for paper and wood products increases, there will be continued need for more intensive forest management. This is the rationale behind extensive herbicide research.

The Competition Omission Monitoring Project (COMP) was established on thirteen sites across the Southeast. One of the objectives of COMP is to compare the relative effects of herbaceous versus woody competition on growth of loblolly pines across a wide range of sites. COMP treatments include 1) check (CK)--no vegetation control other than site preparation, 2) woody control (WC)--hardwoods and shrubs treated during the first five growing seasons, 3) herbaceous control (HC)--herbaceous weeds treated for the first four growing seasons, and 4) total control (TC)--combination of treatments to control all vegetation.

Two locations, one with low hardwood basal area (Counce, TN), and one with high hardwood basal area (Arcadia, LA) are presented as representatives of the thirteen COMP sites. Frequency distributions for DBH, total height, and live crown length were developed by treatment at ages 5, 8, and 11 to determine shifts in the distribution location and coefficients of variation.

DBH distributions at ages 5, 8, and 11 for Arcadia were shifted to the right (to larger diameter classes) for all treatments when compared to the check. At increasing ages, distributions for all treatments became more similar, but with the TC treatment shifted further to the right and with a lower coefficient of variation. Total height distributions exhibited similar convergence over time with location and coefficient of variation for the TC, HC, and WC becoming more similar. Distributions for live crown length across treatments at age 8 were different in location and had different coefficients of variation. By age 11, however, these distributions were very similar, probably due to intraspecific competition and crown closure.

DBH distributions at ages 5, 8, and 11 for Counce showed different distributional patterns. At ages 5 and 8, TC and HC were similar in location and coefficients of variation, as were WC and CK. By age 11 there was a convergence of WC towards TC and HC. Total height distributions at age 8 showed a similar of pattern with TC and HC being similar and WC and CK being similar in location and coefficient of variation. By age 11, TC, HC, and WC had begun to converge. Distributions for live crown length at age 8 had the same characteristic patterns as for DBH and total height, but by age 11, crown closure was evident due to the similar distribution locations and coefficients of variation across treatments.

The pronounced differences in distributions at Arcadia are probably due to high hardwood basal area on the site, whereas the lack of major distributional differences at Counce, particularly at later ages, is likely due to low hardwood basal area on that site. Coefficients of variation generally decreased and distributions were shifted to the right (to larger diameter classes) as different vegetation components were controlled.

A COMPARISON OF BASAL BARK TREATMENTS USING GLYPHOATE 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.

ABSTRACT

Accord is water-soluble and has limited bark penetration. Monsanto 59120 is a surfactant with a blend of ingredients providing water solubility and bark penetration. Potentially Accord+Monsanto 59120 mixtures could be used in basal bark treatments for crown reduction of unwanted woody stems. Dormant and growing season, low-volume basal bark applications of Monsanto 59120+Accord were tested for crown reduction of selected woody species in Arkansas, Mississippi, and South Carolina. Herbicide treatments were applied to a height of 14 inches and until the bark was

saturated without runoff. After one growing season, crown reduction was greater for mixtures of Monsanto 59120+Accord than Accord alone. However, the industry check, Garlon 4+vegetable oil (20:80), provided the best crown reduction of the woody stems tested.

INTRODUCTION

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 surfactant with a blend of ingredients providing water solubility and penetration. Thus, mixtures of Monsanto 59120+Accord have potential for 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 and in holes in 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 were selected from the one-, two- and three-inch 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-inch dbh classes. The third study area was an upland Piedmont site near Pendleton, South Carolina. Sweetgum, and water oak were the major species bordering a right-of-way and a mature hardwood stand. In South Carolina, 90% of the test stems were less than 1.5 inches in dbh. Treated stems were ostensibly 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 eight 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) was 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 inches. 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.

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 in 10% intervals for percent crown reduction. Dormant and growing season evaluations were taken in Arkansas, Mississippi, and South Carolina on June 7 and September 29, June 20 and October 3, or August 7 and September 19, 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

A statistically significant season by species by treatment interaction was detected for percent crown reduction in the Arkansas, Mississippi, and South Carolina study areas. For dormant season treatments, Garlon 4+vegetable oil was significantly better than Accord mixtures for test species in Arkansas (pine and sweetgum) and Mississippi (water, willow, southern red oak and hickory) (Table 2). In South Carolina, similar oak crown reduction was observed for Accord+59120 mixtures and Garlon 4+vegetable oil. Crowns of sweetgum were best reduced with a 25:75 Accord+59120 mixture and Garlon 4+vegetable oil. Crowns of South Carolina oaks were readily reduced, unlike those tested in Mississippi, by all Accord+Monsanto 59120 mixtures. This discrepancy between Mississippi and South

Carolina oaks probably result from differences in species composition and stem size. For growing season treatments, Garlon 4+vegetable oil was numerically the best for all test species and sites (Table 3). In Arkansas, Garlon 4+vegetable oil provided statistically similar crown reduction as Accord+59120 (50:50) for pine. In South Carolina, sweetgum crowns were similarly reduced by Garlon 4+vegetable oil, Accord+59120 (50:50) and Accord+59120 (75:25).

For Arkansas study trees, size was strongly and negatively related to crown reduction for sweetgum: percent crown reduction = 79.3 - 3.3 dbh and for oak: percent crown reduction = 68.3 – 1.2 dbh. Similar trends can be expected for test species in Mississippi and South Carolina.

Best crown reduction for dormant and growing season treatments was achieved with Garlon 4+vegetable oil (Table 4). Significantly less crown reduction was achieved with Accord+Monsanto 59120 mixtures. Data suggest crown reduction generally improved as the amount of penetrant increased, peaked with the 50:50 mixture and then decreased with the 75:25.

In conclusion, Monsanto 59120 did improve crown reduction of basal bark treatments over that of Accord alone. However, the industry standard, Garlon 4+vegetable oil, remains the best option for dormant and growing season basal applications of the woody stems tested.

Table 1. A listing of test treatments and the seasons for which each was tested.

TREATMENT	RATE (%)	SEASONS OF APPLICATION
Accord	100	Dormant Growing
Accord + Monsanto 59120	75:25	Dormant Growing
Accord + Monsanto 59120	50:50	Dormant Growing
Accord + Monsanto 59120	25:75	Dormant Growing
Garlon 4 + Vegetable Oil[1]	20:80	Dormant Growing

[1]A generic commercial grade of vegetable oil.

Table 2. Mean percent crown reduction for dormant season applications evaluated after one growing season. Basal bark applications of Monsanto 59120+Accord were applied on February 13, February 20 and February 28, 1998 in Arkansas, Mississippi, and South Carolina, respectively.

TREATMENT1	ARKANSAS[2]		MISSISSIPPI[2]		S. CAROLINA[2]	
	Pine	Sweetgum	Red Oak	Hickory	Oak	Sweetgum
G4 + VEG (20% + 80%)	80.6a	65.4a	73.2a	82.7a	91.0a	97.8a
AC + 59120 (25% + 75%)	14.2b	11.2b	52.6c	38.3b	79.7a	67.0ab
AC + 59120 (50% + 50%)	12.5b	20.3b	58.3bc	40.5b	91.8a	55.0b
AC + 59120 (75% + 25%)	3.0b	4.1b	68.0b	39.7b	89.6a	40.2bc
AC (100%)	0.1b	21.4b	48.7c	39.3b	40.0b	9.5c

[1] Treatments are: G4=Garlon 4E, VEG=Generic commercial grade of vegetable oil, AC=Accord, 59120=Monsanto 59120.

[2] Means within a column sharing the same letter are not significantly different. (Duncan's New Multiple Range Test, p=0.05)

Table 3. Mean percent crown reduction for growing season applications[1]. Basal bark applications of Monsanto 59120+Accord were applied on June 21 in Arkansas, on May 19 in Mississippi and June 6, 1998 in South Carolina and evaluated after one growing season.

TREATMENT[2]	ARKANSAS[3]		MISSISSIPPI[3]		S. CAROLINA[3]	
	Pine	Sweetgum	Red Oak	Hickory	Oak	Sweetgum
G4 + VEG (20% + 80%)	83.7a	99.3a	51.0a	60.0a	90.3a	100.0a
AC + 59120 (25% + 75%)	50.8b	66.1c	42.7b	28.8b	6.0b	58.8b
AC + 59120 (50% + 50%)	70.8a	81.4b	41.7b	25.2b	14.7b	91.5a
AC + 59120 (75% + 25%)	37.9b	81.6b	38.3bc	27.8b	13.3b	82.0a
AC (100%)	21.0c	82.5b	33.7c	28.7b	3.7b	25.8c

[1] Treatments are: G4=Garlon 4E, VEG=Generic commercial grade of vegetable oil, AC=Accord, 59120=Monsanto 59120.
[2] Means within a column sharing the same letter are not significantly different. (Duncan's New Multiple Range Test, p=0.05)

Table 4. Percent crown reduction by season of application. Dormant and growing season applications were completed on February 13 and June 21 in Arkansas, on February 20 and May 19 in Mississippi and February 28 and June 6, 1998 in South Carolina and evaluated after one growing season.

TREATMENT[1]	ARKANSAS[2]		MISSISSIPPI[2]		SOUTH CAROLINA[2]	
	DORMANT	GROWING[3]	DORMANT	GROWING[3]	DORMANT	GROWING[3]
G4 + VEG (20% + 80%)	73.0a	91.5a	77.9a	55.5a	94a	95a
AC + 59120 (50% + 50%)	16.4b	76.1b	49.4bc	33.5b	73b	53b
AC + 59120 (25% + 75%)	12.7bc	58.5c	45.5c	35.8b	73b	48b
AC + 59120 (75% + 25%)	3.6c	59.8c	53.9bc	33.1b	65b	32c
AC (100%)	10.8bc	51.8c	44.0c	31.2b	25c	15d

[1] Treatment are: G4=Garlon 4E, VEG=Generic commercial grade of vegetable oil, AC=Accord, 59120=Monsanto 59120.
[2] Means within a column sharing the same letter are not significantly different (Duncan's New Multiple Range Test).
[3] Uncommonly high temperatures and below average rainfall provided drought conditions during most of the growing season.

SURFACTANTS AFFECT FOLIAR UPTAKE AND TRANSLOCATION OF TRICLOPYR AND IMAZAPYR IN RHODODENDRON. D. Esen, S. M. Zedaker. Department of Forestry. Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.

ABSTRACT

Great rhododendron (*Rhododendron maximum* L.), a common forest understory shrub species, has been recently recognized as a serious forest woody weed in the eastern-southeastern US. Great rhododendron suppresses regeneration and growth of young trees of natural forests and plantations predominantly in the Southern Appalachians. Manual cutting and burning of rhododendron are both costly and provide only limited control. The use of many herbicides (e.g. fosamine, glyphosate, hexazinone) to control this invasive shrub have been unsuccessful. Foliar herbicide uptake is inhibited by the waxy cuticle on the glossy, adaxial leaf surfaces of rhododendron and limited phloem translocation to roots were responsible for the ineffective herbicidal control. Nonpolar ester-formulated herbicides enhanced foliar penetration of the hydrophobic waxy leaf cuticle. Previous research in UK forestry indicated that oil-soluble Garlon 4® had shown promising results against a Eurasian relative of great rhododendron, *Rhododendron ponticum* L. Research has established that activity of herbicides on herbaceous and woody weeds was enhanced by addition of surfactants. Activity of Arsenal® on *R. ponticum* has been improved substantially by addition of vegetable seed oil, nonionic surfactant blend Mixture B®, and an organosilicone Silwet L-77®.

Effects of different surfactants on the foliar uptake and translocation of triclopyr butoxyethyl ester (BEE) as Garlon 4 (44 % a.e.) and oil-formulated imazapyr isopropylamine salt as Chopper EC (23 % a.e.) were investigated on one-year old great rhododendron (*Rhododendron maximum* L.). Four replications of six treatments were randomly assigned to

24 one-year old great rhododendron seedlings in a glasshouse, using randomized complete block design. The treatments included a low-rate (2.5 %) (v:v) Chopper + 25 % (v:v) Sun-It II, high-rate (5 %) Chopper + 2 % Mixture B, high-rate Chopper + 0.25 % Silwet 408 as well as a low-rate (5 %) Garlon 4 + 25 % Sun-It II, high-rate (10 %) Garlon 4 + 2 % Mixture B, and finally high-rate Garlon 4 + 0.25 % Silwet 408. Foliage of plants were first sprayed with cold formulations of the treatments, simulating a field spray volume of 140 l/ha. Ten 2.42-:L drops of [^{14}C]-labeled herbicides + surfactant combinations were applied to the adaxial surface of a fully expanded leaf of each plant using a microliter syringe. 72 hours after treatment (HAT), the treated surface of each treated leaf was washed with three 5-ml aliquots of deionized water followed by a 5-ml funnel rinse to recover unabsorbed portion of total applied activity. Plants were then harvested, oven-dried, ground, and oxidized using a R. J. Harvey biological oxidizer. Each plant was separated into the treated leaves, parts above and below the treated leaf, and roots. Radioactivity in all samples was determined using a Beckman liquid scintillation counter. Results were analyzed using one way ANOVA. Tukey's least square mean technique was used to separate treatment means.

Chopper achieved significantly greater root translocation than Garlon 4 in rhododendron 72 HAT. Leaf uptake was excellent with Garlon 4. Leaf uptake of Garlon 4 was enhanced by partial solubilization of the waxy leaf cuticle. However, contact phytotoxicity might have inhibited translocation of this herbicide out of treated leaves. Type of surfactant had no effect on Garlon 4 uptake and translocation. Sun-It II and Mixture B- the latter at the intermediate level- substantially enhanced both foliar uptake and translocation of Chopper out of treated leaves over Silwet 408. Seven and 15 % of total Chopper applied activity was found translocated to roots with Mixture B and Sun-It II, respectively whereas only 4 % of total applied activity was recovered in roots with Silwet 408. This translocation enhancement is attributed to these surfactants' abilities to improve leaf wetting and spreading as well as enhanced dissolution of the waxy cuticle on rhododendron leaves. Enhanced Chopper root translocation by Mixture B and Sun-It II in the present study may explain greater control of *R. ponticum* in the UK by imazapyr-Mixture-B and imazapyr-vegetable-seed-oil combinations.

Combinations of low rates of Garlon 4 and the surfactants may, in the future, enhance herbicide activity on rhododendron by reducing this herbicide's phytotoxic effects at high rates. Use of Mixture B and Silwet 408 with low rates of Chopper may present an alternative to Sun-It II in field efficacy.

IMAZAPIC, IMAZAQUIN, IMAZETHAPYR, AND PENDAMETHALIN FOR HERBACEOUS COMPETITION CONTROL IN HARDWOOD PLANTATIONS. A. W. Ezell, Department of Forestry, Mississippi State University, Mississippi State, MS 39762 and H. E. Quicke, American Cyanamid Company, Auburn, AL 36830.

INTRODUCTION

In a continuing effort to examine potentially effective chemicals for use in hardwood plantation management, imazapic and imazethapyr were included in a protocol for field trials involving sweetgum (*Liquidambar styraciflua*). Controlling herbaceous competition can be a tremendous benefit in first year survival of hardwoods, and subsequent growth is expected to benefit from enhanced root development during the first growing season.

MATERIALS AND METHODS

<u>Treatments</u>. A complete list of treatments is found in Table 1. A total of 12 herbicide treatments were compared to an untreated check and a mechanical cultivation (hoeing) treatment. Two application timings of six treatments represent the spectrum of herbicide testing. All applications were replicated three times in an RCB plot arrangement.

<u>Study site</u>. The study site was located in Clay Co., MS approximately 5 miles north of Pheba, MS. The area had previously been in soybean cultivation and had been uncultivated for two years prior to tree planting. The soil was an Urbo silty clay loam with an average pH of 5.7 and organic matter content of 2.18%.

<u>Plot layout</u>. Each treatment plot contained 10 sweetgum seedlings planted in a single row on 2-ft. spacings. A 12-ft. buffer area was established between treatment plots to avoid any spray drift problems. Plot center was marked on each end with a pin flag and each plot was marked with an aluminum tag noting plot number, treatment number, and replication. No trees were planted in the untreated plots (Treatment 13), as these areas were for competition control comparison.

Treatment application. Preplant treatments were applied January 31, 1998. Seedlings were planted on February 8, and prebudbreak treatments were applied February 27. All treatments were applied with a CO_2-powered backpack sprayer using a 4-nozzle boom (8002 tips). A 6-ft.-wide swath was applied over the tree planting area with the planting row as the center of the swath.

Evaluation. The plots were evaluated at 60, 90, 120 DAT, and at the end of the growing season. At each evaluation, an ocular estimate of the percent coverage by grass, broadleaves, vines, shrubs, and weed-free was recorded. In addition, all trees were evaluated for any symptoms of phytotoxicity or other damage. The trees were measured prior to budbreak and at the end of the growing season. All measurements were recorded in a manner to ensure direct comparison of growth. Ground line diameter (GLD) was recorded to the nearest 0.1 mm and height was recorded to the nearest cm. By measuring individual stems and recording data accordingly, survival counts were provided inherently.

RESULTS AND DISCUSSION

Results of this study are presented in terms of competition control, survival, and seedling growth. Overview tabular information is presented for each discussion.

Competition control. The average percent clear ground for each treatment by observation timing is presented in Table 2. Overall, herbicide treatments 4 and 8 provided the best competition control for the 60 and 90 DAT evaluations. After that time, dallisgrass invaded the field and occupied much of what had been clear ground earlier. The change in coverage by grass and sedge can be found in Table 3. No separation tests (statistical) were performed on the grass data, although treatments 4 and 8 had some of the lower percentages of coverage. Virtually all the increase shown in grass coverage was due to the dallisgrass mentioned earlier.

The average percent broadleaf coverage is presented in Table 4. Of the herbicide treatments, treatments 4 and 8 were the most consistent performers across all observation times. Fluctuations in coverage within a treatment usually reflected a change in percent grass coverage, although a few plots were impacted by invasion by peppervine (ex. Treatment 10 plots). Overall, by 120 DAT, only the mechanical treatment (hoeing) provided an extensive weed-free environment.

Survival. Survival of the planted seedlings was excellent. Results are presented in Table 5 and reflect the fact that herbicide damage was not a factor in survival. Only one herbicide treatment had survival less than the mechanical hoeing plots. The growing season of 1998 had an extreme and prolonged drought which impacted plants in the study area from April until November. It is a credit to these treatments that survival was so high. Since no trees were planted in the untreated areas, no survival data is available.

Herbicide damage. At no time throughout the study were any symptoms of herbicide damage observed on the planted seedlings. In addition to the regular evaluation timings, the seedlings were examined at 30 and 45 DAT to check for any damage.

Growth. Overall growth in groundline diameter (GLD) and total height are presented in Table 6. The hoeing treatment resulted in the greatest growth overall for both parameters. Interestingly, while some differences in diameter and height growth resulted between treatments, very little significant statistical separation could be noted (Table 6). When the height information is considered as percent increases, some statistical separation is possible (Table 7). Hoeing still results in the greatest increase, but now treatments 10 and 12 have a significant difference from the remaining treatments. Notably, treatments 4 and 8 had some of the lowest percent increases which indicates that weed control may be only one of the factors in a successful treatment. Coupled with the lower survival of treatment 4, these results indicate that highest rates of imazapic may not be desirable on sweetgum.

In percent increase of GLD, treatments 1, 6, and 12 all separated statistically from the other herbicide treatments (Table 8). Hoeing again resulted in the greatest percent increase. When compared to height percent increase, treatments 1 and 6 resulted in comparable results to the higher (Treatments 10 and 12) increases.

Overall, it appears that treatments 1, 6, and 12 resulted in the most consistent growth increases. While repeated applications of cultivation by hoeing are not a cost-effective competition control alternative, this treatment does indicate the type of growth possible by season-long control.

SUMMARY

The treatments in this study did not visibly damage sweetgum seedlings. Survival was excellent, and growth was admirable in consideration of the harsh conditions of 1998. The initial analysis of this data reveals no strong trends for comparing time of application (prebudbreak vs preplant). All the treatments could be considered a viable option for use in establishing sweetgum plantations, although high rates of imazapic could result in reduced first-year growth.

Table 1. Herbicide treatments in sweetgum study - Clay Co., MS.

Treatment No.	Herbicide	Rate of Product/A	Timing
1	Imazapic	6oz	Preplant
2	Imazapic	12oz	Preplant
3	Imazapic + pendamethalin	12oz + 2.4qt	Preplant
4	Imazapic	24oz	Preplant
5	Imazapic	6oz	Prebudbreak
6	Imazapic	12oz	Prebudbreak
7	Imazapic + pendomethalin	12oz + 2.4qt	Prebudbreak
8	Imazapic	24oz	Prebudbreak
9	Imazethapyr + pendamethalin	2.8oz + 2.4qt	Preplant
10	Imazethapyr + pendamethalin	5.6oz + 2.4qt	Preplant
11	Imazethapyr + pendamethalin	2.8oz + 2.4qt	Prebudbreak
12	Imazethapyr + pendamethalin	5.6oz + 2.4qt	Prebudbreak
13	Untreated	—	—
14	Hoed check	—	—

Table 2. Average percent clear ground in 1998 sweetgum field trials.

	Evaluation Time[1/]		
Treatment No.	60 DAT	90 DAT	120 DAT
	percent		
1	68.3b[2/]	35.0c	8.3cd
2	71.7b	46.7bc	10.0cd
3	73.3b	35.0c	6.7d
4	95.0a	82.0a	25.0bc
5	70.0b	41.7bc	6.7d
6	90.0a	55.0b	8.3cd
7	88.3a	35.0c	10.0cd
8	94.3a	75.0a	13.3c
9	36.7c	15.0d	6.7d
10	66.7b	20.0cd	6.7d
11	63.3b	52.7b	6.7d
12	68.3b	58.3b	10.0cd
13	14.3d	6.7d	3.3d
14	91.7a	85.0a	93.0a

[1/]DAT = Days After Treatment.
[2/]Values followed by the same letter in a column do not differ at P = 0.05.

Table 3. Average percent cover by grass and sedge in 1998 sweetgum field trials.

	Evaluation Time[1/]		
Treatment No.	60 DAT	90 DAT	120 DAT
	percent		
1	21.7	23.3	53.3
2	6.7	10.0	40.0
3	5.7	15.0	26.7
4	4.0	5.0	35.0
5	15.0	18.3	46.7
6	3.7	6.7	35.0
7	2.0	6.7	20.0
8	2.3	5.0	30.0
9	13.3	11.7	50.0
10	20.3	21.7	60.0
11	31.7	6.7	56.7
12	16.7	10.0	43.3
13	50.0	50.0	43.3
14	4.3	5.0	2.3

[1/]DAT = Days After Treatment.

Table 4. Average percent cover by broadleaf species in 1998 sweetgum field trials.

	Evaluation Time[2/]		
Treatment No.	60 DAT	90 DAT	120 DAT
	percent		
1	10.0bc[2/]	33.3ab	25.0c
2	5.0cd	16.7c	26.7c
3	18.3b	36.7a	50.0a
4	1.3d	8.3d	21.7cd
5	15.0b	26.7b	38.3b
6	3.7d	13.3cd	30.0bc
7	5.3cd	33.3ab	51.7a
8	1.7d	8.3d	16.7d
9	33.3a	43.3a	16.7d
10	6.7cd	30.0ab	16.7d
11	8.3c	36.7a	25.0c
12	15.0b	23.3bc	25.0c
13	30.0a	36.7a	46.7a
14	4.0d	5.0d	2.3e

[1/]DAT = Days After Treatment.
[2/]Values followed by the same letter in a column do not differ at P = 0.05.

Table 5. Average survival in 1998 sweetgum field trials.

Treatment No.	Survival - GSAT[2]
	------------------ percent ------------------
1	90.0a
2	96.7a
3	93.3a
4	83.3b
5	100a
6	100a
7	100a
8	100a
9	93.3a
10	96.7a
11	100a
12	96.7a
14	86.7ab

[1]Values followed by the same letter in a column do not differ at P = 0.05.
[2]GSAT = One Growing Season After Treatment.

Table 6. Average sweetgum height growth and groundline diameter (GLD) growth by treatment.

Treatment No.	Height Growth[1]	GLD Growth
	---------- cm ----------	---------- mm ----------
1	6.70c	2.50b
2	6.10c	2.41b
3	5.71cd	2.19b
4	6.56c	2.70b
5	4.97cd	1.87bc
6	6.63c	2.77b
7	6.88c	2.19b
8	5.26cd	2.24b
9	7.57c	2.36b
10	7.34c	2.12b
11	7.30c	2.41b
12	8.89b	2.86b
14	14.65a	5.58a

[1]Values followed by the same letter in a column do not differ at P = 0.05.

Table 7. Percent increase in total height for sweetgum in 1998 field trials - Mississippi.

Treatment No.	Average Height Increase
	-------------------- percent --------------------
1	14.9bc[1/]
2	12.9c
3	12.1c
4	13.0c
5	13.2c
6	16.6bc
7	15.3bc
8	10.8c
9	16.5bc
10	18.1b
11	15.2bc
12	19.9b
14	33.2a

[1/]Values followed by the same letter in a column do not differ at P = 0.05.

Table 8. Percent increase in groundline diameter (GLD) for sweetgum in 1998 field trials - Mississippi.

Treatment No.	Average GLD Increase[1/]
	-------------------- percent --------------------
1	65.3b
2	49.2bc
3	41.2c
4	46.3bc
5	41.8c
6	59.7b
7	43.4c
8	46.4bc
9	50.5bc
10	41.9c
11	47.5bc
12	57.3b
14	109.7a

[1/]Values followed by the same letter in a column do not differ at P = 0.05.

PRE-EMERGENT HERBACEOUS WEED CONTROL SCREENING IN HARDWOOD PLANTATIONS WITH AZAFENIDIN, IMAZAPIC, AND DICLOSULAM ON SEVERAL AGRICULTURAL SITES THROUGHOUT THE SOUTHEAST. R. L. Muir Jr. and B. R. Zutter School of Forestry, Auburn University, AL.

ABSTRACT

Pre-emergent herbicide treatments were tested on old agricultural fields for controlling herbaceous competition in young sweetgum (*Liquidambar styraciflua* L.) and sycamore (*Platanus occidentalis* L.) plantations in Escambia County Alabama and Sumter County, South Carolina. Herbicides tested included azafenidin, diclosulam, imazapic, prodiamine, sulfometuron, oxyfluorfen and combinations of oxyfluorfen/azafenidin (1 lb./8, 16 oz. ai/ac), oxyfluorfen/diclosulam (1 lb./0.74, 1.0 oz. ai/ac), sulfometuron/azafenidin and sulfometuron/diclosulam. Applications were made using a CO_2 backpack sprayer utilizing a hand held boom equipped with 4 nozzles in a five-foot swath over the top of newly planted hardwood seedling in early to late March at 20-25 GPA.

Evaluations of weed cover were made at 8 and 16 weeks after treatment (WAT) on the Escambia County AL site and 12 and 24 WAT on the Sumter County, SC. Initial height, first-year height growth and first-year percent survival was assessed for crop trees on both sites. Weed cover, first-year height growth and first-year percent survival were compared to the check using Dunnett's Test (p=0.05).

In Escambia County , survival of sweetgum was significantly lower for imazapic (0.36 lb. ai/ac) compared to the check (57% vs. 87%) in first-year survival. There were no significant differences in height growth among the treatments at year one. Although 1-year heights for sweetgum on herbicide treatments ranged from 0.0 to 0.6 ft greater than the check (1.7 ft of growth), none of the differences were statistically significant. Treatments exhibiting significantly lower rates of herbaceous cover at 16 WAT compared to the check, were azafenidin (8, 16 oz. ai/ac), diclosulam (.74, 1.0 oz. ai/ac), oxyfluorfen/azafenidin (1 lb./8, 16 oz. ai/ac), oxyfluorfen/diclosulam (1 lb./0.74, 1.0 oz. ai/ac), prodiamine (1 lb. ai/ac), and imazapic (0.36 lb. ai/ac).

On the Sumter County site, a prolonged summer drought reduced sweetgum survival. Sweetgum survival was significantly greater than the check on the azafenidin (8,16 oz. ai/ac), sulfometuron (1.125 oz. ai/ac), sulfometuron/azafenidin (1.125 oz./8, 16 oz. ai/ac) and the sulfometuron/diclosulam (1.125 oz./ 0.74, 1.0 oz. ai/ac) treatments. Height growth was significantly greater on the sulfometuron (1.125 oz. ai/ac), azafenidin (16 oz. ai/ac), sulfometuron/azafenidin (1.125 oz./16 oz. ai/ac) and the sulfometuron/diclosulam (1.125 oz./1.0 oz. ai/ac). Weed cover at 12 WAT was significantly lower than the check on sulfometuron (1.125 oz. ai/ac), azafenidin (16 oz. ai/ac), sulfometuron/azafenidin (1.125 oz. /8, 16 oz. ai/ac), sulfometuron/diclosulam (1.125 oz./0.74, 1.0 oz. ai/ac) and imazapic (0.36 lb. ai/ac) treatments (50, 63, 47, 33, 57, 43 and 43 vs. 98 %, respectively). At 24 WAT herbaceous cover was only significantly lower than the check (100% cover) on the sulfometuron/azafenidin (1.125 oz./16 oz. ai/ac) and the imazapic (0.36 lb. ai/ac) treatments at 75 and 73%, respectively.

On both sites, first-year sycamore survival was significantly lower than the check only on the imazapic treatments (0.09, 0.18, 0.36 lb. ai/ac). Reductions in survival ranged from 40% on the Escambia site (50% survival) to a low of 90% on the Sumter County site (0% survival). First-year height growth was significantly greater than the check on the azafenidin treatments (8, 16 oz. ai/ac) on both sites. The Escambia site sulfometuron (1.125 oz. ai/ac), diclosulam (0.74 oz. ai/ac), oxyfluorfen/azafenidin (1 lb./8,16 oz.. ai/ac), oxyfluorfen/diclosulam (1 lb./0.74 oz. ai/ac), and oxyfluorfen (1lb. ai/ac) treatments resulted in significantly greater height growth of sycamore than the check. At 16 WAT on the Escambia site, azafenidin (16 oz. ai/ac), diclosulam (0.74, 1.0 oz. ai/ac), oxyfluorfen/azafenidin (1 lb./8,16 oz. ai/ac), and oxyfluorfen/diclosulam (1 lb./0.74, 1.0 oz. ai/ac) were all significantly lower than the check in total herbaceous cover (all < 30%). Cover at 12 WAT on the Sumter County site for sulfometuron (1.125 oz. ai/ac), azafenidin (8, 16 oz. ai/ac), sulfometuron/azafenidin (1.125 oz./8, 16 oz. ai/ac) and sulfometuron/diclosulam (1.125 oz/0.74, 1.0 oz. ai/ac) treatments were significantly lower than the check.

PRE-EMERGENT HERBACEOUS WEED CONTROL SCREENING IN HARDWOOD PLANTATIONS WITH AZAFENIDIN, IMAZAPIC, AND DICLOSULAM ON SEVERAL CUT-OVER SITES THROUGHOUT THE SOUTHEAST. R. L. Muir Jr. and B. R. Zutter School of Forestry, Auburn University, AL.

ABSTRACT

Pre-emergent herbicide treatments were tested on cut-over sites for controlling herbaceous competition in young sweetgum (*Liquidambar styraciflua* L.) plantations in Dorchester County and Aiken County, South Carolina and a sycamore (*Platanus occidentalis* L.) plantation in Aiken County, South Carolina. The sites were recently harvested loblolly pine (*Pinus taeda* L.) plantations. Herbicides tested included azafenidin, diclosulam, imazapic, sulfometuron and combinations of sulfometuron/azafenidin, metsulfuron/azafenidin and sulfometuron/diclosulam. Trees were hand planted in January, 1998. The Dorchester site was bedded prior to planting. Applications were made using a CO_2 backpack sprayer utilizing a hand-held boom. The boom on the Dorchester site was equipped to spray a 9-foot swath and on the Aiken site was equipped to spray a 5-foot swath over the top of newly planted hardwood seedling. Applications on the Dorchester County site were made in late April over the top of fully leafed-out sweetgum seedling using 8002 Tee jet nozzles at 30 GPA. On the Aiken County site, herbicides were applied pre-bud break over the top of sweetgum and sycamore seedlings in late March using a boom equipped with 6503 Tee jet nozzles at 25 GPA.

Evaluations were made at 8 and 16 weeks after treatment (WAT) on the Dorchester County site and 12 and 24 WAT on the Aiken County, SC site to determine herbaceous weed cover. Initial height, first-year height growth and first-year survival were noted for crop trees on both sites. Weed cover, first-year height growth and first-year percent survival were compared to the check using Dunnett's Test (p=0.05).

On the Aiken County studies, herbaceous cover was significantly less (< 50%) on sulfometuron/azafenidin (1.5 oz./8, 16 oz. ai/ac) and imazapic (0.36 lb. ai/ac). Mixing azafenidin and sulfometuron resulted in lower cover then either herbicide applied alone. On the sweetgum study, treatments did not differ from the check in first-year survival. However, first-year survival of sycamore for imazapic at 0.18 and 0.36 lb. ai/ac treatments was significantly lower than the check and other herbicide treatments. Sulfometuron/azafenidin (1.5 oz./16 oz. ai/ac) resulted in the greatest first-year sycamore height growth and was significantly greater than the check.

On the Dorchester County site, herbaceous weed cover was lower than at the Aiken County site. Herbaceous cover was significantly greater on the diclosulam (1.0 oz. ai/ac) treatment than the treated check (4.3%). Percent survival was not significantly different than the treated check and was excellent (>90%). Height growth was greater than the treated check on the sulfometuron (1.5 oz. ai/ac), azafenidin (16 oz. ai/ac), sulfometuron/azafenidin (1.5 oz./8, 16 oz. ai/ac), sulfometuron/diclosulam (1.5 oz./0.74, 1.0 oz. ai/ac) and metsulfuron/azafenidin (0.3 oz./8, 16 oz. ai/ac) and significantly lower than the treated check on the diclosulam (0.74 oz. ai/ac) treatment.

EVALUATING PRE-EMERGENCE TREATMENTS OF R6447 (AZAFENIDIN) FOR HERBACEOUS WEED CONTROL IN NEWLY PLANTED PINES: YEAR TWO GROWTH RESPONSE. J. L. Yeiser, College of Forestry, Stephen F. Austin State University, Nacogdoches, TX 75962; K. Corbin, AR Forest Resources Center, Monticello, AR 71656.

ABSTRACT

Fifteen, pre-emergence herbicide treatments were applied over the top of newly planted loblolly pine (Pinus taeda L.) seedlings on March 17, 1997. The objective of this study was to assess efficacy and growth response for two years following treatment. Selected combinations of Oust, Oust+Velpar L, Arsenal+Oust, R6447, R6447+Oust, Velpar DF and Oust+Velpar DF were tested. Plots were visually evaluated 6, 12, 18 and 26 weeks after treatment for percent ground cover by major vegetation classes. Seedling performance (survival, height, ground line diameter, and volume) was assessed after the first and second growing seasons. For weed control, the three treatments of R6447+Oust ranked in the top six treatments and R6447 5oz+Oust 3oz ranked in the top two through 26 WAT. Similar results were found with R6447+Oust combinations for total seedling volume. R6447 in combination with Oust showed promise as a pre-emergence treatment for controlling herbaceous weeds.

INTRODUCTION

Herbaceous weed control around newly planted loblolly pine (Pinus taeda L.) seedlings enhances growth, and relative to no herbaceous control, should increase economic gain at the end of the rotation. Oust, Oust+Velpar L, Arsenal and Oust+Arsenal are commonly used in pine plantations for control of unwanted herbaceous pine competitors. DuPont has introduced a new product, R6447 (Azafenidin). This product is a member of the triazolone family, has a mode of action that inhibits chlorophyll production, and shows potential for herbaceous weed control. The objective of this study was to assess efficacy and resultant growth for two years following the application of herbicides over the top of newly planted pine seedlings.

METHODS AND MATERIALS

The study was established on an upper Coastal Plain site in Ashley County in SE Arkansas near Crossett. Soil on the site is a Savannah fine sandy loam (1). This site was clearcut during May of 1995 and aerially treated with 48 oz. of Chopper in a 25% oil:water emulsion with a 5 GPA carrier volume in March of 1996. The following October the site was burned. Genetically improved loblolly pine seedlings were then planted on an 8' X 10' spacing in early January 1997.

The study layout was a randomized complete block design with four blocks. Each block contained 15 treatment plots and each treatment plot consisted of a single row of 16 individual seedlings. The measurement plot comprised the internal 12 seedlings leaving two buffer seedlings at the beginning and end of all plots.

A CO_2-pressurized backpack sprayer and hand-held boom was used to apply all herbicide treatments. Herbicides were mixed with water until the total volume was 10 GPA, and applied in 6-foot bands centered over the top of seedlings. All treatments were pre-emergence applications made on March 17, 1997 to bare soil. The following 15 treatments (product/acre) were tested:

1) R6447	5 oz	6) R6647 + Oust	5 oz + 3 oz	11) Velpar DF	0.67 lb
2) R6447	10 oz	7) Oust + Velpar DF	5 oz + 0.67 lb	12) Oust + Velpar DF	2 oz + 0.67 lb
3) R6447	20 oz	8) R6447 + Velpar DF	10 oz + 0.67 lb	13) Untreated Check	
4) R6447 + Oust	50 oz + 1.5 oz	9) Oust	1.5 oz	14) Velpar L + Oust	1 qt + 2 oz
5) R6447 + Oust	10 oz + 1.5 oz	10) Oust	3 oz	15) Arsenal AC + Oust	4 oz + 2 oz

Plots were visually evaluated 6, 12, 18 and 26 WAT for percent ground cover for vegetation classes of grass, broadleaf, woody tree/shrub, and vine where 0 equaled exposed ground and 100 equaled totally covered ground. Plants present in plots were taxonomically identified 12 WAT. Visual evaluations for weed control were previously analyzed and reported in Birmingham, Alabama in 1998 (2).

Seedlings were assessed for survival and measured for total height and total ground line diameter (GLD). Seedlings were evaluated initially in April, after one growing season in September 1997, and again in September 1998 following two growing seasons. Volume was computed as (total height)(total ground line diameter^2). Data were analyzed using an analysis of variance procedure of SAS with means separated according to Duncan's New Multiple Range test (3). All tests were conducted at the p=0.05 level.

RESULTS AND DISCUSSION

Survival after one- (90.5%) and two-growing (86.7%) seasons was good (Table 1). Survival for Velpar DF (0.67 lb) treated seedlings was 70% following the first growing season, 64% after the second growing season, and for both years, significantly less than other treatments.

First year growth was moderate, possibly due to extremes in precipitation and summer temperatures, with mean total height of only 13.4 in. (Table 1). R6447+Oust (5+3oz) treated seedlings ranked first in volume and had 170% more volume than check seedlings. Five treatments provided seedling volumes that were statistically similar to that of R6447+Oust (5+3oz): Arsenal+Oust (4+2oz), Velpar+Oust (1qt+2oz), R6447+Oust (10+1.5oz, 5+1.5oz), and R6447+Velpar DF (5oz+.67lb). Of the best six treatments, three were R6447+Oust combinations R6447+Oust (10+1.5oz, 5+1.5oz, 5+3oz), two were industry checks (Arsenal+Oust (4+2oz), Velpar+Oust (1qt+2oz)) and one was a mixture of R6447+Velpar DF (5oz+.67lb).

Considering a drought encompassed most of the second growing season, growth was good with mean height of 33.8 in. and mean GLD of 0.547 in. or 2.5 times the total height and 2.7 times the total GLD of the first year. The greatest seedling volume was recorded for two R6447+Oust (10+1.5oz, 5+3oz) treatments with all three R6447+Oust combinations ranked in the top six of 15 treatments. R6447+Oust (10+1.5oz) and R6447+Oust (5oz +3oz) treated seedlings exhibited more than 250% greater volume than the untreated check. For this same period, industry checks, Arsenal+Oust (4+2oz) and Velpar L+Oust (1qt+2oz), ranked in the top four treatments for seedling volume.

In conclusion, R6447+Oust combinations showed excellent potential as an alternative pre-emergence treatment for herbaceous weed control and early pine growth. Further testing is warranted.

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Table 1. Year one mean seedling performance for survival (%), total height (in.), ground line diameter (GLD) (in.), and volume (in.^{3}/surviving tree). Pre-emergent treatments were applied on March 19, 1997. Treatments are ranked according to volume.

Herbicide[1]	Rate (Product)	Survival[2]	Total Height[2] (in.)	Total GLD[2] (in.)	Total Volume[2] (in.^{3})
R6447+Oust	5oz+3oz	97.8a	15.1a	.245a	1.25a
Arsenal+Oust	4oz+2oz	93.5a	14.5ab	.238a	1.22a
R6447+Oust	10oz+1.5oz	100.0a	15.5a	.237a	1.07ab
VelparL+Oust	1qt+2oz	91.9a	14.1abc	.218a	0.90ab
R6447+VelparDF	5oz+.67lb	93.2a	14.5ab	.201b	0.87ab
R6447+Oust	5oz+1.5oz	92.7a	13.3abc	.219a	0.87ab
Oust	1.5oz	92.7a	13.2abc	.200b	0.78bc
R6447+VelparDF	10oz+.67lb	93.2a	13.5abc	.197b	0.69bc
R6447	10oz	88.1a	13.8abc	.198b	0.66cd
Oust	3.0oz	89.4a	12.5bcd	.198b	0.56cd
R6447	20oz	90.2a	12.5bcd	.189b	0.54cd
CHECK		89.1a	13.6abc	.168d	0.46de
Oust+VelparDF	2oz+.67lb	90.5a	11.5de	.179c	0.44ef
VelparDF	.67lb	70.2b	12.2cde	.163e	0.35f
R6447	5oz	86.0a	10.6e	.161e	0.34f

[1] Herbicides are in units of product per treated acre. Total application volume is 10 GPA.
[2] Means within a column sharing the same letter are not significantly different (Duncan's Multiple Range Test).

Table 2. Mean seedling performance for survival (%), total height (in.), ground line diameter (GLD) (in.), and volume (in.^{3}/surviving tree) after two growing seasons. Pre-emergent treatments were applied on March 19, 1997. Treatments are ranked according to volume.

Herbicide[1]	Rate (Product)	Survival[2]	Total Height[2] (in.)	Total GLD[2] (in.)	Total Volume[2] (in.^{3})
R6447+Oust	10oz+1.5oz	88.9a	41.4a	.749a	30.09a
R6447+Oust	5oz+3oz	91.3a	39.1ab	.724a	29.96a
Velpar L+Oust	1qt+2oz	91.9a	36.1abc	.652ab	21.38b
Arsenal+Oust	4oz+2oz	93.5a	36.1abc	.594bcd	19.37bc
R6447+Oust	5oz+1.5oz	87.8a	34.9bc	.621bc	17.72bc
R6447+Velpar DF	5oz+.67lb	90.9a	36.4abc	.544cde	15.66bcd
Oust	1.5oz	82.9a	31.5cde	.508de	14.52bcde
Oust	3.0oz	85.1a	31.1cde	.582bcd	12.60cdef
R6447+Velpar DF	10oz+.67lb	88.6a	33.1cd	.489def	12.35cdef
R6447	20oz	87.8a	34.1bc	.514cde	11.98cdef
Oust+Velpar DF	2oz+.67lb	88.1a	32.0cde	.542cde	11.90cdef
R6447	10oz	90.5a	33.1cd	.489def	10.78cdef
CHECK		89.1a	32.8cd	.440efg	8.51def
R6447	5oz	83.7a	28.2de	.401fg	6.60ef
Velpar DF	.67lb	63.8b	27.1e	.349g	4.58f

[1] Herbicides are in units of product per treated acre. Total application volume is 10 GPA.

[2] Means within a column sharing the same letter are not significantly different (Duncan's Multiple Range Test, p=0.05).

SECOND YEAR PINE GROWTH RESPONSES TO EARLY AND LATE POST-EMERGENCE TREATMENTS OF SELECTED IMIDAZOLINONES. J. L. Yeiser, College of Forestry, Stephen F. Austin State University, Nacogdoches, TX 75962.

ABSTRACT

Thirty-one treatments (15 early post-emergence, 15 late post-emergence and an untreated check), were tested on two sites in SE Arkansas for weed control, pine safety and resultant growth. The first site was a bedded site in Drew County near Cominto, and the second was a chemically prepared site in Ashley County near Crossett. Uncommonly heavy precipitation may have jeopardized study integrity in Drew County. In Ashley County, Plateau (32oz) and Arsenal (8oz) were the only treatments approximating the weed free, grass and broadleaf control of industrial checks (Arsenal+Oust 4+2oz, Velpar+Oust 1qt+2oz). Perhaps modest growth resulted from environmental extremes. For early treatments, best growth occurred on plots treated with Arsenal+Oust (6+2oz), Arsenal+Oust (4+2oz) and Velpar+Oust (1qt+2oz) following both growing seasons. As late post-emergence (herbs approximately 4" tall) treatments, following the first growing season, seedling performance was best on plots treated with Velpar+Oust (1qt+2oz), Arsenal (6oz), and Arsenal+Oust (6+2oz). After the second growing season, best performance occurred on plots treated with Velpar+Oust (1qt+2oz), Arsenal+Oust (6+2oz) and Arsenal+Oust (4+2oz). As a late post-emergence treatment, Velpar+Oust (1qt+2oz) had statistically more volume than all other treatments for years one and two.

INTRODUCTION

Herbaceous weed control enhances early growth and survival of newly planted seedlings of loblolly pine (Pinus taeda L.). No single herbicide totally controls the array of post-harvest competitors invading pine sites. Managers need options to better match competitors with herbicide treatments for economically responsible and socially acceptable vegetation management. Thus, researchers routinely search for new products of potential value to forest vegetation management. The objective of this study was to assess early and late post-emergence applications of Pendulum, Plateau (imazameth), Pursuit (imazethapyr) and Scepter (imazaquin) combinations for weed control, pine tolerance and resultant growth for two years following treatment.

METHODS AND MATERIALS

The study was established in SEAR on an Ashley County near Crossett. Soil at the Ashley County site is a Savannah fine sandy loam soil (1). This site was clearcut in May 1995, and aerially treated with 48 oz. of Chopper in a 25% oil:water emulsion with a total volume of 5 GPA in March 1996. A burn followed in October. In January 1997, the site was planted with genetically improved loblolly pine (Pinus taeda L.) seedlings on an 8 ft X10 ft spacing.

Thirty-one treatments were compared, 15 as early post-emergence and 15 as late post-emergence in addition to an untreated check (Table 1). Early treatments (herbs approximately 2" tall) were sprayed on April 16, 1997. Late treatments (herbs approximately 4" tall) followed on May 15, 1997. A CO_2-pressurized backpack sprayer with hand-held boom and four 8002 nozzles was used to apply all herbicide treatments. Herbicides were mixed with water until the total volume was 10 GPA, and applied in 6-ft bands centered over the top of seedlings.

The study layout was a randomized complete block design with four blocks. Each block contained thirty-one treatment plots and each treatment plot consisted of a single row of 16 individual seedlings. The measurement plot consisted of the internal 12 seedlings leaving two buffer seedlings at the beginning and end of all plots.

Plots were visually evaluated 12 and 22 WAT for percent ground cover for vegetation classes of grass and broadleaf where 0 equaled exposed ground and 100 equaled totally covered ground. Means for visually evaluated weed control were computed and reported in 1998 in Birmingham, Alabama (2). Seedlings were assessed for survival and measured for total height and ground line diameter (GLD). All treatments were measured initially in April 1997, in September 1997, following one growing season, and in September 1998, following two growing seasons.

Data were analyzed using an analysis of variance procedure within SAS with means separated according to Duncan's New Multiple Range test (3). All tests were conducted at the p=0.05 level.

RESULTS AND DISCUSSION

First-year survival was 89.3%. Second-year survival, although good, decreased more on plots receiving late (79.4%) rather than early (84.9%) applications of herbicide. Perhaps this decline resulted from the mid-June through October drought. If so, then data supports early weed control for maximum root and seedling development as protection against extreme weather.

At the end of the first growing season, seedling growth was meager for both early and late treatments. This possibly resulted fromthe extremes in precipitation and June night temperatures that rarely fell below 85^{o} F. The second growing season drought probably provided conditions even less suitable for seedling growth, yet second year growth was good with height and GLD 2.5 times greater than year one height and GLD.

The best three early post-emergence treatments, ranked by total volume, for both growing seasons were Arsenal+Oust (6+2oz), Arsenal+Oust (4+2 oz), and Velpar+Oust (1qt+2oz). Following the first growing season, these treatments provided 224%, 216% and 184% more total volume than untreated checks, respectively. After two growing seasons, total volume for these same treatments was 439%, 430%, and 323% greater than the untreated check, respectively.

For late post-emergence treatments, best seedling performance occurred on plots treated with Velpar+Oust (1qt+2oz). Following two growing seasons, this treatment yielded volumes that were more than 400% greater than the untreated check. For both years, seedling growth for Arsenal+Oust (6+2oz, 4+2oz) and Arsenal (6oz) was ranked by volume in the top four, but these treatments provided statistically less growth than the Velpar+Oust (1qt+2oz) treatment.

Plateau provided promising control of competitors, but exhibited at the 16oz and 32oz rates, significant pine damage, probably explaining the moderate seedling growth. Plateau damaged seedlings exhibited clustered buds, twisted shortened needles, sprouting from the base, and chlorosis.

In conclusion, early and late treatments of selected imidazolinones failed to out perform industrial checks (Velpar+Oust 1qt+2 oz; Arsenal+Oust 4+2). Plateau (16 and 32 oz) showed promising weed control, inadequate seedling tolerance, and resultant moderate growth.

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Table 1. Year one mean seedling performance for survival (%), height (in.), ground line diameter (GLD, in.), and total volume (VOL, $in.^3$ per surviving tree) on a flatwoods site near Crossett, AR. Early post-emergence treatments were applied on April 19, 1997. Late post-emergence treatments were applied on May 16, 1997. Treatments are ranked according to volume.

	Early Post-Emergence Treatments					Late Post-Emergence Treatments			
	Year One					Year One			
Treatment[1]	Sur[2] (%)	Total[2] (in)	Total[2] (in)	Total[2] (in^3)	Treatment[1]	Sur[2] (%)	Total[2] (in)	Total[2] (in)	Total[2] (in^3)
AROU 4+2oz	91a	14.7a	.246a	1.20a	AR 6oz	94a	13.9b	.235bc	1.03b
VEOU 1q+2o	89a	14.5ab	.243a	1.08a	AROU 6+2oz	96a	13.4bc	.248b	1.01b
AR 6oz	89a	12.8bcd	.190b	0.61b	AROU 4+2oz	96a	13.2bc	.237bc	0.96bc
AR 4oz	96a	13.1abcd	.183bc	0.57bc	AR 8oz	89ab	11.9cdef	.204de	0.68cd
PURS 4oz	85a	11.9d	.174bc	0.50bc	PLAT 16oz	77b	11.2defg	.217cd	0.63de
SC 2.8oz	87a	12.4cd	.179bc	0.50bc	AR 4oz	89ab	11.2defg	.188def	0.58def
AR 8oz	86a	11.7de	.184bc	0.49bc	SC 11.2oz	89ab	12.2cde	.195def	0.54def
PLAT 32oz	89a	9.9ef	.190b	0.43bc	SC 2.8oz	91a	12.7bcd	.186efg	0.54def
PURS 16oz	86a	11.3def	.173bc	0.41bc	PLAT 32oz	85ab	9.4h	.184efg	0.41def
SC 5.6oz	95a	11.3def	.172bc	0.38bc	PURS 8oz	95a	10.8efgh	.166fgh	0.37def
SC 11.2oz	88a	11.6de	.165bc	0.38bc	PLAT 8oz	83ab	9.5gh	.175efgh	0.36def
PURS 8oz	83a	11.4def	.157c	0.36bc	PURS 16oz	91a	10.1gh	.156gh	0.30ef
PLAT 8oz	94a	9.6f	.177bc	0.36bc	SC 5.6oz	94a	10.4fgh	.149h	0.27f
PLAT 16oz	85a	9.9ef	.158c	0.29c	PURS 4oz	85ab	9.3h	.151h	0.26f
CHECK	78	11.3	.161	0.38					

[1] Herbicides are in units of product per treated acre. Total application volume is 10 GPA. AR=Arsenal, OU=Oust, PL=Plateau, PURS=Pursuit, SC=Scepter, VE=Velpar L.

[2] Means within a column sharing the same letter are not significantly different (Duncan's New Multiple Range Test, p=0.05).

Table 2. Mean seedling performance for survival (%), height (in.), ground line diameter (GLD, in.), and total volume (VOL, in.^{3} per surviving tree) after two growing seasons on a flatwoods site near Crossett, AR. Early post-emergence treatments were applied on April 19, 1997. Late post-emergence treatments were applied on May 16, 1997. Treatments are ranked according to volume.

	Early Post-Emergence Treatments					Late Post-Emergence Treatments			
	Year Two					Year Two			
Treatment[1]	Sur[2] (%)	Total[2] (in)	Total[2] (in)	Total[2] (in^3)	Treatment[1]	Sur[2] (%)	Total[2] (in)	Total[2] (in)	Total[2] (in^3)
VEOU 1q+2o	91a	38.4a	.769a	27.95b	AROU 4+2oz	90abc	38.5bc	0.776b	32.01b
AR 6oz	80ab	32.8bc	.532b	12.68c	AR 6oz	89abc	35.9cd	0.640c	22.44c
AR 4oz	92a	33.7b	.516b	11.74c	AR 8oz	87abc	33.2de	0.554cd	15.16cd
AR 8oz	81ab	30.0bcd	.498bc	9.65c	AR 4oz	74c	31.8def	0.542d	14.42de
SC 2.8oz	83ab	30.7bcd	.471bcd	8.96c	PLAT 16oz	77bc	32.3de	0.538d	13.43def
PURS 16oz	86ab	28.3cdef	.468bcd	8.25c	SC 11.2oz	83abc	34.9cd	0.527d	12.87defg
SC 5.6oz	93a	29.8bcd	.466bcd	8.03c	SC 2.8oz	91abc	31.2def	0.507de	10.78defg
PLAT 32oz	80ab	23.6f	.486bcd	7.93c	SC 5.6oz	85abc	28.8efg	0.428ef	6.88defg
PURS 4oz	79ab	26.9def	.434bcd	7.43c	PLAT 8oz	79abc	25.1g	0.410ef	6.45defg
PLAT 8oz	81ab	24.5ef	.404cd	7.27c	PURS 8oz	93ab	26.9fg	0.419ef	6.11efg
PLAT 16oz	83ab	27.7def	.437bcd	6.44c	PURS 4oz	85abc	25.0g	0.383f	5.36fg
PURS 8oz	72b	28.4cde	.441bcd	5.52c	PLAT 32oz	78abc	23.7g	0.391f	4.92fg
SC 11.2oz	85ab	27.8def	.394d	5.51c	PURS 16oz	94a	24.3g	0.375f	4.40g
CHECK	76	27.3	.388	6.60					

[1] Herbicides are in units of product per treated acre. Total application volume is 10 GPA. AR=Arsenal, OU=Oust, PL=Plateau, PURS=Pursuit, SC=Scepter VE=Velpar L.
[2] Means within a column sharing the same letter are not significantly different (Duncan's New Multiple Range Test, p=0.05).

SECOND-YEAR RESPONSES OF LOBLOLLY PINE SEEDLINGS TO COMBINED HERBACEOUS WEED CONTROL AND FERTILIZATION: INFLUENCE OF TAPROOT CONFIGURATION. T. B. Harrington, J. A. Gatch, Warnell School of Forest Resources, University of Georgia, Athens, GA 30602, M. B. Edwards, USDA Forest Service, Southern Research Staton, Athens, GA 30602 and T. S. Price, Georgia Forestry Commission, Macon GA 31298.

ABSTRACT

At three sites in the Piedmont or Upper Coastal Plain of Georgia, studies were initiated in 1996 to determine if seedlings planted with bent taproots respond to herbaceous weed control and fertilization in the same way as those planted with straight taproots. Sites included an abandoned pasture (Milledgeville), a recent forest cutover (Juliette), and an agricultural field (Fort Valley). At each site, a completely randomized design was installed with three replications of each of three taproot configurations: "J"-shaped, "L"-shaped, or straight. Each main plot (0.26 acre) was split, and one half was randomly assigned to receive a combination of herbaceous weed control and fertilization (H+F). In November 1996, sites were prepared prior to planting by mowing the fields (Milledgeville and Fort Valley) or by hand spraying hardwood and shrub sprouts at the cutover site (Juliette) with a 20% mixture of Garlon® 4 (triclopyr) in JLB Improved Plus® oil. In December 1996, 1+0 bare-root seedlings of loblolly pine (*Pinus taeda* L.) were planted with a planting shovel via the dug-hole method to ensure that root-collar depth and planting hole characteristics did not differ among taproot configurations. Initial size (groundline diameter and height) was measured on each of 25 seedlings per split plot. For split plots assigned to receive H+F, a banded application (3' swath) of Oust® (sulfometuron) was applied in March 1997 at a rate of 6 oz. of product in 40 gallons of water per treated acre. In the same split plots, broadcast applications of urea and triple superphosphate were applied in June 1997 at a rate of 50 lbs. of elemental N and P per acre, respectively. In September 1997, cover of forbs and grasses was estimated visually within each of five 1 m^2 frames per split plot. First- and second-year measurements of seedling survival and growth were taken in December 1997 and 1998, respectively. Data were subjected to analysis of variance with initial size as a covariate (95% significane level).

Following herbaceous weed control and fertilization (H+F), first-year forb cover at each site was 16% to 42% of that observed in the absence of treatment. At Milledgeville and Fort Valley, first-year grass cover was 72% to 197% greater in the presence versus absence of H+F, presumably as a result of reductions in forb cover in combination with addition of nitrogen fertilizer. Grass cover did not vary significantly with the H+F treatment at Juliette. First-year and second-year pine survival at Fort Valley was significantly greater in the presence of H+F, while second-year survival at Juliette was significantly greater in the absence of H+F. The interaction of taproot configuration and H+F treatment was significant for second-year pine diameter at Fort Valley. In the presence of H+F, stem diameter varied little among

taproot configurations; however, in the absence of H+F, mean stem diameter of seedlings varied among taproot configurations as follows:"J"-shaped > "L"-shaped > straight taproots. Each of the main effects of taproot configuration and H+F treatment were significant for second-year pine height at Fort Valley. Ranking of mean heights by taproot configuration mirrored that found for stem diameter, with greater differences being observed in the absence versus presence of H+F. Results of this research indicate that variability in growth responses to taproot configuration decreased in the presence of H+F, while they increased in its absence. Possible causes for increases in growth of trees planted with bent taproots include increased availability of surface soil water and nutrients because of the more shallow and lateral configuration of the root system, stimulated root and cambial growth from the accumulation of carbohydrates at the point of bending (1), and stimulated cambial growth in response to increased ethylene production -- a stress phenomenon that results from bending of the stem (2).

Funding for this research was provided by the Georgia Forestry Commission, USDA Forest Service, and McIntire-Stennis Program.

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PINE SEEDLING PERFORMANCE TWO GROWING SEASONS FOLLOWING EARLY POST-EMERGENCE APPLICATIONS OF DE564 (DICLOSULAM). J. L. Yeiser, College of Forestry, Stephen F. Austin State University, Nacogdoches, TX 75962, M. E. Corbin, School of Forest Resources, University of Arkansas at Monticello, 71656.

ABSTRACT

Ten, early post-emergence herbicide treatments were applied over the top of newly planted loblolly pine (Pinus taeda L.) seedlings on a site in SE Arkansas near Crossett. The objective of this study was to assess efficacy and growth response for two years following treatment of newly planted pine seedlings with applications of Oust+Velpar L, Arsenal+Oust, Arsenal, DE-564, and DE-564+Arsenal. Plots were visually evaluated 6, 12 and 20 weeks after treatment (WAT) for percent ground cover by major vegetation classes. At 12 and 20 WAT, Velpar 1qt+Oust 2oz and Arsenal 4oz+Oust 2oz were significantly more weed free than all other treatments. In addition, Velpar L 1qt+Oust 2oz had significantly more mean volume than all other treatments with 1.40 in^3 after one growing season and 30.92 in^3 after two growing seasons.

INTRODUCTION

Herbaceous weed control around newly planted loblolly pine seedlings reduces competition, enhances growth and potentially offers greater returns at the end of the rotation. Forest managers have commonly used Arsenal, Arsenal+Oust, and Velpar L+Oust in pine plantations for control of unwanted herbaceous pine competitors. Dow AgroSciences has introduced a new product with potential in herbaceous weed control, DE-564 (Diclosulam). The objective of this study was to assess efficacy and resultant seedling performance for two years following the application of herbicides over the top of newly planted loblolly pine seedlings.

METHODS AND MATERIALS

The study was established on an upper Coastal Plain site in Ashley County in SE Arkansas. Soil on the site is a Savannah fine sandy loam (1). This site was clearcut in May of 1995. Site preparation consisted of an aerial treatment of 48 oz. of Chopper in a 25% oil:water emulsion with a total volume of 5 GPA in March 1996 and a burn in October. Genetically improved loblolly pine seedlings were then planted on an 8 ft X 10 ft spacing in early January 1997.

All herbicide treatments were applied with a CO_2-pressurized backpack sprayer with a hand-held boom. Herbicides were mixed with water until the total volume was 10 GPA, and applied in 6-ft bands centered over the top of seedlings. All treatments were early post-emergence (herbs approximately 2" tall) applications made on April 21, 1997 to 68% bare soil.

The following 10 treatments (product/acre) were tested:

1. Velpar L+Oust	1qt+ 2oz
2. Arsenal+Oust	4oz+2oz
3. Arsenal	6oz
4. DE-564+Arsenal	0.62+4oz
5. DE-564+Arsenal	0.42+4oz
6. DE-564	0.62oz
7. DE-564	0.42oz
8. DE-564	0.31oz
9. DE-564	0.84oz
10. Untreated Check	-

The study layout was a randomized complete block design with four blocks. Each block contained 10 treatment plots. Each treatment plot consisted of a single row of 16 individual seedlings. The internal 12 seedlings comprised the measurement plot leaving two buffer seedlings at the beginning and end of all plots. Plots were visually evaluated 6, 12 and 20 weeks after treatment (WAT) for percent ground cover for vegetation classes of grass and broadleaf where 0 equaled exposed ground and 100 equaled totally covered ground. Plants present in plots were taxonomically identified 12 WAT. Results for visual evaluations for weed control were computed and reported in 1998 in Birmingham, Alabama (2). Seedlings were assessed for survival and measured for total height and total ground line diameter (GLD). Initial measurements were taken in April 1997. Seedlings were again measured in September 1997, after one growing season and in September 1998, after two growing seasons. Seedling volume was computed as (total height)(total ground line diameter^2). Data were analyzed using the analysis of variance procedure of SAS with means separated according to Duncan's New Multiple Range test (3). All tests were conducted at the p=0.05 level.

RESULTS AND DISCUSSION

Seedling survival for the first (88.7%) and second (86.1%) growing seasons was good. In spite of the 1998 summer drought, survival was maintained from year to year for all treatments except DE564 + Arsenal AC (.62oz+4oz). Second year survival for this treatment declined from 88.6% to 74%. First year growth was moderate, perhaps due to environmental extremes. After the second growing season, total mean height was 2.5 times greater than year one total mean height, and total mean GLD was 2.9 times greater than year one total mean GLD. Best seedling performance after one and two growing seasons occurred on plots treated with Velpar L 1qt + Oust 2oz. This treatment had significantly more mean volume at 1.40 in^3 and 30.92 in^3 than all other treatments with 250% and 400% greater volume than untreated checks for years one and two, respectively. (Tables 1 and 2). For DE-564 0.84oz, the highest application rate of DE564, total volume ranked second the first year and third the second year. Though not significantly different than the next two treatments ranking below it (DE564+Arsenal (.62+4oz; .42+4oz), if repeatable, this is of interest considering percent ground cover was always significantly higher than the check for all evaluations following treatment. Growth on DE564 plots generally ranked just above that on check plots. Growth may have been limited by the intense grass competition inhabiting test plots (2).

In conclusion, best seedling growth resulted from the industry check, Velpar L (1qt+2oz). Growth on test plots of DE564 (diclosulam) ranked intermediate, below the industry checks and above the untreated check. Future studies should investigate the weed control (both grasses and broadleaf weeds) and seedling performance of DE564+Oust plots.

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Table 1. Year one mean seedling performance for survival (%), total height (in.), ground line diameter (GLD) (in.), and volume (in.^{3} per surviving tree). Early post-emergent treatments were applied on April 21, 1997. Treatments are ranked according to volume.

Herbicide[1]	Rate (Product)	Survival[2]	Total Height[2] (in.)	Total GLD[2] (in.)	Total Volume[2] (in.^{3})
Velpar+Oust	1qt+2oz	97.9a	15.5a	.261a	1.40a
DE564	.84 oz	91.3ab	14.0ab	.232ab	.92b
Arsenal+Oust	4oz+2oz	91.3ab	13.4bc	.235ab	.92b
DE564+Arsenal	.42oz+4oz	87.1ab	12.9bcd	.207bc	.75bc
DE564+Arsenal	.62oz+4oz	88.6ab	12.3bcde	.171d	.63bcd
Arsenal	6oz	81.0b	12.0cde	.186cd	.57cd
CHECK		88.9ab	11.0de	.162d	.40d
DE564	.42oz	84.4ab	11.2de	.152d	.38d
DE564	.31oz	86.7ab	10.6e	.158d	.35d
DE564	.62oz	89.4ab	11.4cde	.153d	.34d

[1] Herbicides are presented in units of product per treated acre. Total application volume is 10 GPA.

[2] Means within a column sharing the same letter are not statistically different (Duncan's New Multiple Range Test, p=0.05).

Table 2. Mean seedling performance for survival (%), total height (in.), ground line diameter (GLD) (in.), and volume (in.^{3} per surviving tree) after two growing seasons. Early post-emergent treatments were applied on April 21, 1997. Treatments are ranked according to volume.

Herbicide[1]	Rate (Product)	Survival[2]	Total Height[2] (in.)	Total GLD[2] (in.)	Total Volume[2] (in.^{3})
Velpar+Oust	1qt+2oz	95.7a	39.1a	.806a	30.92a
Arsenal+Oust	4oz+2oz	91.3a	34.9abc	.681b	21.99b
DE564	.84 oz	87.0ab	36.0ab	.636b	19.43b
DE564+ARS	.62oz+4oz	74.3b	34.2bc	.586bc	17.87bc
DE564+ARS	.42oz+4oz	87.1ab	32.9bcd	.645b	17.36bc
Arsenal	6oz	83.3ab	30.5cde	.533cd	10.91cd
DE564	.62oz	91.5a	29.2de	.501cde	10.91cd
DE564	.31oz	86.7ab	28.0e	.477de	8.26d
DE564	.42oz	82.2ab	26.5e	.453de	8.24d
CHECK		82.2ab	27.0e	.408e	6.18d

[1] Herbicides are presented in units of product per treated acre. Total application volume is 10 GPA.

[2] Means within a column sharing the same letter are not statistically different (Duncan's New Multiple Range Test p=0.05).

PRE-EMERGENCE CONTROL OF HERBACEOUS WEEDS IN NEWLY PLANTED PINE WITH PENDULUM, ARSENAL, PLATEAU, PURSUIT AND SCEPTER: YEAR TWO GROWTH RESULTS. J. L. Yeiser, College of Forestry, Stephen F. Austin State University, Nacogdoches, TX 75962.

ABSTRACT

Twenty-seven treatments of Arsenal, Escort, Pendulum, Plateau (imazameth), Pursuit (imazethapyr), Scepter (imazaquin), Oust, and Velpar L. were screened for weed control plus seedling tolerance and growth on a flatwoods site in SE Arkansas near North Crossett. Weed free growing conditions 26 weeks after treatment were greatest for plots treated with Arsenal+Oust (6+2oz, 4+2oz) and Velpar+Oust (1qt+2oz). Seedling volume was greatest after one and two growing seasons for Arsenal+Oust (6+2oz, 4+2oz) combinations. Several test treatments exhibited seedling volume below that of untreated checks. The pre-emergence, over the top application of Plateau (16 oz) provided persistent weed control but significant pine damage and inadequate pine growth.

INTRODUCTION

Managers match herbicide and weed pests to achieve socially acceptable and economically responsible weed control. Since no single herbicide on the market today is best suited to all sites and conditions confronting managers, researchers continue to examine various products for feasibility. The objective of this study was to screen Pendulum, Arsenal, Plateau, Pursuit and Scepter for weed control and seedling performance resulting from pre-emergence applications over the top of newly planted loblolly pine (Pinus taeda L.) seedlings.

METHODS AND MATERIALS

This study was established on an upper Coastal Plain site near North Crossett in Ashley County. Soil there was a Savannah fine sandy loam (1). An industrial pine stand was clearcut in May 1995. The site was prepared in March 1996 with an aerial application of 48 oz Chopper in a 25% oil:water emulsion with a total volume of 5 GPA. In October, approximately 26 weeks after treatment, the site was burned . The site was planted in early January 1997 on a 8 ft X 10 ft spacing with genetically improved loblolly pine seedlings.

This study compared 27 treatments (Table 1). Herbicides were mixed with water until the total volume was 10 GPA and were then applied in 6-foot bands centered over the top of seedlings with a CO_2-pressurized backpack sprayer and hand-held boom supporting four, 8802 nozzles. All treatments were applied on March 28, 1997 to bare ground.

The study layout was a randomized complete block design with four blocks. Each block contained 27 treatment plots. Treatment plots consisted of 16 individual trees. The measurement plot comprised the internal 12 seedlings with two buffer seedlings at the beginning and end of all treatment plots.

Plots were visually evaluated for percent ground cover relative to untreated checks where 0 equaled exposed ground and 100 equaled totally covered ground. Plots were evaluated 12 (June 23, 1997) and 26 weeks after treatment (WAT) (Sept 10, 1997). Results from visual evaluations for weed control were previously analyzed and reported in Birmingham, Alabama in 1998 (2).

Seedlings were assessed for survival and measured for total height and ground line diameter. Seedlings were measured initially in April 1997, after one growing season in October 1997, and after two growing seasons in September 1998. Seedling volume was computed as (total height)(total ground line diameter)^2. An analysis of variance procedure within SAS was used to analyze data according to a randomized complete block design with four blocks and 27 treatments per block. Means were separated according to Duncan's New Multiple Range test (3). All tests were conducted at the p=0.05 level.

RESULTS AND DISCUSSION

Study survival was good. The drought from mid-June to mid-October 1998 impacted second-year seedling survival very little as survival ranged from89.6% after one growing season to only 88.9% after the second growing season. At the end of the first growing season, seedling performance was moderate (11.7" height; 0.18" ground line diameter, Table 1). This was perhaps due to the extremes in precipitation and June night temperatures that rarely fell below 85° F. Second year seedling performance was good (25.9" height; 0.44" ground line diameter, Table 2) with mean total height more than two times and ground line diameter more than three times that of year one. Best seedling performance in years one and two was observed on plots treated with Arsenal AC+Oust (6+2, 4+2 oz). After two growing seasons, volumes on plots treated with Arsenal AC + Oust (6+2, 4+2 oz) combinations were 200% greater than the untreated check. Volumes on plots treated with Velpar L + Oust (1qt+2oz) were 111% greater than the untreated check and 49% less than the Arsenal AC + Oust (4oz+2oz) treatment. Arsenal AC + Pendulum (6oz + 76oz) treatment showed relatively good seedling performance. Several treatments provided seedling volumes numerically less than reported for checks. Damage was observed for seedlings released with applications of 16oz of Plateau. These seedlings exhibited clustered buds, twisted shortened needles, sprouting from the base, and chlorosis and probably explains the lack of seedling performance.

In conclusion, none of the test treatments provided better seedling growth than the industry checks (Arsenal+Oust 6+2, 4+2; VeLpar L+Ousts 1qt+2oz). Seedling volume for years one and two was statistically greater on the Arsenal+Oust (6+2, 4+2 oz) plots providing, after two growing seasons, over 3 times more growth than untreated checks. Seedling volume was less for several treatments than for checks. Plateau (16 oz) provided persistent competitor control but pine tolerance was inadequate for acceptable pine growth.

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Table 1. Age one mean survival (%), total height (in.), ground line diameter (GLD) (in.), and volume (in^3/surviving tree) on a flatwoods site near Crossett in Ashley County. Pre-emergence treatments were applied on March 28, 1997. Treatments are ranked by volume.

Herbicide[1]	Rate (Product)	Survival[2]	Total[2] Height	Total[2] GLD	Total[2] Volume
Arsenal+Oust	6oz+2oz	97.6a	13.8a	.276ab	1.70a
PU+PN	4oz+76oz	91.1a	11.5cdefg	.240abcd	1.69a
Velpar L+Oust	1qt+2oz	84.1a	12.3bcd	.298a	1.59ab
Arsenal+Oust	4oz+2oz	87.0a	13.1ab	.276ab	1.52abc
Arsenal+PN	6oz+76oz	85.4a	12.3bcd	.259abc	1.42abcd
PN	76oz	89.1a	12.3bc	.250abcd	1.34abcde
Arsenal+PN	4oz+76oz	93.8a	11.7cdef	.236abcd	1.18abcdef
PU	8oz	85.1a	10.5efghij	.236abcd	1.13abcdefg
Scepter	10.7oz	89.6a	12.0bcde	.165cdef	0.97bcdefgh
Arsenal	6oz	83.3a	11.3cdefg	.177cdef	0.94cdefgh
Arsenal	8oz	91.3a	11.5cdefg	.178cdef	0.93cdefgh
Scepter+PN	21.3oz+76oz	89.6a	10.8defghi	.183bcde	0.87cdefgh
PL	8oz	89.1a	11.1cdefgh	.154defg	0.80defgh
PU+PN	8oz+76oz	89.6a	10.0ghij	.156defg	0.75efgh
PL+PN	8oz+76oz	88.4a	10.4fghij	.166cdef	0.74efgh
PL	16oz	95.6a	10.4fghij	.156defg	0.71efgh
Arsenal+PN	4oz+155oz	86.4a	10.5efghij	.135efg	0.69efgh
Scepter	21.3oz	91.5a	10.0ghij	.137efg	0.66fgh
PL+PN	16oz+76oz	88.4a	9.0j	.155defg	0.64fgh
PN	39oz	91.3a	10.7efghi	.131efg	0.64fgh
CHECK		87.0a	11.4cdefg	.108efg	0.63fgh
Arsenal	4oz	89.4a	10.7defghi	.122efg	0.60fgh
PN	155oz	89.1a	11.5cdefg	.115efg	0.59fgh
Arsenal+PN	6oz+155oz	88.9a	9.8hij	.118efg	0.58fgh
PU	4oz	92.9a	10.8defghi	.081fg	0.46gh
PN	233oz	93.3a	10.2fghij	.066g	0.39h
Scepter+PN	10.7oz+76oz	91.3a	9.6ij	.066g	0.35h

[1] Herbicides are in units of product per treated acre. Total application volume was 10 GPA. PL=Plateau, PN=Pendulum, PU=Pursuit.

[2] Means within a column sharing the same letter are not significantly different (Duncan's New Multiple Range Test, p=0.05).

Table 2. Age two mean survival (%), total height (in.), ground line diameter (in.), and volume (in³/surviving tree) for a flatwoods site near Crossett in Ashley County. Pre-emergence treatments were applied on March 28, 1997. Treatments are ranked by volume.

Herbicide[1]	Rate (Product)	Survival[2]	Total[2] Height (in.)	Total[2] GLD (in.)	Total[2] Volume (in.^{3})
Arsenal+Oust	4oz+2oz	87.0ab	33.0ab	.679a	20.19a
Arsenal+Oust	6oz+2oz	97.6a	33.4a	.674a	19.07a
Velpar+Oust	1qt+2oz	86.3ab	29.3abcd	.535b	13.59b
Arsenal+PN	6oz+76oz	92.7ab	29.2abcd	.477bcde	9.87bc
Arsenal	8oz	89.1ab	28.1cdef	.494bcd	9.84bc
Arsenal	6oz	79.2b	27.3cdefgh	.499bc	9.72bcd
Arsenal+PN	4oz+76oz	93.8ab	29.5abc	.495bcd	9.32bcde
PU+PN	4oz+76oz	93.3ab	28.7bcde	.457bcdef	8.71cdef
PL	8oz	89.1ab	29.4abc	.471bcde	8.45cdefg
PU+PN	8oz+76oz	93.8ab	27.4cdefg	.450bcdef	7.19cdefg
Arsenal+PN	4oz+155oz	88.6ab	26.0cdefghi	.435cdefg	6.47cdefg
CHECK		87.0ab	26.0cdefghi	.411cdefgh	6.44cdefg
PN	76oz	91.3ab	25.9cdefghi	.431cdefg	6.43cdefg
Arsenal	4oz	89.4ab	25.7cdefghij	.427cdefg	6.31cdefg
PU	8oz	85.1ab	23.9efghij	.406defgh	5.94cdefg
PL+PN	8oz+76oz	83.7ab	23.7fghij	.413cdefgh	5.90cdefg
Scepter	10.7oz	91.7ab	26.0cdefghi	.397efgh	5.45cdefg
PN	155oz	93.5ab	25.7cdefghij	.391efgh	5.41cdefg
PN	39oz	80.4b	21.0j	.330h	5.18cdefg
PN	233oz	93.3ab	24.5defghij	.369fgh	5.10defg
PL	16oz	93.3ab	23.0ghij	.394efgh	5.08defg
Arsenal+PN	6oz+155oz	88.9ab	22.0ij	.373fgh	4.92efg
Scepter+PN	21.3oz+76oz	83.3ab	22.5ghij	.366fgh	4.70efg
PU	4oz	83.3ab	22.4hij	.357gh	4.38fg
Scepter	21.3oz	91.5ab	22.7ghij	.343gh	4.25fg
PL+PN	16oz+76oz	88.4ab	22.3ij	.370fgh	4.18fg
Scepter+PN	10.7oz+76oz	87.0ab	22.3ij	.328h	3.72g

[1] Herbicides are in units of product per treated acre. Total application volume was 10 GPA. PL=Plateau, PN=Pendulum, PU=Pursuit.

[2] Means within a column sharing the same letter are not significantly different (Duncan's New Multiple Range Test, p=0.05).

A FORTHCOMING FIELD MANUAL ON FOREST PLANTS AND SHRUBS OF THE SOUTHEAST. J. H. Miller, US Forest Service, Auburn University, AL 36849, and K. V. Miller, School of Forest Resources, Univ. of Georgia, Athens, 30602.

ABSTRACT

During the coming summer, the Southern Weed Science Society will publish a field manual "Forest Plants and Shrubs of the Southeast". The manual was written by J.H. Miller and K.V. Miller, and features the photography of Ted Bodner (Ted Bodner Photography, Auburn, AL). The book contains descriptions of 185 genera of forbs, grasses-grasslikes, shrubs, semiwoody plants and woody vines, ferns, palms, cactus, and ground lichens, detailing 334 species. Commonly occurring genera and species are the focus, with extra attention to those important for wildlife and exotic invasive species. Genus and Species descriptions contain characteristics of growth form, stems, leaves, flowers, fruits, seeds, range, and ecology. For each genus a section describes their important wildlife attributes. There are 630 images to illustrate identifying features. The photographs are on facing pages to the descriptions throughout, not in a separate section.

The planning and layout have been assisted by the Society's Forest Plant ID Guide Subcommittee members over the past four years. 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 Univ.), David Bourgeois (Westvaco), 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 Univ.). Overall reviews of descriptions have been contributed by John Everest (Auburn Univ.) and Timothy Harrington (Univ. of Georgia), and selected sections by Fred Fallis (Weyerhaeuser) and Jim McIlwain (retired US Forest Service).

FIELD BINDWEED (*Convolvulus arvensis*) CONTROL ALONG OKLAHOMA ROADSIDES. D. P. Montgomery, L. M. Cargill, D. L. Martin, and J. D. Jamison, Department of Horticulture and Landscape Architecture, Oklahoma State University, Stillwater, OK 74078.

ABSTRACT

A study was conducted during the fall of 1997 to evaluate the effects of fall and spring applied Plateau for field bindweed control. Herbicide treatments evaluated included Plateau at 0.07, 0.14, 0.21 kg ai ha, and Vanquish at 1.12 kg ai ha. Single applications were made on 24 October (fall) and 21 April (spring). Fall applications were made prior to the first killing frost and spring applications were made several weeks after initiation of field bindweed growth. All treatments included a non-ionic surfactant at a rate of 0.25 % V/V. Treatments were applied to 1.5 by 3.0 meter plots using a CO_2-pressurized bicycle sprayer calibrated to deliver 187 l ha. Treatments were arranged in a randomized complete block design with three replications. Visual evaluations were made the following May, June, and July for percent field bindweed control and common bermudagrass injury as compared to the untreated check.

Plateau at 0.07 kg ai ha produced no more than 56% control of field bindweed regardless of application date. Plateau at 0.14 kg ai ha fall applied produced 80% control of field bindweed in May which decreased to 65% by late July. Spring applied Plateau at 0.14 kg ai ha produced 33% control of field bindweed in May with control increasing to 68% by July. Plateau at 0.21 kg ai ha applied in the fall produced 86% control of field bindweed and was able to maintain 82% control through July. The spring applied treatment of Plateau at 0.21 kg ai ha produced early field bindweed control of 37% which increased to 78% by July. Overall Plateau at 0.14 and 0.21 kg ai ha produced moderate field bindweed control similar to today's standards. Plateau applied in the fall produced better early summer control of field bindweed but by mid summer fall and spring treatments were producing similar control. The addition of 2,4-D (or similar product) to Plateau treatments or split applications would likely increase control to an acceptable level. The standard treatment of Vanquish at 1.12 kg ai ha produced similar results from both the fall and spring applications. Field bindweed control ranged from 77 to 95% in May which fell to 65 to 75% in July.

Common bermudagrass is the desirable roadside grass species in Oklahoma and is susceptible to injury from imidazolinone herbicides such as Plateau. Injury is usually compounded when applications are made during the

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FIELD BINDWEED (*Convolvulus arvensis*) CONTROL ALONG OKLAHOMA ROADSIDES. D. P. Montgomery, L. M. Cargill, D. L. Martin, and J. D. Jamison, Department of Horticulture and Landscape Architecture, Oklahoma State University, Stillwater, OK 74078.

ABSTRACT

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Common bermudagrass is the desirable roadside grass species in Oklahoma and is susceptible to injury from imidazolinone herbicides such as Plateau. Injury is usually compounded when applications are made during the

dormancy period of common bermudagrass. Bermudagrass injury was present at May evaluations from all Plateau treatments in this study. Injury produced from fall treatments of Plateau was 10 to 20% less than similar spring treatments. Injury for fall Plateau treatments ranged from 2 to 22% and would be acceptable for most roadside situations. Injury from spring Plateau treatments ranged from 27 to 37% with the 0.14 and 0.21 kg ai ha treatments producing unacceptable temporary injury. Bermudagrass had recovered from all Plateau injury by June evaluations. No bermudagrass injury was produced from Vanquish treatments.

EVALUATION OF FLUROXYPYR FOR CONTROL OF KOCHIA (*Kochia scoparia* L.) ON BERMUDAGRASS ROADSIDES IN OKLAHOMA. L. M. Cargill, D. L. Martin, D. P. Montgomery and J. D. Jamison, Department of Horticulture and Landscape Architecture, Oklahoma State University, Stillwater, OK 74078.

ABSTRACT

A field study was initiated in June 1998 to evaluate the efficacy of fluroxypyr and Vanquish for control of kochia and herbicide tolerance of common bermudagrass. Herbicide treatments evaluated included fluroxypyr at 0.14, 0.21, 0.28 and 0.56 kg ai/ha^{-1}. Two comparative standard treatments evaluated included Vanquish at 0.28 and 0.56 kg ai/ha^{-1}. All herbicide treatments included a non-ionic surfactant at a rate of 0.25 % v/v. Treatments were applied to 13-36 cm tall kochia plants in plots 1.5 by 3.0 meters. Applications were made with a CO_2 pressurized R & D brand boom-type bicycle sprayer equipped with three TeeJet 8002 VS flat-fan spray tips and calibrated to deliver 187 l ha^{-1} at a pressure of 172 kPa. Treatments were arranged in a randomized complete block design with three replications. Visual observations were made at 14, 30 and 60 days-after-treatment (DAT) for percent kochia control and common bermudagrass injury as compared to the untreated check plots.

No common bermudagrass injury was observed from any herbicide treatment at 14 DAT. However, when evaluations were conducted at 30 DAT, all herbicide treatments were producing 3.3% to 8.3% injury. By 60 DAT, no injury was present (0%) and the bermudagrass had fully recovered. All common bermudagrass injury visually observed in this experiment was acceptable for Oklahoma roadside situations. Acceptable bermudagrass injury along Oklahoma roadsides from any herbicide treatment should not exceed 40% to 50% and not persist for longer than 4 to 6 weeks.

For acceptable kochia control, herbicide treatments should provide a minimum of 90% control for roadside situations in Oklahoma. Percent kochia control from all herbicide treatments was unacceptable (37% to 60%) when evaluations were made at 14 DAT. By 30 DAT, the highest rate of both fluroxypyr and Vanquish (0.56 kg ai/ha^{-1}) were producing significantly better control (although marginal) of kochia (75% to 85%) than the remaining treatments (35% to 47%). When evaluations were conducted at 60 DAT, all herbicide treatments were producing marginal to an acceptable level of kochia control (84% to 97%). The two higher rates of fluroxypyr at 0.28 and 0.56 kg ai/ha^{-1} were equally effective (93% to 97%) as compared to the two equivalent rates of the standard treatments of Vanquish at 0.28 and 0.56 kg ai/ha^{-1} (94% to 97%) and provided acceptable kochia control. The two lowest rates of fluroxypyr (0.14 and 0.21 kg ai/ha^{-1}) produced only marginal kochia control (84% to 88%).

WEED CONTROL IN ROUGH TURF WITH A COMBINATION MOWER-HERBICIDE APPLICATOR. P. L. Hipkins, Department of Plant Pathology, Physiology and Weed Science, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.

ABSTRACT

A combination mower-herbicide applicator was evaluated for use as an ultra-low volume device for weed control in low maintenance turf and as a fertilizer applicator. Trials were established in 1997 and 1998 on mixed cool season turf as well as bluegrass (*Poa pratensis*) and turf type tall fescue (*Festuca arundinacea*). Products were applied at 28 L ha^{-1} total solution.

Triclopyr amine alone (0.84 Kg ha^{-1}) and tank mixed with clopyralid (0.084, 0.168, and 0.336 Kg ha^{-1}) or picloram (0.062, 0.112, and 0.224 Kg ha^{-1}) as well as dicamba (diglycolamine) alone (0.56 and 1.121 Kg ha^{-1}) and tank mixed with triclopyr amine (1.121 Kg ha^{-1}) and clopyralid (0.157 Kg ha^{-1}) provided excellent control of bull thistle (*Cirsium vulgare*) at 4 weeks after treatment (WAT). At 12 WAT all treatments continued excellent control except for the dicamba plus clopyralid which was fair (80%), the triclopyr alone and with picloram (0.84 plus 0.112 Kg ha^{-1} which was poor (67%) and the dicamba alone (0.56 Kg ha^{-1}) and with triclopyr (17% and O respectively). None of these tretaments gave adequate control of horsenettle (*Solanum carolinense*), though triclopyr plus clopyralid (0.84 + 0.168 Kg ha^{-1}) was fair (77%), nor white clover (*Trifolium repens*). It is possible that the clover was too short to be adequately mowed thus leaving it untreated. Subsequent treatments in 1998 using the same products as well as metsulfuron methyl showed that only clopyralid (0.210, 0.420, and 0.840 Kg ha^{-1}) could provide fair to good control of horsenettle (73-87%) at 10 WAT.

Yellow nutsedge (*Cyperus esculentus*) plots were established in August, 1998 to determine if the same methodology could be used to apply halosulfuron and bentazon. Treatments were applied with both the mower and a bicycle sprayer (280.6 L ha^{-1}). Halosulfuron was applied at 0.035 and 0.069 Kg ha^{-1} while the bentazon was applied at 1.12 and 2.24 Kg ha^{-1}. Bentazon gave excellent control (98-100%) 5 WAT at both rates when applied with the mower and at the high rate when applied with the sprayer. Halosulfuron treatments were fair to good (50-83%) at the 0.035 and 0.069 Kg ha^{-1} when applied with the mower and fair at the high rate (65%) when sprayed.

Liquid fertilizer (30%N) was applied to turf type tall fescue over intervals of 4 weeks, 2 weeks, and 1 week using the wet blade mower and compared to urea which was dissolved in water and applied with a sprayer (280.6 L ha^{-1}) at the same total Nitrogen (7.06 Kg ha^{-1}). Ratings for quality were made weekly on a 1 to 9 scale with 5 and above being acceptable and better. At 5 WAT all ratings (7.0-7.7) were better than the check (6.7) but only the weekly application of the liquid fertilizer (7.7) was significantly (0.05) superior to the check. At 10 WAT, the bi-weekly and weekly applications of the liquid fertilizer and the weekly application of dissolved urea (7.3, 7.7, and 8.0) were significantly better than the check (7.0). Clippings were collected and weighed at 5 and 10 weeks. There was no significant difference in any clipping weights at 5 weeks. At 10 weeks, all treatments except urea every 4 weeks (105 g) was significantly superior to the check (88g). The biweekly and weekly applications of the liquid fertilizer (162g and 152g, respectively) were significantly better than any treatment except the weekly application of dissolved urea (145g).

FOAM BRUSH: A TRACTOR MOUNTED APPLICATOR THAT USES HERBICIDE-LADEN FOAM FOR NON-CROPLAND VEGETATION CONTROL. C. S. Graves III, Reddick Equipment Company, Inc., Williamston, NC 27892.

ABSTRACT

In 1993, Reddick Equipment Company began working with Dr. John Anderson of N. C. State University on a wiper bar, originally developed in Florida, called the Weed Sweep. Dr. Anderson, along with several other researchers at NCSU were interested in finding alternatives to mowing ditch banks in order to improve Bobwhite quail habitat.

The early Weed Sweep bars were built from aluminum channel iron and incorporated a small capillary tube that distributed concentrated herbicide across the top of the bar. When the bar was mounted on an offset frame and pulled over woody vegetation, the bark of the vegetation was scraped away and a small amount of herbicide was wiped onto the cambium tissue. Tests were done using several herbicides. A combination of Accord and Arsenal was found to be very effective on mixed vegetation. Using this wiping technology, tall growing woody plants could be killed without destroying low growing native plants that support wildlife, filter nutrients, and prevent erosion control. Researchers then realized that there were other applications for this wiping technology.

On 9/13/95, a test was done by Dr. Anderson on a Duke Power right of way near Haw River, NC.. Treatment was 29.2 oz per acre of glyphosate and 14.4 oz per acre of imazypyr. Four weeks after treatment, the plot was evaluated. For control ratings, any plants exhibiting new leaf tissue or viable buds were considered to be uncontrolled. Early control was very limited with several species showing no control. Sweetgum showed the highest response with a 16% control rating. After six months, results had improved dramatically. Dogwood was rated as 81% controlled, eastern hophorn beam 67%, hickory 98%, maple 87 %, oaks 77%, pine 30%, sweetgum 98%, and tulip poplar 57% controlled.

While the test results established that the wiping technology could be used effectively for brush control, Reddick Equipment recognized the need for a more durable unit if the product was to be offered for commercial applications. In the spring of 1998, Reddick began experimenting with the use of foam as a carrier for the herbicide. This allowed the concentrated herbicide to be more uniformly distributed down the eight foot long wiper bars, and the operator could now visually verify chemical output. The new unit was also built out of formed steel and utilized a much more aggressive abrader bar on the leading edge of the bar. A brush was added to the bottom of the wiping bar to catch and redistribute any chemical which was not wiped off in the foam state. These changes appeared to work well. The redesigned unit was named the Foam Brush.

In the summer of 1998, approximately twenty five test plots were treated with the Foam Brush. Tests were conducted in the states of NC, SC, GA and MS.. Several different chemicals and chemical rates were tested on different species of woody vegetation. While early test results were promising, these areas will not be fully evaluated until the spring of 1999. Results will be available by mid-summer.

Acknowledgements: I would like to thank Dr. John Anderson, Dr. Peter Bromley, Dr. William Palmer, and Dr. Stratford Kay for their research and assistance on this project.

STARTING A KUDZU (*PUERARIA LOBATA*) CONTROL DEMONSTRATION IN MISSISSIPPI. J. D. Byrd, Jr., Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Kudzu became a Federal Noxious Weed in December, 1997. Two sites were established in Mississippi in 1998 to demonstrate the effectiveness of herbicides or herbicide combinations for kudzu management. Infested sites near Oxford and Holly Springs were treated August 27 and 28, respectively, with Transline at 22 fl oz/A, Transline at 22 fl oz/A plus Garlon 4 at 32 fl oz/A, Tordon 101 at 256 fl oz/A, Tordon 2K at 64 fl oz/A, Vanquish at 64 fl oz plus Escort at 3 oz/A, Vanquish at 64 fl oz/A plus Transline at 11 fl oz/A, Vanquish at 128 fl oz/A, Roundup Pro at 128 fl oz/A plus Escort at 2 oz/A, Roundup Pro at 128 fl oz/A, Escort at 4 oz/A, Garlon 4 at 96 fl oz/A, or Transline at 16 fl oz/A plus Escort at 3 oz/A. Timberland 90 surfactant was used with all treatments at 0.5% by volume, except those treatments that contained Roundup Pro. Plot size at the two locations varied from 0.5 to 0.7 acre. Treatments were applied by air in 80 gallons volume at Oxford and 20 gallons volume at Holly Springs to blooming kudzu. By 9 weeks after treatment (WAT), all treatments provided approximately 100% visual control. Plots will be evaluated next spring and summer and retreated next fall. Current plans are to apply these treatments for five consecutive in an attempt to find a treatment that provides long-term control.

COMPARISON OF JOHNSONGRASS WEED CONTROL PROGRAMS APPLIED BEFORE OR AFTER MOWING IN HIGHWAY RIGHTS-OF-WAY. J. M. Taylor and G. E. Coats. Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Johnsongrass [*Sorghum halepense* (L.) Pers] is a common weed found along roadsides in Mississippi. Typically, growth is sufficient to warrant mowing by late May or early June. Experiments were conducted in 1998 to evaluate herbicide treatments for johnsongrass control to coincide with mowing. Treatments were applied 2 wk before or 2 wk after mowing.

Experiment 1. All treatments were applied to separate bermudagrass [*Cynodon dactylon* (L.) Pers.] plots on May 19 and June 16 and all plots were mowed to a height of 6 in on June 3. Treatments were: 1.33 oz pr/A MON 37500; 1.0 oz pr/A sulfometuron; or 8 fl oz/A imazapic applied alone or tank-mixed with 3.3 lb ai/A MSMA or 12 fl oz/A glyphosate. In addition, MSMA or glyphosate was applied alone. Averaged over application timing at 12 wk after treatment (WAT), MON 37500 controlled johnsongrass 89%, which was better than control with either imazapic or sulfometuron (74 to

77%). Glyphosate or MSMA controlled johnsongrass 36% or less while all tank-mixes controlled johnsongrass 84 to 89%. MON 37500 alone, before or after mowing, controlled knotroot foxtail [*Setaria geniculata* (Lam.) Beauv.] 18% or less 12 WAT. MON 37500 tank-mixed with MSMA or glyphosate controlled knotroot foxtail 35% or less when applied before mowing and 60 to 68% when applied after mowing. Sulfometuron alone or tank-mixed with MSMA or glyphostate controlled knotroot foxtail 60 to 77% when applied before mowing and 85 to 90% when applied after mowing. Knotroot foxtail was controlled 80 to 90% by imazapic applied alone or tank-mixed with glyphosate or MSMA regardless of application timing. MON 37500 controlled southern crabgrass [*Digitaria ciliaris* (Retz.) Koel.] 83% 12 WAT when applied before mowing and 8% when applied after mowing. Southern crabgrass control was reduced to 63% when glyphosate was added to MON 37500 applied before mowing. MON 37500 plus glyphosate controlled southern crabgrass 75% when applied after mowing, and MON 37500 plus MSMA controlled southern crabgrass 85 to 90% when applied at either application timing. Sulfometuron controlled southern crabgrass 74% when applied before mowing and all other treatments containing sulfometuron controlled southern crabgrass 88 to 90%. All treatments containing imazapic controlled southern crabgrass 80 to 90%. Averaged over application timing, MON 37500 resulted in greater density of bermudagrass at 4 WAT than any treatment containing sulfometuron or imazapic. Bermudagrass density was 29% following MON 37500 at 4 WAT compared to 15 and 16%, respectively, for sulfometuron and imazapic. Increased bermudagrass density was observed 8 or 12 WAT when MSMA was added to MON 37500 compared to MON 37500 applied alone. Bermudagrass density for MON 37500 at 8 WAT was 36% and 50% for MON 37500 plus MSMA. At 12 WAT MON 37500 plus MSMA resulted in 56% bermudagrass density while MON 37500 resulted in 40% density. MSMA also increased bermudagrass density when added to imazapic compared to imazapic or MSMA applied alone. Bermudagrass density 12 WAT for imazapic, MSMA, and imazapic plus MSMA was 39, 38, and 55%, respectively.

Experiment 2. All treatments were applied to separate bahiagrass (*Paspalum notatum* Fluegge) plots on May 15 and June 23 and all plots were mowed to a height of 4 in on June 4. Treatments were: 1.33 oz pr/A MON 37500, 0.5 oz pr/A sulfometuron, 4 fl oz/A imazapic, or 17 fl oz/A clethodim. At 12 WAT MON 37500 controlled johnsongrass 90% regardless of application date. Sulfometuron, imazapic, or clethodim controlled johnsongrass better when applied after mowing compared to before mowing treatments. When applied after mowing these treatments controlled johnsongrass 75 to 80% compared to 30 to 53% when applied before mowing.

TOLERANCE OF CRIMSON CLOVER CULTIVARS TO IMAZAPIC AND DE-564. T. R. Murphy, Crop and Soil Sciences Department, University of Georgia, Griffin, GA 30223-1797.

ABSTRACT

Field observations showed in an earlier grass roadside herbicide trial that crimson clover (*Trifolium incarnatum*) appeared to be tolerant to DE-564. An experiment was conducted in 1998 to evaluate the tolerance of three crimson clover cultivars (‘Tibbee’, ‘Dixie’ and ‘Robin’) to imazapic and DE-564. Imazapic at 0.063 and 0.125 lbs. ai/acre and DE-564 at 0.031 and 0.063 lbs. ai/acre were applied on March 19 to crimson clover in the vegetative growth stage. These herbicides were also applied on April 13 to crimson clover that was in the mid-bloom (Tibbee, Dixie) and full bloom (Robin) growth stage. A nonionic surfactant at 0.25% v/v was included with all herbicide applications. Both rates of imazapic severely injured all crimson clover cultivars when applied at the vegetative growth stage. At the May 11 evaluation (81 DAA, days after application), crimson clover injury from imazapic ranged from 70 to 91%. In contrast, when applied at the vegetative growth stage, injury from both rates of DE-564 was $\leq$ 11% at any evaluation. Both imazapic and DE-564 injured crimson clover cultivars when applied at the mid- to full-bloom growth stage. However, at the May 11 evaluation (28 DAA) injury from DE-564 was $\leq$ 9%, while injury from both rates of imazapic averaged 25%. Imazapic applied at the vegetative growth stage severely reduced ($\geq$ 97%) crimson clover seed yields. In contrast, DE-564 applied at the vegetative growth stage did not significantly reduce crimson clover seed yield. Both imazapic and DE-564 reduced crimson clover seed yield when applied at the mid- and full-bloom growth stage. However, DE-564 at 0.031 and 0.063 lbs. ai/acre reduced crimson clover seed yield 51 and 42%, respectively, in contrast to the $\geq$ 97% crimson clover seed yield reduction recorded for both rates of imazapic. This experiment showed that crimson clover was more tolerant to DE-564 than to imazapic. Imazapic caused severe injury to crimson clover and essentially eliminated seed production. Crimson clover is a reseeding winter annual. DE-564 caused only slight injury to crimson clover when applied at the vegetative growth stage and did not reduce crimson clover seed yield. DE-564, applied at the mid- and full-bloom growth stage injured crimson clover and reduced seed yield more than when applied at the vegetative growth stage. Buckhorn plantain (*Plantago lanceolata*) was not effectively controlled with either imazapic or DE-564. Imazapic was more effective than DE-564 in controlling Italian ryegrass (*Lolium multiflorum*).

MONITORING THE RESPONSE OF RARE SPECIES TO VEGETATION MANAGEMENT PRACTICES WITHIN POWERLINE CORRIDORS. J. E. Settles and W. W. Witt, Department of Agronomy, University of Kentucky, Lexington, KY 40546-0091.

ABSTRACT

Sensitive and rare plant communities containing such species as orange crested orchid (*Platanthera cristata*), grass pink (*Calopogon tuberosus*), white fringeless orchid (*Platanthera integrilabia*), yellow screwstem (*Bartonia virginica*), and Nuttall's lobelia (*Lobelia nuttallii*) have been found within several powerline corridors throughout Kentucky. It has become increasingly necessary to determine which vegetation management practices maintain, enhance, or decimate the integrity of these interesting plant communities. This study was developed as an attempt to add insight into how utilities may better manage their powerline corridors to protect these communities.

Five powerline corridors in four counties have been selected for this study. Four of these powerline rights-of-way can be found in various regions of the Cumberland Plateau, and the plant communities within these powerlines are comprised primarily of indian grass (*Sorghastrum nutans*), big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), *Solidago* species, *Eupitorium* species, and other native herbaceous and woody species. The remaining site is located within the Mississippian Plateau in the "Big Barrens" area, which is known for containing some of the largest grassland areas in the state. This site has the components for providing suitable habitat for species such as purple coneflower (*Echinacea purpurea*), rattlesnake master (*Eryngium yuccifolium*), and the globally endemic glade cress (*Leavenworthia exidua*).

These sites will be studied to observe possible differences in the response of the plant communities to the three vegetation management practices: mowing, prescribed burning, and herbicide applications. Three replications of each treatment will be implemented within each powerline right-of-way. The herbicide application will consist of a broadcast application of 25 GPA of an Arsenal / Accord tank mixture. The mowing treatment was conducted in the fall of 1998, and the prescribed burning and herbicide applications will be conducted in the spring. The plots are arranged in a randomized complete block design, and the plot sizes are 15m x 30m. Within each plot, three permanent line transects 10m in length have been established. Species data is recorded at each 1m interval within each line transect. Belt method surveys have also been established within these selected powerline rights-of-way. Using the belt method, rare and sensitive species of interest are counted within each treatment and these values will be compared with subsequent values obtained after implementation of the treatments. The changes in species richness and species composition will be compared between each treatment providing insight into the best method or methods for preserving these sensitive plant communities.

EVALUATION OF FIVE SURFACTANTS WITH IMAZAPYR FOR CONTROL OF CATTAILS, (*Typha latifolia*). S. T. Hoyle, S. H. Kay Crop Science Department, North Carolina State University, Raleigh, NC 27695.

ABSTRACT

Cattail (*Typha latifolia*) has become a serious problem reducing water flow in roadside ditches throughout many areas of the country. In eastern North Carolina, heavy rainfall from recent tropical storms has caused flooding along many of our highways. By maintaining water flow in these roadside ditches, we may be able to reduce damage to both paved and unpaved portions of these highways. Traditional control methods such as mowing and herbicide applications of glyphosate (Rodeo®) have provided only short-term control.

A field test was initiated September 16,1997 to determine the influence of different surfactants on the efficacy of imazapyr (Arsenal®) for control of cattail. A single application of imazapyr was applied at either 2 or 4 pints/acre using a handgun applicator at 45 psi with a total application volume of 40 gallons/acre. Blazon Blue spray pattern indicator was used to ensure uniform treatment of each plot. Five chemically different surfactants were applied, including d, l-limonene (Cide - Kick II®), alkyl polyoxylkane ether, free fatty acids (Induce®), polyalkyleneoxide modified

polydimethylsioloxane (SilEnergy®), methylated seed oil (Sun-It II®), and paraffin base petroleum oil (Agri - Dex®) at a rate of 0.25% v/v.

The experimental area chosen was adjacent to Interstate 40 in Johnson County, North Carolina. Experimental design was a randomized complete block, with treatments replicated 4 times. Plot size was 10 feet X 25 feet. Evaluations were made at four and six weeks after treatment (WAT) to determine if any of the surfactants gave more rapid kill. Plots were mowed in early April 1998 prior to spring growth to allow better evaluation of new shoots and replacement vegetation. Spring evaluations of the plots consisted of counting the number of live stems present in three 1-m^2 areas/plot. A mid-summer evaluation was made July 15, 1998 to determine if treatments would successfully control cattail long term. Notes were also made as to the type and density, based on visual ground cover estimates, of replacement vegetation present in the plot area.

Evaluations at four WAT showed few differences in percent dead stems. Pooled across surfactants imazapyr at 4 pt/A controlled cattail 44.75 % while the 2 pt/A rate controlled cattail 38.5 %. This increase with rate was not significant. Percent dead stems in the nontreated plots was 16.25 % at this time. By six WAT, all treated plots controlled cattail more than 65 % with imazapyr at 4 and 2 pt/A controlled cattail 82.25 and 74.4%, respectively. Percent dead stems in nontreated plots was 20.0 at this time. SilEnergy® and Sun-It II® with imazapyr at 2 pt/A rate controlled cattail 80 and 82% respectively.

Agri-Dex® with the 2 pt/A rate of imazapyr showed the most regrowth of any treated plot with a mean of .33 new shoots /m^2. No new growth was observed with four of five surfactants with imazapyr at the high rate. Plots treated with Cide – Kick II® averaged 0.08 new shoots/m^2. Additional observations throughout the summer and into fall showed no new growth in any plot. Plants present included Virginia buttonweed (*Diodia virginiana*), Asian spiderwort (*Murdannia keisak*) [very abundant], water primrose (*Ludwigia palustis*) [abundant], barnyard grass (*Echinochloa crus-galli*) [fairly abundant], broadleaf signal grass (*Brachiaria platyphylla*), climbing hempweed (*Mikania scandens*), fall panicum (*Panicum dichotomiflorum*) [common]. This vegetation should provide soil stability and reduce erosion in the absence of cattail.

A noted concern with the use of imazapyr along highways has been non-target effects or off site movement of the herbicide. No evidence of any problem was seen in or around these plots. Site specific circumstances may limit the use of this product, however, if applied carefully, it can fit into an effective roadside vegetation management plan. North Carolina Department of Transportation estimates the cost of glyphosate at 2 gal /A as $272/mile, while an application of 2 pt/A of imazapyr will average $255/mile. These figures include fixed cost of equipment and personnel as well as herbicide and surfactant. They also estimate mowing cost at $75 – $100/mile. Imazapyr can provide 2 or more years control and save $34/mile over annual applications of glyphosate and may reduce the mowing cycle to 3 – 4 years. This may result in a savings of $45 - $135/mile over conventional annual mowing.

USE OF THE WEED SWEEP APPLICATOR FOR HERBICIDE TREATMENT ON TERRESTRIAL REEDS, *Phragmites australis*. S. H. Kay and S. T. Hoyle, North Carolina State University, Raleigh, NC 27695.

ABSTRACT

A test was initiated in September 1997 to evaluate the feasibility of using new wipe-on technology to apply non-selective herbicides for control of terrestrial stands of common reed (*Phragmites australis*). A single application of imazapyr (Arsenal), glyphosate (Rodeo), or a tank mixture of both herbicides was applied using the Weed Sweep wipe-on applicator at application rates of 6 pt $acre^{-1}$ when a herbicide was used alone or at 3 pt $acre^{-1}$ of each herbicide when used in combination. The site was mowed in March 1998, and live shoots counts were made three weeks later. Reed treated with glyphosate had shoot densities similar to those of the controls, but imazapyr, alone or in combination with glyphosate, gave almost complete suppression of reed.

INTRODUCTION

Common reed, *Phragmites australis* (Bav.) Trin., is a serious problem in coastal areas and around the Great Lakes region of the United States. Reeds growing in monoculture stands dominate the flora in temperate climates around the edges of freshwater marshes and wetlands (van der Werff et al. 1987). The U.S. Fish and Wildlife Service and other agencies consider reeds to be highly-invasive weeds having little value for fish and wildlife (Kay 1995).

Large reed infestations usually are managed with herbicide spray applications, particularly glyphosate [N-(phosphonomethyl) glycine]. Herbicides may provide fairly effective control, particularly if applied after flowering (Beck 1971, Cross and Fleming 1989). Herbicide treatments usually provide only temporary suppression, so frequent re-treatments are needed (Kay 1995). Recent evidence suggests that imazapyr (2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid) provides longer and more effective control of reeds than glyphosate (Konstantinovic et al. 1998). Broadcast herbicide spraying adversely impacts the desirable understory vegetation and may leave residues in the soil. Traditional alternatives to spraying, including mowing and burning, also have undesirable impacts on non-target vegetation. Effective, non-spraying herbicide application alternatives that could effectively kill the reeds with minimal effect on understory vegetation and without leaving soil residues would very be desirable.

A potential alternative to spraying and other traditional management techniques is wipe-on application. The development of the rope wick applicator (Dale 1979) and other wipe-on methods (Wyse and Habstritt 1977; McWhorter 1966; Chandler 1979) were landmarks in application technology that provided safe, effective application of non-selective systemic herbicides in cropping systems (McWhorter 1966; Anderson et al. 1982), to woody vegetation on rights-of-ways (Gaultney and Holt 1983; Mayeux 1983), and in rangelands (Mayeux and Crane 1984). A modified rope wick applicator was used with some success along ditch banks (Comes and Kelley 1988). Rope-wick application of glyphosate has been examined for control of reeds in sugarcane fields (Linedale 1985). More recently, Kay (1995) demonstrated partial control of reeds in an aquatic environment with imazapyr and glyphosate using a canvas-covered wipe-on applicator. These application methods reduced the amount of herbicide used and allowed safe application in sensitive areas without spraying.

Recent research at NC State University has demonstrated a new, non-spraying, herbicide application technique, the Weed Sweep, that could revolutionize selective vegetation control in noncropland areas. The Weed Sweep (Anderson et al. 1996) abrades the bark of woody vegetation and wipes herbicide onto the bark and into the cut surfaces. Field testing under power lines and on ditch banks gave excellent control of saplings without damaging understory vegetation (Anderson 1996, Anderson et al. 1996, Warson et al. 1996). The Weed Sweep applicator reduces herbicide application rates up to 60% compared with broadcast spraying. Efficacy of this equipment has not been evaluated on terrestrial reeds.

The objectives of this study were to examine the feasibility of applying the non-selective herbicides, glyphosate and imazapyr, to terrestrial reeds using the Weed Sweep wipe-on application technology.

MATERIALS AND METHODS

A test was initiated in September 1997 at the Mattamuskeet National Wildlife Refuge in Hyde Co., near Swan Quarter, NC, to evaluate the feasibility of using recently-developed wipe-on technology to apply Arsenal for control of terrestrial stands of common reeds (*Phragmites australis*) without using broadcast spraying, thus reducing non-target impacts on understory vegetation and reducing the likelihood of surface and ground water contamination.

A single application of imazapyr (Arsenal), glyphosate (Rodeo), or a tank mixture of both herbicides was applied using the Weed Sweep, an abrasion/wipe-on applicator, using a total solution volume of approximately 1 GPA. Application rates and combinations were: Arsenal alone, 6 pt acre^{-1}; Rodeo alone, 6 pt acre^{-1}; combination, 3 pt acre^{-1} Arsenal + 3 pt acre^{-1} Rodeo. Rodeo was used as a positive control, because it normally is used for reed control by spray application. The combination treatment was examined because of possible treatment enhancements and the potential for cost reductions compared with a 6 pt acre^{-1} Arsenal application. Methylated seed oil (Sun-it II) was used at 1 % v/v in each treatment combination. The study was conducted in a completely randomized design, with three replicates of each treatment combination. Experimental plots were approximately 8 x 300 ft., separated by mowed alleys. The mowed alleys were used during the spring as untreated checks for comparison. All plots were mowed in March 1998 to remove dead stems and thatch and facilitate evaluations. Three weeks after mowing (April 1998), the test was evaluated using counts of green shoots on five 1-meter square quadrats placed along the center line of each plot. For comparison, similar shoot counts were made in three of the mowed alleys adjacent to the plots. The averages of shoot counts in the five quadrats from each plot were submitted to an analysis of variance, and means were separated with a Duncan's multiple range test.

RESULTS AND DISCUSSION

The effects of the Weed Sweep on the reeds, regardless of treatment, were very slow to appear. Visual evaluations made four and eight weeks after treatment showed very little sign of herbicide symptoms. The reed stands were extremely variable in both height and density at this site. Early herbicide damage symptoms on the reeds were more obvious in areas of lower reed density within a given plot. This appears to have been an artifact of having better contact of the applicator with reeds under conditions of lower density. Also, in areas of tall reed stature (10 to 12 feet), the taller reeds appeared to have protected those of shorter stature, at least temporarily. In areas of individual plots where both reed density and stature were lower, we also observed substantial damage to non-target vegetation, primarily asters and an unidentified species of the grass, *Paspalum* sp. This occurred primarily because the height of the Weed Sweep applicator bar was adjusted to contact reeds which were of low stature (4 to 6 feet in height). Non-target damage was limited almost entirely to these areas. In areas of higher reed stature and densities, either there were no non-target understory plants, or those present were protected by the reeds.

Evaluations made in the spring of 1998 showed significant differences in treated plots compared with untreated checks (Table 1). All plots containing Arsenal, either alone or in combination with Rodeo, had good control of reeds at this time. Live stem densities averaged only 1 to 3 m^{-2} compared with controls at 29 and Rodeo alone at nearly 34 live stems m^{2}, respectively. The lack of any significant kill with Rodeo alone at 6 pt $acre^{-1}$ suggests that little product was translocated to the root and rhizome system. The excellent results in the combination treatment with 3 pt Arsenal + 3 pt Rodeo $acre^{-1}$ also suggests that most of the activity may have been due to Arsenal rather than any enhancement resulting from the combination of the two herbicides. This also suggests that Arsenal might be effective at substantially lower application rates than tested in the current study. The slow response to the herbicide treatment on reeds using the Weed Sweep wipe-on applicator was similar to that observed in previous studies with the Weed Sweep on terrestrial woody vegetation (Anderson et al 1996).

There was considerable return of non-target vegetation in the treated plots in the spring of 1998, particularly in areas which had low reed densities during the previous fall at the time of treatment. The return of these non-target plants apparently reflects the presence of a good seed bank, as many of the broadleaf plants were annuals. This observation also suggests that very little or no Arsenal had reached the soil and demonstrates an obvious advantage of the Weed Sweep over a broadcast spray application, especially when using a herbicide that has substantial soil residual activity and particularly in a wetland environment in which the water table may be only a few inches beneath the surface.

This study demonstrated that terrestrial reed may be controlled effectively with wipe-on application technology. Further research is needed to examine timing of treatments, to refine application rates used with wipe-on technology, and to evaluate the impacts on non-target vegetation.

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Table 1. Evaluation of Arsenal and Rodeo applications, alone and in combination, on terrestrial reeds using the Weed Sweep wipe-on applicator. Evaluations are means of 3 replicate plots (± sd) taken on April 27, 1998. Means in a column followed by the same letter are not significantly different according to Duncan's multiple range procedure at $p < 0.05$.

Treatment	Herbicide Rate(s)	Live Shoots m^{-2}
Check	None	29.3 (18.6)a
Rodeo	6 pt $acre^{-1}$	33.9 (18.6)a
Arsenal	6 pt $acre^{-1}$	1.2 (1.0)b
Arsenal + Rodeo	3 pt + 3 pt $acre^{-1}$	3.4 (1.7)b

USE OF IMAZAPIC FOR ESTABLISHMENT AND RELEASE OF NATIVE WARM SEASON GRASSES.
C. T. Horton, American Cyanamid Company, Townville, SC 29689, J. G. Vollmer, and J. L. Vollmer, American Cyanamid Company, Laramie, WY 82072.

ABSTRACT

Establishment of prairiegrass and wildflower stands often result in intense weed competition where desirable species are out competed by aggressive annual weeds. Such prairie planting can take years to establish under traditional methods, or in some cases, result in complete stand loss. Imazapic (*Plateau*®) is being developed specifically for prairie renovation and restoration.

Nine common prairiegrass species were tested for tolerance to imazapic (*Plateau*). Imazapic (*Plateau*) was applied to newplantings, newly emerged seedlings and to established perennial plants. Results show that major prairiegrass species elicit good tolerance both as seedlings and as mature plants. Research results show big bluest, indiangrass, little bluestem, sideoats grama can set seed the first growing season when treated with imazapic (*Plateau*).

These studies along with other trails conducted across the U.S. have shown, that when using imazpaic (*Plateau*) successful prairie plantings can be achieved in one year, compared to three to five years for conventional methods.

ABSORPTION, TRANSLOCATION AND METABOLISM OF CLORANSULAM-METHYL IN IMIDAZOLINONE-RESISTANT AND SUSCEPTIBLE SMOOTH PIGWEED (*AMARANTHUS HYBRIDUS* L.). D. H. Poston[1], J. Wu[2], K. K. Hatzios[2], and H. P. Wilson[1]. [1]Eastern Shore Agricultural Research and Extension Center, Virginia Polytechnic Institute and State University, Painter, VA 23420, [2]Department of Plant Pathology, Physiology and Weed Science, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.

ABSTRACT

Several populations of smooth pigweed (*Amaranthus hybridus* L.) with resistance to the imidazolinone herbicides have been identified in recent years. Greater control of one imidazolinone-resistant smooth pigweed population (R2) compared to the susceptible (S) wild type occurred in greenhouse trials when cloransulam-methyl was applied at 18 g/ha. Laboratory studies were conducted in 1998 to determine if differences in absorption, translocation and metabolism of cloransulam-methyl exist between the S and R2 populations. Absorption of cloransulam-methyl into the treated leaf was rapid and no significant differences between populations occurred. At 8 h after application, 91 and 93 % absorption of ^{14}C-cloransulam-methyl occurred in S and R2 populations, respectively. Translocation of ^{14}C-cloransulam-methyl out of the treated leaf was generally similar in both populations. Approximately 20, 35, 30, and 1 % of the absorbed radioactivity was recovered fromthe treated leaf, shoot above the treated leaf, shoot below the treated leaf, and roots, respectively, in both populations 168 h after application. Metabolism of ^{14}C-cloransulam-methyl was similar in S and R2 populations. Three metabolites with Rf values of approximately 0.83 (A), 0.65 (B), and 0.45 (C) have been isolated from both populations. At 8 h after application, the parent compound (Rf = 0.98) represented >60% of the extracted radioactivity. This value decreased slowly over time and by 168 h after herbicide application the parent compound represented approximately 40% of the extracted radioactivity. This decrease in parent compound over time was accompanied by a corresponding increase in metabolite A, which accounted for >50% of the extracted radioactivity 168 h after herbicide application. Metabolites B and C were considered minor metabolites because at no time did they individually represent greater than 5 percent of the extracted radioactivity. It is unlikely that absorption, translocation, and metabolism play a significant role in the differential tolerances of S and R2 to cloransulam-methyl.

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D. H. Poston[1], J. Wu[2], K. K. Hatzios[2], and H. P. Wilson[1]. [1]Eastern Shore Agricultural Research and Extension Center, Virginia Polytechnic Institute and State University, Painter, VA 23420, [2]Department of Plant Pathology, Physiology and Weed Science, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.

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CHARACTERIZATION OF ACETOLACTATE SYNTHASE IN PALMER AMARANTH (*Amaranthus palmeri*). G. G. Light, P. A. Dotray, and J. R. Mahan. Texas Tech University and USDA-ARS, Lubbock, TX 79409.

ABSTRACT

Pyrithiobac is a preemergence and/or postemergence herbicide used in cotton (*Gossypium hirsutum*) that controls a broad spectrum of annual broadleaf weeds, including Palmer amaranth (*Amaranthus palmeri*), lanceleaf sage (*Salvia reflexa*), and Venice mallow (*Hibiscus trionum*). In its three years of commercial use, inconsistent weed control has been observed in the field. This inconsistency may be influenced by rate, weed size, spray coverage, and environmental factors such as light, rainfall, and temperature. Potential sources of thermal limitation for herbicides include uptake, translocation, metabolism, and enzyme inhibition. Enzyme inhibition may be an important factor in pyrithiobac inhibition because the site-of-action is acetolactate synthase (ALS). This study sought to obtain the kinetic parameters of ALS from Palmer amaranth, determine whether ALS sensitivity to pyrithiobac varied with temperature, and correlate enzyme inhibition with field efficacy.

Crude extract of ALS from Palmer amaranth was prepared by a modified Shimizu (1994) method. Acetolactate synthase activity was assayed at six pyrithiobac concentrations (0 to 500 nM), six pyruvate concentrations (0 to 20 K_m) and nine temperatures (0 to 50° C in 5° C increments). The maximal velocity (V_{max}) and the Michaelis constant (K_m) were determined at each temperature using non-linear regression. Relative inhibitor potency (I_{50}) values were obtained by determining the pyrithiobac concentration where the velocity was 50% of the V_{max} at each assay temperature.

The V_{max} as a function of temperature fit the Arrhenius curve ® = 0.96) with an activation energy of 12,696 cal/mole. The K_m values exhibited a thermal dependence with the lowest K_m occurring at 20° C. Acetolactate synthase inhibition by pyrithiobac also varied with temperature. The lowest I_{50} value was observed at 30° C, indicating efficient inhibition. Temperatures both above and below 30° C showed decreased inhibition efficiency of ALS.

Correlation with field efficacy was obtained by independently cultivating 16 plots of 5-10 cm Palmer amaranth during a two-year period. One half of each plot was treated with pyrithiobac at 71 g ai/ha in a solution containing crop oil concentrate at 1% (v/v). A carrier volume of 140 L/ha was delivered using a backpack sprayer and 8002 nozzles. Plant/soil scene temperatures were monitored with IRt/c sensors and air temperatures were monitored with a thermocouple at a height of 1 m. These temperatures were recorded at 15-minute intervals throughout the trials. Plant samples (10-20) were taken at the time of herbicide application and again 14 days post-application. The field activity was expressed as accumulated dry weight (DW) using the equation: treated DW - baseline DW/(non-treated DW - baseline DW). Under these calculations, a low percentage reflected high pyrithiobac activity and a high percentage indicated low pyrithiobac activity. Optimal field activity occurred at ambient temperatures of 20 to 34° C. Comparison of field activity and enzyme inhibition indicated that both accumulated DW and the I_{50} values increased rapidly above 34° C. Therefore, the thermal dependence of the ALS-pyrithiobac interaction may contribute to variable activity observed in the field.

PHYSIOLOGICAL EFFECTS OF A PHYTOTOXIC SESQUITERPENE LACTONE FROM SEVERAL SPECIES OF COMPOSITAE. J. C. Galindo, A. Hernández,* F. E. Dayan,* R. N. Paul,** and S. O. Duke,* Department of Organic Chemistry, Faculty of Sciences, University of Cadiz, Apdo. 40, 11520 - Puerto Real, Cádiz, Spain and United States Department of Agriculture, Agricultural Research Service, *Natural Products Utilization Research Unit, P.O. Box 8048, University, MS 38677 and **Southern Weed Science Research Unit, Stoneville, MS 38677.

ABSTRACT

Dehydrozaluzanin C, a phytotoxic sesquiterpene lactone found in several species of Compositae, causes rapid plasma membrane leakage. At the transmission electron microscope level, the first symptom observed was the plasma membrane separating from the cell wall as is typical of plasmolysis. Dehydrozaluzanin C is more active at 50 µM than the same concentration of the herbicide acifluorfen, and the disruption of membrane integrity is not dependent on light. Reversal of its phytotoxic effects on root growth was obtained using the amino acids histidine, glycine, proline, and the mixtures (aspartic acid + glutamic acid + alanine), (phenylalanine + tyrosine + tryptophan), and (cysteine + methionine). A strong reversal effect is also obtained with reduced glutathione, which is able to minimize the leakage effect observed. Photosynthetic, respiratory, and mitotic processes, as well as NADH oxidase activity appear to be unaffected by this compound. Our results indicate that dehydrozaluzanin C exerts its effects on plants through two different mechanisms: one related to the plasma membrane leakage effect and another that reduces growth through a different mechanism.

CONFIRMATION AND MECHANISM OF RESISTANCE TO ARYLOXYPHENOXY PROPIONATE AND CYCLOHEXANEDIONE HERBICIDES IN A JOHNSONGRASS [*SORGHUM HALEPENSE* (L.) PERS.] BIOTYPE FROM VIRGINIA. K. W. Bradley, E. S. Hagood, J. Wu, and K. K. Hatzios, Virginia Polytechnic Institute and State University, Blacksburg, VA 24060.

ABSTRACT

Field experiments were conducted during 1996 and 1997 to investigate the likelihood of graminicide resistance in a johnsongrass population that demonstrated a reduced response to repeated applications of quizalofop-P. Areas of heaviest johnsongrass infestation were treated with fluazifop-P at 0.375 lbs ai/A, quizalofop-P at 0.137 lbs ai/A, sethoxydim at 0.375 lbs ai/A, and clethodim at 0.312 lbs ai/A. Visual control ratings were recorded at weekly intervals following application. During 1997, clethodim provided 83% johnsongrass control at 2 months after treatment, while sethoxydim, quizalofop-P, and fluazifop-P afforded only 15, 17, and 34% control, respectively. To determine the mechanism responsible for resistance to these herbicides, johnsongrass seedlings were grown from seed harvested during 1996 and 1997 and collected at the two-leaf stage for use in subsequent *in vitro* acetyl-coenzyme A carboxylase (ACCase) assays. The results of these assays revealed a significantly higher level of ACCase activity in extracts from the resistant biotype compared to those from the susceptible biotype, when incubated in either sethoxydim, clethodim, or quizalofop-P at the 0, 0.1, 1, 10, 100, or 1000 :M concentration. These results suggest that the mechanism of resistance in this johnsongrass biotype is an overexpression of the ACCase enzyme. Additional comparisons between resistant and susceptible biotypes in the absorption, translocation, and metabolism of these graminicides will be conducted in order to verify this conclusion.

PHYSIOLOGICAL BASIS FOR DIFFERENTIAL RESPONSES OF SOYBEAN CULTIVARS TO SULFENTRAZONE. Z. Li, R. H. Walker, and G. Wehtje. Agronomy and Soils Department, Alabama Agric. Exp. Stn., Auburn University, AL 36849-5412.

ABSTRACT

Laboratory studies were conducted to determine the basis of the cultivar-based, sulfentrazone tolerance that is exhibited by germinating seedlings. Two soybean cultivars were used; Stonewall (sulfentrazone tolerant) and Asgrow 6785 (sensitive). In a seedling-growth, sulfentrazone-bioassay study, seeds were first imbibed (24 h), subsequently allowed to germinate (30C, dark, 96 h) in solutions which had been spiked with sulfentrazone at concentrations ranging from 0 to 50 ppm. Seedling hypocotyl and root lengths were reduced by sulfentrazone at $\geq$ 5 ppm for both cultivars. However, this response was greater for Asgrow 6785 than for Stonewall. For example, at 10 ppm hypocotyl length reduction (relative to 0 ppm) was 34 and 19% for Asgrow 6785 and Stonewall, respectively.

Seed imbibition of sulfentrazone increased with time and increased temperature for both cultivars. However, total amount imbibed from a 10 ppm solution after 24 h at 30C was 1.40 and 0.88 ug/g seed (dry weight) for Asgrow 6785 and Stonewall, respectively. Differential metabolism may also be a contributing factor in cultivar response. Amount of absorbed ^{14}C-sulfentrazone recovered as unaltered parent after 24 h was 28 and 23% for Asgrow 6785 and Stonewall, respectively.

Electrolyte leakage from leaf discs, which had been taken from true leaves and immersed in a sulfentrazone solution, did not differentiate between the two soybean cultivars. However, data from this technique has provided an excellent correlation with across species comparisons (e.g. soybean vs sicklepod vs coffee senna) of sulfentrazone sensitivity.

Results indicate that differential sulfentrazone absorption by germinating seed and resulting germlings is the primary basis of differential cultivar response. Differential metabolism is probably of secondary importance.

REMOTE SENSING AS A TOOL FOR DETECTING WEED DISTRIBUTIONS. F. E. LaMastus, D. R. Shaw, R. L. King, and M. W. Shankle, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Aircraft and satellite remote sensing in the visible and near-infrared wavelengths of light has shown considerable benefit for detecting the presence and extent of stress factors such as water and nutrient deficiencies that affect the growth of agricultural crops. Recently computer image processing techniques have been used to quantify weed and brush infestations in rangelands from aerial photographs. To effectively use remote sensing for detecting weed infestations and distributions in agricultural fields, initial databases of information must be established. These should include spectral response patterns for particular weed species that describe the reflectance properties under different densities and environmental conditions. Once these are developed, comparisons of the spectral response patterns from crop and weed species in a given area can be used to determine the distribution and density of the weeds present.

An experiment was designed to observe the spectral properties and detection capabilities of four weed species at different densities. A split plot design was utilized for the study. Weed species evaluated in the study were pitted morningglory (*Ipomoea lacunosa* L.), entireleaf morningglory (*Ipomoea hederacea* var. *integriscula* Gray), sicklepod [*Senna obtusifolia* (L.) Irwin and Barnaby], and common cocklebur (*Xanthium strumarium* L.). Densities were 1, 2, 4, and 8 plants/m^2 for pitted morningglory, entireleaf morningglory, and sicklepod, and 0.5, 1, 2, and 4 plants/m^2 for common cocklebur. Comparison treatments of soybean, weedy soybean, weedy, and bare ground were included in the study. Experimental units were 4 x 4 m with a 2-m alley surrounding each unit to ensure delineation between plots in the imagery. All plots were hand planted on June 10, 1998. Due to extremely dry environmental conditions, plots were irrigated approximately 2 weeks after planting, resulting in late emergence of the weeds. Plots were maintained to specific densities and species by hand removal of all other plants. Alleys were maintained by hand removal of all

vegetation. Multispectral digital imagery was acquired using a 4 CCD array camera (1320 by 1035 pixel array) with sensors ranging from 540 nm (green) to 840 nm (near infrared). All images are 8-bit image pixels, which results in a pixel value of 0 to 255. This is a measure of the relative intensity of the signal or reflectance. ITD Spectral Visions, Bay St. Louis, MS, provided multispectral digital images on a bi-weekly basis. Images were taken at approximately 3200 feet with 1-m resolution between the hours of 10:00 a.m. and 2:00 p.m. Images from August 11, 18, and 28, 1998, were analyzed for differences between densities and species. Spectral responses were obtained by selecting the center 9 to 12 pixels and averaging the pixel values for each band. The mean pixel value was used as the spectral response pattern for each plot in the study.

Using a linear discriminate function for analysis, the spectral response patterns acquired from the August 11 images resulted in 12 out of 16 observations of pitted morningglory being classified by species with an error rate of 25%, entireleaf morningglory was classified 10 times correctly with an error rate of 38%, common cocklebur was classified correctly 7 times with an error rate of 56%, and sicklepod was classified correctly only four times with an error rate of 75%. When cross-validation was utilized, 12, 8, 5 and 4 observations were classified correctly with error rates of 25%, 50%, 68%, and 75% for pitted morningglory, entireleaf morningglory, common cocklebur, and sicklepod, respectively. For the August 18 image, 13 observations were classified correctly for sicklepod and pitted morningglory, while 11 and 9 observations were classified correctly for entireleaf morningglory and common cocklebur with error rates of 19% for sicklepod and pitted morningglory, 32% for entireleaf morningglory, and 43% for common cocklebur. Cross-validation resulted in 13 out of 16 observations correctly classified for pitted morningglory with error rate of 19%. Entireleaf morningglory was classified 11 times correctly with an error rate of 31% while sicklepod and common cocklebur were classified 8 and 5 times correctly with error rates of 50% and 69%, respectively. The August 28 image resulted in 15 observations classified correctly for pitted morningglory with an error rate of only 6%, 11 observations for sicklepod were classified correctly with an error rate of 31%, 10 observations for entireleaf morningglory were classified correctly with an error rate of 38%, and only 9 of the common cocklebur were classified correctly with an error rate of 44%. When a cross-validation was utilized 13, 11, 9, and 8 observations were classified correctly with error rates of 19%, 31%, 43% and 50% for pitted morningglory, sicklepod, entireleaf morningglory and common cocklebur, respectively.

INFLUENCE OF ADJUVANTS ON ABSORPTION OF CLETHODIM IN BARNYARDGRASS. A. S. Culpepper, D. L. Jordan, A. C. York, F. T. Corbin, and Y. Sheldon, Crop Science Department, North Carolina State University, Raleigh, NC 27695.

ABSTRACT

Adjuvants can have a dramatic effect on efficacy of postemergence herbicides. However, response to adjuvants depends on interactions among herbicides, herbicide rates, adjuvant type, weed species, size and stage of weed growth, and a number of environmental conditions. Research in the field demonstrated that clethodim applied with methylated seed oil (MSO) or a blend of methylated seed oil and organosilicone surfactant (MSO/OSL blend) controlled barnyardgrass (*Echinochloa crus-galli*) more effectively than when applied with crop oil concentrate (COC), nonionic surfactant (NIS), or organosilicone surfactant (OSL). COC was the more efficacious adjuvant compared with OSL or NIS. Determining the mechanism of differential response of clethodim efficacy to adjuvants may lead to more effective weed management. Research was conducted in the laboratory to compare absorption of ^{14}C-clethodim in barnyardgrass when applied with MSO (1.0% v/v), MSO/OSL blend (0.5% v/v), COC (1.0% v/v), NIS (0.25% v/v), and OSL (0.125% v/v). The ^{14}C-label was applied to the second leaf of barnyardgrass. Treated leaves were removed 10, 20, 30, and 40 minutes after application and washed for 1 minute in deionized water followed by a wash of 1 minute in chloroform. Treated leaves and the remaining shoot were homogenized in methanol with a glass homogenizer and filtered under vacuum. The percentage of ^{14}C-label absorbed was calculated by determining the difference between the amount of ^{14}C-clethodim applied and the amount of ^{14}C-label recovered in the water and chloroform washes divided by the amount of ^{14}C-clethodim applied. Additionally, the amount of ^{14}C-label considered protected from photodegradation was calculated by determining the difference between the amount of ^{14}C-clethodim applied and the amount of ^{14}C-label in the water wash divided by the amount of ^{14}C-clethodim applied. Data for percent absorbed and percent protected were subjected to analysis of variance with partitioning appropriate for the factorial treatment arrangement. Means of significant main effects and interactions were separated using Fisher's Protected LSD test at $P = 0.05$.

The interaction of timing of harvest and adjuvant was not significant. However, main effects of both treatment factors were significant. Pooled over timings of harvest, the percentage of ^{14}C-label absorbed was 59, 55, 48, 34, and 21% when ^{14}C-clethodim was applied with MSO, MSO/OSL blend, COC, OSL, and NIS, respectively. The percentage of ^{14}C-label considered protected for these respective adjuvant treatments was 83, 79, 66, 39, and 36%. Previous research in the field demonstrated that clethodim at 0.07 kg ai/ha applied with MSO, MSO/OSL blend, COC, NIS, and OSL controlled barnyardgrass 91, 76, 62, 53, and 43%, respectively. Collectively, these data suggest that clethodim is more effective when applied with adjuvants that enhance the rate of absorption. Other research suggests that clethodim is susceptible to photodegradation. Greater absorption of clethodim would limit photodegradation and would most likely allow a greater amount of parent compound to reach the site of action.

VELVETLEAF (*Abutilon theophrasti*) INTERFERENCE AND SEED-RAIN DYNAMICS IN COTTON. W. A. Bailey, J. W. Wilcut, and S. D. Askew, Crop Science Department, North Carolina State University, Raleigh, NC 27695-7620.

ABSTRACT

Velvetleaf (*Abutilon theophrasti* Medicus) is a member of the family *Malvaceae* and is an intense competitor in several agronomic crops. Most research has been conducted on the interference characteristics of velvetleaf in corn and soybeans while little has been conducted with velvetleaf in cotton. Velvetleaf success is due to a combination of factors including seed dormancy, ability to germinate from deep within the soil, prolific seed production, and limited control measures. Past research (1977) has reported cotton yield reductions of 2.7% per velvetleaf plant in 10.1 m of row. Yield and harvesting efficiency reductions can be attributed to velvetleaf in cotton as well as a number of other economically important crops. Seed production of economic and sub-economic threshold populations is a concern and there is little or no published data on this area.

Field experiments were conducted at Clayton, NC in 1997 and 1998 to evaluate velvetleaf for competition and interference characteristics and to determine seed production and seed-rain dynamics when planted at different densities in conventional tillage cotton. Commercial cotton varieties used were 'Stoneville BXN 47' in 1997 and 'Deltapine 51' in 1998. Plot size was 3.7 X 9.1 m (4 rows per plot). Velvetleaf seedlings at the cotyledon to 2-leaf stage were planted into the center two rows of each plot at densities of 0, 1, 2, 4, 8, 12, 16, and 32 plants per row. All plots were kept weed-free except for velvetleaf for the entire season in both years of the study. All velvetleaf seed were harvested as pods matured. One velvetleaf plant from each plot was mapped throughout the season to determine the node placement for each mature pod. Height measurements for cotton and velvetleaf were taken weekly until 5 weeks after planting and bi-weekly for the remainder of the season.

Results determined that there was no effect on cotton height by any velvetleaf density up to 4 weeks after planting (WAP) in 1997 or 1998. Velvetleaf height was affected by density at all measurement times in 1997, but was not affected until 9 WAP in 1998. In 1998, velvetleaf and cotton achieved maximum height later than in 1997. However, velvetleaf seed production and cotton lint yield was higher in 1998. Differences in velvetleaf fresh weights and stem diameters were not significant in 1997, but decreased significantly as velvetleaf density increased in 1998. Bulk seed production in 1998 was nearly twice the bulk seed production in 1997. The majority of seed were produced higher on the plant in 1997 than in 1998. In both years, the higher plant densities of 8, 12, 16, and 32 plants per row resulted in seed being produced higher on the velvetleaf plants. In 1997, most seed were produced between nodes 6 and 20 while in 1998, most seed were produced between nodes 1 and 10. In both years, cotton lint yield decreased linearly as density increased. Velvetleaf densities required to cause a 3% yield loss were approximately 6 plants per 9.1 m of row (6795 plants/ha) in 1997 and approximately 1 plant per 9.1 m of row (1133 plants/ha) in 1998. Rainfall amounts and heat units produced throughout the growing season were collected for both years. Rainfall amounts were 4.2, 8.6, and 12.9 cm in 1997 and 10.1, 3.8, and 18.1 cm in 1998 for the months of May, June, and July, respectively. Total rainfall for the entire growing season was 50.4 cm in 1997 and 60.4 cm in 1998. Heat units measured in cumulative degree-days were 245, 458, and 743 in 1997 and 364, 690, and 787 in 1998 for the months of May, June, and July, respectively. Total heat units produced for the entire growing season were 2530 in 1997 and 3202 in 1998. Differences in all parameters over years can most likely be attributed to differences in moisture and heat units produced early in the growing season as well as minor differences in the agronomic characteristics of BXN 47 and Deltapine 51. Additionally, velvetleaf appears to

be sensitive to changes in the environment of the growing season. This is verified by the adaptive ability and competitive nature of velvetleaf as it has previously been more common and troublesome in the Midwest than in most southern states.

These results indicate that velvetleaf is a very strong mid-to-late season competitor with cotton. However, velvetleaf should not cause significant yield losses if controlled in the first 4 weeks after planting. Velvetleaf canopied over cotton at 4 weeks after planting in 1997 and 2 weeks after planting in 1998. Highest lint yield in 1998 was 714 kg/ha with the control density of 0 velvetleaf plants per 9.1 m of row. A 3% yield loss with this yield would cost $35.34/ha (with cotton price estimated at $1.65/kg). This level of yield loss would justify the use of Roundup (approximately $18.50/ha) or Buctril (approximately $27.00/ha) systems for control of velvetleaf at densities as low as 1 plant per 9.1 m of row (1133 plants/ha).

REDUCED PROPANIL RATES AND NATURALLY SUPPRESSIVE CULTIVARS FOR BARNYARDGRASS [ECHINOCHLOA CRUS-GALLI (L.) BEAUV.] CONTROL IN DRILL-SEEDED RICE. R. S. C. Chavez, D. R. Gealy, and H. Black. USDA-ARS Dale Bumpers National Rice Research Center, Stuttgart, AR 72160.

ABSTRACT

The development of propanil resistance in barnyardgrass populations in Arkansas rice farms prompted studies on alternative methods of controlling this troublesome weed. The use of weed suppressive rice cultivars coupled with reduced herbicide rates can be an economically profitable and an environmentally sound weed management strategy. Field studies were conducted in 1995, 1996, and 1998 at the University of Arkansas Rice Research and Extension Center in Stuttgart to evaluate the inherent suppressive abilities of four commercial U.S. rice cultivars (Lemont, Cypress, Kaybonnet, and Starbonnet) and three foreign cultivars (Teqing and Guichou from China and T65/2XT(N)1 (PI312777) from the Philippines. Simple economic analysis was also done to evaluate the benefit of reduced propanil rates in conjunction with weed suppressive cultivars. Postemergence applications of propanil at 1.12 (1/4X), 2.24 (½X), and 4.85 (1X) kg a.i./ha were applied. Untreated plots were included for comparison. Bentazon was applied at 1.12 kg a.i./ha for general broadleaf weed control on as needed basis. A split-plot design in randomized complete block, with propanil rates as main plots and rice cultivars as sub-plots, was used in this study. Each treatment was replicated four times. Rice was drill-seeded in 9 rows (18 cm apart) by 3 m. Standard cultural practices for the area were adopted. Plots were fertilized with a one-time pre-flood application of 112 N kg/ha as urea. The plots were over seeded with barnyardgrass. Primary species also included bearded sprangletop (*Leptochloa fascicularis*) which dominated the weed population at rice harvest in untreated and fallow plots.

Averaged across years, yields generally increased and weed biomass at harvest decreased with increasing propanil rate in most rice cultivars tested. Without propanil application, rough rice yields decreased among cultivars in the following order: PI312777 > Guichou > Teqing > Kaybonnet > Lemont > Cypress > Starbonnet. For Starbonnet, Lemont, Cypress, Kaybonnet, and Guichou, grain yield quadratically and significantly decreased with increasing weed biomass at harvest. Excellent weed control throughout the season for these cultivars is essential to achieve maximum potential yield. PI312777 and Teqing did not exhibit this quadratic relationship indicating that these two cultivars suppressed weeds throughout the season and maintained high yields even in untreated plots.

Economic analysis showed that all cultivars (except PI312777) had a marginal benefit cost return (MBCR) of 2 or more indicating that propanil application was beneficial for these cultivars. Highest actual and marginal returns were different among cultivars. Application of 2.24 kg a.i. (1/2X) propanil/ha resulted in highest marginal and actual returns for Kaybonnet and Teqing. Application of 1.12 kg a.i. propanil/ha (1/4X) resulted in highest MBCR for Lemont, Starbonnet, and Guichou. Marginal returns diminished as propanil rate increased for Lemont, Starbonnet and Guichou. PI312777 consistently suppressed barnyardgrass and consequently produced higher grain yield with or without propanil application. Economic benefit of using propanil in PI312777 was marginal and probably not needed depending on the initial weed pressure early in the season. Foreign cultivars such as PI312777, Teqing, and Guichou produced higher yields thereby resulting in higher actual returns compared to the local commercial cultivars Starbonnet, Kaybonnet, Lemont, and Cypress. Results indicate that the choice of cultivar is critical in achieving maximum returns. MBCR can be a useful tool in evaluating the optimum rate of propanil to apply once the choice of cultivar has been made.

THE INFLUENCE OF DISCING ON THE EFFICACY OF IMAZAPYR FOR COGONGRASS [*Imperata cylindrica* (L.) BEAUV.] CONTROL. E. R. R. L. Johnson, J. F. Gaffney, and D. G. Shilling. Department of Agronomy, University of Florida, Gainesville, FL 32611.

ABSTRACT

Cogongrass (*Imperata cylindrica* (L.) Beauv. var. *major*) a non-native, invasive grass from southeast Asia, is a weed problem throughout the tropical and sub-tropical regions of the world. *Imperata* has spread extensively throughout the southeastern United States becoming a major nuisance. Cogongrass thrives on roadways, in pastures and mining areas, pine forests, parks and other recreational areas but does not survive in heavily cultivated areas (1,3).

Extensive research has been performed to study the effects of mechanical and chemical controls and these methods alone have not been shown to provide satisfactory control of cogongrass (2). However, little research has been done on the interactive effects of mechanical and chemical controls for cogongrass management. Therefore, studies were performed in 1994 and repeated in 1995 to look at the combined effects of mechanical and chemical control methods. An intensive scheme of foliar and soil applied imazapyr treatments, discing only, and combinations of these treatments was investigated at two sites, one with a clay soil and the other a sandy soil, in Polk county Florida.

The entire study area was either burned or mowed to remove thatch and above ground biomass and to establish a uniform experimental area leaving only fine ash or bare soil. The study was arranged as a 4 x 3 factorial with four herbicide treatments and three discing regimes. The herbicide treatments included an untreated check, imazapyr applied at 0.84 kg/ha the day after initial biomass removal, 0.84 kg/ha imazapyr applied to foliar regrowth at day 44 after initial biomass removal, and an application of 0.42 kg/ha imazapyr applied to foliar regrowth 44 and 90 days after initial biomass removal. The discing treatments were as follows. Two-thirds of the plots were disced after initial herbicide applications, and one-half of these plots received a second discing 90 days later. The last treatment was the untreated control. The timing of the discing treatments allowed for regrowth of foliage and herbicide translocation.

Excellent control of regrowth was achieved by several of the treatments up to 18 months after initial treatment. The most effective treatments over both sites and years was 1) discing one day after initial biomass removal followed by 0.84 kg/ha of imazapyr at day 44, followed by discing at day 90 and 2) discing at one day after initial biomass removal followed by 0.84 kg/ha of imazapyr split at day 44 and day 90; these treatments provided 91% control. Two discings alone provided a maximum of 53% control. While imazapyr alone provided 82% control when split over two application dates. Two discings in combination with a split application of imazapyr at day 44 and day 90 only provided 86% control of cogongrass. Management of cogongrass was not significantly effected by soil type with the most effective treatments being equal at both sites.

Although discing alone did not provide adequate control, the cogongrass may have been reacting to the loss of apical dominance from the removal of the apical meristem to cause a greater flush of regrowth. This coupled with timely applications of imazapyr, to allow for maximum coverage and absorption, provided good control in these studies. Lastly, multiple inputs or combinations of inputs are required to assure control of cogongrass.

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WEED CONTROL ACTIVITY OF ALLELOPATHIC RICE. R. Bevitori, R. Dilday, J. Mattice, and R. E. Talbert, Department of Agronomy, University of Arkansas, Fayetteville, AR 72701.

ABSTRACT

Rice germplasm accessions from USDA/ARS were evaluated for allelopathic activity to barnyardgrass. Some of them had significantly fewer barnyardgrass plants than the other accessions (Dilday et al., 1996). However, the demonstration of this effect in the lab has been difficult. This is an obstacle to isolate and identify allelochemicals responsible for allelopathy. Bioassays are needed both in screening for allelopathic potential in new germplasm and in extraction and purification of allelochemicals.

The objectives of this research were to demonstrate under laboratory conditions the allelopathic potential found in the field studies and to determine if root contact is required for allelopathic activity. To achieve these objectives we have used modified root observation chambers, previously described by Mahall and Callaway (1991). Barnyardgrass had different root elongation rates after contact with allelopathic rice roots (PI 312777) and non-allelopathic rice roots (Rexmont). In the former case, decrease in elongation roots that touched PI 312777 occurred following such contact. Rates of elongation of barnyardgrass roots were not affect by contact with Rexmont. The effect seen here may be responsible for the allelopathic activity previously seen only under field conditions.

These results may suggest contact among roots may be necessary to diffuse allelochemicals a very short range. Rice roots may interfere with barnyardgrass through root-mediated allelopathy. This mechanismcould consequently result in depletion of barnyardgrass growth. Interactions among roots are very complex and inclusion of root in allelopathy studies may provide more explanation for allelopathy phenomena.

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WEED DISPERSAL AND SOIL RELATIONSHIPS DESCRIBED BY STATISTICAL ANALYSIS TECHNIQUES. C. R. Medlin, D. R. Shaw, M. S. Cox, F. E. LaMastus, and P. D. Gerard, Plant and Soil Sciences Department and Experimental Statistics Unit, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Site-specific management techniques often result in an abundant supply of soil, environmental, crop, and weed population data. Many times these data are collected through different sampling techniques and/or different sampling intensities. These differences often result in data sets which are difficult to manage until certain techniques can spatially link the data through interpolated values; however, researchers often question the validity of interpolated data. The objective of this research was to compare weed prediction models formed from actual data with those formed from actual data combined with interpolated data.

Prior to planting soybean, the soils of a 15 ha field located on the Black Belt Branch Experiment Station, Brooksville, MS, were intensively sampled on a 0.4 ha grid. Soil nutrient factors analyzed were pH, percent organic matter (% OM), cation exchange capacity (CEC), Ca, K, Mg, Na, and P. Six weeks after planting, natural pitted morningglory (*Ipomoea lacunosa* L.) populations, within a 1-m^2 area, were counted on a 0.1 ha grid overlaying the soil sampling grid. Kriging techniques were applied to the soil nutrient factors to obtain interpolated soil information at corresponding weed sampling locations. Results of weed population analysis with MSU-HERB indicated the presence of pitted morningglory in the 1-m^2 sample was above the economic threshold level and should be treated with a recommended treatment. Therefore, a binary response variable was constructed with 0 indicating weed presence (and need for herbicide treatment)

and 1 indicating weed absence (and no need for herbicide treatment). The binary response variable and the soil nutrient data were analyzed using stepwise logistic regression analysis to construct a prediction model for pitted morningglory based on actual soil data, or actual soil data combined with interpolated soil data.

Using the actual soil data the logistic regression model logit(p) = -0.36 - 1.82(pH) + 0.03(K) + 0.10(Na) was developed. The predicted probability (p) of a weed being present with certain soil pH, K, and Na values was then determined by $p = e^{logit(p)} / (1+e^{logit(p)})$. A classification rule was then developed to predict weed presence if the predicted probability exceeded a predetermined threshold. Within a predicted probability range of 0.30 to 0.46, the logistic regression model correctly predicted pitted morningglory presence or absence at 76% of the sampled field locations. Under a given set of soil pH, K, and Na parameters, and within a predicted probability range of 0.30 to 0.46, this model correctly predicted pitted morningglory presence at least 84% of the time and correctly predicted its absence at least 65% of the time. Using the actual soil data combined with the interpolated values resulted in exclusion of the extractable potassium variable from the model. The logistic regression model formed was logit(p) = 15.39 – 2.48(pH) + 0.05(Na). Within a predicted probability range of 0.34 to 0.72, this second logistic regression model correctly predicted pitted morningglory presence or absence at 70% of the sampled field locations.

Indicator kriging was also conducted on the binary response variable associated with the weed sample locations taken from the 0.4 ha grid. Estimates obtained from point kriging indicated the probability of weed presence or absence at each of the 0.1 ha grid locations. Probability values less than 0.5 were interpreted as indicating weed presence and probability values greater than 0.5 were interpreted as indicting weed absence. Predicted outcomes were then validated using the originally constructed binary variable. Predicted outcomes correctly indicated weed presence or absence at 67% of the prediction locations when compared to the original binary variable. Comparison of the two prediction models constructed from interpolated values indicated 37% of the total incorrect response locations were incorrectly predicted by both models.

RED RICE (*Oryza sativa* L.) EMERGENCE AND GROWTH RESPONSE TO FLOODING DEPTH AND LOW TEMPERATURE. D. R. Gealy. USDA-ARS Dale Bumpers National Rice Research Center, Stuttgart, AR 72160.

ABSTRACT

Red rice is one of the most troublesome weeds in the rice cropping systems in the southern United States. Red rice populations in these cropping systems are highly variable and are comprised of numerous biotypes. During the past five years, a large number of red rice accessions (biotypes) and several red rice-rice hybrids have been collected, and maintained at Stuttgart, AR. Two experiments were conducted in growth chambers to assess tolerance of either chilling stress or flooding stress among these biotypes. In the first experiment, 27 red rice biotypes were placed on soil, covered with either 0 cm (saturated soil) or 15 cm water, and incubated at 13, 18, 23, or 30 C. Germination was determined after 21 d. In a second experiment, growth, chlorosis, and photosynthetic productivity of 3-leaf biotypes were compared after a 7-day exposure to chilling (10 C) or normal (30/25 C) temperatures.

Response of red rice biotypes to flooding and chilling stress varied widely. In the first experiment, red rice germination was most inhibited at 13 C and in 15-cm water, averaging about 5% of the optimum level at 30 C and 0 cm. Chilling generally inhibited germination of red rices more than commercial white rices. The most cold-sensitive red rice biotypes were the strawhull types, 4A and 20E, and the blackhull type, 5A. The least cold-sensitive biotypes were the strawhull types, 16B and KatyRR (a rice-red rice hybrid), and the blackhull type 10A. In the second experiment, exposure to 10 C induced chlorosis in leaves and reduced growth and photosynthesis nearly to zero. Blackhull types (esp. 18E) generally developed more chlorosis than did strawhull types and white rice standards. Photosynthesis in chilled red rice plants was lower than in a chilling-tolerant commercial cultivar, M202, but both red rice and rice had recovered at least 50% of their optimum photosynthetic capacity within 24 h after warming to 30/25 C. In a separate field study, most of the 52 red rice biotypes tested were initially more dormant than commercial cultivars and had lost dormancy after 6 months of afterripening. The blackhull types, MS4 and 1995-10 remained moderately dormant after 6 months. Generally, blackhull types were more dormant than strawhull types.

Overall, germination, growth and photosynthesis of the various red rice biotypes varied greatly in response to chilling and flooding stresses, but none of the biotypes was consistently more or less tolerant than others to all of these conditions. Even so, the diversity among these red rice biotypes may be great enough to influence the interaction of a particular red rice biotype within a particular management/environment setting.

INFLUENCE OF GLYPHOSATE TIMING, IRRIGATION, AND SOYBEAN DENSITY IN DRILLED SOYBEAN ON PITTED MORNINGGLORY (*Ipomoea lacunosa*) AND HEMP SESBANIA (*Sesbania exaltata*) INTERFERENCE. J. K. Norsworthy and L. R. Oliver; Department of Crop, Soil, and Environmental Sciences; University of Arkansas; Fayetteville, AR 72704.

ABSTRACT

The increased use of glyphosate tolerant soybean has established a need to obtain interference data on weed species which are suppressed by glyphosate. Research was initiated to assess the effects of glyphosate timing on interference of pitted morningglory and hemp sesbania in drill-seeded soybean at differing soybean seeding rates under dryland and irrigated conditions. Field experiments were initiated in 1998 at the Northeast Research and Extension Center in Keiser, AR. Delta King 5961 Roundup-Ready soybean was drill seeded in 19-cm width rows on June 2 at densities of 309,000, 618,000, and 926,000 seed/ha and emerged on June 11. Three weeks after soybean emergence, soybean densities were 244,000, 477,000, and 730,000 plants/ha. Experimental design was a split-split plot with a factorial treatment structure with four replications. The main split was irrigation type (irrigated, dryland) with soybean seeding rate as the sub-split and herbicide treatment randomly arranged within each seeding rate. Glyphosate at 0.56 kg ai/ha was applied at V2; V4; V2 and V4; V2, V4, and R2 soybean growth stages and none. Irrigated treatments were border irrigated according to the Arkansas Irrigation Scheduling Program. Control of hemp sesbania and pitted morningglory was rated at 2, 4, 6, 8, and 10 wk after the V2 application and prior to harvest. Biweekly, beginning 1 WAE, pitted morningglory, hemp sesbania, and soybean above-ground biomass was harvested from 0.5 m^2, oven-dried for 2 wk, and plant dry weight determined. A line quantum sensor was used to monitor photosynthetic active radiation interception by soybean throughout the growing season. At soybean maturity, plots were harvested to obtain soybean, pitted morningglory, and hemp sesbania seed yields with soybean moisture adjusted to 13%.

Soybean yielded 1200 kg/ha greater under irrigated than dryland conditions when averaged over glyphosate application and soybean seeding rate. Increasing seeding rate from 309,000 to 926,000 seed/ha increased yield by 570 kg/ha pooled over irrigation type and glyphosate application. When averaged over irrigation type and soybean seeding rate, soybean yield was similar for all glyphosate applications and only different fromtreatments not receiving glyphosate. Generally, hemp sesbania and pitted morningglory control increased while seed production decreased with increasing soybean density. Irrigated soybean intercepted more photosynthetic active radiation than dryland soybean. Interception by soybean increased linearly with soybean density. Untreated irrigated hemp sesbania competing with 244,000 soybean/ha produced 20 million seed/ha, and while untreated pitted morningglory produced 1.1 million seed/ha. All glyphosate applications reduced pitted morningglory seed production >80%. The V4 glyphosate application resulted in hemp sesbania and pitted morningglory control comparable to sequential applications at 477,000 and 730,000 soybean/ha. Pitted morningglory and hemp sesbania seed production following the V4 glyphosate application was also similar to repeat applications.

EVALUATION OF PLANT GROWTH REGULATORS ON THE PHENOLOGY AND GROWTH AND DEVELOPMENT OF PURPLE NUTSEDGE (*Cyperus rotundus*). M. W. Edenfield, B. J. Brecke, D. G. Shilling, M. E. Kane, J. A. Dusky, D. L. Colvin, and G. E. MacDonald. University of Florida, Gainesville.

ABSTRACT

Purple nutsedge (*Cyperus rotundus*) has been identified as one of the world's worst weeds in the major agricultural areas of the world. This perennial plant generally produces numerous seed, but dispersal is primarily by bulbs and chains of tubers since only a fraction of the seed are viable. Conventional weed control generally includes tillage and/or herbicides. However, control is often less than adequate because many tubers remain dormant on the tuber chain of actively growing plants thus reducing translocation of many herbicides. Purple nutsedge tuber dormancy has been attributed to the presence of inhibitory substances, and a hormonal balance between growth inhibtors and promotors control dormancy. A greenhouse study designed to examine the use of plant growth promoters to alter the morphological characteristics of purple nutsedge was performed during the spring of 1998. Additionally, a field study was conducted in the summer of 1998 to investigate pre-conditioning purple nutsedge with plant growth hormones to facilitate its control with herbicides.

Promalin™ (a proprietary formulation with equal concentrations of gibberellic acid $_{4+7}$ and benzyladenine) was evaluated as a POST treatment in an effort to alter the growth and development of purple nutsedge shoots and tubers. Promalin™ was applied POST in a spray volume of 20 gallons acre^{-1} and included a non-ionic surfactant at 0.25% v/v. In the greenhouse study Promalin™ was applied at 0, 25, 50, 100, 200 and 300 ppm of each growth hormone to purple nutsedge 1, 3, or 6 weeks after emergence (WAE) with a second application 1 week after the initial treatment. Promalin™ ^{3} 100 ppm increased shoot number four weeks after treatment by at least 50 and 20% when applied 1 and 3 WAE, respectively. There was no increase in shoot number when applied 6WAE. Promalin™ had no effect on tuberization when applied 1WAE, however, tuberization was reduced 68 and 74% when applied at 3 and 6WAE, respectively.

In the field study treatments were applied to plots 10 by 10 ft with four replications. Treatments included herbicide applied 3WAE, herbicide 3WAE followed by (fb) herbicide 6WAE, and Promalin™ 3WAE fb herbicide 6WAE. Herbicide treatments included paraquat at 0.75 lb/A, MSMA at 2.0 lb/A and glyphosate at 1.0 lb/A. Promalin™ was applied at either 100 ppm or 300 ppm of each growth hormone. Three weeks after the sequential herbicide application purple nutsedge control was visually evaluated. The entire test site was cultivated 3 weeks later and purple nutsedge shoot density was determined in a 2.7 ft^{-2} area in each plot. Two applications of either glyphosate or MSMA were most effective for purple nutsedge control and reducing re-infestation. There was no difference in shoot regrowth following tillage between one application of herbicide or Promalin™ fb herbicide with either paraquat or MSMA. However, Promalin™ fb glyphosate was more effective than a single application of glyphosate and was as effective as two applications of glyphosate in reducing purple nutsedge re-infestation. Plant growth hormone rate had no effect on purple nutsedge control or reducing re-infestation.

INFLUENCE OF GROWTH STAGE AND HERBICIDE RATE ON POSTEMERGENCE JOHNSONGRASS (Sorghum halepense) CONTROL. E. Rosales-Robles and J. M. Chandler. Texas Agricultural Experiment Station, College Station, TX 77843.

ABSTRACT

Johnsongrass, a coarse perennial plant, is considered one of the most common and troublesome weeds in cotton and corn in southern United States. Experiments were conducted in 1995 and 1996 to evaluate the effect of full and reduced rates of postemergence herbicides on seedling and rhizome johnsongrass at different growth stages. Herbicides evaluated included nicosulfuron, primisulfuron, fluazifop-P, and clethodim. Each herbicide was applied at its labeled rate (1X), one-half (0.5X), and one-fourth (0.25X) of the labeled rate. Labeled rates were nicosulfuron at 35 g/ha, primisulfuron at 40 g/ha, fluazifop-P at 210 g/ha, and clethodim at 140 g/ha. A non-ionic surfactant at 0.25% v/v was added to primisulfuron, nicosulfuron, and fluazifop-P, and a crop oil concentrate at 1 % v/v was added to clethodim. Herbicides were applied on seeddling and rhizome johnsongrass at 2 to 3 leaves, 4 to 5 leaves, 5 to 6 leaves, and 7 to 8 leaves. An untreated check was also included in every growth stage. Treatments were applied in air-pressurized spray chamber calibarated to deliver 187 L/ha with an even flat nozzle.

Contour graphs to predict fair (70-79%), good (80-89%), and excellent (≥ 90%) control at different growth stages were developed using visual control ratings at 4 WAT for each herbicide and johnsongrass reproductive form. Excellent seedling and rhizome johnsongrass control was obtained with reduced rates of herbicides applied at the 3- to 5-leaf stages. Fluazifop-P and clethodim provided better johnsongrass control than nicosulfuron and primisulfuron. In general, seedling johnsongrass was more susceptible to herbicides than rhizome plants.

INFLUENCE OF ALLY ON TOTAL NON-STRUCTURAL CARBOHYDRATE LEVELS IN ROOTS OF SERICEA LESPEDEZA. C. H. Koger, J. F. Stritzke, M. P. Anderson, and C. L. Goad, Oklahoma State University, Stillwater, OK 74078.

ABSTRACT

Sericea lespedeza (*Lespedeza cuneata* [Dum. Cours] G. Don) is an introduced, perennial, herbaceous legume species that has become a major weed problem in tallgrass prairies and improved pastures of Oklahoma, and is currently listed as a noxious weed in 56 counties of southeastern Kansas. Sericea lespedeza was first introduced in the late 1800's into the southeastern United States for grazing and haying purposes. Sericea lespedeza was planted for soil conservation and forage production beginning in the 1930's, with peak production occurring in the 1950's. Sericea lespedeza forage is utilized early in the growing season by cattle. However as tannin and lignin content increase through the growing season, palatability and utilization decreases. Established plants of sericea lespedeza are very competitive of other forage species and have allelopathic properties towards emergence and growth of some grass forage species. Perennial plant species are dependent upon root carbohydrate reserves to persist and initiate vegetative growth each growing season and control of many perennial species with mechanical options and herbicides is typically improved when carbohydrates are translocated from aboveground tissue to the roots for storage. Fall applications of Ally (metsulfuron-methyl), a sulfonylurea type herbicide, is currently labeled for control of established sericea lespedeza plants in Oklahoma. This is the time frame when many perennial species are translocating carbohydrates (CHO) to the roots for storage. However, little is known about seasonal fluctuations in total non-structural carbohydrate (TNC) levels in the roots of established sericea lespedeza plants. The objectives of this research was to document root TNC levels for untreated plants at different stages of plant maturity through the growing season the effects of low application rates of Ally (metsulfuron-methyl) in conjunction with grazing and mowing on (TNC) levels in the roots of treated plants.

A two factorial-randomized complete block design experiment was initiated in June of 1997 at one location near Stillwater, Oklahoma. One factor was no-mow and mow in June of 1997. The second factor was applications of Ally at 0.1 oz/A applied in June, July and August of 1997. One randomized complete block design experiment with four herbicide treatments was initiated in June of 1997 at locations near Fairfax and Roff Oklahoma. The Fairfax location was burned in the spring of 1997 and grazed continuously by cattle at 2 A/hd between April 1 and July 15. The Roff location is not burned but grazed 4 out of every 44 days between April and October by cattle at 0.5 A/hd. Roots of treated

and untreated established sericea lespedeza plants were collected in June, July, August and October of 1997 at all locations. Root TNC levels were determined using spectroscopy at 520 nm according to the Nelson (1944) method.

Root TNC levels for untreated plants in June ranged from 4.8 to 10.8 umol glucose/gm root wt. at all three locations and were lower when compared to root TNC levels in July and August which ranged from 12.2 to 12.8 in July to 12.3 to 15.9 in August. Root TNC levels for many untreated perennial species typically increases through out the growing season up to initiation of flower development. Root TNC levels decreased at all three locations between the August and October sampling dates with October levels ranging from 10.9 to 12.6. This decrease between August and October is attributed to an increase in energy requirements needed for flowering and seed development. Root TNC levels in June for plants burned in the spring and continuously grazed at high stocking densities between April and July (4.8 umol glucose/gm root wt.) were much lower compared to root TNC levels for plants not burned but grazed with a rotational grazing system between April and October (9.2 umol glucose/gm root wt.). Lower root TNC levels for burned and continuously grazed plants were attributed to higher levels of sericea lespedeza utilization by cattle, which resulted in less leaf tissue for photosynthesis, the major pathway for carbohydrate synthesis, compared to the rotationally grazed location. Removal of aboveground plant tissue with mowing alone in June also reduced root TNC levels for the July, August, and sampling dates to 8.4, 7.7, and 8.1 compared to June root TNC levels of 10.6, respectively. Root TNC levels in August for plants treated with Ally in June at both grazed locations (7.5 and 12.3) were lower compared to root TNC levels for untreated plants (12.3 and 15.9). However by the October sampling date, root TNC levels had recovered to levels that were not different from untreated plants. Root TNC levels in October for plants treated with Ally in July (11.0 to 15.5) and August (8.5 to 11.0) at all locations recovered to levels that were not different from levels for untreated plants.

HEAT STRESS TOLERANCES OF TRANSGENIC SOYBEANS. J. M. Gertz, Jr. and W. K. Vencill, Univ. of Georgia, Athens, GA 30602-7272.

ABSTRACT

Field and greenhouse studies were conducted to compare agronomic and physiological characteristics of selected herbicide-resistant and conventional soybean varieties. Field studies were conducted in 1997 and 1998 to compare six glyphosate-resistant lines, one glufosinate-resistant and sulfonylurea-tolerant variety, and four conventional soybean varieties. Glyphosate-resistant soybeans tended to be shorter and have lower chlorophyll content and yield than other varieties examined. Glufosinate-resistant soybeans were similar to or had more vigorous growth than non-transgenic soybeans examined in both years of the study. In 1998, glyphosate-resistant soybeans exhibited a higher percentage (100% versus 60-70%) of base stem splitting that has been observed to occur in heat-stressed soybean than other transgenic and non-transgenic soybean varieties examined. Growth chamber studies were initiated to examine the effects of heat stress of soybean in a sterile environment. Twelve soybean varieties (six glyphosate-resistant, one glufosinate-resistant, one sulfonylurea-tolerant, and four conventional varieties) were examined in three temperature regimes (25/20C, 35/30C, 45/30C under a 16 h photoperiod). Overall, soybean growth was most vigorous at 35/30C and poorest at 45/30C. Glyphosate-resistant soybeans tended to be more susceptible to heat stress than glufosinate-resistant, sulfonylurea-tolerant, and conventional soybean varieties. The glyphosate-resistant soybean varieties were shorter and lower in chlorophyll content and fresh weight than non-glyphosate-resistant soybean varieties. Base stem splitting between V1 and V2 that had been reported from field observations was observed at the 45/30C regime. Glyphosate-resistant soybean varieties exhibited a higher percentage (100%) stem splitting than glufosinate-resistant (50%) or conventional soybean varieties (45-70%). To better understand the stem splitting effect, an acid-detergent fiber (ADF) analysis was conducted to describe lignin content. At 25/20C, glyphosate-resistant soybeans had elevated lignin content (12-13% w/w). At 45/30C, the lignin content of conventional soybeans equaled that of the glyphosate-resistant soybean varieties. A significant correlation between lignin content at 25/20C and stem splitting at 45/30C was observed. It is possible that the enhanced lignin content of glyphosate-resistant soybean varieties could cause a predisposition towards stem splitting between V1 and V2 stages of growth. Further research is needed to make this conclusion.

PROFITABILITY ASSOCIATED WITH JOHNSONGRASS (*Sorghum halepense*) INTERFERENCE IN COTTON. M. L. Wood, J. C. Banks and D. S. Murray; Department of Plant and Soil Sciences, Oklahoma State University, Stillwater, OK 74078.

ABSTRACT

Field experiments were conducted in 1996 and 1997 on the Irrigation Research Station near Altus, OK to evaluate two harvest methods and harvest efficiency of cotton which was grown with six johnsongrass [*Sorghum halepense* (L.) Pers.] densities. Harvest method included the comparison of a commercial stripper and picker. The effects of the six johnsongrass densities on cotton fiber properties (micronaire, length, uniformity), lint yield, and loan rate (value) was also evaluated. A randomized complete block design was used with four replications. Plot size was four rows, 1 m wide by 15 m long that included johnsongrass densities of 0, 3, 4, 5, 8 and 15 plants/15 m of row. Johnsongrass seed were planted approximately 5 to 10 cm from the center two rows in hills on May 29, in 1996 and 1997. Hills were covered by paper plates to minimize injury prior to treatments with prometryn at 1.4 kg/ha and metolachlor at 1.68 kg/ha each year. Seedlings were thinned to the desired densities 2 weeks after emergence. Plots were hand weeded throughout the season to remove unwanted plants. The center two rows of each plot were harvested on December 16, 1996 and November 11, 1997 to obtain yield data and collect samples for fiber properties. All fiber properties were tested using High Volume Instrumentation (HVI) testing. Loan rate (value) was calculated using a 5 year average. Properties used to determine loan rate (value) are leaf grade, micronaire, strength, and color grade.

No differences in harvest method were detected between a stripper or picker in either year, therefore, harvest efficiency by density effects were evaluated. A density of 15 plants/15m of row in 1996, caused a lower harvest efficiency when compared to the check. No differences for harvest efficiency were detected in 1997. There were no differences among harvest methods for fiber properties and loan rate (value) in either year. Micronaire and loan rate were different for a density of 8 plants/15 m of row in 1996, but in 1997 differences for micronaire were detected at densities of 8 and 15 plants/15 m of row. A density of 15 plants/15 m of row resulted in differences for loan rate (value) in 1997. Length differences in 1996 were detected at a density of 3 plants/15m of row; however, in 1997 no differences were detected. Uniformity differences in 1996 were detected for densities of 3 and 8 plants/15m of row; however, in 1997 no differences were detected. The relationship between weed density and cotton lint yield fit a linear model for both harvest methods each year with a yield reduction ranging from 29 to 43 kg/ha or 4 to 6% for each increase by one johnsongrass plant/15 m of row. Johnsongrass decreased harvest efficiency, fiber properties, and loan rate (value), but the largest reduction measured in these experiments was yield.

TEMPERATURE EFFECTS ON THE RESPONSE OF LIBERTY-LINK AND ROUNDUP-READY SOYBEANS TO GLUFOSINATE AND GLYPHOSATE TREATMENTS. W. A. Pline, K. K. Hatzios. Virginia Polytechnic Institute & State University, Blacksburg, VA 24061-0330.

ABSTRACT

The influence of variable temperature on the response of transgenic crops to herbicide treatments was investigated using soybeans engineered with either a metabolism-based resistance (Liberty-Link®), or an altered target site resistance (Roundup-Ready®). Liberty-Link® soybeans engineered with the *pat* (phosphinothricin acetyl transferase) gene, detoxify glufosinate to the non-toxic metabolite, acetyl-glufosinate, while Roundup-Ready® soybeans, transformed with an altered EPSP synthase enzyme, prevent glyphosate from binding to its' target site. V1 stage soybeans were grown in chambers with constant temperatures of 15°, 25°, or 35° C. Liberty-Link® soybeans were treated with glufosinate rates ranging from 0.25 to 2.0 kg/ha, and Roundup-Ready® soybeans, with glyphosate rates ranging from 0.5 to 4.0 kg/ha. Chlorophyll measurements revealed a rate-dependant loss of chlorophyll in glufosinate-treated Liberty-Link® soybeans which was greater at 15° C rather than 25° or 35° C. Conversely, the rate of chlorophyll loss in the terminal trifoliolate of glyphosate-treated Roundup-Ready® soybeans was greater at 35° than at 15° or 25° C. The rates of absorption, translocation, and metabolism of ^{14}C-glufosinate in Liberty-Link® soybeans were measured at 3, 12, 24, and 48 hours after treatment. Absorption and translocation of ^{14}C-glyphosate in Roundup-Ready® soybeans was measured at 1, 3, 5, 7 days after treatment. Treatments in Liberty-Link and Roundup-Ready were examined under different temperature regimes in order to explain the observed injury from these herbicides at 15° C and 35° C respectively. Uptake of ^{14}C-glufosinate was significantly greater at 25° C than 15° C at 12, 24, and 48 hours after treatment. There

were only slight differences in ^{14}C-glufosinate translocation in Liberty-Link® soybeans. ^{14}C-glufosinate metabolism to the ^{14}C-acetyl-glufosinate metabolite was significantly less at 3 hours in 15° C than 25° C. After 3 hours, however, metabolism was not different at the two temperatures. Roundup-Ready® soybean ^{14}C-glyphosate absorption was not significantly different at any of the time periods investigated at 15° and 35° C. Soybeans kept at 35° C showed more translocation to the shoots and leaves above the treated leaf, while those kept in 15° C translocated more ^{14}C-glyphosate to the shoots and leaves below the treated leaf. These results suggest that injury to Liberty-Link® soybeans at 15° C is due to reduced or slowed ^{14}C-glufosinate metabolism. Damage to Roundup-Ready® soybeans at 35° C, could be due to increased translocation of ^{14}C-glyphosate to leaves above the treated leaves, possibly inhibiting chlorophyll synthesis, or due to possible temperature sensitive expression of the altered EPSP synthase enzyme.

SPATIAL AND TEMPORAL EXPANSION PATTERNS OF HEMP DOGBANE (*Apocynum cannabinum*) PATCHES. T. M. Webster, USDA-ARS, Coastal Plain Experiment Station, Tifton, GA 31793-0748; J. Cardina, Ohio Agricultural Research and Development Center, Ohio State University, Wooster 44691; and S. J. Woods, Agricultural Technical Institute, Ohio State University, Wooster 44691.

ABSTRACT

Hemp dogbane is a native creeping perennial that is an increasing problem weed in corn and soybean rotations throughout the Midwest U.S. When growing in competition with agronomic crops, hemp dogbane tends to rely on vegetative reproduction, thus producing patches of this weed. Little is known about the rate of spread of hemp dogbane patches. Studies were initiated to determine the inter-season and intra-season expansion patterns of natural patches of hemp dogbane over several years.

Field studies were conducted in 1996 through 1998 in Wooster, OH in an area with a natural population of hemp dogbane that included many discrete patches of this weed. The field was planted to soybean in 1996 and 1998 and was fallow in 1997. Inter-season expansion was measured using a Trimble Pro-XL global positioning system with real time differential correction from Racal Landstar. This system was used to measure the area of eight patches in 1996 and 27 patches in 1997 and 1998. These patches ranged in size from 22 to 350 m^2 in 1997. Intra-season expansion was determined by monitoring emergence weekly. Newly emerged shoots (> 0.5 cm) were marked with plastic surveyor's tape of different colors. At the conclusion of the season, each patch was divided into 1 m^2 quadrats and all of the shoots from each emergence date were quantified with a spatial reference. Soil temperature to a depth of 2.5 cm was monitored and growing degree units (GDU) were calculated using a base temperature of 6 C (determined in a preliminary study).

Regression analysis indicated strong relationships among patch size in 1996 and 1997 (r^2 = 0.81) and patch size in 1997 and 1998 (r^2 = 0.76). Patches less than 20 m^2 in 1996 increased by more than 100% in 1997. A regression of the square root of patch radius in 1997 against that in 1996 indicated that there was an exponential increase in patch size over this time period (r^2 = 0.89). However, this growth was not observed between 1997 and 1998; patches decreased in size 6 to 51% over this time period. Analysis indicated that these patches decreased in size exponentially from 1997 to 1998 (r^2 = 0.95). This decrease in patch size can most likely be attributed to a mid-August mowing of the experimental area in 1997. This late season mowing corresponded to the late flower to early fruit stage of this weed, a time when carbohydrate levels have been shown to be the lowest in the root system.

The relationship between patch size and GDU (r^2 = 0.97) and patch size and emerged percent of the final hemp dogbane population (r^2 = 0.99) were described by a rectangular hyperbole function. Patches borders were established relatively early in the growing season. Patches were at 50% of their final size on 27 May 1997 and 14 May 1998, a time when only 22% of the hemp dogbane population had emerged.

Knowledge of patch size could help growers time weed scouting to account for the later emergence patterns of this species. This information could also be utilized in precision agriculture in the form of a prediction of the appropriate timing for aerial photography; these photographs could be useful in quantifying the percent of a field that is infested with this weed species. Areas with high numbers of patches can be identified from aerial photographs, which may allow for focused intensive hemp dogbane management programs.

GLYPHOSATE UPTAKE AND MOVEMENT IN ROUNDUP READY COTTON AS AFFECTED BY GROWTH STAGE AND ENVIRONMENT. S. L. File, D. B. Reynolds[1], K. N. Reddy[2], and K. M. Bloodworth.[1] [1]Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39759 and [2]USDA-ARS, Southern Weed Science Laboratory, Stoneville, MS 38776.

ABSTRACT

Laboratory studies were conducted to evaluate the absorption, translocation, and partitioning of ^{14}C-glyphosate in Roundup Ready cotton as affected by environmental conditions and plant growth stage. Treatments were arranged as a two factor factorial in a randomized complete block design with four replications and the experiment was repeated. Factor A had two levels which represented cotton grown under optimumand sub-optimumtemperatures. Plants grown under optimal and sub-optimal temperatures were grown at 65 / 75 and 75 / 85 F night / day temperatures with a 12 hour photoperiod. Factor B had four levels of herbicide treatment consisting of topical applications at the 3, 6, and 12 leaf cotton growth stages, and a post-directed application to cotton in the 6 leaf growth stage.

Paymaster 1215RR cotton was planted at delayed intervals so cotton would be at the 3, 6, and 12 leaf growth stages the day herbicide treatments were applied. Prior to treatment with 1 :Ci of ^{14}C-glyphosate, plants were either treated topically in a spray chamber or with a hand-held post-directed boom with 1.0 lb ai/A of unlabeled glyphosate to simulate the effects of topical or post-directed applications. Following topical application with unlabeled glyphosate the ^{14}C-glyphosate was applied to the third leaf of 3, 6, and 12 leaf cotton. The post-directed treatment had ^{14}C-glyphosate applied to the 1^{st} and 2^{nd} internodes following treatment with unlabeled glyphosate. Following treatment with ^{14}C-glyphosate, plants were returned to their respective environments and allowed to develop to the 13 to 14 leaf stage at which time they were harvested. All plants were sectioned by leaf, internode, and fruiting body and frozen until analyzed. All sectioned plants parts were dried in a 30^0 C oven and combusted in a Biological Oxidizer for 4 minutes and analyzed by Liquid Scintillation Spectrophotometry.

The environmental conditions evaluated had little effect on the parameters evaluated.However the growth stages at time of application had a significant effect on all parameters evaluated. Percent absorption of ^{14}C-glyphosate applied at the 6 lf growth stage was greater when applied to the stem (39%) than when applied to the leaf (27%). Acropetal translocation from topical applications ranged from 1 to 11% and was significantly less than the 14 to 18% observed with the post-directed application. Basipetal translocation of 4.5 to 10% was observed with the post-directed application and was significantly greater than the 0.1 to 1.5% observed with the topical applications. More ^{14}C-glyphosate was partitioned into Zone 2 (nodes 5-8) and Zone 3 (nodes 9-14) and less in Zone 1 (nodes 1-4) when applied to the stem than from any topical application.

A TECHNIQUE FOR MEASURING NONCOMPETITIVE EFFECTS OF PIGWEED SPECIES ON GRAIN SORGHUM. J. W. Moore, D. S. Murray, and R. B. Westerman, Department of Plant and Soil Sciences, Oklahoma State University, Stillwater, OK 74078.

ABSTRACT

In 1998, a preliminary field experiment was conducted at the Agronomy Research Station near Perkins, OK to develop a technique for measuring the losses of grain sorghum quality caused by the noncompetitive presence of Palmer amaranth (*Amaranthus palmeri* S. Wats.). Grain sorghum was grown weed free until maturity and then weeds were included at harvest. 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 10 m long. Six weed densities were used in this experiment which were 0, 1, 2, 4, 6, and 12 weeds per 10 m of row. A field adjacent to this experiment was used to collect the 200 Palmer amaranth needed for this experiment. All Palmer amaranth used in this experiment were measured and cut at approximately 1.4 m tall.

An apparatus was designed to hold the Palmer amaranth near the rows of grain sorghum at harvest. The apparatus was composed of two 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 10

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 at one end of each segment and were connected with a short joint of PVC pipe for support and transporting. For additional support, tees were placed randomly along the sides of the apparatus and positioned parallel to the ground and connected with a short joint of PVC pipe.

The center two rows were harvested for data collection. The Palmer amaranth stalk that was left in the apparatus after harvest was measured and represented that approximately 80% of each weed went through the combine. After all plots were harvested, moisture and weights were taken for each grain sample. Grain samples were then cleaned in order from low weed density to high weed density to remove foreign material including broken grain kernels. After all samples were cleaned, moisture and weights were taken again for each grain sample. Sample moisture and sample weights before cleaning were higher than the check for weed densities of 6 and 12. Grain moisture after cleaning was higher than the check for weed densities of 4, 6 and 12. Grain weight after cleaning was higher than the check at weed densities of 6 and 12. The only explanation of why the plots with higher weed densities reported higher grain weights, might be that the weeds buffered the grain going through the cylinder and reduced the number of broken kernels. The technique used in this experiment was successful in acquiring the data needed, but the apparatus will require minor adjustments before being reused.

RESPONSE OF KAYBONNET TO RED ECOTYPES AND POPULATION DENSITIES. L. E. Estorninos, Jr., R. E. Talbert and D. R. Gealy. University of Arkansas Fayetteville 72704 and USDA-ARS, Dale Bumpers National Rice Research Center, Stuttgart, AR. 72160.

ABSTRACT

Red rice *Oryza sativa* L. has been a major problem weed in most rice growing areas in the United States. Red rice is difficult to control in rice fields because red rice and rice belong to the same species. Red rice infestations increase when not controlled or when control is inadequate. Research at Arkansas in 1985 showed that grain yield of rice was reduced from 22 to 82% when red rice density increased from 5 to 215 plants/m^2.

Field experiments were conducted at the University of Arkansas Rice Research and Extension Center at Stuttgart, Arkansas, in 1997 and 1998, to evaluate the growth response of Kaybonnet rice to four seeding rates of three red rice ecotypes. The experimental units were arranged in a split-plot design with red rice ecotypes as main plots and seeding rates as subplots. Red rice ecotypes used were Stuttgart strawhull (tall, high tillering, and most common red rice in Arkansas), Katy (presumed hybrid between Katy rice and a red rice biotype), and Louisiana red rice, LA3, (tall, high tillering, late maturing, and awned). The seeding rates were 7, 13, and 20 kg/ha in 1997 and 14, 26, and 40 kg/ha in 1998. Red rice seeds were broadcast seeded into dry soil then Kaybonnet seeds at 100 kg/ha were drilled in 7-inch rows using a tractor seeder.

In 1997, leaf area index (LAI) of Kaybonnet was not affected by the three red rice ecotypes at the various red rice seeding rates at all sampling times. Kaybonnet panicle density was reduced with the presence of Stuttgart strawhull (16-22%) and LA3 (20-32%) and was reduced more by increasing seed rates of LA3. Seed yield of LA3 was higher than Stuttgart strawhull and KatyRR at red rice seeding rates of 13 and 20 kg/ha. In 1998, LAI of Kaybonnet did not vary between red rice seeding rates at 28 and 40 days after rice emergence (DAE). At 70 and 91 DAE, LAI of rice alone was higher than that of rice grown with red rice. At 91 DAE, LAI of Kaybonnet decreased in all seeding rates of red rice. Panicle density of Kaybonnet was reduced with the presence Stuttgart strawhull (67%) and LA3 (59%) and decreased 46% and 73% as red rice seeding rate increased from 14 to 40 kg/ha. Grain yield of Kaybonnet was reduced by 67% when grown with Stuttgart strawhull and 94% when with LA3; however, Kaybonnet yield was not affected by KatyRR. Yield of rice decreased by 53- and 79% as red rice pressure fromincreased seeding rates of 14 to 40 kg/ha, respectively. These results indicate that Kaybonnet is less competitive against LA3, moderately competitive to Stuttgart strawhull and competitive to Katy red rice.

EFFECTS OF SMUTGRASS COMPETITION ON BAHIAGRASS PRODUCTION. J. A. Dusky, J. J. Mullahey, M. D. Fanning, and W. H. Sherrod. University of Florida, Everglades Research and Education Center, Belle Glade, FL 33430 and Southwest Florida Research and Education Center, Immokalee, FL 34142.

ABSTRACT

Giant smutgrass (*Sporobulus jacquemontii*) is a non-native invasive plant that has become a serious weed problem in south Florida cattle pastures. Bahiagrass is displaced by the giant smutgrass and this results in lower production and forage quality. Chemical control with Velpar has proven effective. However, repeated applications are necessary due to the soil seed bank that exists in most pastures. Mowing and grazing also have been shown to reduce giant smutgrass populations. Information is lacking on the loss of bahiagrass (yield and quality) as a result of competition from giant smutgrass. Consequently, it is difficult for landowners to justify the expense of any treatment (mowing, grazing, or herbicides) for control of giant smutgrass.

Studies were initiated to determine the influence of giant smutgrass competition on bahiagrass production. Studies were conducted at a ranch in Immokalee, FL. The study area was staged back (mowed and raked) prior to plot establishment and the area fertilized. Plots were established according to giant smutgrass population levels based on percent groundcover. Three populations of smutgrass were established: low (<20% smutgrass ground cover), medium (> 20% but < 70% smutgrass ground cover), and high (>70% smutgrass ground cover). Plots were 20 ft^2 and there were 10 replicates of each smutgrass population level. Plots were completely randomized. Within each plot a 2 ft^2 area, pre-selected using a random number generator, was harvested at monthly intervals for five months. At each harvest, the bahiagrass and giant smutgrass plants were cut at ground level and separated. Plant material was dried and weighed for biomass accumulation. At the second harvest in July, Velpar (1.0 lb ai/A) was applied to one half of the plot using a back-pack sprayer calibrated to deliver 30 gpa. Kinetic was added to the spray mixture at 0.1% (v/v).

Biomass accumulation data from low, medium, and high populations of giant smutgrass over a five month sampling period did not detect any intraspecific competition, even at the high smutgrass population level. Competition from high populations of giant smutgrass reduced bahiagrass production 75% when compared to low populations. Applications of Velpar provided excellent control of giant smutgrass. Bahiagrass in the low and medium smutgrass population levels was injured by Velpar, however, injury was transient. There was a 37% increase in bahiagrass biomass accumulation three months after Velpar application in the low smutgrass population plots when compared to the high smutgrass population plots. The use of Velpar resulted in an increase of 38% in bahiagrass biomass production in the high smutgrass population plots when compared with those not receiving Velpar and sustaining continued competition from giant smutgrass.

INTERACTION OF BAS 625 WITH SELECTED BROADLEAF TANK MIXTURES. C. L. Brommer, D. R. Shaw, K. N. Reddy, and S. O. Duke, Plant and Soil Sciences Department, Mississippi State University, Mississippi State, MS 39762, USDA/ARS Southern Weed Science Unit, Stoneville, MS, 38776, and USDA/ARS Natural Products Research Unit, Oxford, MS 38667.

ABSTRACT

Weed control in rice is a very important part of a production system. Control of both broadleaf and grass species is necessary to maximize yields. Often, producers use tank mixtures of two or more herbicides to control a broad spectrum of weed species. There are many cases where the herbicidal action of graminicides is antagonized by a tank mixture with herbicide from another family. Greenhouse and laboratory research was conducted in 1997 to determine the antagonistic effects of various tank mixtures: BAS 635 (40 g ai/ha); bensulfuron (60 g ai/ha); bentazon (1000 g ai/ha); chlorimuron (10 g ai/ha); and pyrazosulfuron (50 g ai/ha) on BAS 625 efficacy, uptake, and translocation in barnyardgrass [*Echinochloa crus-galli* (L.) Beauv.] and broadleaf signalgrass [*Brachiaria platyphylla* (Griseb.) Nash]. BAS 625 either alone or in tank mixture was applied to plants at 3- to 4-leaf (3-wk-old) stage and shoot fresh weights were recorded 2 weeks after treatment. Bensulfuron and BAS 635 did not antagonize control of barnyardgrass or broadleaf signalgrass from BAS 625 in greenhouse experiments. Tank mixtures of BAS 625 and pyrazosulfuron decreased control of barnyardgrass from 100 to 84% and broadleaf signalgrass from 100 to 81%. Tank mixtures with bentazon were the most

antagonistic on barnyardgrass efficacy, resulting in only 40% control. Antagonism of BAS 625 activity by bentazon or chlorimuron was similar with broadleaf signalgrass, reducing control to 28 and 32%, respectively. Addition of 5% (v/v) ethanol to spray solution eliminated all signs of antagonism with the herbicides used in both weed species; control was at least 98% for each tank mixture. Radiolabeled BAS 625 was used to monitor the uptake and translocation in barnyardgrass and broadleaf signalgrass. When plants were at 3- to 4-leaf stage, the second leaf was treated with 10 :l solution containing 3.7 kBq of ^{14}C-BAS 625. At 12 hours after ^{14}C-BAS 625 treatment, over 93% of applied was absorbed and less than 7% of absorbed was translocated in both species. Addition of pyrazosulfuron to spray solution had no effect on uptake of ^{14}C-BAS 625 in both species. However, uptake of ^{14}C-BAS 625 was reduced to 62% of applied in broadleaf signalgrass and to 75% of applied in barnyardgrass when tank-mixed with bentazon. Uptake and translocation of ^{14}C-BAS625 at 12 hours after treatment was not enhanced with the addition of ethanol to spray solutions of BAS 625 alone or tank-mixtures.

INTERFERENCE AND SEED-RAIN DYNAMICS OF FOUR *POLYGONUM* SPECIES IN COTTON. S. D. Askew, J. W. Wilcut, W. A. Bailey, and G. H. Scott, North Carolina State University, Raleigh, NC 27695.

ABSTRACT

Smartweeds comprise a major weed complex prevalent in cotton (*Gossypium hirsutum*). Some of the more common species include Pennsylvania smartweed (*Polygonum pensylvanicum*), pale smartweed (*P. lapathifolium*), and ladysthumb (*P. persicaria*). Another species, tufted knotweed (*P. caespitosum* var. *longisetum*), is common in lawns and wooded areas and sometimes found in cotton in North Carolina. Information on interspecific variation in smartweed control by herbicides is less available than for many other weed complexes due in part to complicated seed dormancy that makes establishment of *Polygonum* spp. difficult, but some variation does exist. For example, clomazone controls Pennsylvania and pale smartweed but doesn't control ladysthumb. In addition to variation in herbicide control, phenological differences indicate that an evaluation by species is important. Little is known about the competitive effect of these species in cotton so separate studies that evaluated interference and seed rain of these four species in 'Stoneville BXN 47' cotton were conducted.

Studies were conducted at Clayton, NC in 1998. Each species was planted ten cm from the cotton row at 0, 1, 2, 4, 8, 16, and 32 plants per 10 row m. An additional treatment had no cotton and one plant per 10 row m to simulate a non-competitive environment. Undesirable weeds were removed throughout the season. Height of four cotton and weed plants and diameter of weed canopies were determined bi-weekly throughout the season. Just before cotton harvest, all seed remaining on plants were hand harvested. All weeds were then carefully removed and fresh and dry weights of four weeds were obtained. To account for seed fallen prior to harvest, seed on the ground were counted within four randomly placed 10-cm diameter rings. Cotton was then harvested and lint yield determined. Data were subjected to ANOVA. Bi-weekly height and weed canopy diameter data were treated as repeated measures to control correlation structure. Orthogonal polynomial contrasts were used to completely partition sums of squares for comparison of the no-competition control to the seven density treatments in cotton. Regression analysis was used for the seven densities in cotton and trends with significant correlation coefficients were interpreted.

No smartweed density affected cotton height until at least nine weeks after planting indicating a wide time window for weed removal. This is evidenced by the fact that no density effect was observed on weed dry weight. However, dry weight increased in absence of cotton competition. For example, average ladysthumb dry weight was 473 g per plant regardless of weed density in cotton, but increased to 2690 g per plant without cotton competition. This suggests two things: 1) the aforementioned densities in cotton were too low to cause intraspecific weed competition, and 2) the smartweeds have the ability to exploit more resources if available. Late in the season, all species at 16 and 32 plants per 10 row m except tufted knotweed reduced cotton height by 15 cm. Average cotton height was 91 cm while smartweed heights were as much as 244, 235, 183, and 70 cm for pale smartweed, ladysthumb, Pennsylvania smartweed, and tufted knotweed, respectively. This height combined with over 304 cm diameter of some smartweed plant canopies would make cotton harvest difficult to impossible if plants were not controlled.

A negative linear effect resulted on cotton lint yield from increasing densities of all four species. Within the range of densities evaluated, Pennsylvania smartweed, pale smartweed, ladysthumb, and tufted knotweed reduced cotton lint yield 77, 70, 59, and 23 kg/ha for each weed in 10 row m. Excluding tufted knotweed, yield reduction was 0.02% per weed

in every 10 row m regardless of weed species. A typical herbicide program in bromoxynil-tolerant cotton including tillage and seed costs and using soil-applied and layby herbicides with one application of bromoxynil cost $101.80 per ha. A selling price of $1.40 per kg cotton lint suggests a break-even threshold of 73 kg lint/ha or about 2.3, 2.6, and 3 weeds per every 10 row m for Pennsylvania smartweed, pale smartweed, and ladysthumb, respectively. However, this excludes negative impacts on harvest including equipment damage, poor lint removal due to gummed machinery, and increased trash and stains feasibly caused by such large weeds.

Another consideration not included in the simple economic threshold above is seed rain. Seed rain of all four species increased linearly with increasing density. Considering ground and on-plant enumeration, seed rain was 45.5, 13.5, 10.6, and 3.85 million seed per ha for each increase in smartweed per 10 row m for pale smartweed, Pennsylvania smartweed, ladysthumb, and tufted knotweed, respectively. At cotton harvest, 83 and 89% of mature seed were still on ladysthumb and pale smartweed plants, respectively. Only 64 and 36% of mature seed remained on Pennsylvania smartweed and tufted knotweed plants, respectively. These differences in seed-rain are probably due to differing flowering dates between the four species and will be evaluated in future research.

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

ABSTRACT

Red morningglory (*Ipomoea coccinea* L.) is the most common morningglory found in Louisiana sugarcane fields. Atrazine, an inhibitor of electron transport at photosystem II, is the primary herbicide used to control this weed in Louisiana sugarcane. Atrazine is used on approximately 80% of the Louisiana sugarcane acreage and as much as 11.2 kg ai/ha may be used per year. Growers have reported that red morningglory control with atrazine has declined over the past few years, possibly indicating triazine resistance. Biotypes of 64 weed species worldwide have been identified as atrazine resistant, making the triazines the most common herbicide chemistry for resistance development. In all cases, resistance 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 and 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 fluorescence of leaf material from triazine susceptible plants increases upon exposure to atrazine, while no change in fluorescence occurs in resistant plants. In addition, the native level of 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. Seed were collected from 20 commercial sugarcane fields in 8 parishes where red morningglory control failures were reported. In addition, seed 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 34 C and a 14 hr photoperiod. In the laboratory, the third youngest, fully expanded leaf was removed from plants at the 5 to 7 leaf stage. A 10 mm diameter cork borer was used to remove a section from each side of the midvein. The leaf sections were floated in deionized water for 30 min in the dark and 30 min under a light source with an intensity of 2.46 :mol/m^2/s. The fluorometer was set to a gain of 0.6 and the light intensity was adjusted to 0.72 :mol/m^2/s. Leaf sections 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 for 180 min 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 exposed to atrazine. CRF values ranged from 46 to 65 fluorescence units. T tests indicated that all CRF values were different from zero. Analysis of variance indicated small differences in CRF values, but no differences in initial

fluorescence were detected among populations. Data indicate that these red morningglory populations are not genetically resistant to atrazine.

A greenhouse study was conducted to evaluate atrazine susceptibility of the red morningglory populations. The experimental design was a randomized complete block replicated 5 times. Plants at the 2 to 3 leaf stage from each of the 24 locations were treated with 1.12 kg ai/ha + 0.25% nonionic surfactant or surfactant only. Visual control ratings were made 10 days after treatment. All atrazine treated plants were controlled at least 99%, supporting results from the fluorescence assay.

THE MILAN NOTILL FIELD DAY WEED CONTROL TOURS. T. C. Mueller, R. M. Hayes, G. N. Rhodes, Jr., and B. A. Brown, The University of Tennessee, Knoxville, TN.

ABSTRACT

In 1998, The Milan No-Till Field Day brought 5,850 visitors from 32 states, 11 foreign countries and 79 of Tennessee's 95 counties. Always held on the fourth Thursday in July at the Milan Experiment Station northeast of Memphis, TN, the field day offers farmers a broad range of topics. This year's tour started with a comparison of weed control in conventional and no-tillage systems by Neil Rhodes and Todd Willian. The second stop, after the visitors viewed double-cropped soybean weed management research being conducted by Bob Hayes, was "Application Technology for Drift Reduction and Weed Control", by Tom Mueller and Robert Etheridge. Lab data obtained with a Malvern laser instrument (in conjunction with Al Womac) was presented on the new "venturi" type drift-reducing nozzles. At this stop, a sprayer was used to visually demonstrate the different spray patterns. The third stop covered herbicide activity and symptomology, where Joyce Tredaway and Anthony Ohmes lead the farmers through field plots of crops and weeds. Since this was a no-till field day, all plots had been established under no-till conditions. The fourth and final stop dealt with weed identification, and was facilitated by Jimmy Summerlin, Cheryl Ashburn, Carrie Stiles, Greg Breeden, and Eric Walker. The groups of 10 to 50 farmers were divided into smaller groups for weed identification. The farmers appreciated the hands-on experience provided in this tour. Many field days provide information, but the chance to have plants in your hands for weed identification, and to closely observe the different herbicide symptomology was a valuable learning experience. Care was given to integrate the tour stops into one event that flowed from beginning to end. Current graduate students and a recent graduate working in another state were involved as facilitators.

USE OF THE SWSS GRADUATE WEED CONTEST SITES FOR EXTENSION AGENT WEED CONTROL INSERVICE TRAINING. G. N. Rhodes, Jr. and T. C. Mueller, University of Tennessee, Knoxville, TN 37901; G. S. Stapleton, American Cyanamid Company, Dyersburg, TN 38024.

ABSTRACT

Timely, technically oriented inservice training for agricultural extension agents is a high priority within the University of Tennessee Agricultural Extension Service. In weed management, classroom type update training is provided for agents in each extension district every winter. While this venue is quite suitable for label updates, new product profiles, and discussions of results from weed management research and demonstrations conducted the previous summer, it is inadequate for training in weed identification, herbicide injury symptom recognition and field problem diagnosis. Over the years we have covered these subjects at in-field inservice sessions, but set up for this type of training requires substantial time and resources.

The SWSS Graduate Weed Contest is held annually and rotates locations each year in the southern region. The event was hosted by the University of Tennessee in Knoxville in 1997, and by American Cyanamid at Agricenter International in Memphis in 1998. The contest sites were used both years for extension agent weed control inservice training. The day-long training sessions were held on the day following the contest each year. Instructors included University of Tennessee extension and research faculty, weed science graduate students and in 1998, American Cyanamid technical services personnel. Training areas were those utilized as contest events and included weed identification, herbicide symptomology, field problem diagnosis and sprayer calibration. The mystery event was utilized also and consisted of

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rating weed control plots in 1997 and trailer towing safety in 1998. Agents were divided into five groups at registration. These groups rotated among the five sessions throughout the day. Lunch, refreshments and hand lenses were provided for all participants. At the end of the day, participants were provided the opportunity to return to the stops to make pictures or video. Participants, where applicable, received certified applicator recertification points and Certified Crop Advisor continuing education units.

Approximately one week following the training each year, a survey was sent via email to each participant. Results from respondents were summarized each year. Participants indicated overwhelmingly each year that the training was worth their time, that the information was presented at an understandable level, and that knowledge gained at the training would improve their ability to assist producers with weed management issues. In general, the participants enjoyed weed identification, herbicide symptomology, and field problem diagnosis more than sprayer calibration. Within weed identification, they strongly preferred plant identification to seed identification. Comments and suggestions from respondents were numerous. Several indicated they would have benefitted from more emphasis on vegetable, fruit, ornamental and noncrop weed control and less on row crop weed control. Some indicated they would have preferred more time than allotted on weed identification. Many indicated they would like to see similar training events in entomology, plant pathology and soil fertility.

LOUISIANA COOPERATIVE EXTENSION SERVICE'S RESPONSE TO EXCESSIVE ATRAZINE LEVELS IN DRINKING WATER. D. E. Sanders, R. J. Lencse, and R. E. Strahan, Louisiana State University Agricultural Center, Cooperative Extension Service, Baton Rouge, LA 70894.

ABSTRACT

The Louisiana Cooperative Extension Service (LCES) became involved with the problems associated with high levels of the herbicide atrazine in the drinking water originating from one water treatment plant in the Upper Terrebonne Basin Watershed (UTBW) at the request of the Louisiana Department of Agriculture and Forestry in early January 1998. The LCES began a four part program to attempt to reduce the levels of atrazine going into the water treatment plant in 1998.

Earlier monitoring studies indicated that increased levels of atrazine were present in surface waters (the water source for the treatment plant) in late winter and early spring with levels falling well below health advisory limits during the summer, fall and early winter. The first part of the LCES program was to inform the growers of the nature, scope and potential outcome of continued elevated levels of atrazine. This was first done with a regional multi-crop meeting with over 200 growers in attendance where concerns were expressed and recommendations offered that would reduce atrazine use and/or runoff. This meeting was following by distribution of these same recommendations by mail through the county agents offices. Recommendations were based on the best available data while indicating that more work was needed to answer outstanding questions.

The second part of the program involved an intensive water sampling of the five tributaries that lead into the Intercoastal Waterway (water source for the treatment plant). This was done twice weekly from late February through April. This was done to try and determine the sequence of events that cause increased levels and to attempt to pinpoint geographic areas that were contributing a greater or lesser degree to the problem. Water samples were analyzed for the presence of atrazine by the LSU Department of Agricultural Chemistry.

The third part of the program involved direct monitoring of corn and sugarcane fields (the two largest users of atrazine) for atrazine runoff. This was accomplished by LCES personnel applying known amounts of atrazine under different protocols and utilizing automatic water samplers that began sampling runoff water from the first rainfall event after application sufficient to cause runoff. These samples were also analyzed for the levels of atrazine by the LSU Department of Agricultural Chemistry.

The fourth part of the program involved field trials of alternative herbicide treatments or reduced rate treatments on both corn and sugarcane. Trials were monitored for weed control efficacy and when possible taken to yield. Nine corn trials and three sugarcane trials were completed on growers' fields in the UTBW.

Results from these findings were presented back to the growers in a meeting in October of 1998. Those findings were:

1. Atrazine levels in the tributaries leading into the Intercoastal Waterway are associated with rainfall events sufficient to cause runoff. In 1998 these levels increased rapidly following a rainfall, peaked and declined rapidly.

2. Runoff from individual fields as monitored by the automatic samplers increase rapidly over the first 30 minutes, peak and decline thereafter. Most of the runoff that occurs from a field is associated with the first rainfall event sufficient to cause runoff. In comparison runoff from treatments utilizing reduced rates of atrazine resulted in lower atrazine levels in the runoff water. Levels found in the runoff water was generally a function of the amount of atrazine applied to the field. Runoff from trials where no new atrazine was applied contained no or only trace amounts of atrazine. This indicated no problem with atrazine accumulation over time.

3. A number of conventional alternative herbicides were tested in comparison to a standard treatment containing atrazine. Weed control levels were reduced with the alternative herbicides as compared to the atrazine containing standard. Transgenic or nontransgenic herbicide resistant corn varieties (those utilizing a treatment not containing atrazine) were evaluated for weed control and yield potential. Three of these trials were conducted in the UTBW and two similar trials were conducted outside the UTBW. Some of the varieties tested appear promising, yielding near the conventional varieties and some yielded very poorly.

4. Alternative herbicide treatments in sugarcane performed very well in comparison to the atrazine containing standard. Harvest is currently still in progress, but weed control ratings and visual phytotoxicity ratings appear favorable.

5. Grower use of atrazine (based on dealer surveys) was reduced significantly, 57 percent from previous years. Most of this reduction can be attributed to sugarcane growers switching to alternative herbicides. Corn acreaged was increased from previous years and the total amount used on corn is estimated to have increased. The decrease in sugarcane usage offset the increases in corn usage due primarily to the large differences in amounts active ingredient used on sugarcane verses corn.

6. Significantly lower levels of atrazine were present in the finished drinking water originating from the water treatment plant in 1998 compared to the previous two years (the plant has been in operation for three years). This can be accounted for by lower levels of atrazine in the surface water as a result of lowered peak levels, increased levels of shorter duration and increased filtration capabilities of the water treatment plant.

7. The LCES plans to continue with reduced rates and alternative herbicide trials in corn and sugarcane in 1999 in conjunction with field level monitoring of runoff to better establish the relationship between agricultural practices and atrazine runoff.

FEDERAL NOXIOUS WEED ERADICATION PROJECTS. T. J. English, A. E. Miller, and G. L. Clement. USDA-APHIS-PPQ, Oxford, NC, Conyers, GA, and Harrisburg, PA.

ABSTRACT

Personnel from the USDA-APHIS-PPQ, Oxford Plant Protection Station, located at Oxford, NC, have been cooperating with PPQ and State Noxious Weed Personnel since the establishment of the facility in 1995. Eradication treatments and application technology have been collaboratively developed, applied and/or assessed with public agencies and individuals involved in the containment and eradication of tropical soda apple (*Solanum viarum* Dunal), small broomrape (*Orobanche minor* Sm.), witchweed [*Striga asiatica* (L.) Kuntze], cogongrass [*Imperata cylindrica* (L.) Beauv.], kudzu [*Pueraria lobata* (Willd.) Ohwi.] and most recently giant hogweed (*Heracleum mantegazzianum* Sommier & Levier). Due to the time limitations, two of these eradication projects will be discussed, witchweed and giant hogweed.

Witchweed (ww) an obligate root parasite of gramineous crops and common weedy grasses was detected in the Carolinas during the late 1950s. Following detection and delimiting surveys, federal and state quarantines were imposed to complement a containment spray program and regulatory effort. During the 1980s eradication became the program goal with the advent of increased funding, preemergence and postemergence witchweed corn and soybean herbicides (Goal, Reflex), postemergence over-the-top grass killers and the ability to apply ethylene, a witchweed seed germinator, to most infested sites. Since then, a continual decrease in infested acres has been achieved. During 1995, the North Carolina Department of Agriculture became the administrator for the witchweed eradication program. New challenges to witchweed eradication appear each year as did the need for full season grass/ww control for chufa and seedling bahiagrass during 1998. New technologies such as Roundup Ready Crops may help prevent the emergence of ww on host crops and late season weedy grasses. At one time 436,000 acres and 39 counties were ww infested. Presently only 8001 acres and parts of 9 counties in North and South Carolina remain under quarantine. Of the once infested acres 98% have been released from quarantine.

Giant Hogweed (GHW) is a large and showy plant introduced into North America during the 1900s. It was cultivated as an ornamental because of its large size and clusters of white flowers. It is now considered an undesirable weed as it has escaped from cultivation and its sap can cause severe chemical burns to the skin. After survey and assessment USDA-APHIS-PPQ organized an hogweed eradication team during 1998. The team was composed of personnel from APHIS-PPQ, Gannon University and the Pennsylvania Department of Agriculture-Bureau of Plant Industry (PDA-BPI). Each organization had primary but not totally distinct responsibilities. PPQ - funding, organization, administration; Gannon University - publicity, land owner contacts, site mapping, lab research; PDA-BPI - treatment research, treatment application, survey, and education. After publicizing the hazards of GHW, Gannon University confirmed and recorded the infested sites as reported. Seed heads were removed before seed deposition as needed. Sites were treated by PDA-BPI with a treatment determined by earlier screening. The treatment was applied utilizing the Thinvert Spraying System which applied a pre-mixture of Thinvert RTU 93% + Garlon 4 5% + Transline 2% v/v. This system applies thin white invert droplets of the herbicide mixture over hogweed leaves. BPI with this application system has the ability to broadcast or direct the treatment of invert droplets, to use broad spectrum herbicides selectively in sensitive areas.

During the first year of eradication, 116 giant hogweed sites were reported/detected in a variety of sites ranging from abandoned areas, to recreational parks to flower gardens and all were successfully treated. This eradication project has an excellent chance to succeed due to the fact that there is a treatment available for all sites, eradication was initiated while the number and size of sites were manageable, and because the stakeholders support the removal of this poisonous species.

STRATEGIES FOR EARLY DETECTION, REPORTING, AND MONITORING OF INVASIVE PLANTS. L. Fowler, USDA-APHIS, Raleigh, NC.

ABSTRACT

Invasive plants are a serious problem in the United States, causing billions of dollars of damage to agricultural, managed, and natural ecosystems. In 1994, it was estimated that the economic impact of weeds, the cost to us all for food and fiber, was about $20 billion per year. On our public lands alone, it has been estimated that we are losing 4000 to 5000 acres per day due to the incursion of invasive species.

Collection of interception data at our ports of entry indicate that we are currently preventing entry to only 5 to 30 percent of all pests. Current efforts to correct this situation include recent introduction of the Plant Protection Act to grant our Secretary increased authority and an intensified search for new technologies to enhance our detection and mitigative capabilities. The Federal Interagency Committee for the Management of Noxious and Exotic Weeds (FICMNEW) is a consortium of 16 federal agencies. The National Strategy for Invasive Plant Management (NSIPM) is the document developed by this group to address invasive plants within the United States. Early detection, reporting, and monitoring are critical components of NSIPM. Partnerships, state weed teams, are being formed. These teams all have committees to provide early detection. Historically, lack of partnerships have created information gaps. New invasive plants have been collected and identified, but the information failed to be shared with individuals who could have responded in a way to effect appropriate action.

The following is a mission statement and associated activities formulated by a state in the formation of a state partnership. **Mission.** To provide a network within the state for protecting the sustainability and biodiversity of managed and natural ecosystems. This is to be accomplished by the following:

1. Establish a network to provide early detection of incipient occurrences,
2. Respond to invasive plants, and
3. Rehabilitate infested sites, when appropriate.

The mission statement will be accomplished when the following activities are effected:

1. Educate and Motivate. The initial step in the formation of a network involves the education and motivation of individuals to participate in the process. Any individual who has the capacity to identify plants is potentially valuable to the process. **2. Survey.** Educated and motivated individuals will survey within their area of the state. Idealistically, all counties of the state would be surveyed for new invasive plants on a regular basis. **3. Submit.** Specimens will be submitted for final identification to an accredited botanist within the network. For alleged infestations not accompanied by a specimen, an on-line report will provide information to allow collection and processing at a later date. **4. Identify.** Submitted specimens will be identified by an accredited source. **5. Evaluate.** The identified specimen will then be evaluated. This process is sometimes referred to as a risk assessment. The purpose of assessment is to determine if specimen is invasive. If not, the process stops. **6. Record.** Pertinent information regarding invasive specimens will be recorded and idealistically, stored electronically in a database with interactive on-line capability. **7. Accession.** As a minimum, all new state and county finds should be validated by a vouchered specimen, probably housed in an institutional herbarium. **8. Report.** The information regarding significant accessions will be reported or made available to appropriate agencies. It is this step in the process that has been lacking. Not uncommonly, regulatory agencies have discovered much later about new infestations. Steps 1 through 8 constitute "early detection". **9. Regulate**. Information regarding new infestations will be made available to agencies and institutions for appropriate action. **10. Restore.** To the extent possible, and when appropriate, measures will be taken to restore the original habitat adversely impacted by the infestation.

GUILTY UNTIL PROVEN INNOCENT: A CONCEPT FOR PEST EXCLUSION. R. E. Eplee and R. Norris, USDA APHIS, CPHST, Raleigh NC and Oxford NC.

ABSTRACT

The Agricultural, managed and natural ecosystems of the USA are constantly being threatened and damaged by various taxa of insects, diseases and plants from foreign sites. These "pest" arrive as inadvertent contaminates of commodities or as infestations in packing material. Many pest taxa arrive intentionally by people for marketing, as biological curiosities or by people who just do not understand the consequences of introducing an alien taxa into the USA.

An effective and efficient system is needed to protect the USA ecosystems from the introduction and establishment of invasive taxa that pose a threat to our ecosystems. The Environmental Protection Agency, the Food and Drug administration and other regulatory agencies have long ago adopted the simple principle that "no product" can be sold or distributed in the USA until it has been proven safe to humans and the environment. This policy insures the protection of the environment from chemical pollutants. A policy that prevents the introduction, movement or establishment of a taxa of flora or fauna would likewise protect our ecosystems from potential biological pollutants. Unlike chemical pollutants that typically break down over time, biological pollutants can grow, adapt, reproduce and spread, causing an ever greater problem over time. If we recognize that it is deemed necessary to have a policy of "guilty until proven innocent" for chemicals such as pharmaceuticals and pesticides, that dissipate from the environment over time, it is even more appropriate that a policy of "guilty until proven innocent" be applicable to biological pollutants.

In order to put the concept of "Guilty Until Proven Innocent into perspective as a means of protecting our ecosystems, the following statements are germane:

"A **smart** person can solve difficult problems, but a **wise** person prevents problems from happening."

"No person has the right to move an undesired taxa from where it is to where it is not wanted."

"Prevention is the best management strategy for and invasive pest."

If we as a nation are to have an effective protection system from invasive pest, we must have an attitude toward potential biological pollutants like we have for chemical pollutants. We must recognize their potential consequences on crop productivity, their effect on the sustainability of natural ecosystems, their threat to endangered species and their detriment to the esthetics of our recreational areas.

Fundamental to protection is an effective and supported national, state and local prevention structure. We must have laws and regulations that articulate "what and how" live organisms can be brought into or moved within the USA. We need to identify what taxa is "approved" for unrestricted movement, what taxa are prohibited from entry into or moved within the USA and those taxa that must be assessed for pest risk before they can enter or be moved. This can be accomplished through the use of an effective permitting system, similar in effect, to what now protects our environment from potentially damaging chemicals.

Like our system of regulating chemicals, the regulation of potential pest must involve full cooperation of the trade industry and the traveling public.. They must accept the responsibility of compliance with the principles of regulation to protect the biological integrity of our ecosystems. Compliance with the laws and regulations that protect our environments from chemical pollution is supported by a system of civil penalties. A system of significant civil penalties is also necessary to protect the biological component of our ecosystems.

Prevention of man aided movement of live "pest" is the best way to protect our agricultural, managed and natural ecosystems from invasive species. Determining that a taxa is "safe" before it can be moved to where it does not occur can be an effective way to protect our environment.

CLODINAFOP-PROPARGYL: A NEW SELECTIVE HERBICIDE FOR GRASS CONTROL IN WHEAT. J. E. Driver, D. W. Kidder, and J. R. James, Novartis Crop Protection, Inc., Greensboro, NC 27419.

ABSTRACT

Clodinafop-propargyl, 2-propynyl (R)-2-[4-(5-chloro-3-fluoro-2-pyridinyloxy)phenoxy]-propionate is a new aryloxyphenoxy propionate herbicide being developed by Novartis Crop Protection, Inc. This new selective herbicide provides postemergence control of annual grasses in small grain cereals including wheat, rye, and triticale. It is formulated for use with a safener, cloquintocet-methyl, 5-chloro-8-quinolinoxyacetic acid-1-methylexyl-ester, which improves crop safety by accelerating the metabolism of the acid form of clodinafop-propargyl. Clodinafop-propargyl applied postemergence at uses rates of 56g ai/ha and 70g ai/ha has excellent activity against numerous monocotyledous species. These species include: wild oats (*Avena fatua)*, large crabgrass (*Digitaria sanguinalis*), barnuyardgrass (*Echnichloa crus-galli*), goosegrass (*Eluesine indica*), ryegrass and Persian darnel *(Lolium spp*.), proso millet (*Panicum milleaceum*), and green and yellow foxtail (*Setaria spp.)* . *Bromus spp*., *Cyperus, spp*., and broad-leaved species exhibit low susceptibility to clodinafop-propargyl. Clodinafop-propargyl is compatible with dicot cereal herbicides for broad spectrum grass and broadleaf weed control.

Clodinafop-propargyl has low soil leaching potential, limited preemergence activity at label postemergence use rates, and a soil half-life of a few hours to 5 days. Degradation is primarily by microorganisms. It has an acute oral and dermal LD50 and lethal concentration (LC50) of greater than 2000 mg/m^3. At low use rates (56g ai/ha and 70g ai/ha) and short half-life, clodinafop-propargyl is safe to users and the environment.

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Clodinafop-propargyl, 2-propynyl (R)-2-[4-(5-chloro-3-fluoro-2-pyridinyloxy)phenoxy]-propionate is a new aryloxyphenoxy propionate herbicide being developed by Novartis Crop Protection, Inc. This new selective herbicide provides postemergence control of annual grasses in small grain cereals including wheat, rye, and triticale. It is formulated for use with a safener, cloquintocet-methyl, 5-chloro-8-quinolinoxyacetic acid-1-methylexyl-ester, which improves crop safety by accelerating the metabolism of the acid form of clodinafop-propargyl. Clodinafop-propargyl applied postemergence at uses rates of 56g ai/ha and 70g ai/ha has excellent activity against numerous monocotyledous species. These species include: wild oats (*Avena fatua)*, large crabgrass (*Digitaria sanguinalis*), barnuyardgrass (*Echnichloa crus-galli*), goosegrass (*Eluesine indica*), ryegrass and Persian darnel *(Lolium spp*.), proso millet (*Panicum milleaceum*), and green and yellow foxtail (*Setaria spp.)*. *Bromus spp*., *Cyperus, spp*., and broad-leaved species exhibit low susceptibility to clodinafop-propargyl. Clodinafop-propargyl is compatible with dicot cereal herbicides for broad spectrum grass and broadleaf weed control.

Clodinafop-propargyl has low soil leaching potential, limited preemergence activity at label postemergence use rates, and a soil half-life of a few hours to 5 days. Degradation is primarily by microorganisms. It has an acute oral and dermal LD50 and lethal concentration (LC50) of greater than 2000 mg/m^3. At low use rates (56g ai/ha and 70g ai/ha) and short half-life, clodinafop-propargyl is safe to users and the environment.

Field trials were conducted during the 1997-1998 wheat season in Texas and Oklahoma to evaluate efficacy on wild oats in winter wheat. Excellent wild oat control and wheat tolerance was provided by Clodinafop-propargyl at 56g ai/ha. No antagonism was observed in tank mixtures with either 2,4-D or Harmony Extra. Wild oat control, alone or in tank mixture, was comparable to that provided by Silverado and superior to other cereal herbicides - Assert, Maverick, Achieve, Tiller and Hoelon.

WEED CONTROL WITH IMIDAZOLINONE TOLERANT RICE. R. H. White and H. M. Hackworth, American Cyanamid Company, Princeton, NJ 08543 and Pocahontas, AR 72455.

ABSTRACT

Imidazolinone tolerant rice is a line of nontransgenic rice developed, *via* seed mutatgenesis, with significant tolerance to the imidazolinone class of herbicides. Imazethapyr is currently being developed for use in imidazolinone tolerant rice because of its margin of crop tolerance and efficacy on red rice and other important grass and broadleaf weeds common to rice production in North America. Imazethapyr can also effectively control weeds when used as a soil or foliar application.

Field studies were conducted in numerous locations within the Southern rice growing region in 1998. Weed control and crop tolerance evaluations were made from various imazethapyr use rates (ranging from 0.032 to 0.156 lb ai/a) and application timings (preplant incorporated, PI; preemergence, PE; delayed PE, 5-7 days after planting; and postemergence, PO, 2-3 leaf rice). Sequential applications of PI or PE followed by PO were also tested. All treatments were replicated 3 or 4 times within each study. Standard small test plot experimental procedures were used at each location.

Single postemergence applications of imazethapyr (0.125 lb ai/A) provided 90% control of red rice. Soil applications were less effective than foliar applications on a rate-for-rate basis, providing 75-85% control at the higher use rates. In general, red rice control was better in 1997 than 1998 with single applications of imazethapyr.

Sequential applications of imazethapyr e.g., 0.063 lb ai/A soil-applied followed by 0.063 lb ai/A postemergence, provided greater than 95% season-long control of red rice in imidazolinone tolerant rice. When followed by a postemergence application, red rice control did not differ between preemergence or preplant incorporated imazethapyr applications. Efficacy of imazethapyr applied sequentially was very consistent amongst locations and between 1997 and 1998. Control (greater than 90%) of other rice weeds, such as barnyardgrass, broadleaf signalgrass, sprangletop and yellow nutsedge, was achieved with single postemergence applications of imazethapyr (0.094 - 0.125 lb ai/A). As with red rice, the sequential applications provided greater than 95% control of these key weed species and were most consistent across locations. The experimental imidazolinone tolerant rice line, 93AS3510, exhibited little (<10%) injury from either single or sequential imazethapyr applications.

The availability of imazethapyr for weed control in imidazolinone tolerant rice will provide rice growers with numerous benefits. For example, the control of red rice and other key weeds should increase rice yields and decrease dockage fees, provide growers with greater flexibility in rice planting dates and methods as well as enable them to better manage their water resources and rice production acres. Full EPA registration of imazethapyr for use in imidazolinone tolerant rice is anticipated by 2001. The first release of new commercial varieties of imidazolinone tolerant rice is also anticipated in 2001.

COMMAND 3ME: WEED CONTROL IN SOUTHERN RICE. H. R. Mitchell and E. V. Gage, FMC Corporation, Louisville, MS and Pine Creek, TX.

ABSTRACT

Clomazone (Command 3ME) has been evaluated in private and university rice weed management research programs during the past five years for crop tolerance, weed efficacy and subsequent effect on yield. Results presented herein are a compilation of experiments conducted between 1995 and 1998 with clomazone 3ME applied preemergent (PRE) and delayed preemergent (DPRE, 5-7 days after planting but prior to rice emergence) at rates of 0.4, 0.5 and 0.6 lb ai/A. Herbicide standards compared against clomazone included quinclorac either PRE or DPRE at 0.38 lb ai/A, thiobencarb DPRE at 4.0 lb ai/A and pendimethalin DPRE at 0.75 lb ai/A.

Clomazone applied PRE to a clay soil at rates up to 0.6 lb ai/A or silt loam soil at 0.4 lb ai/A resulted in less than 7 % chlorosis by 15 days after emergence. Greater chlorosis was observed when clomazone was applied PRE at the 0.5 lb ai/A rate on a silt loam soil. However, by 21 days after emergence, chlorosis at these rates was less than 10% indicating the potential for rapid recovery of rice to initial clomazone symptoms. Rates of 0.4-0.5 lb ai/A on silt loam and 0.4-0.6 lb ai/A on clay soils showed excellent crop tolerance. No significant stand reduction or stunting between treatments and the untreated check were observed.

Clomazone provided excellent control (91-99%) of both propanil-susceptable and -resistant barnyardgrass (*Echinochloa crus-galli*), sprangletop (*Leptochloa* spp.), broadleaf signalgrass (*Brachiaria platuphylla*) and large crabgrass (*Digitaria sanguinalis*) at approximately 30 days after planting. Differences in efficacy among rates and application methods were negligible. Clomazone provided barnyardgrass control equal to that of quinclorac and superior to thiobencarb (57-75%) and pendimethalin (84%). Sprangletop control was generally equal to thiobencarb and pendimethalin but superior to quinclorac (< 70%). Broadleaf signalgrass control was equal to quinclorac but superior to thiobencarb (49%) and pendimethalin (54%). Clomazone provided large crabgrass control superior to thiobencarb (80%) and quinclorac (50%). Clomazone also provided suppression of several key broadleaf weeds of rice including Northern jointvetch (*Aeschynomene virginica*) (78-80%), Indian jointvetch (*Aeschynomene indica*) (90-93%), pitted morningglory (*Ipomoea lacunosa*) (60-79%), Pennsylvania smartweed (*Polygonum pensylanicum*) (97%), prickly sida (*Sida spinosa*) (69-80%), redweed (*Melocia corchorifolia*) (93-98%) and spreading dayflower (*Commelina diffusa*) (96-97%) in limited trials.

Superior weed control resulted in superior yields when clomazone was evaluated against currently registered grass herbicides of rice. Clomazone at 0.5 lb ai/A PRE provided a yield of 132 Bu/A compared to quinclorac at 0.38 lb ai/A DPRE of 125 Bu/A in 22 replicated trials. At the same rate and application method, clomazone also provided 133 and 121 Bu/A in 33 and 17 replicated trials, respectively, compared to thiobencarb at 4.0 lb ai/A DPRE and pendimethalin at 0.75 lb ai/A DPRE of 112 and 99 Bu/A, respectively.

These data support acceptable rice tolerance to clomazone applied PRE or DPRE at 0.5 to 0.6 lb ai/A to clay soils or 0.4 to 0.5 lb ai/A to silt loam soils. At these rates and application methods, clomazone will provide excellent control of the major grass weeds in rice resulting in superior yields.

UTILIZATION OF AIM FOR BROADLEAF WEED CONTROL IN RICE. H. R. Mitchell and E. V. Gage, FMC Corporation. Louisville, MS and Pine Creek, TX.

ABSTRACT

Carfentrazone-ethyl (AIM 40DF) is a new postemergent broadleaf herbicide discovered and in development by FMC Corporation. It is an aryltriazolinone that acts by inhibiting protoporphyrinogen oxidase in the chlorophyll pathway, resulting in rapid disruption of the cell membrane. Carfentrazone-ethyl is absorbed by the shoots of emerged weeds. 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 rates of 0.02 to 0.03 lb ai/A in rice and has a short soil half-life.

Carfentrazone-ethyl has been evaluated in private and university rice weed management research programs during the past four years for its potential fit as a broadleaf weed control herbicide in rice. Results presented herein are a compilation of experiments conducted in 1997 and 1998 by private and university personnel with carfentrazone-ethyl 40 DF applied early-post (EPOST) at rates of 0.02 to 0.03 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 crop tolerance was observed with all rates of carfentrazone-ethyl evaluated. Rice injury in the form of stand reduction or stunting was not observed with any rate of carfentrazone-ethyl tested. 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 (> 90% 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*), texasweed (*Caperonia palustris*) and redweed (*Melochia corchorifolia)* at rates of 0.02 lb ai/A. No significant grass activity was observed at the rates used 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 0.02 to 0.03 lb ai/A. At these rates 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.

TECHNICAL OVERVIEW OF ZA1296, A NEW CORN HERBICIDE FROM ZENECA. B. D. Black, R. A. Wichert, J. K. Townson, D. W. Bartlett, D. C. Drost. ZENECA Ag Products, Richmond, CA.

ABSTRACT

ZA1296 (2-[4-methylsulfonyl-2-nitrobenzoyl]-1,3-cyclohexanedione) is an experimental triketone (2-benzoylcyclohexane-1,3-diones) herbicide being developed for the preemergence and postemergence corn (*Zea mays* L.) herbicide market. ZA1296 provides control of all the major broadleaf weeds, while providing the producer with application flexibility, excellent crop tolerance, and residual weed control.

The proposed common name for ZA1296 is mesotrione. The molecular target for ZA1296 is the enzyme p-hydroxyphenylpyruvate dioxygenase (HPPD). This enzyme is involved in the pathway that converts the amino acid tyrosine to plastiquinone. ZA1296 is structurally similar to the substrate p-hydroxyphenylpyruvate and acts by competitive inhibition, the result is the blockage of carotenoid synthesis. Corn is naturally tolerant to ZA1296 because of its ability to rapidly metabolize ZA1296.

Weeds are expected to have low potential to develop resistance to ZA1296 because there are few HPPD inhibitors on the market and mutagenized *Arabidopsis* populations have yielded no mutants resistant to ZA1296. Similar *Arabidopsis* populations have shown frequent mutations for ALS resistance.

ZA1296 has a favorable environmental profile. ZA1296 is not a carcinogen and has no detectable residues at harvest. ZA1296 presents negligible risks to mammals, birds and aquatic species. The adsorption coefficient of ZA1296 varies over a wide range (Kd 0.1-5.0 L Kg^{-1}) according to the pH of the soil, with adsorption decreasing as soil pH increases.

ZA1296 applied preemergence will primarily be used in combination with acetochlor to provide broad spectrum control of all of the major broadleaf and grass weeds in corn. Postemergence ZA1296 provides broad spectrum control of all the major broadleaved weeds and some grasses as well as providing residual control of later-germinating weeds

ZA1296: A VERSATILE PREEMERGENCE AND POSTEMERGENCE BROADLEAF HERBICIDE FOR CORN. J. D. Smith and T. H. Beckett, 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 preemergence and postemergence broadleaf weed control in corn.

For broad spectrum preemergence weed control, a premix of ZA1296 and acetochlor is under development. This premix has been evaluated for several years in conventional, reduced tillage, and no-till fields with excellent results. ZA1296/acetochlor provides 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.), kochia [*Kochia scoparia* (L.)Schrad.], common sunflower (*Helianthus annuus* 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.

ZA1296 has also been extensively tested as a postemergence herbicide. For optimum postemergence herbicide performance, the addition of crop oil concentrate, alone or with UAN fertilizer, is recommended. ZA1296 controls velvetleaf, common cocklebur (*Xanthium strumarium* L.), pigweeds, waterhemps, common lambsquarters, common ragweed, jimsonweed, nightshade, common sunflower, smartweed, and several other common broadleaf weeds. 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 exhibits excellent tolerance to both preemergence and postemergence applications of ZA1296.

WEED CONTROL PROVIDED BY *S*-METOLACHLOR IN THE SOUTHERN REGION. M. L. Thornton, and J. C. Holloway, Novartis Crop Protection, Greenville, MS, H. R. Smith, Novartis Crop Protection, College Station, TX, W. W. Bachman, Novartis Crop Protection, Jackson, TN, C. Moseley, Novartis Crop Protection, Greensboro, NC, J. R. James, Novartis Crop Protection, Charlotte, NC, B. W. Minton, Novartis Crop Protection, Houston, TX.

ABSTRACT

Metolachlor is the second largest volume herbicide used in the U.S. Structurally, it contains a chiral center and a chiral axis allowing for two diasteriomer pairs. Most of the biological activity of metolachlor is associated with the 1*S* sterioisomers. These *S*-isomer pairs were designated as CGA-77102. Field trials in 1983 to 1985 were conducted to evaluate the efficacy of CGA-77102 relative to metolachlor. The results indicated that CGA-77102 rates could be 30% to 40% less than metolachlor and provide the same biological activity. However, the production process during the 1980's was not feasible. In 1993, a revolutionary new technology developed within Novartis allowed for the economic production of the active isomer pair. Biological characteristics are not compromised with approximately a 35% reduction in active ingredient application rate in the metolachlor product line conversion from metolachlor to the *S*-isomer products. Positive stewardship impacts occur in reduced environmental loading, reduced applicator exposure and trade volumes, and the conversion meets the political and industrial goal for annual pesticide volume reduction.

Metolachlor is an acetamide herbicide that was first registered in November 1976, for use in corn. Since then, various formulations of Dual and Bicep brand herbicides have continued to grow in use. Corn comprises the major percentage

of metolachlor use, followed by soybeans, sorghum, peanuts, cotton, and others, including several minor crops. An opportunity to reduce use rates will result in reduced herbicide poundage applied, reduce volume needed for biological efficacy, reduced volume in the supply chain, reduced potential for user exposure, and reduced environmental loading.

BAY FOE 5043 & ISOXAFLUTOLE: A NEW BROAD SPECTRUM HERBICIDE FOR CORN. A. T. Palrang, J. R. Bloomberg, J. P. Sleesman, I. Dannenberg and G. J. Aagesen; Bayer Corporation, Kansas City, MO 64120.

ABSTRACT

BAY FOE 5043 & Isoxaflutole is a new combination herbicide that Bayer Corporation is developing for corn. It is composed of two new active ingredients, flufenacet and isoxaflutole. Flufenacet is from the newer class of chemistry called the oxyacetamides, and has been developed by Bayer under the code name FOE 5043. Isoxaflutole is the active ingredient in the new herbicide being developed by Rhone-Poulenc called Balance. This new combination product will contain 48% flufenacet and 10% isoxaflutole, and will be formulated as a 58% dry flowable. It has been in field testing for the past couple of years under the code name USA1000, and the trade name will be EPIC™.

EPIC™ will offer broad-spectrum control of annual grasses and dicots. It will have flexible application timing, tank mix recommendations, and crop rotations. It can be applied pre-plant surface, pre-plant incorporated, or pre-emergence. EPIC™ has low use rates and will have "re-chargeable" activity following periods with limited moisture availability. It will control ALS/triazine resistant weeds and will offer burndown weed control. EPIC™ 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. Crop rotation options will be quite flexible. Corn can be re-planted immediately. After 6 months, cabbage, carrots, cotton, lettuce, peppers, potato, radish, soybeans, sugarbeets, and all other leafy vegetables can be planted. At 12 months is a sizeable list that includes several grasses, forage crops and cereals. The acute toxicity values for EPIC™ are relatively safe; it will carry a CAUTION signal word on the label. Because of the dual nature of its components, EPIC™ will have two distinct modes of action, both of which are different from most other corn herbicides. This will be an important Resistance Management feature of EPIC™.

Efficacy on broadleaf signalgrass, barnyardgrass, large crabgrass, giant foxtail, green foxtail, and fall panicum has been very good to excellent with EPIC™ at rates between 0.32-0.81 kg A.I./H. Activity against Texas panicum, woolly cupgrass, and yellow foxtail has been good. EPIC™ also has activity against a wide range of dicot species, including velvetleaf, pigweeds, common sunflower, common ragweed, lambsquarters, and pennsylvania smartweed. The efficacy of EPIC™ against these weed species has been comparable to or better than that of metolachlor & atrazine in direct (within-trial) comparisons. Tank mixing of atrazine with EPIC™ enhances activity against several difficult weed species including cocklebur, morningglory, and giant ragweed. Corn tolerance of EPIC™ and EPIC™+atrazine has been very good over a wide range of soil types and moisture conditions.

A BELTWIDE EVALUATION OF WEED MANAGEMENT SYSTEMS IN TRANSGENIC AND NON-TRANSGENIC COTTON. J. W. Wilcut, S. D. Askew , North Carolina State University, Raleigh, NC; B. J. Brecke, University of Florida, Jay, FL; D. C. Bridges and S. M. Brown, University of Georgia, Griffin and Tifton, FL; J. M. Chandler, Texas A&M University, College Station, TX; R. M. Hayes, University of Tennessee, Jackson, TN; J. A. Kendig, University of Missouri Delta Center, Portageville, MO; D. K. Miller, Louisiana State University, St. Joseph, LA; R. L. Nichols, Cotton Incorporated, Raleigh, NC; C. E. Snipes, Mississippi State University, Stoneville, MS.

ABSTRACT

Experiments conducted at 15 locations in 1997 and 1998 investigated weed control, cotton tolerance, and yield of transgenic herbicide resistant and standard non-transgenic varieties. The non-transgenic varieties included Stoneville 474 except in Texas where DPL 50 was planted. The BXN variety was Stoneville BXN 47. The Roundup Ready varieties included DPL 5690RR in Texas, DPL 5415RR in Georgia, Florida, Mississippi, Louisiana, and North Carolina (1998 only). Paymaster 1220RR was planted both years in Tennessee and Paymaster 1330RR in North Carolina in 1997. There were weed-free checks for the Roundup Ready, BXN, and non-transgenic varieties at all locations which allowed

for direct comparison of the yield potential. These weed-free plots were treated with trifluralin at 1.0 pint/acre preplant incorporated (PPI) followed by (fb) a preemergence (PRE) treatment of fluometuron at 2.0 to 3.0 pints/acre and weekly hand weedings and hoeings. Herbicide systems evaluated for the non-transgenic varieties included trifluralin PPI plus fluometuron PRE fb either 1) fluometuron at 2.0 pints/ac plus MSMA at 2.0 lb ai/ac early post-directed (EPDS) fb cyanazine at 26 fl. oz./ac plus MSMA late post directed (LAYBY) or 2) pyrithiobac at 1.2 oz product/ac early postemergence (EPOST) over-the-top fb cyanazine plus MSMA LAYBY. The BXN system used trifluralin PPI fb fluometuron PRE fb bromoxynil at 0.5 lb ai/ac EPOST fb a LAYBY of cyanazine plus MSMA. The Roundup systems included 1) trifluralin PPI fb fluometuron PRE fb glyphosate at 1.0 to 2.0 pints/ac EPOST fb cyanazine plus MSMA LAYBY, 2) trifluralin PPI fb glyphosate as needed (ASN), 3) glyphosate ASN fb cyanazine plus MSMA LAYBY, and 4) glyphosate ASN with no other herbicides. Roundup Ultra was the formulation of glyphosate used and it was applied postemergence over-the-top on 4L cotton or smaller. All applications made after the 4L growth stage of cotton were post-directed or applied under a spray hood to minimize contact with cotton foliage. Bromoxynil and glyphosate were not applied with any spray adjuvants while a non-ionic surfactant at 0.25% (v/v) was applied with pyrithiobac, EPDS, and LAYBY treatments.

Sicklepod control in North Carolina was better with glyphosate systems than with the traditional EPDS plus LAYBY system, the pyrithiobac system, or the bromoxynil system. However in Georgia and Florida, sicklepod control was comparable with all herbicide systems and technologies. Morningglory control which included entireleaf, tall, and ivyleaf morningglory was excellent with all systems in North Carolina, Tennessee, and Texas. Common cocklebur , smallflower morningglory, redweed , Palmer amaranth, common lambsquarters, velvetleaf , and prickly sida control was good to excellent with all systems. Smooth pigweed control in Louisiana was near 100% with all systems except the bromoxynil system which controlled smooth pigweed 75%.

Yields of cotton kept weed free were comparable for all varieties with only minor and inconsistent differences seen across all locations in both years of the study. All weed management systems in 1997 except the bromoxynil system conserved at least 90% of the weed-free yields when averaged across all locations. The bromoxynil yield protection was down due to a late grass infestation in Mississippi in the 1997 trial. Averaged across seven locations in 1997, the standard EPDS and LAYBY system yielded 94% of the weed free, the standard plus pyrithiobac EPOST plus a LAYBY yielded 95% of the weed free, the standard plus bromoxynil plus the LAYBY yielded 82% of the weed free, and standard plus glyphosate plus a LAYBY yielded 97% of the weed free. In 1998 averaged across seven locations, the standard EPDS and LAYBY system yielded 92% of the weed free, the standard plus pyrithiobac EPOST plus a LAYBY yielded 92% of the weed free, the standard plus bromoxynil plus the LAYBY yielded 93% of the weed free, and standard plus glyphosate plus the LAYBY yielded 98% of the weed free.

With the glyphosate technology, many producers are looking at reducing inputs of other herbicides. Averaged across locations in 1997, the glyphosate alone ASN systems yielded 98% of the weed free check, glyphosate plus the LAYBY yielded 91% of the weed free, trifluralin plus glyphosate yielded 99% of the weed free, and residual herbicides at planting plus glyphosate EPOST plus a LAYBY yielded 97% of the weed free. In 1998 averaged over seven locations, the glyphosate alone ASN system yielded 86% of the weed free, glyphosate plus the LAYBY yielded 95% of the weed free, trifluralin plus glyphosate yielded 96% of the weed free, and residuals at planting plus glyphosate EPOST plus a LAYBY yielded 98% of the weed free. At several locations in the 1998 trials, glyphosate weed management systems that used only glyphosate without soil applied herbicides yielded less than systems which used soil applied herbicides plus glyphosate. These lower yields may reflect the early season interference from uncontrolled weeds which stunted cotton growth and development.

WEED CONTROL PROVIDED BY TRIASULFURON PLUS DICAMBA IN PASTURE AND WHEAT. H. R. Smith, J. E. Driver, B. W. Minton, D. W. Kidder, and T. Threewitt; Novartis Crop Protection, Greensboro, NC 27419.

ABSTRACT

Rave (triasulfuron + dicamba) is a new herbicide currently registered for postemergence weed control in wheat, barley, pasture, rangeland and CRP acres. Rave is formulated as a 58.8% WDG and is recommended at 2 to 4 oz/a for the control of over 70 weed species. The combination of triasulfuron and dicamba provides two modes of activity for faster knockdown and longer residual control of tough weeds.

Research results in wheat and pasture indicate excellent crop tolerance to Rave. Rave's performance has been excellent on economically important weeds such as ALS-resistant Kochia , mustards, thistles, wild buckwheat, marshelder, western ragweed, and wooly croton.

Rave has the potential to slow the spread of ALS-resistant weed species and help prevent development of resistance in others species.

GROUNDED, A DEPOSITION AGENT FOR SOIL APPLIED PESTICIDES. J. M. Thomas, III, R. E. Mack, G. Volgas, and J. R. Roberts, Helena Chemical Company, Memphis, TN 38120.

ABSTRACT

Traditionally, adjuvants have been used with post-emergence herbicides to increase efficacy through better coverage or penetration of the leaf surface. Adjuvants have not been related to soil-applied herbicides. To be effective, soil-applied herbicides must reach the soil surface, stay in the target area, cover the target area, and should not injury the crop. With these parameters in mind, studies were established to evaluate HM9679-A (Grounded) as an adjuvant for soil-applied herbicides. Replicated small plot studies were initiated across the Southern states with various pre-emergence and pre plant incorporated herbicides in soybeans. Herbicide use rates where the upper label rates for crop and soil type. HM9679-A was applied at 1 pt/A product tank-mixed with the herbicide. Herbicides included cloransulam at 0.75 oz/A applied pre-emergence, flumetsulam WDG at 1.33 oz/A applied pre-emergence, flumetsulam + metolachor at 2.5 pt/A applied pre-emergence, pendimethalin 3.3 EC at 3 pt/A applied pre plant incorporated, dimethenamid 6EC at 32 oz/A applied pre-emergence, metribuzin 4F at 1.25 pt/A applied pre-emergence, or clomazone 3ME at 2.5 pt/A applied pre-emergence.

One of the functions of HM9679-A is to reduce the amount of product being leached from the surface area of soil to a lower area below the germinating weeds and into the area where the crop is germinating resulting in possible crop injury. This was demonstrated in the lab using a pendimethalin solution leached through sand and the leachate collected in glass tubes. Without the HM9679-A, the yellow color was much more visible.

In Arkansas, the control of morningglory was improved for cloransulam and flumetsulam at 7 and 14 days after the treatment. Palmer amaranth (*Amaranthus palmeri*) control was improved for pendimethalin, flumetsulam + metolachlor, dimethenamid, and metribuzin especially at 28 days after treatment. In Tennessee, yellow nutsedge (*Cyperus esculentus*) and morningglory control was improved with clomazone, metribuzin, and pendimethalin again especially at 28 days after treatment. Also, redroot pigweed (*Amaranthus retroflexus*) control was improved with pendimethalin. In Louisiana, barnyardgrass (*Echinochloa crus-galli*) control was improved with pendimethalin and clomazone at 28 days after treatment. Hemp sesbania (*Sesbania exaltata*) control was improved at 14 days after treatment of metribuzin. Pitted morningglory (*Ipomoea lacunosa*) control was improved at 14 days after treatment with flumetsulam.

HM9679-A (Grounded) has shown efficacy improvement with soil-applied herbicides as well as reduced leaching through sandy soils. Addition work should include additional products and crops as well as various soil types.

PESTICIDE SORPTION BY INORGANIC AMENDMENTS USED ON GOLF PUTTING GREENS. G. Wehtje, R. H. Walker and J. N. Shaw. Alabama Agric. Exp. Stn., Auburn. AL 36849.

ABSTRACT

Adsorptive ability of seven inorganic amendments, which are used in golf putting greens, toward oxadiazon, fenarimol and imazaquin were evaluated using a soil solution technique. Amendments evaluated included Clinolite, Ecolite, Pro's Choice, Motan Plus, Isolite, Profile, Axis, and Green's Choice. These amendments are derived from various naturally-occurring deposits of zeolites, diatomaceous earths and/or clays; typically they are fired. Intent is to provide long-lived, stable, and uniform-sized, particle that can contribute favorable water- and nutrient-retention properties. Their use

Research results in wheat and pasture indicate excellent crop tolerance to Rave. Rave's performance has been excellent on economically important weeds such as ALS-resistant Kochia , mustards, thistles, wild buckwheat, marshelder, western ragweed, and wooly croton.

Rave has the potential to slow the spread of ALS-resistant weed species and help prevent development of resistance in others species.

GROUNDED, A DEPOSITION AGENT FOR SOIL APPLIED PESTICIDES. J. M. Thomas, III, R. E. Mack, G. Volgas, and J. R. Roberts, Helena Chemical Company, Memphis, TN 38120.

ABSTRACT

Traditionally, adjuvants have been used with post-emergence herbicides to increase efficacy through better coverage or penetration of the leaf surface. Adjuvants have not been related to soil-applied herbicides. To be effective, soil-applied herbicides must reach the soil surface, stay in the target area, cover the target area, and should not injury the crop. With these parameters in mind, studies were established to evaluate HM9679-A (Grounded) as an adjuvant for soil-applied herbicides. Replicated small plot studies were initiated across the Southern states with various pre-emergence and pre plant incorporated herbicides in soybeans. Herbicide use rates where the upper label rates for crop and soil type. HM9679-A was applied at 1 pt/A product tank-mixed with the herbicide. Herbicides included cloransulam at 0.75 oz/A applied pre-emergence, flumetsulam WDG at 1.33 oz/A applied pre-emergence, flumetsulam + metolachor at 2.5 pt/A applied pre-emergence, pendimethalin 3.3 EC at 3 pt/A applied pre plant incorporated, dimethenamid 6EC at 32 oz/A applied pre-emergence, metribuzin 4F at 1.25 pt/A applied pre-emergence, or clomazone 3ME at 2.5 pt/A applied pre-emergence.

One of the functions of HM9679-A is to reduce the amount of product being leached from the surface area of soil to a lower area below the germinating weeds and into the area where the crop is germinating resulting in possible crop injury. This was demonstrated in the lab using a pendimethalin solution leached through sand and the leachate collected in glass tubes. Without the HM9679-A, the yellow color was much more visible.

In Arkansas, the control of morningglory was improved for cloransulam and flumetsulam at 7 and 14 days after the treatment. Palmer amaranth (*Amaranthus palmeri*) control was improved for pendimethalin, flumetsulam + metolachlor, dimethenamid, and metribuzin especially at 28 days after treatment. In Tennessee, yellow nutsedge (*Cyperus esculentus*) and morningglory control was improved with clomazone, metribuzin, and pendimethalin again especially at 28 days after treatment. Also, redroot pigweed (*Amaranthus retroflexus*) control was improved with pendimethalin. In Louisiana, barnyardgrass (*Echinochloa crus-galli*) control was improved with pendimethalin and clomazone at 28 days after treatment. Hemp sesbania (*Sesbania exaltata*) control was improved at 14 days after treatment of metribuzin. Pitted morningglory (*Ipomoea lacunosa*) control was improved at 14 days after treatment with flumetsulam.

HM9679-A (Grounded) has shown efficacy improvement with soil-applied herbicides as well as reduced leaching through sandy soils. Addition work should include additional products and crops as well as various soil types.

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ABSTRACT

Adsorptive ability of seven inorganic amendments, which are used in golf putting greens, toward oxadiazon, fenarimol and imazaquin were evaluated using a soil solution technique. Amendments evaluated included Clinolite, Ecolite, Pro's Choice, Motan Plus, Isolite, Profile, Axis, and Green's Choice. These amendments are derived from various naturally-occurring deposits of zeolites, diatomaceous earths and/or clays; typically they are fired. Intent is to provide long-lived, stable, and uniform-sized, particle that can contribute favorable water- and nutrient-retention properties. Their use

includes incorporation into the media during greens construction and as a top dressing following mechanical arification. Amendments offer an alternative to sand/peat mixtures which are historically used for these purposes. Samples of the amendments were wetted to field capacity and spiked to 1 ppm (dry weight basis) with the aforementioned pesticides using both formulated and ^{14}C-labelled materials. Water was extracted by centrifugation after a 24-h equilibration period. Aliquots were subjected to quantification of radioactivity. Samples were rewetted with fresh water at a volume equivalent to that extracted. Five cycles of extraction, rewetting and equilbration were conducted over a five-day period. Sand, peat and a native soil (Dothan loamy sand) were included for comparative purposes. Amendments evaluated had considerable variation in CEC, surface area and field capacity. 'Retention' of pesticides (i.e. quantity not recovered in extracted solution) was also variable; but generally more than that of sand and frequently equivalent to peat. Calcium saturation reduced fenarimol 'retention' by at least 2% (Green's choice), and up to 56% (Clinolite). Pesticide 'retention' by amendments is probably the sum of both true adsorption and entrapment. Scanning electron microscopy revealed that the particles of some amendments are extremely porous. Since the addition of amendments to putting greens generally does not exceed 20% (v/v), their impact on pesticide preformance is probably minimal. In the extreme, they can be considered as comparable to peat.

CYANAZINE AND METOLACHLOR LOSSES IN SURFACE RUNOFF: EFFECTS OF SOIL TYPE AND PRECIPITATION TIMING. S. M. Schraer, D. R. Shaw, W. L. Kingery, M. Boyette, and C. R. Medlin, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Previous research at Mississippi State University has monitored cyanazine and metolachlor concentrations in the Mississippi Delta. This research indicated that surface water concentrations of cyanazine were correlated to the predominant soil type in the drainage basin. Metolachlor concentrations were also correlated with sampling date, indicating that higher concentrations could be expected at earlier sampling dates; i.e. closer to time of application.

Research was initiated to evaluate the effects of precipitation timing and soil type on cyanazine and metolachlor losses in surface runoff. Research was conducted using raised-bed, micro-scale, runoff plots (0.25 x 0.5 x 1.2 m). Soils used in this research included a silty clay (1.6% organic matter [OM]) and two silt loam soils (0.7 and 1.8% OM). Cyanazine and metolachlor application rates were adjusted for soil texture and OM. Precipitation timings consisted of simulated rainfall events 0, 2, and 14 days after herbicide application. All surface runoff and leachate was collected for each rainfall event. High-pressure liquid chromatography (HPLC) and gas chromatography (GC) were used to determine cyanazine and metolachlor concentrations, respectively.

Precipitation timing and soil type did not affect total leachate volume or sediment yield. Mean leachate volume and sediment yield was 33000 L/ha and 143 kg/ha, respectively. Time to runoff initiation and total runoff volume was affected by soil type, but not precipitation timing. Less time was required for runoff initiation with the two silt loam soils (6 min) than was required by the silty clay soil (53 min). Total runoff was higher with the two silt loam soils (207000 and 171000 L/ha) compared to the silty clay soil (66000 L/ha). The two silt loam soils did not differ with respect to runoff initiation or total runoff. Cyanazine and metolachlor loss, expressed as total or as percent of applied, in leachate, runoff, or overall did not differ with respect to precipitation timing or soil type with one exception. Soil type significantly affected cyanazine loss. Cyanazine loss was 222 g/ha with the high OM silt loam soil. This was higher than 101 and 88 g/ha with the low OM silt loam and silty clay soils, respectively, which did not differ. Mean metolachlor loss was 108 g/ha.

Plot by plot regression analysis of log herbicide concentration against time revealed log concentrations decreased with time during a 90 min rainfall event. Additionally, averaged across soils, predicted initial cyanazine and metolachlor concentrations were 340 and 67 mg/mL, respectively. The slopes and intercepts were compared. Precipitation timing and soil type did not affect the rate of decrease in sample concentration for either cyanazine or metolachlor. Initial concentrations for cyanazine and metolachlor were significantly different between soil types. Initial cyanazine concentrations were similar between the silt loam soils and between the high OM silt loam and the silty clay soil. However, initial cyanazine concentrations from the silty clay soil were higher than from the low OM silt loam. Initial metolachlor concentrations were similar between the high OM silt loam and silty clay soils. However, initial metolachlor concentrations from these two soils were greater than from the low OM silt loam soil.

EFFECT OF ADJUVANTS ON NORFLURAZON LEACHING IN A SANDY SOIL. R. S. Chandran and M. Singh, University of Florida-Citrus Research and Education Center, Lake Alfred, FL 33880.

ABSTRACT

Thirty-six adjuvants were screened for efficacy to reduce leaching of the preemergence herbicide norflurazon in a Florida sandy soil. Soil columns bioassayed for herbicide leaching following a simulated rainfall event indicated that six of the adjuvants tested reduced herbicide leaching significantly. Of these, E-17-2, monazoline-O, and monazoline-T, were found more effective and were further tested at different application rates. E-17-2 reduced herbicide leaching by 58% when applied at equal proportion to the herbicide solution. Monazoline-T and monazoline-O were 15% less effective to reduce herbicide leaching compared to E-17-2. Linear regression models predicted 50, 25 and 10% reduction of norflurazon leaching by mixing E-17-2 at 75, 25, and 0.78% w/w, respectively, with the herbicide. Greenhouse studies with pigweed and barnyardgrass indicated that the effective adjuvants did not bind the herbicide to affect weed control even at the highest rate of adjuvant used. Counts and shoot fresh weights of weeds that received norflurazon with or without the adjuvants were similar.

HERBICIDE AND SEDIMENT LOSSES IN RUNOFF AS AFFECTED BY PERENNIAL GRASSES. A. Rankins, Jr., D. R. Shaw, M. Boyette, W. L. Kingery and M. C. Smith, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

In recent years, much attention has been placed on reduced water quality due to nonpoint source pollution problems. Technological advances expanding pesticide detection limits have heightened these concerns. Vegetative filter strips as best management practices are increasingly being investigated for reducing the off-site movement of agrochemicals. Researchers have found that tall fescue (Festuca arundinacea Schreb.) filter strips reduce sediment and herbicides losses in surface runoff. However, grasses with stiff, upright growth characteristics may be more tolerant to inundation from surface runoff.

Field experiments were conducted in 1996, 1997, and 1998 at Brooksville, MS, to investigate the utility of giant reed (Arundo donox L.), eastern gamagrass (Tripsacum dactyloides L.), big bluestem (Andropogon gerardii Vitman), switchgrass (Panicum virgatum L.), and tall fescue as filter strips for reducing sediment, fluometuron, and norflurazon losses in surface runoff. Cotton (Gossypium hirsutum L.) was planted in 4 x 22 m soil erosion plots, and fluometuron and norflurazon were each applied PRE at 1.7 kg/ha. Treatments consisted of a 0.3 m filter strip of each species and an untreated check with no filter strip. A rainfall simulator was used to supplement natural rainfall as needed to provide timely runoff events. Following each runoff event, runoff samples were collected from each plot and stored at 2 C until HPLC analysis. Sampling continued for 127 days after herbicide applications on July 7, 1996, June 26, 1997, and June 25, 1998. Sediment and herbicide loss data from all three years were subjected to regression analysis to describe loss patterns, and the slope equality of regression equations were used to determine treatment differences.

Giant reed and eastern gamagrass filter strips resulted in less cumulative runoff losses than the other three species evaluated. The presence of a filter strip reduced sediment losses in surface runoff, regardless of species. Fluometuron and norflurazon concentration in runoff was highest in the initial runoff events in all three years. Generally, filter strip effects on herbicide concentration in runoff were less dramatic than their effects on runoff and sediment losses. Differences in herbicide concentration in runoff across years were related to rainfall patterns and stand establishment of the filter strip species. Across years, 12% of the total applied fluometuron was lost in surface runoff when no filter strip was present. However, fluometuron losses in runoff did not exceed 5% of the total applied when a filter strip was present, regardless of species. Approximately 5% of the total applied norflurazon was lost in surface runoff when no filter strip was present. Norflurazon losses in runoff did not exceed 2% of the total applied when a giant reed, eastern gamagrass, or big bluestem filter strip was present.

INFLUENCE OF FORMULATION AND METHODS OF APPLICATION ON SULFENTRAZONE DISSIPATION. K. B. Collins, L. A. Weston, W. W. Witt, Department of Agronomy, University of Kentucky, Lexington, KY 40546.

ABSTRACT

Sulfentrazone has shown promise for control of yellow nutsedge and ivyleaf morningglory in field ornamental nursery setting and in cool season turf. This research investigated the rate of sulfentrazone wettable powder and granular formulations on the soil surface, incorporated into the soil, or applied to Kentucky bluegrass turf. A cotton root inhibition bioassay was utilized to determine the amount of bioavailable sulfentrazone in soil. Sulfentrazone dissipation was described by first order kinetics and calculated half-lives ranged from 1.7 to 4.6 days. The dissipation of a 5 G formulation was significantly greater in turf than on the soil surface.

INTRODUCTION

Sulfentrazone is a herbicide developed by the FMC Corporation for selective control of certain broadleaf and grass weed species (FMC, 1993). It has been registered for use in both soybeans (*Glycine max*) and tobacco (*Tabacum nicotiana*). Sulfentrazone has provided up to 12 weeks control of traditionally noxious weeds such as yellow nutsedge (*Cyperus esculantus*) and ivyleaf morningglory (*Ipomoea hederacea*) in a nursery setting. However, it has also caused phytotoxicity in some sensitive species (Collins et al., 1996). There has been concern about possible injury to rotational or cover crops due to sulfentrazone persistence in the soil. Sulfentrazone has a pKa value of 6.56, and a vapor pressure of 1 x 10^{-9} mm Hg at 25 C. Sulfentrazone loss in soil appears to be primarily due to microbial degradation. It is not susceptible to photodecomposition or volatility when applied to the soil (FMC, 1993). Grey et al. (1997) found that soil pH was an important factor in determining the behavior of sulfentrazone. Because the pKa value falls within the range of normal field production pH values (6.0 to 7.5), adsorption could decrease and susceptibility to leaching could increase if the pH values were to exceed the pKa (Grey et al., 1997). They also determined that sulfentrazone persistence could be pH dependent.

Conservation efforts have encouraged farmers to use minimum tillage practices, including no-till, to reduce soil erosion. Several nurseries use grass cover crops between rows of nursery stock. Interception of herbicides by plant residues may affect herbicide persistence in the soil, especially those herbicides that need to reach the soil to provide weed control. Several factors can determine the amount of herbicide intercepted by plant residue, including the type, amount, and distribution of residue and the formulation (liquid vs. granular) of the herbicide. A herbicide intercepted by plant residue will often remain there until it is washed away by rainfall, volatilized in the air, or degraded. An applicator should be concerned with the occurrence and duration of the first rainfall after application and the photodegradability and/or volatility of the herbicide (Witt, 1992).

The objective of this study was to determine the dissipation rate of sulfentrazone as affected by formulation (granular or a wettable powder), soil surface characteristics (bare soil or turf), and placement (surface or soil incorporation) in a field nursery or turf condition.

MATERIALS AND METHODS

The experiment was conducted in 1997 at the University of Kentucky Horticulture Research Farm near Lexington, Kentucky on a Maury silt loam (mixed, mesic, Typic Paleudalf). The pH was 6.3 under bare ground and turf, while the organic matter was 4.6% under bare ground and 5.3% under turf. The treatments evaluated are listed in Table 1. The rate of 0.55 kg ai/ha sulfentrazone was selected because it is the greatest rate likely to be labeled in turf or ornamentals. Each plot was 2.1x 9.1m, with a 1.8 m border between each plot. Within each plot, 6 subplots were assigned randomly to a sampling week (0, 1, 2, 4, 8, and 16 WAT). Treatments were established May 23, 1997. Wettable powder treatments were applied in water using a CO_2 pressurized plot sprayer calibrated to deliver 236 liters per hectare at 207 kPa. Granular treatments were applied using a drop spreader calibrated to deliver 0.55 kg ai/ha. Each treatment was replicated 4 times, and the experiment was conducted in a randomized complete block design.

SOIL SAMPLING PROCEDURES. Soil samples were collected 0, 1, 2, 4, 8, and 16 weeks after treatment (WAT). A 10 cm diameter golf cup cutter was used to collect 3 cores to a depth of 10 cm from each plot. The cores were composited, and 50 grams from each sample was used to determine wet and dry weight of the soil. The remaining sample of approximately 1000 was stored at -80C until analysis. For each sampling date, 100 grams of soil of each control treatment was treated with a 5 ppm solution of sulfentrazone. This 5 ppm rate caused 50% phytotoxicity and root injury in cotton, the bioassay indicator species used in this study. This provided a background level of sulfentrazone to determine if degradation had occurred during the storage process.

BIOASSAY PROCEDURE. A bioassay procedure was used to determine bioavailable sulfentrazone concentration in the previously described soil samples. The soil was air dried and ground to pass through a 2 mm mesh screen. Three 150 g subsamples from each plot (for a total of 12 reps of each treatment) were placed in a plastic cone shaped bioassay tube plugged with cotton.

Ivyleaf morningglory (*Ipomoea hederacea*) and cotton (*Gossypium hirsutum* cult. Acala 90) were evaluated as indicator species during a preliminary greenhouse study. Sulfentrazone rates evaluated were: 0, 0.03, 0.07, 0.1, 0.5, 1, 2.5, and 5 ppm. The morningglory plants were extremely sensitive to all sulfentrazone treatments and all plants died above the rate of 0.5 ppm. However, cotton grew uniformly and exhibited moderate sensitivity. Cotton root injury, at increasing sulfentrazone concentrations, was found to be highly significant for a linear regression ($p<0.0001$, R2=0.97).

The bioassay consisted of germinating cotton seeds at 30 C for 30-48 hours in darkness until radicles were 3-9 mm in length. Two of these seeds were planted in the bioassay tubes, with radicles down, approximately 0.6 cm deep (plants were thinned to 1 plant/tube after emergence). After planting, 5 mls of water were added to the top of each tube to prevent dessication of the cotton seeds. The tubes were placed in racks and subirrigated overnight. The next morning, the racks were placed in a growth chamber environment of 16 h daylight and 8 h darkness at 30 C and 25 C, respectively. Each tube was watered to 70% field capacity (w/w) daily. Seedling height and phytotoxicity ratings, measured on a 0 to 10 scale, where 0 represented no phytotoxicity and 10 represented plant death, were taken every three days. After 3 weeks, the plants were harvested, roots separated from the shoots on each plant, and root length and fresh weight of both the root and the shoot were measured. A visual root rating, based on a 0 to 10 scale, where 0 represented no damage compared to the control and 10 represented root death was also recorded at this time.

Each bioassay set was accompanied by a set of standard concentrations of sulfentrazone based on the rates used in the preliminary greenhouse experiment. Sulfentrazone concentration were 0, 0.03, 0.07, 0.1, 0.5, 1, 2.5, and 5 ppm sulfentrazone. Three replicates from each herbicide concentrations were bioassayed as previously described. The mean cotton root weight, shoot weight, root injury rating, phytotoxicity rating, root length, and plant height from each standard curve was combined and regressed upon the natural log of the soil concentrations.

RESULTS AND DISCUSSION

BIOASSAY. The natural log of the standard soil concentrations of sulfentrazone was regressed against cotton seedling root length and plant height, and regressions were not significant. Sulfentrazone concentration regressed against root dry weight was significant Predicted concentrations appeared reasonable and were within the limits of the applied concentrations. Therefore, root dry weight was determined to be the best parameter used to predict the concentration of sulfentrazone when it was regressed upon the natural log of the standard soil concentrations ($P<0.05$, R2=0.72).

DISSIPATION. For each treatment, the natural log of the predicted sulfentrazone concentration was regressed upon time (weeks after treatment). This yielded highly significant linear correlations for all treatments ($P<0.01$, $R^2 = 0.78$); therefore, first-order kinetics appeared to describe sulfentrazone dissipation.

First-order reaction kinetics are often used to interpret results in soil persistence experiments where the rate of degradation is directly proportional to concentration:

$$dC/dt = -kC$$

where C is the concentration after time t, and k is the first-order rate constant, or dissipation rate. When the natural logarithmofthe concentration is plotted againsttime, a straight line results witha slope proportionalto the rate constant:

$$\ln C = \ln C0 \quad kt$$

where C0 is the initial concentration. The dissipation half life (t1/2), or the time taken for 50% disappearance is given by:

$$t1/2 = \ln 2/k = 0.693/k$$

(Walker, 1987).

Herbicide dissipation rates and half lives for each treatment are given in Table 2. Half live values ranged from 1.7 days for the 5 G formulation applied to turf to 4.6 days for the 80 WP incorporated into soil. No differences in dissipation rates were found when comparing formulations and placement methods. However, the dissipation rate of sulfentrazone 5 G applied on bare ground was significantly less than the dissipation rate of sulfentrazone 5 G applied to turf as determined by a test of heterogeneity of slopes (Table 3) (Freund and Littell, 1981). This resulted in t1/2 values of 4 days in granular sulfentrazone applied on bare ground and 1.7 days in granularsulfentrazone applied on turf. The t1/2 values for the surface application of sulfentrazone 80 WP on bare ground was 2.4 days and for the incorporated application of sulfentrazone 80 WP on bare ground was 4.6 days. These values were not significantly different according to a test of heterogeneity of slopes (Table 3) (Freund and Littell, 1981).

Since no differences were found in the half-life of sulfentrazone when comparing formulations, either 5 G or 80 WP would persist equally in bare ground soil. The 80 WP formulation is not used on turf because of leaf injury, so a granular formulation is the only option in that situation. The persistence obtained from incorporation of sulfentrazone 80 WP on bare ground did not significantly differ from that of a surface application; therefore, placement did not alter sulfentrazone persistence. This study showed that granular sulfentrazone persisted slightly longer when applied to bare ground than when applied to turf. The very short persistence of sulfentrazone in Kentucky bluegrass turf may partially explain the relatively poor control in turf that has been observed.

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Table 1. Sulfentrzone treatments evaluated in 1997 at Lexington, KY for persistence on a Maury Silt Loam soil.

Site	Sulfentrazone		
	Formulation	Rate Kg/ha	Placement
1. Bareground control			
2. Bareground	5 G	0.55	surface
3. Bareground	80 WP	0.55	surface
4. Bareground	80 WP	0.55	incorporated 3-5 cm
5. Turf control			
6. Turf	5 G	0.55	surface

Table. 2. Dissipation constants and half life of two sulfentrazone (0.55 Kg/ha) formulations applied to soil or turf in 1997.

Site	Formulation	K	r^2	t 1/2
1. Soil Surface	5 G	-0.173	.82	4
2. Soil Surface	80 WP	-0.289	.78	2.4
3. Soil Incorporated	80 WP	-0.149	.78	4.6
4. Bluegrass Turf	5 G	-0.419	.87	1.7

Table 3. Comparison of sulfentrazone formulations and type of application based on heterogeneity of slopes.

Comparison	P Value
Soil Surface 5 G vs Soil Surface 80 WP	0.21
Soil Surface 5 G vs Kentucky Bluegrass turf 5 G	0.01
Soil Surface 80 WP vs Soil incorporated 80 WP	0.30

DISSIPATION OF SULFENTRAZONE IN SURFACE SOIL. G. A. Ohmes, R. M. Hayes, and T. C. Mueller. Dept. of Plant and Soil Science. The University of Tennessee, Knoxville, TN 37901.

ABSTRACT

Although a trend in herbicide use patterns is developing where more herbicide applications are made after the crop has emerged, soil-applied products will continue to be an important component in soybean weed management systems. Herbicide dissipation represents a compromise between residual control and rotational restrictions. These two attributes are influenced by the herbicide dissipation rate. Dissipation rate is influenced by environmental conditions (rainfall and temperature), soil properties (pH, organic matter, and texture), and transformation processes (microbial and chemical). Studies have indicated that sulfentrazone efficacy and availability in soil solution are related to organic matter and pH (1, 2). Currently there is limited information on sulfentrazone behavior in surface soil. Therefore, this study characterized sulfentrazone dissipation in surface soil under field conditions and evaluated potential injury to cotton, a common rotational crop.

Sulfentrazone dissipation was examined in field and laboratory studies. Field studies were conducted in 1995, 1996, and 1997 at Knoxville, TN on a Sequatchie loam with a pH of 6.1 and organic matter of 1.3%. Treatments (sulfentrazone at 0 and 840 g/ha) were applied preemergence over four row conventionally tilled plots with 75 cm row spacing using a CO_2 backpack sprayer. Plots were cropped using glyphosate tolerant soybeans and glyphosate was applied as needed for weed control. Soil samples were taken in each plot at a depth of 0 - 8 cm throughout the growing season. Cotton was no-till planted into the sulfentrazone plots in order to evaluate potential carryover. Cotton injury in the form of height reduction was taken and converted to percent injury based on the untreated check. The degradation experiment was conducted in the laboratory for a period of 336 days with a sampling interval of two weeks. Soil from two depths, 0-10 cm and 30-40 cm, was collected from the field site prior to sulfentrazone application.

Samples from the field studies were air dried, passed through a 2 mm sieve, and 40 g placed in 250 ml plastic bottles. In the degradation study, autoclaved and nonautoclaved treatments were evaluated with seven grams of moist soil placed into 20 ml glass vials, fortified with 1000 ppbw of sulfentrazone, and incubated in the dark at 30 C. Lab analysis for both field and lab experiments included adding methanol to the containers of soil based at 2 ml of methanol per 1 g of soil. Samples were agitated 16 h, filtered, and concentrations determined using high performance liquid chromatography (HPLC) with a 50:50 v/v acetonitrile:water+H_3PO_4 mobile phase. Data were empirically fit to first order kinetics, half-lives (DT_{50}) were calculated.

Field half-lives were correlated to rainfall. In 1995 and 1997, rainfall for 0-90 DAT was 17 and 24 cm, respectively. Sulfentrazone half-lives for these two years were 113 and 85 d, respectively. In 1996, rainfall for this period was 38 cm, which was higher than the other two years and subsequently sulfentrazone half-life was 25 d. Cotton injury was directly related to sulfentrazone half-life. In 1997, when the half-life from the previous year was only 25 d there was no visible injury. In 1996 and 1998, when half-lives were 113 and 85 d from the previous years, 60% and 35% cotton injury was observed, respectively. In the laboratory study the half-life in the autoclaved soil was 200 d. This was greater than the observed half-lives in the 0-10 and 30-40 cm nonautoclaved soils, which were 93 and 100 d, respectively. These data indicate that microbial degradation is a primary dissipation mechanism. However, the autoclaved soil followed a similar quadratic pattern to that of the nonautoclaved soils suggesting that chemical degradation is also involved in sulfentrazone dissipation.

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DEGRADATION OF DICLOSULAM IN TILLED AND NON-TILLED SOIL. S. W. Murdock, and W. W. Witt, Department of Agronomy, University of Kentucky, Lexington, KY 40546.

ABSTRACT

Field experiments were conducted in 1997 and 1998, near Princeton and Lexington, Kentucky, to evaluate the dissipation and persistence of diclosulam under conventional (moldboard plow), minimum (two diskings), and no-tillage. Diclosulam was applied at 0, 8.6, 13, 26, and 52 g/ha immediately after planting. Soil samples were collected to a 10 cm depth from the 0, 26, and 52 g/ha plots in Princeton on 0, 1, 2, 4, 8, 16, and 44 WAT in 1997, and 0, 1, 2, 4, 8, and 16 WAT in 1998. The amount of diclosulam reaching the soil decreased as the amount of tillage decreased. Diclosulam was not detected 8 WAT in seven of the twelve treatments and only detected in two treatments 16 WAT. The dissipation of diclosulam was linear and independent of rate. Thus, diclosulam followed first order rate kinetics and diclosulam dissipation was relatively rapid. Dissipation was more rapid in 1998 than in 1997 and this was attributed to increased rainfall. Diclosulam half-lives ranged from 10 to 16 days in 1997, and 7 to 9 days in 1998. Corn was planted in 1998 to evaluate the potential for crop injury following diclosulam applications in 1997. There was no corn injury or yield reduction from diclosulam persistence in any tillage at any rate.

SOIL BINDING VALUES FOR HERBICIDES NEED TO BE STANDARDIZED. J. B. Weber, J. W. Wilcut, G. G. Wilkerson, Crop Science Department and R. B. Leidy, Toxicology Department, North Carolina State University, Raleigh, NC 27695 and S. Senseman, W. W. Witt, W. K. Vencil, R. E. Talbert, D. R. Shaw, T. F. Peeper, T. Mueller, D. K. Miller, B. K. Brecke, and M. Barrett, Members of the S-286 Regional Research Technical Committee[3].

ABSTRACT

Herbicide soil/solution distribution coefficients (K_d) are used in mathematical models to predict the movement of herbicides in soils. Herbicides bind to various soil constituents to differing degrees. The universal soil colloid that binds most herbicides is organic matter, but clay minerals and metallic hydrous oxides are more retentive for cationic and phosphoric and arsenic acid compounds, and weakly basic herbicides bind to both organic and inorganic soil colloids. The soil organic carbon affinity coefficient (K_{oc}) has become a common parameter for comparing herbicides binding in soil, but because organic matter and/or organic carbon determinations vary greatly from method to method and laboratory to laboratory, K_{oc} values vary greatly also. This paper discusses this phenomenon and offers suggestions for obtaining the most accurate K_d and K_{oc} values for selected herbicides.

INTRODUCTION

Herbicide soil/solution disribution coefficients (K_d or K_f) are used in mathematical models to predict the movement of herbicides through the soil and in ground water plumes (2,3). A K_d value is the ratio of the amount of a specific herbicide bound to the concentration of the compound in the solution phase of a sorption experiment at or near equilibrium, i.e., K_d = amount ofherbicide sorbed to soil/concentration of herbicide in solution. A K_f value is obtained by using several concentrations of herbicide and utilizing the Freundlich equation ($x/m = K_f C_e^{1/n}$, where x/m = nmole/g herbicide sorbed, K_f=constant, C_e= nmole/ml herbicide in solution, and 1/n = constant) to compute the amount of herbicide bound to the soil at an equilibrium concentration of 1 nmole/ml, assuming a 1/n value of one, i.e., $K_f = x/m \div C_e$.

Nonionizable organic pesticides generally bind to soil organic matter (OM) more readily than to other soil colloids, so many investigators compute an organic carbon (OC) affinity value (K_{oc}) for specific herbicides on specific soil samples. A K_{doc} or K_{foc} (K_{oc}) value may then be obtained using the following equation: K_{oc} = K/% organic carbon content x 100. The OM content of soil may be determined by many different methods, including dry or wet combustion, and generally ranges from 0 to 5% (5). The OC content of soil OM generally ranges from 50 to 58%, i.e., a soil with an OM content of 1% will thus have an OC content of 0.50 to 0.58%, and this is usually expressed as the OC/OM index. The method used to determine the % OC content of the soil should always be reported, as different methods result in different values and this directly affects the calculated K_{oc} values. In addition, K_{oc} values calculated for cationic herbicides, such as paraquat^{2+}, or for herbicides with ionizable phosphoric acid groups, such as glyphosate, which bind much more strongly to inorganic soil colloids than to organic colloids cause the K_{oc} value to have little meaning (6).

Herbicide formulation has a great influence on the dissolution of a chemical in a tank of water or on a plant surface, but has little influence on the behavior of the compound in the soil because the soil media reacts with many compounds converting them to other forms or serves as a chromatographic media to separate the parent compound from the formulation additives (6). This is especially true of acidic compounds that are formulated as esters. Ester formulations are readily hydroyzed to acid forms in soils (4) and this greatly influences their soil binding potential (6). These matters will be made clearer later on in this paper.

METHODS AND MATERIALS

All of the herbicide data reported in this paper has been taken from the Herbicide Handbook (1) but K_d, K_f, K_{doc} and K_{foc} values reported in various databases needed to be evaluated with the same scrutiny as those reported in the Herbicide Handbook.

[3]We acknowledge the North Carolina State Agricultural Service for financial support.

RESULTS AND DISCUSSION

Table 1 contains reported herbicide soil/solution distribution coefficient (K_d), organic carbon affinity (K_{oc}) and selected soil property values, and calculated organic carbon (OC) and OC/OM indices for four herbicides, examples of twenty-one compounds for which this comprehensive information is available in the Herbicide Handbook (1). The major problem with the use of some of these values for predicting herbicide mobility in soils is the large variation in the OC/OM indices, which range from 0.379 to 1.538 but should not range more than 0.50 to 0.58 (5), and reflects the accuracy of the reported K_{oc} values. It is recommended that the K_d values for these compounds be utilized, using the soil properties as a guide for soils with similar properties but unknown K_d values. To calculate K_{oc}, it is suggested that an OC/OM index of 0.54 be used to calculate %OC from the reported %OM values and K_{oc} values computed using $K_{oc} = K_d/\%OC \times 100$, e.g., for atrazine with $K_d = 0.20$ and %OM = 0.9, %OC = OC/OM index x %OM = 0.54 x 0.9 = 0.49, and K_{oc}=0.20/0.49 x 100 = 40.8.

Table 2 contains reported K_d values and selected soil propery values for three herbicides, examples of six compounds for which this information is available in the Herbicide Handbook (1). Since individual K_{oc} values are not provided for each soil, we assumed an OC/OM index of 0.54 in order to calculate %OC and K_{oc} values, e.g., for acetochlor with K_d=0.4 and %OM=0.7, %OC = 0.54 x 0.70 = 0.38 and K_{oc} = 0.4/0.38 x 100 = 105. Where provided, soil property values may be used to compute K_d or K_{oc} values for additional soils with relatively similar properties.

Table 3 contains reported average organic carbon affinity (K_{oc}) values and calculated herbicide soil/solution distribution coefficient (K_d) values for six herbicides, assuming soils with 1.0, 2.5, and 5.0% OM contents and an OC/OM index of 0.54(5). Sixty six additional herbicides fall into this group of herbicides in the Herbicide Handbook (1). K_d values have been calculated since they are used in predicting plume movement (2). Calculated Kd values assumed an OC/OM index of 0.54, e.g., for aciflurofen with K_{oc} = 113 and a soil with 1.0% OM (0.54% OC), $K_d=(K_{oc})(\%OC)/100$ = (113)(0.54)/100=0.610. Several additional problems are apparent in the use of the K_{oc} values for the herbicides in Table 3. For some compounds, the range of reported K_{oc} values is large, e.g., for alachlor reported K_{oc} values ranged from 43 to 209, making it difficult to calculate accurate K_d values. For others, like bifenox, a K_{oc} value of 10,000 is reported for the ester formulation, but the compound is readily hydroloyzed to the acid anionic form in soils (4). The anion, estimated K_{oc} = 100, is much more mobile in soils than the ester form (6). For herbicides with arsenic acid groups like cacodylic acid, the K_{oc} is meaningless since these compounds react much more strongly with metallic hydrous oxides and clay minerals than with organic matter (6). For cationic herbicides like difenzoquat^{2+}, K_{oc} is also meaningless since these compounds react primarily with clay minerals in soils (6). In these cases, the K_d values are much preferred parameters to use in modeling studies.

Table 4 contains reported herbicide soil/solution distribution coefficient (K_d), Freundlich parameters (K_f, 1/n), organic carbon afinity (K_{oc}) and selected soil property values for six herbicides, examples of twenty five herbicides in this group. K_d values for herbicides with reported K_{oc} values only may be computed by assuming an OC/OM ratio of 0.54 and soil organic matter contents of 0 to 5%, as was done for herbicides in Tables 2 and 3.

Reported K_d values were found to be correlated with selected soil properties for 19 of 28 herbicides listed in the Herbicide Handbook (1). Table 5 contains correlation coefficient values and equations for calculating K_d values for three herbicide as examples of the 19 compounds. Soil OM and CM contents and soil pH were found to be the most useful predictors of K_d, depending on the chemical properties of the herbicide involved.

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Table 1. Reported herbicide soil/solution distribution coefficient (K_d), organic carbon affinity (K_{oc}) and selected soil properties, and calculated organic carbon (OC) and OC/OM indices (1).

	Reported values[a]					Calculated values	
Common Name	K_d	K_{oc}	OM	CM	pH	OC[b]	OC/OM index[c]
	ml/g		%			%	
Atrazine	0.20	39	0.9	2.2	6.5	0.51	0.570
	0.73	155	0.8	9.0	6.7	0.47	0.589
	0.79	70	1.9	16.8	7.5	1.13	0.594
	2.46	87	4.8	42.0	5.9	2.83	0.589
Haloxyfop	0.5	47	2.3	nav	7.2	1.06	0.462
	2.0	76	2.9	nav	7.3	2.63	0.907
Nicosulfuron	0.16	38.4	1.1	nav	6.6	0.42	0.379
	0.28	28.8	2.1	nav	6.5	0.97	0.463
	1.73	78.8	4.3	nav	5.4	2.19	0.510
Primisulfuron	0.01	2.1	4.8	2.2	6.5	0.48	0.100
	0.04	4.0	0.9	16.8	7.5	1.00	1.110
	0.09	20.0	0.8	9.0	6.7	0.45	0.562
	0.38	13.0	1.9	42.0	5.9	2.92	1.538

[a]nav = not available
[b]%OC = K_d/K_{oc} x 100.
[c]%OC/%OM ratio.

Table 2. Reported herbicide soil/solution distribution coefficient (K_d), average organic carbon affinity (K_{oc}) and selected soil property values, and calculated % organic carbon (OC) content and organic carbon affinity (K_{oc}) values assuming an OC/OM index of 0.54(1).

Common Name	Reported values[a]					Assumed OC/OM Index[b]	Calculated	
	Kd	Koc	OM	CM	pH		OC[c]	K_{oc}[d]
	ml/g		%				%	ml/g
Acetochlor	0.4	nav	0.7	nav	nav	0.54	0.38	105
	1.1	nav	1.2	nav	nav	0.54	0.65	169
	1.6	nav	2.4	nav	nav	0.54	1.30	123
	2.7	nav	3.4	nav	nav	0.54	1.84	147
Chlorsulfuron	0.69	nav	4.3	nav	5.4	0.54	2.32	29.7
Average		40						
Dithiopyr	7.89	nav	0.8	8.0	8.0	0.54	0.43	1835
	12.82	nav	1.0	8.0	7.5	0.54	0.54	2393
	45.93	nav	3.2	59.0	6.2	0.54	1.73	2655
Average		1638						

[a]nav = not available
[b]OM ranges from 50 to 58%OC (mean = 54%)(5).
[c]OC = 0.54 (OM).
[d]$K_{oc} = K_d$ / %OC x 100.

Table 3. Reported average herbicide organic carbon affinity (K_{oc}) values and calculated herbicide soil/solution distribution coefficient (K_d) values, assuming soils with 1.0, 2.5, and 5.0% OM contents and an OC/OM index of 0.54(1).

Common Name	Reported Average K_{oc}	Calculated K_d values[a,b] Assumed 1.0% OM (0.54% OC)	Assumed 2.5% OM (1.35% OC)	Assumed 5.0% OM (2.70% OC)
Aciflurofen	113	0.610	1.53	3.05
Alachlor	124[c]	0.670	1.67	3.35
Bifenox	100[d]	0.540	1.35	2.70
Cacodylic acid	1000[e]	5.40	13.5	27.0
Difenzoquat^{2+}	54,500[f]	294	736	1471
Maleic hydrazide	250[g]	1.35	3.37	6.75

[a]%OM for most soils ranges from 0 to 5%, OM ranges from 50 to 58% OC (mean = 54%), assumed OC/OM index of 0.54(5).
[b]Kd = (K_{oc})(%OC) / 100.
[c]Reportedly ranges from 43 to 209.
[d]Reported as 10,000 for ester, which is transformed to acid in 10 days (4); value is estimate for acid.
[e]Binds to clay minerals and hydrous oxide primarily, so K_{oc} is meaningless (6).
[f]Binds to clay minerals primarily (6).
[g]Reported as 20 for salt formulation and 250 for acid form.

Table 4. Reported herbicide soil/solution distribution coefficient (K_d), Freundlich parameters (K_f, 1/n), organic carbon affinity (K_{oc}) and selected soil property values (1).

	Reported values[a]							
Common Name	K_d	K_f	1/n	K_{oc}	OM	OC	CM	pH
	ml/g			ml/g	%			
Clethodim	0.05-0.23	nav	nav	nav	nav	nav	nav	nav
Clopyralid	0.41	nav	nav	6.0	nav	nav	nav	nav
Diuron	nav	nav	nav	480	nav	nav	nav	nav
Hexazinone	nav	nav	nav	54.0	nav	nav	nav	nav
	nav	0.2	0.95	nav	nav	nav	nav	nav
	nav	1.0	1.05	nav	nav	nav	nav	nav
Imazaquin	nav	nav	nav	20	nav	nav	nav	7.0
	nav	0.24	nav	nav	4.7	nav	30.4	7.6
	nav	0.33	nav	nav	1.6	nav	11.2	6.4
	nav	0.59	nav	nav	4.7	nav	19.2	7.0
	nav	3.57	nav	nav	53.1	nav	4.0	5.9
MSMA	nav	nav	nav	7000[b]	nav	nav	nav	nav
	0.50	0.39	1.13	250[b]	nav	nav	nav	nav
	11.4	13.3	0.70	2850[b]	nav	nav	nav	nav
	18.7	20.0	0.77	1170[b]	nav	nav	nav	nav
	39.4	34.8	0.68	2190[b]	nav	nav	nav	nav

[a]nav = not available.
[b]Binds to metallic hydrous oxides and clay minerals primarily, so K_{oc} is meaningless (6).

Table 5. Correlation (r) of herbicide soil/solution distribution coefficient (K_d) values versus selected soil properties and equations for calculating K_d values when soil property values (1) are available.

Common name	Mean K_d	Soil property	r[a]	Equation
	ml/g	%		
Acetochlor	1.40	OM	0.98*	K_d = -0.052 + 0.78 (%OM)
Atrazine	1.04	OM	0.96*	K_d = -0.018 + 0.506(%OM)
		CM	0.99**	K_d = 0.072 +0.056 (%CM)
Nicosulfuron	0.720	OM	0.97*	K_d = -0.57 + 0.518 (%OM)
		pH	-0.99**	K_d = 8.8 - 1.31 (pH)

[a]Significant at the 0.05 (*) and 0.01 (**) level.

DISSIPATION OF SULFONYLUREA HERBICIDES NICOSULFURON AND RIMSULFURON IN SURFACE SOIL. C. A. Ashburn, R. M. Hayes, and T. C. Mueller. The University of Tennessee, Department of Plant and Soil Sciences, Knoxville, TN 37901.

ABSTRACT

Many factors influencing herbicide dissipation have been studied; however, the effect of the presence of one herbicide on another herbicide's dissipation rate has not been extensively investigated. This is a common concern when products are applied simultaneously. Basis Gold™ is a package mix containing a 48:1:1 ratio of atrazine, nicosulfuron, and rimsulfuron. Field studies were established in 1997 and 1998 on a Sequatchie silt loam in Knoxville, TN to investigate the dissipation of the two sulfonylureas in this mixture. Treatments applied to tilled, bare ground included nicosulfuron (0.046 kg ai ha^{-1}), rimsulfuron (0.046 kg ai ha^{-1}), nicosulfuron (0.046 kg ai ha^{-1}) + rimsulfuron (0.046 kg ai ha^{-1}), and an untreated control. This is approximately a normal use rate for nicosulfuron and a 2X rate of rimsulfuron. Samples (0-8 cm) were collected from 0 to 31 days after treatment (DAT) in 1997 and 1998. Studies under controlled conditions were also conducted using the same soil. Soil was fortified at 50 ppb ($\mu g\ g^{-1}$) with nicosulfuron, rimsulfuron, and nicosulfuron + rimsulfuron and equilibrated in a dark incubator at 30 C. Samples for the laboratory study were removed from the incubator 0, 1, 2, 3, and 7 DAT and frozen until extraction. Methods were a modification of those used by Powley and deBernard (1). Field samples were thoroughly mixed and 50 grams placed in a polyethylene bottle. Samples were extracted twice with 90:10 (v:v) 0.1 M aqueous ammonium carbonate/ acetone for 20 minutes. Solid phase extraction C_{18} and silica columns were used for sample cleanup and concentration. Samples were analyzed using High Performance Liquid Chromatography. The mobile phase system utilized a tertiary gradient, with singular components being acetonitrile, potassium phosphate buffer (30mM) at pH 2.7, and potassiumphosphate buffer (30mM) at pH 6.2. Neither rimsulfuron nor nicosulfuron dissipation was influenced by the presence of the other herbicide. Field studies in 1997 and 1998 determined that both herbicides alone and in mixture dissipated quickly. Rainfall within 12 hr of application in each year and a soil pH of 5.7 encouraged rapid degradation. In 1997, the half-life (DT_{50}) of nicosulfuron was 5.3 d and the DT_{50} of rimsulfuron was 3.1 d. When the two herbicides were applied in combination, the DT_{50} of nicosulfuron was 4.2 d and the rimsulfuron DT_{50} was 3.5 d. In 1998, all DT_{50} were $\leq$ 2.2 d. Rapid degradation was observed in the soil fortification experiments with DT_{50} for all treatments < 3.5 d. This indicated minimal residual weed control and slim chance of rotational crop injury. Sulfonylurea dissipation is favored in warm, moist, light textured soil (2,3). Conditions of this study, including environmental and soil conditions, favored rapid breakdown via both chemical and microbial processes which supports previous research (4).

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AN ASSESSMENT OF THE POTENTIAL FOR ENHANCED DEGRADATION OF CHLORIMURON, IMAZAQUIN, AND IMAZETHAPYR IN SOIL. A. M. Young and M. Barrett, University of Kentucky, Lexington, KY 40546.

ABSTRACT

Maury silt loam soil (pH 6.3, OM 3%) that had been treated annually for six consecutive years with either chlorimuron (62 g/ha^{-1}) or imazaquin (141 g/ha^{-1}) was used to evaluate the potential for enhanced degradation of these herbicides plus imazethapyr. Enhanced degradation of a herbicide in soil is a common phenomena observed after repeated use of the material in an area. Soil was collected from the treated field areas and further conditioned by retreating the imazaquin soil monthly with imazaquin at 0.1 and 1.0 kg/ha^{-1} or imazethapyr at 0.50 kg ha^{-1}. The chlorimuron soil was retreated monthly with chlorimuron at 0.03 and 0.34 kg ha^{-1}. The treated soil was placed in pots in the greenhouse with corn (Pioneer 3245IR) seed planted into the soil. Sufficient moisture and fertility were supplied to maintain corn growth.

Soil collected from the same area as the treated soil, but which never had any of these herbicides applied to it, was used as a control. At the end of each monthly period, the corn was removed and the soil retreated. The soil was treated for a total of twelve times. The degradation of chlorimuron, imazaquin, and imazethapyr was measured by treating 100 g of the soil with 0.68, 0.34, and 0.45 ppm, respectively, of ^{14}C -herbicide. Moist soil (15.6% by weight) was incubated for zero and two weeks. Soil water was extracted by centrifugation at 1800 x g. Total radioactivity recovered in the soil water, the fraction of the radioactivity remaining in the aqueous phase following methylene chloride partitioning, and parent herbicide and metabolites in the organic phase were determined. Despite the repeated and concentrated herbicide treatments of the soil, we saw little to no evidence of enhanced degradation for any of these herbicides.

ALTERNATIVE HERBICIDE PROGRAMS FOR DICLOFOP-RESISTANT ITALIAN RYEGRASS (*Lolium multiflorum*) IN WHEAT. L. T. Barber, F. L. Baldwin, C. C. Wheeler, T. L. Dillon and L. R. Oliver. Department of Crop, Soil and Environmental Science, University of Arkansas, Fayetteville, AR 72704.

ABSTRACT

Diclofop (Hoelon)-resistant Italian ryegrass is becoming a major problem in Arkansas wheat production. Italian ryegrass is a very competitive weed, and an alternative control to diclofop has not been found. Studies were conducted at Willow Beach, Arkansas, in 1998 to determine alternative methods of control by utilizing various herbicides and cultural practices, such as conventional and no-till methods.

Two herbicide screening studies (one conventional tillage, one no-till) were conducted at Willow Beach on a clay loam soil. A natural infestation of diclofop- resistant ryegrass, which was resistant to 7.5lb ai/A of diclofop, was present at this location. “Mason” wheat was drilled at a rate of 110 lb/A, with a row spacing of 7.5 in. The studies were randomized complete blocks with a plot width of 10 ft. and a length of 25 ft., with four replications. Treatments were sprayed with a backpack sprayer at 10 GPA. Visual ratings were taken at 28 days after treatment (DAT), 113 (DAT), and at harvest. Data were subjected to ANOVA, and the means were separated by least significant difference at the 0.05 level of significance ($LSD_{0.05}$).

In the no-till experiment paraquat (Gramoxone Extra) at 0.5lb ai/A, and glyphosate (Roundup Ultra) at 0.5 lb ai/A provided equivalent burndown control of 80 to 90% at 28 DAT. At 113 DAT, and at harvest, only treatments containing chlorsulfuron (Glean) provided 80 to 85% control. At harvest, 0.023lb ai/A of chlorsulfuron provided 80 to 85% control, while all other treatments were less than 40%. The addition of tralkoxydim (Achieve) at 0.24lb ai/A did not improve control over chlorsulfuron alone. In the conventional study, diclofop at 3.75lb ai/A was again ineffective against Italian ryegrass. At 28 DAT preemergence treatments of pendimethalin (Prowl) + chlorsulfuron gave 68 to 82% control. Only chlorsulfuron treatments maintained Italian ryegrass control approximately 90% at 113 DAT. At harvest, chlorsulfuron still provided the highest level of control. Pendimethalin at 1.0lb ai/A and tralkoxydim provided equivalent control at all three rating dates.

Italian ryegrass was resistant to diclofop. Chlorsulfuron was the only treatment that provided 75 to 90% control when applied burndown, preemergence, or delay-preemergence. Pendimethalin + tralkoxydim in the conventional study provided 48 to 65% control over the three rating dates. All treatments improved wheat yields over untreated check in both evaluations. Treatments containing chlorsulfuron had the highest yield.

EFFECT OF PREEMERGENCE HERBICIDE AND TIMING OF POSTEMERGENCE APPLICATIONS ON WEED CONTROL AND YIELD IN ROUNDUP READY SOYBEAN. D. K. Miller, J. L. Milligan, and C. F. Wilson, Louisiana State University Agricultural Center, Northeast Research Station, St. Joseph, LA 71366.

ABSTRACT

A field study was conducted in 1998 at the Northeast Research Station in St. Joseph, LA, on a silty clay loam soil. Experimental design was a randomized complete block with a factorial arrangement of PRE herbicides and Roundup Ultra POST application timings. At planting treatments consisted of Broadstrike + Dual (flumetsulam + metolachlor) at 2.5 pt/A, Turbo (metolachlor + metribuzin) at 2.25 pt/A, or no PRE herbicide. Due to lack of significant rainfall for the first 30 days after planting and subsequent lack of adequate weed population and stress on few weeds present, initial POST timings of 2, 3, 4, 5, 2 followed by 5, or 3 followed by 5 weeks after planting for Roundup Ultra at 1.5 pt/A were

Soil collected from the same area as the treated soil, but which never had any of these herbicides applied to it, was used as a control. At the end of each monthly period, the corn was removed and the soil retreated. The soil was treated for a total of twelve times. The degradation of chlorimuron, imazaquin, and imazethapyr was measured by treating 100 g of the soil with 0.68, 0.34, and 0.45 ppm, respectively, of ^{14}C -herbicide. Moist soil (15.6% by weight) was incubated for zero and two weeks. Soil water was extracted by centrifugation at 1800 x g. Total radioactivity recovered in the soil water, the fraction of the radioactivity remaining in the aqueous phase following methylene chloride partitioning, and parent herbicide and metabolites in the organic phase were determined. Despite the repeated and concentrated herbicide treatments of the soil, we saw little to no evidence of enhanced degradation for any of these herbicides.

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Diclofop (Hoelon)-resistant Italian ryegrass is becoming a major problem in Arkansas wheat production. Italian ryegrass is a very competitive weed, and an alternative control to diclofop has not been found. Studies were conducted at Willow Beach, Arkansas, in 1998 to determine alternative methods of control by utilizing various herbicides and cultural practices, such as conventional and no-till methods.

Two herbicide screening studies (one conventional tillage, one no-till) were conducted at Willow Beach on a clay loam soil. A natural infestation of diclofop- resistant ryegrass, which was resistant to 7.5lb ai/A of diclofop, was present at this location. “Mason” wheat was drilled at a rate of 110 lb/A, with a row spacing of 7.5 in. The studies were randomized complete blocks with a plot width of 10 ft. and a length of 25 ft., with four replications. Treatments were sprayed with a backpack sprayer at 10 GPA. Visual ratings were taken at 28 days after treatment (DAT), 113 (DAT), and at harvest. Data were subjected to ANOVA, and the means were separated by least significant difference at the 0.05 level of significance ($LSD_{0.05}$).

In the no-till experiment paraquat (Gramoxone Extra) at 0.5lb ai/A, and glyphosate (Roundup Ultra) at 0.5 lb ai/A provided equivalent burndown control of 80 to 90% at 28 DAT. At 113 DAT, and at harvest, only treatments containing chlorsulfuron (Glean) provided 80 to 85% control. At harvest, 0.023lb ai/A of chlorsulfuron provided 80 to 85% control, while all other treatments were less than 40%. The addition of tralkoxydim (Achieve) at 0.24lb ai/A did not improve control over chlorsulfuron alone. In the conventional study, diclofop at 3.75lb ai/A was again ineffective against Italian ryegrass. At 28 DAT preemergence treatments of pendimethalin (Prowl) + chlorsulfuron gave 68 to 82% control. Only chlorsulfuron treatments maintained Italian ryegrass control approximately 90% at 113 DAT. At harvest, chlorsulfuron still provided the highest level of control. Pendimethalin at 1.0lb ai/A and tralkoxydim provided equivalent control at all three rating dates.

Italian ryegrass was resistant to diclofop. Chlorsulfuron was the only treatment that provided 75 to 90% control when applied burndown, preemergence, or delay-preemergence. Pendimethalin + tralkoxydim in the conventional study provided 48 to 65% control over the three rating dates. All treatments improved wheat yields over untreated check in both evaluations. Treatments containing chlorsulfuron had the highest yield.

EFFECT OF PREEMERGENCE HERBICIDE AND TIMING OF POSTEMERGENCE APPLICATIONS ON WEED CONTROL AND YIELD IN ROUNDUP READY SOYBEAN. D. K. Miller, J. L. Milligan, and C. F. Wilson, Louisiana State University Agricultural Center, Northeast Research Station, St. Joseph, LA 71366.

ABSTRACT

A field study was conducted in 1998 at the Northeast Research Station in St. Joseph, LA, on a silty clay loam soil. Experimental design was a randomized complete block with a factorial arrangement of PRE herbicides and Roundup Ultra POST application timings. At planting treatments consisted of Broadstrike + Dual (flumetsulam + metolachlor) at 2.5 pt/A, Turbo (metolachlor + metribuzin) at 2.25 pt/A, or no PRE herbicide. Due to lack of significant rainfall for the first 30 days after planting and subsequent lack of adequate weed population and stress on few weeds present, initial POST timings of 2, 3, 4, 5, 2 followed by 5, or 3 followed by 5 weeks after planting for Roundup Ultra at 1.5 pt/A were

changed to 21, 35, 42, 48, 21 followed by 48, or 35 followed by 48 days after planting (DAP). Asgrow 5901 Roundup Ready soybean was planted on May 6. Due to extreme drought conditions and erratic weed emergence during the growing season, only late season visual weed control evaluations were made.

A significant PRE herbicide by Roundup Ultra POST timing interaction was not noted for season-long control of barnyardgrass (*Echinochloa crus-galli*), large crabgrass (*Digitaria sanguinalis*), prickly sida (*Sida spinosa*), pitted morningglory (*Ipomoea lacunosa*), and entireleaf morningglory (*Ipomoea hederacea* var. *integriuscula*). Averaged across PRE herbicides, barnyardgrass and prickly sida were controlled 96 and 90%, respectively, with Roundup Ultra applied 21 DAP, which was equivalent to all other POST timings. Large crabgrass was controlled at least 98% at all timings. The sequential Roundup Ultra program of 35 followed by 48 DAP provided 93% season-long control of pitted morningglory, which was equal to the 91% for the sequential program of 21 followed by 48 DAP, and greater than all other timings (50 to 87%). Delaying Roundup Ultra application to 42 DAP or later or making sequential applications resulted in equivalent entireleaf morninnglory control ranging from 92 to 96%. Averaged across Roundup Ultra timings, large crabgrass and entireleaf morningglory were controlled at least 99 and 89%, respectively, and similarly regardless of whether a PRE herbicide was applied. Barnyardgrass control with Broadstrike + Dual and Turbo was 99 and 98%, respectively, and greater than the 90% when no treatment was applied. Broadstrike + Dual provided 94% control of prickly sida, which was equal to the 91% control with Turbo, and greater than the 88% with no PRE herbicide. Pitted morningglory was controlled 84% with Broadstrike + Dual, which was greater than the 77 and 79% with Turbo and no PRE treatment, respectively.

A significant PRE herbicide by Roundup Ultra POST timing interaction was noted for season-long control of hemp sesbania (*Sesbania exaltata*) and sicklepod (*Senna obtusifolia*), as well as soybean yield. At the 21, 48, and 21 followed by 48 DAP timings, season-long hemp sesbania control was no greater than 33, 70, and 50%, respectively, and not enhanced with PRE herbicide application. At the 35 and 42 DAP timing, hemp sesbania control following a PRE application of Turbo was 65 and 77%, respectively, and greater than control with Broadstrike + Dual or Roundup Ultra total POST. At the 35 followed by 48 DAP timing, including Broadstrike + Dual or Turbo PRE resulted in at least 80% hemp sesbania control, which was greater than the 64% for Roundup Ultra total POST.
Sicklepod control at the 42 and 21 followed by 48 DAP timings was 82 and 83%, respectively, for Roundup Ultra total POST and not enhanced with a PRE herbicide application. At all other POST timings, Roundup Ultra following Broadstrike + Dual PRE resulted in 73 to 90% sicklepod control, which was greater than control with Roundup Ultra total POST.

At the 21 and 21 followed by 48 DAP timings, soybean yield was no greater than 3.6 and 10.6 bu/A, respectively, and equal whether or not a PRE herbicide was applied. Roundup Ultra following Broadstrike + Dual PRE resulted in a yield of 12, 16.1, and 11.6 bu/A for the 35, 42, and 48 DAP timings, respectively, which was a 6.1, 10.4, and 3.0 bu/A increase over Roundup Ultra total POST at those respective timings. At the 35 followed by 48 DAP timing, PRE treatment of Turbo increased yield 6 bu/A over that observed with Roundup Ultra total POST.

Although not receiving an activating rainfall until 30 days after application, programs including Broadstrike + Dual followed by Roundup Ultra at 35, 42, or 48 DAP resulted in greater yields than a Roundup Ultra total POST program at the same respective timings. Due to the limited number and growth rate of weeds in the initial weed flush, effectiveness of the 21 DAP timing was reduced. Including a PRE application of Broadstrike + Dual can improve weed control and yield in a Roundup Ready program, even under extreme drought conditions.

RELATIONSHIP OF STAPLE RATE AND THRIPS INJURY IN COTTON. R. W. Costello, J. L. Griffin, B. R. Leonard, D. K. Miller, and M. E. Holman, Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

Field studies were conducted at the Northeast Research Station, St. Joseph, LA and the Macon Ridge Research Experiment Station, Winnsboro, LA to investigate possible interactions between Staple and thrips in respect to cotton growth and development. >Stoneville 474' cotton was planted May 26 and June 23 in Winnsboro and St. Joseph, respectively. A split-plot experimental design with four replications was used. Main plots were Temik at 0.5 lb ai/A applied in-furrow or no Temik. Sub plots were Staple applied at 0, 0.5, 1, 2, 4, 8, and 16 oz ai/A to 2-3 leaf cotton. Cotton leaf area per plant was obtained from 0.5m section of row 10 and 16 days after treatment (DAT) at St. Joseph and 10, 17, and 34 DAT at Winnsboro. Height of 10 cotton plants, total nodes, and nodes to first square were determined

at the same time that leaf area was measured. In addition, cotton height was measured 38 DAT at St. Joseph and 24 DAT at Winnsboro. After flowering, nodes above white flower (NAWF) were determined from 10 plants weekly until NAWF totaled no more than 5. Plots were kept weed free by hand weeding. Normal cultivation and fertility practices were followed.

The Staple by Temik interaction at each location was not significant for any parameter measured and data were averaged across Temik treatments. Due to variations in thrips populations between the two locations, cotton growth was improved by the addition of Temik at Winnsboro but not at St. Joseph.

At St. Joseph, no significant differences among Staple rates were observed for cotton leaf area per plant at 10 DAT. At 16 DAT, leaf area of cotton treated with 2, 4, 8, or 16 oz/A was at least 32% less than the nontreated control. Only with 16 oz/A Staple was cotton height reduced 10 DAT when compared with the nontreated control. At 16 DAT, height of nontreated cotton was at least 11% greater than for cotton treated with 4, 8, or 16 oz/A. Differences in cotton height were not observed 38 DAT. No significant differences were noted among Staple rates for total nodes per plant, nodes to first square, nodes above white flower (NAWF), or seed cotton yield.

At Winnsboro, cotton leaf area per plant 10 DAT was not reduced by Staple applications. At 17 DAT, Staple at 2, 4, 8, or 16 oz/A reduced leaf area at least 28% when compared with the nontreated control. The differences in leaf area were not observed 34 DAT. There were no significant differences among Staple rates in total nodes per plant, however, Staple at 8 and 16 oz/A increased nodes to first square by at least one node. Cotton height was reduced at least 13% with Staple at 8 and 16 oz/A 17 DAT and at least 19% 24 DAT when compared with the nontreated control. Nodes above white flower following Staple application of 2, 4, 8, or 16 oz/A were greater than the nontreated control on July 14 but not on July 22. No significant differences among Staple rates were noted for seed cotton yield. These results show that thrips damage did not enhance cotton injury from Staple.

INTERACTION OF GLYPHOSATE RATE AND INITIAL APPLICATION TIMING ON SEASON-LONG WEED CONTROL IN ROUNDUP READY SOYBEAN. M. C. Smith, D. R. Shaw, and A. C. Bennett, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

In a Southern soybean production system, sequential glyphosate applications are often required to establish and maintain season-long weed control in Roundup Ready soybean. Experiments were conducted in 1997 and 1998 at the Coastal Plain Branch Experiment Station, Newton, MS, and in 1998 at the Plant Science Research Center, Starkville, MS. Experimental factors included 3 application timings and 4 glyphosate rates. The initial application timings were 2 weeks after planting (WAP), 3 WAP, and 4 WAP indicated by early-, mid-, and late-timing, respectively . Sequential applications always followed 2 weeks after initial application. Glyphosate rates included 0.42 kg ai/ha followed by (fb) 0.28 kg/ha, 0.56 fb 0.42 kg/ha, 0.84 fb 0.56 kg/ha, and 1.1 fb 0.84 kg/ha. Pitted morningglory and sicklepod control was rated 10 WAP in 1997 and 1998. Large crabgrass control was rated at the same time in 1997 at Newton, and in 1998 at Starkville.

Averaged over glyphosate rates, pitted morningglory was controlled at least 87% in 1997, regardless of timing. However, in 1998, the mid-timing controlled pitted morningglory 72%, compared to less than 51% with other timings. Averaged over years and timings, 0.84 fb 0.56 kg/ha glyphosate controlled pitted morningglory 76%, compared to 70% control with lower rates. Increasing the glyphosate rate to 1.1 fb 0.84 kg/ha did not increase pitted morningglory control. Averaged over glyphosate rates, the mid-timing controlled sicklepod at least 86% in 1997 and 1998. In 1997, the late-timing controlled sicklepod as well as the mid-timing. However, the early-timing in both years and the late-timing in 1998 controlled sicklepod no more than 81%. Averaged over years, glyphosate rate did not affect sicklepod control when applied early. However, as application was delayed, higher rates were needed to maximize control. Sicklepod control was least consistent with the early-timing and most consistent with the mid-timing. Large crabgrass control was not affected by glyphosate rate. When averaged over rates, all application timings controlled large crabgrass at least 89%. However, at Newton in 1997 large crabgrass control was less with the early-timing compared to other timings. Soybean yield was unaffected by glyphosate rate.

At Newton in 1997, soybean yielded approximately 2900 kg/ha averaged over glyphosate rates, regardless of application timing. However, at Newton in 1998, soybean treated at the mid-timing yielded 2220 kg/ha compared to less than 1700

kg/ha with the other timings. At Starkville in 1998, soybean treated with the early- and mid-timings yielded at least 2350 kg/ha, compared to 2020 kg/ha with the late-timing.

In conclusion, increasing glyphosate rate above 0.84 fb 0.56 lb/A did not increase weed control. Pitted morningglory and sicklepod control was maximized with the mid-timing because of late-season emergence with the early-timing and incomplete weed control with the late-timing. Application timing was most critical under adverse conditions, illustrated by more ideal growing conditions at Newton in 1997 and high stress conditions in 1998. Soybean yield was not affected by glyphosate rate but was greatly affected by application timing in 2 out of 3 years. Soybean yield was maximized with the mid-timing because of late-season weed competition with the early-timing and full-season weed competition with the late-timing.

IMAZAQUIN DISSIPATION PATTERNS IN A SHARKEY CLAY SOIL. S. Seifert, D. R. Shaw, M. Boyette, W. L. Kingery, R. A. Wesley, and C. E. Snipes. Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762, USDA-ARS Application and Production Technology Research Unit, Stoneville, MS 38776, and Delta Research and Extension Center, Stoneville, MS 38776.

ABSTRACT

Studies to evaluate the effect of tillage systems on imazaquin dissipation in a smectitic soil (Sharkey clay; thermic Chromic Epiaquerts; 3% sand, 36% silt, 61% clay, pH 6.2, 1.7% organic C) were conducted at the Delta Research and Extension Center, Stoneville, MS, in 1998. Treatments consisted of conventional tillage and subsoiling. Imazaquin was applied preemergence (PRE) to soybean [(*Glycine max* (L.) Merr.] at the labeled rate of 140 g ai/ha. After each rainfall event, the total volume of runoff water was measured and water samples were collected to determine imazaquin concentrations using HPLC. Soil samples at depths of 0-8 cm and 8-15 cm were collected at 0, 1, 2, 3, 4, and 8 weeks after treatment (WAT) and extracted to determine imazaquin concentration using a method developed by American Cyanamid Company. In addition, plant-available concentration of imazaquin in soil samples was evaluated using a corn (*Zea mays* L.) root bioassay. Field persistence was determined by a field bioassay using cotton (*Gossypium hirsutum* L.) and corn grown in plots receiving 140 g/ha imazaquin the previous year.

Tillage systems did not affect the concentration of imazaquin lost in runoff water, or the total amount of water leaving the field after rainfall events. Imazaquin concentration diminished over time, with approximately 6% and 5% of the applied imazaquin being lost from conventional tilled and subsoiled plots, respectively. Tillage systems did not affect the extractable amount of imazaquin in a Sharkey clay soil. Concentrations detected in the upper soil were greater compared to lower soil layer, regardless of tillage treatment. The concentration of imazaquin diminished over time, with a half-life of approximately 15 days, regardless of tillage treatment. The corn root bioassay did not reveal any differences in plant-available concentration of imazaquin in soil due to different tillage treatments at each soil depth. Although height reduction in early season cotton and discoloration of corn veins were apparent the year after imazaquin application, no differences in weight and height measurements occurred for both cotton and corn field bioassays at the termination of the study.

COMMAND BASED SYSTEMS FOR ANNUAL WEED CONTROL IN RICE. B. J. Williams and A. B. Burns; Northeast Research Station, St. Joseph, LA, Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

Weed management systems in dry-seeded rice (*Oryza sativa*) utilizing clomazone were evaluated in 1997 and 1998 at the Northeast Research Station near St. Joseph, LA on a Sharkey clay soil and at the Macon Ridge Research Station near Winnsboro, LA on a Gigger silt loam soil. Rice 'Cypress' at 140 kg/ha was drill seeded in rows 19 cm apart. Permanent floods were established 4 to 5 weeks after planting each year. 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. Herbicide treatments were arranged in randomized complete blocks with three replications. Weed control ratings, rice injury ratings, and rice yield data were subjected to analysis of variance by year and soil type. Means were separated using Fisher's Protected LSD at the 5% level. Only data collected in 1998 are discussed, since results were similar between years.

Clomazone at 0.34 to 0.67 kg ai/ha caused very little bleaching in rice on the Sharkey clay. Rice bleaching on the Gigger silt loam increased as clomazone rate increased from 0.34 to 0.67 kg ai/ha. Additionally, rice bleaching was greater with preplant incorporated > preemergence > delayed preemergence clomazone applications. The highest bleaching (23%) was from 0.67 kg ai/ha clomazone applied preplant incorporated on the Gigger silt loam. Rice yields were not reduced by any clomazone treatment on either soil type. In fact, on the Sharkey clay the best yielding treatments were 0.67 kg ai/ha clomazone. Rice yielded the same on the Gigger silt loam regardless of clomazone rate.
Barnyardgrass (*Echinochloa crus-galli*) control was maximized with clomazone at 0.34 (96%) and 0.44 (99%) kg ai/ha applied delayed preemergence on the Gigger silt loam. On the Sharkey clay soil, barnyardgrass control was maximized with clomazone at 0.56 (91%) and 0.67 (97%) kg ai/ha applied delayed preemergence. Amazon sprangletop (*Leptochloa panicoides*) and broadleaf signalgrass (*Brachiaria platyphylla*) control with clomazone was the same as barnyardgrass. However, signalgrass was only evaluated in 1998.

It is expected that the labeled rate for clomazone will be between 0.34 and 0.67 kg ai/ha. At these rates, clomazone will be used primarily to control annual grasses. Additional treatments will be required for broadleaf weed and sedge control. In 1998, programs for controlling broadleaf weeds and sedges following clomazone were evaluated. Early postemergence applications of 0.022 kg ai/ha carfentrazone plus 2.24 to 4.48 kg ai/ha propanil controlled sicklepod (*Cassia obtusifolia*) and hemp sesbania (*Sesbania exaltata*) 90 to 92%. Carfentrazone at 0.022 kg ai/ha applied alone only controlled sicklepod and sesbania 60 to 72%, while 4.48 kg ai/ha propanil controlled sicklepod and sesbania 90 and 85%, respectively. Early postemergence applications of quinclorac controlled sicklepod and sesbania 88 and 93%, respectively. Bispyribac-sodium applied alone or in combination with carfentrazone or halosulfuron controlled sesbania 95 to 98%. Propanil at 4.48 kg ai/ha plus 0.84 kg ai/ha bentazon or 0.22 kg ai/ha triclopyr controlled annual sedge (*Cyperus iria*) 100%. Halosulfuron at 0.067 kg ai/ha also controlled annual sedge 100%.

An emulsifiable concentrate (EC) formulation of clomazone was used in most of the early research evaluating clomazone for use in rice. The research reported here was conducted using a microencapsulated (ME) formulation of clomazone, which is expected to be registered for use in rice. Rice tolerance and annual grass control was excellent with the ME clomazone formulation, and similar to that reported with the EC clomazone formulation.

QUANTITATION OF GROWTH REGULATOR VAPOR DRIFT AND PLANT INJURY. A. S. Sciumbato, J. M. Chandler, and S. A. Senseman, Texas Agricultural Experiment Station., Department of Soil and Crop Sciences, College Station, TX 77843-2474 and K. L. Smith, University of Arkansas, Monticello, AR 71656.

ABSTRACT

The use of auxin-like herbicides for postemergence control of broadleaf weeds in cereal crops and rangeland has been popular since the introduction of these herbicides during the 1940's. Soon after prevalent use of these first selective herbicides began, off target movement hazards to susceptible broadleaf crops became a concern. While volatility problems have led to restrictions on their use, the auxin-like herbicides have remained popular with producers by providing an effective, economical source of weed control. One of the most important factors to be determined after auxin-like herbicide injury has been found on a susceptible crop is the herbicide exposure rate. The ability to determine the concentration of herbicide drift affecting a crop would be helpful in deciding what course of action is to be taken after herbicide vapor exposure has occurred. Upon determining drift rates, producers would be able to ascertain the likelihood of crop losses and, in instances where exposure is found to be at unacceptable rates, modify management strategies immediately.

In 1998, greenhouse studies were conducted on the campus of Texas A&M University to develop a method of quantifying growth regulator herbicide off target movement and subsequent plant injury attributed to volatility. Reduced rates ranging from $4x10^{-1}$ to $1x10^{-5}$ times the normal use rate of 2,4-D (Weedar 64), dicamba (Clarity) and triclopyr (Remedy) were applied to cotton (*Gossypium hirsutum L.*) and soybean (*Glycine max* (L.) Merr.) so that rate response curves could be established. Injury was recorded for 14 days after treatment using a specific categorical injury rating scale. Additional cotton and soybean plants were then exposed to vapors of the dimethylamine salt of 2,4-D, the diglycolamine salt of dicamba and the butoxyethyl ester of triclopyr using greenhouse volatility chambers built for this purpose. Injury resulting from this exposure was again evaluated for 14 days using the same injury rating scale that was used to produce the injury curves. Volatility injury data were then applied to the rate response curves so those herbicide rates corresponding with observed injury could be calculated for each of the three herbicides used. Herbicide volatility rates in cotton were determined to be $2.7x10^{-3}$, $9.5x10^{-4}$ and $4.9x10^{-2}$ times the normal rates of 2,4-D, dicamba and

triclopyr, respectively. Soybeans exposed to volatility drift developed injury consistent with $1.8x10^{-2}$, $7.9x10^{-4}$ and $2.5x10^{-2}$ times the normal use rate of 2,4-D, dicamba and triclopyr, respectively. It was determined that, based on these results, this method provided herbicide volatility rates based on plant injury that were consistent with rates and injury from the rate-response curve.

COMPARISON OF WEED CONTROL IN ROUNDUP READY, STS, AND CONVENTIONAL SOYBEANS.

K. N. Reddy and K. Whiting, USDA-ARS, Southern Weed Science Research Unit, Stoneville, MS 38776 and Deltapine Seed, Scott, MS 38772.

ABSTRACT

Two-year field study was conducted in1997 and 1998 at the Southern Weed Science Research Unit Farm, Stoneville, Mississippi on a Dundee silty clay loam soil to compare weed control efficiency and economics of Roundup Ready (DP 5806R, Late MG V), sulfonylurea tolerant (DP 3571S, Late MG V), and conventional (DP 3588, Late MG V) soybean systems. Soybeans were planted on June 05, 1997 and May 05, 1998. Experimental plots consisted of 8 rows of 7.5 m long and 50 cm apart. The experiment was conducted in a randomized complete block design with four replications.

The five weed management systems for DP 5806R were: 1) glyphosate (EP 1.12 + LP 0.56 kg/ha); 2) dimethenamid (PRE 1.22 kg/ha) + imazaquin (PRE 0.14 kg/ha) plus glyphosate (EP 1.12 kg/ha); 3) dimethenamid (PRE 1.22 kg/ha) + imazaquin (PRE 0.14 kg/ha) plus acifluorfen (EP 0.28 kg/ha) + bentazon (EP 0.56 kg/ha); 4) glyphosate (EP 1.12 kg/ha) plus chlorimuron (LP 0.011 kg/ha); and 5) no herbicide. For DP 3571S (STS), the five weed management systems were: 1) chlorimuron (EP 0.022 + LP 0.022 kg/ha); 2) sulfentrazone (PRE 0.211 kg/ha) + chlorimuron (PRE 0.043 kg/ha) plus chlorimuron (EP 0.011 kg/ha); 3) dimethenamid (PRE 1.22 kg/ha) + imazaquin (PRE 0.14 kg/ha) plus chlorimuron (EP 0.022 kg/ha); 4) dimethenamid (PRE 1.22 kg/ha) + imazaquin (PRE 0.14 kg/ha) plus acifluorfen (EP 0.28 kg/ha) + bentazon (LP 0.56 kg/ha); and 5) no herbicide. The three weed management systems for DP 3588 were: 1) dimethenamid (PRE 1.22 kg/ha) + imazaquin (PRE 0.14 kg/ha) plus acifluorfen (EP 0.28 kg/ha) + bentazon (EP 0.56 kg/ha); 2) sulfentrazone (PRE 0.211 kg/ha) + chlorimuron (PRE 0.043 kg/ha) plus chlorimuron (EP 0.011 kg/ha); and 3) no herbicide. Premergence (PRE) herbicides were applied the same day after planting. Early postemergence (EP) and late postemergence (LP) herbicides were applied at 2 and 4 weeks after planting (WAP), respectively, in 1997 and 4 and 6 WAP, respectively, in 1998.

Visual weed control ratings were made at 4 weeks after LP. Herbicide treatments provided ≥ 90% control of browntop millet [*Brachiaria ramosa* (L.) Stapf], yellow nutsedge (*Cyperus esculentus* L.), pitted morningglory (*Ipomoea lacunosa* L), and hemp sesbania [*Sesbania exaltata* (Raf.) Rydb. ex A.W.Hill] compared to untreated plots regardless of soybean varieties in both years. Prickly sida (*Sida spinosa* L.) control among three soybean varieties with various herbicides was ≥ 98% in both years except for 65% control in DP 3571S with chlorimuron (EP + LP) in 1997. Control of hyssop spurge (*Euphorbia hyssopifolia* L.) with herbicides ranged from 93 to 100% in DP 5806R and from 88 to 100% in DP 3588 in both years. However, in DP 3571S, control of hyssop spurge was variable. In 1997, sulfentrazone (PRE) + chlorimuron (PRE) plus chlorimuron (EP) controlled 100% hyssop spurge compared to 63 to 86% control with other herbicides.

Soybean yield in DP 5806R with glyphosate applied EP + LP was 2876 and 3161 kg/ha, respectively, in 1997 and 1998 with a net income (gross income - seed and herbicide cost) of 603 and 489 \$/ha, respectively, 1997 and 1998. DP 3571S with chlorimuron applied EP + LP yielded 2391 and 2605 kg/ha, respectively in 1997 and 1998 resulting in a net income of 437 and 383 \$/ha, respectively, in 1997 and 1998. Soybean yield for DP 3588 with dimethenamid + imazaquin (PRE) plus acifluorfen + bentazon (EP) was 2838 and 2697 kg/ha, respectively in 1997 and 1998 with a net income of 549 and 364 \$/ha, respectively, in 1997 and 1998. Overall, the net income was highest in DP 5806R with glyphosate alone applied POST in both years.

ADSORPTION-DESORPTION OF HALOSULFURON ON SELECTED TEXAS SOILS. A. C. Carpenter, S. A. Senseman, and H. T. Cralle, Texas Agricultural Experiment Station, College Station, TX 77345.

ABSTRACT

Halosulfuron (methyl 5-[[(4,6-dimethoxy-2-pyrimidinyl) amino] carbonylaminosulfonyl] -3-chloro-1-methyl-1-*H*-pyrazole-4-carboxylate) is a relatively new sulfonylurea herbicide used postemergence in corn, sorghum, and sugarcane production for the control of numerous broadleaf weeds and *Cyperus* species. Characteristics of the sulfonylureas include low mammalian toxicity, low usage rates (halosulfuron at 35.9 g ha^{-1} in corn and sorghum), a high degree of selectivity, and good control of difficult to control weed species. Despite the benefits of this new family of herbicides, concerns have developed regarding injury to sorghum. Since adsorption affects the amount of herbicide available for plant uptake, information regarding the adsorptive characteristics of halosulfuron will be useful in determining its root uptake in sorghum. Numerous studies have examined the adsorption and desorption of various sulfonylurea herbicides. In general, these studies have concluded that adsorption of various sulfonylurea herbicides decreases as soil pH increases, and that desorption increases at high pH values. While general trends in adsorption are consistent for many sulfonylurea herbicides, the magnitude of adsorption may differ greatly between compounds. Studies have also shown a positive correlation between adsorption and clay content. A positive correlation between soil organic matter content soil adsorption was shown for certain sulfonylurea herbicides, but not for others. The objective of this study was to determine the likelihood of sorghum injury from halosulfuron based upon the relative soil adsorption and desorption of halosulfuron.

Soils collected from five sorghum growing areas throughout the state of Texas, and one from Kansas, were used. The Texas soils were: Acuff Estacado sandy clay loam, Bernard clay loam, Houston Black clay, Ships clay, and Victoria silty clay loam; the soil from Kansas was a Harney silty clay loam. The batch equilibrium method was used for adsorption determination. Samples were treated with halosulfuron at rates of 0x, ½x, 1x, 1½x, and 2x. Following addition of $CaCl_2$ and 24 h shaking, quantification of ^{14}C-halosulfuron was made. For desorption determination, additional supernatant were removed, discarded, and replaced with $CaCl_2$. The samples were then shaken for an additional 24 h and centrifuged. A 1-ml aliquot of the supernatant was removed and analyzed with the liquid scintillation counter to determine desorption of halosulfuron from each soil. Adsorption isotherms were constructed for each soil using the Freundlich model.

There was a positive relationship between organic matter content and halosulfuron adsorption. With the exception of the Victoria silty clay loam, statistically significant ($p \geq 0.05$) relationships between solution concentration and halosulfuron adsorption were found. Desorption of halosulfuron was directly related to clay content. Sorghum injury would be least likely to occur on soils with high organic matter, such as Harney silty clay loam and Bernard clay loam. Halosulfuron exhibited hysteresis on all soils.

EFFECT OF IMAZETHAPYR ON SEVERAL RED RICE (*Oryza sativa* L.) ACCESSIONS AND RICE LINES. D. R. Gealy and H. L. Black. USDA-ARS Dale Bumpers National Rice Research Center, Stuttgart, AR 72160.

ABSTRACT

Numerous red rice accessions ('biotypes') have been collected from rice-growing areas of the South. Field studies were conducted at Stuttgart, AR to determine biological characteristics of these accessions (1995-1998) as well as tolerance to 1X (0.063 lb. ai/A) and 2X (0.125 lb. ai/A) post emergence applications of imazethapyr (Pursuit) (1997-1998). Broad differences in growth and development patterns and moderate differences in susceptibility to imazethapyr were found among the accessions. The commercial cultivar Kaybonnet (101 cm-tall) was shorter than both the shortest red rice, 18E (118 cm) and the tallest red rice, 13A (161 cm). Days to heading ranged from 83 for 14C to 108 for LA3. Most red rice biotypes produced more than twice the number of tillers per m of row compared to the Kaybonnet standard. Nearly all accessions were completely killed by 1X and 2X rates of imazethapyr. Several accessions were slightly tolerant to this herbicide at the 1X rate in both 1997 and 1998, but control was always at least 90%. These include the blackhull types TX4 and 1995-8. Control of all accessions exceeded 85% in both years. Overall, these data suggest that imazethapyr should be useful in herbicide-resistant rice cropping systems, so long as prudent herbicide rotation regimes are implemented that will minimize the selection pressures for herbicide-tolerant types.

WEED CONTROL WITH GLYPHOSATE FORMULATIONS AND AMMONIUM SULFATE. J. L. Mulkey, J. L. Griffin, D. K. Miller, P. A. Clay, and J. M. Ellis. Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

Field studies were conducted to evaluate Roundup Ultra and Touchdown applied preplant with and without ammonium sulfate for control of winter and summer weeds, and to compare efficacy of various glyphosate formulations. In a preplant winter weed experiment conducted at St. Joseph, LA, Touchdown at 1.25 and 1.66 pt/A plus nonionic surfactant (0.25% v/v) provided control equivalent to that of Roundup Ultra at 2.0 pt/A and control was not increased with the addition of ammonium sulfate at 8.5 lb/100 gallons of spray solution. Italian ryegrass, cutleaf eveningprimrose, swinecress, henbit, common chickweed, and wild onion control for the Touchdown and Roundup Ultra treatments 28 days after treatment (DAT) averaged 87, 66, 66, 95, 90, and 95%, respectively.

Preplant summer weed control experiments were conducted at St. Joseph and Baton Rouge, LA using the same treatments evaluated in the winter weed experiment. With the exception of pitted morningglory at St. Joseph, weed control at both locations was not increased with the addition of ammonium sulfate to either Touchdown or Roundup Ultra. Weed control was equivalent for the Touchdown and Roundup Ultra treatments. Hemp sesbania control 14 DAT averaged 49% at Baton Rouge and 71% at St. Joseph. For prickly sida, control at Baton Rouge averaged 74% and for barnyardgrass at St. Joseph, control averaged 95%. Pitted morningglory control averaged 87% at St. Joseph. In other experiments conducted at Baton Rouge and St. Joseph, addition of ammonium sulfate to Roundup Original and Glyfos each applied at 1.5 pt/A did not improve control of hemp sesbania, prickly sida, or pitted morningglory.

In fallow areas at St. Joseph and Baton Rouge, LA weed control was evaluated with glyphosate formulations Roundup Ultra, Roundup Original + Induce (0.5% v/v), Glyfos + Induce (0.5% v/v), Glyfos Extra, and CHA 4510 at 1.5 pt/A. At Baton Rouge, hemp sesbania control for the herbicide treatments 14 DAT ranged from 44 to 60%. Control with Roundup Ultra and Glyfos Extra was 46 and 44%, respectively, and less than that for Roundup Original. At St. Joseph, hemp sesbania control 14 DAT was 65 to 72% and control was greater for Roundup Original than for Roundup Ultra. Prickly sida was controlled 70% with Glyfos and 63 to 66% for the other treatments. Pitted morningglory control was 70 to 75% and equivalent for all herbicide treatments. Glyphosate formulation experiments were also conducted using Asgrow 5901RR soybeans at Baton Rouge, LA using the same treatments in the fallow experiments with the addition of Touchdown + Induce (0.5% v/v). In the first experiment, no differences among the glyphosate formulation treatments were observed and barnyardgrass, hemp sesbania, and entireleaf morningglory control 16 DAT averaged 98, 57, and 76%, respectively. At 7 DAT, some soybean injury was observed for all treatments and was 21% for Touchdown. However, at 16 DAT, soybean injury was observed only for Touchdown (3%). In the second experiment, barnyardgrass control 21 DAT was 95% for all glyphosate formulations. Hemp sesbania was controlled 40 to 54% and was lowest for Glyfos. Soybean injury with Touchdown was 11% 7 DAT and 5% 21 DAT.

In conclusion, control of winter weeds and summer weeds with Roundup Ultra and Touchdown was equivalent when the herbicides were applied at same rate of active ingredient per acre. The addition of ammonium sulfate to Roundup Ultra or Touchdown in most cases did not improve weed control. Where improvement was observed, the increase in weed control was of little practical significance. In most cases, Glyfos, Glyfos Extra, and CHA 4510 controlled barnyardgrass, hemp sesbania, prickly sida, pitted morningglory, and entireleaf morningglory equivalent to Roundup Ultra. In two of four experiments, hemp sesbania control was greater for Roundup Original than for Roundup Ultra, but control was no more than 72%. Some injury to glyphosate resistant soybean was observed with all glyphosate formulations, but in all cases injury was transient.

GLUFOSINATE-RESISTANT RICE LINES TREATED WITH GLUFOSINATE AT INTERVALS THROUGHOUT THE SEASON. D. Y. Lanclos, E. P. Webster, and W. Zhang, Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

A study was conducted in 1998 at the Rice Research Station near Crowley, LA to evaluate rice injury and yield of glufosinate-resistant rice lines associated with glufosinate applications throughout the growing season. Glufosinate-resistant rice lines CPRS PB-13 and BNGL HC-11 that were derived from commercial parentage were drill seeded on April 24 and harvested on September 31. The study was a randomized complete block with a factorial arrangement of treatments and 4 replications. Plot size was 4' x 20' with 7 drills per plot. The soil was a Crowley silt loam with a pH of 5.5, 1.4% OM, and CEC of 19.1. Treatments included glufosinate applied at 0.75 lb ai/A weekly starting 2 d after emergence (DAE) and continuing through 56 DAE. A nontreated check for each line was added for comparison. All herbicide applications were made with a CO_2 backpack sprayer with an application volume of 15 gallons/A. Visual crop injury was rated weekly following herbicide application. Days to 50% heading and plant height from the soil surface to the tip of the panicle was determined at harvest. All data were subjected to analysis of variance and means separated by Fisher's Protected LSD at the 5% probability level.

At 21 d after treatment (DAT), injury for CPRS PB-13 ranged from 0 to 9 %. Glufosinate applied at 2, 7, 14, 21, and 56 DAE resulted in increased injury compared to the nontreated. CPRS PB-13 height was reduced with the 28 and 42 DAE applications compared to the nontreated. Yield for CPRS PB-13 ranged from 6200 to 6550 lb/A when treated 56 and 21 DAE, respectively. No differences in yield occurred when compared to the nontreated.

BNGL HC-11 injury ranged from 1 to 24% at 21 DAT. Rice injury was greater with glufosinate applications at 2, 7, 14, and 56 DAE when compared to the nontreated. BNGL HC-11 injury was highest for the 2 and 14 DAE application with 24 and 19% injury, respectively. Visual symptoms observed were chlorosis and necrosis of the leaves. There were no differences in height. All yields were equal to the nontreated with a yield of 7460 lb/A, except the 56 DAE with a yield of 5230 lb/A.

In conclusion, excessive injury, height reduction, and yield reduction of glufosinate-resistant rice lines can occur if glufosinate is applied early or late in the growing season. Increased injury was observed for both lines when treated 2, 7, 14, and 56 DAE. However, the only yield reduction occurred with BNGL HC-11 treated 56 DAE.

WILD OAT CONTROL IN THE ROLLING PLAINS OF TEXAS. T. A. Baughman, B. E. Warrick, and W. D. Worrall. Texas A&M Research and Extension Center, Vernon, TX and Texas Agricultural Extension Service, San Angelo, TX.

ABSTRACT

Wild oat (Avena fatua) is one of the most common and troublesome weeds affecting winter wheat production in the Rolling Plains of Texas. Wild oat are difficult control because often multiple flushes of new germinating seedlings occur during one growing season. Wild oat reduces wheat yields and increases dockage in harvested grain. Also, delayed seeding to reduce wild oat populations can reduce forage for grazing, which is traditionally part of the overall wheat production system in the Rolling Plains. Five trials were established to evaluate various herbicides and herbicide rates for control of wild oat. Trials in Eula and Abilene evaluated Achieve, Assert, Discover, Hoelon, Puma, Silverado, and Tiller at labeled or proposed labeled rates. Wild oat was 5 to 7 leaf at the time of application for both locations. The first trial at Paint Creek (Paint Creek - 1) was established to compare Maverick (0.66 oz/A) to the standard wild oat treatments Assert (24 fl oz/A), Hoelon (21 fl oz/A), and Silverado (8 fl oz/A), and also in combination with Silverado (0.33 oz/A + 4 fl oz/A). Wild oat was 1 to 5 leaf at the time of application. Paint Creek - 2 evaluated two application timings (POST1: 1 to 5 leaf and POST2: 1 to 3 tiller) and three rates (0.5, 0.75, and 1X of the labeled rate) of Assert and Silverado. Paint Creek - 3 evaluated Discover compared to Achieve, Assert, Maverick, and Silverado at labeled or proposed labeled rates. Wild oat was 1 to 3 tiller at the time of application. Traditional small plot techniques were used, and recommended adjuvants were used where needed.

Wild oat control was greater than 90% with Discover and Silverado at Eula, TX and Paint Creek - 3 and with Discover, Puma, and Tiller at Abilene, TX. The only treatment controlling wild oat greater than 90% at the Paint Creek - 1 location was Assert. The combination of Maverick + Silverado increased control when compared to Maverick alone but not when compared to Silverado alone. Assert (POST 1) and Silverado (POST 2) regardless of rate controlled wild oat at least 90% at Paint Creek - 2. Wild oat were larger than the label directs for Assert at the POST 2 application timing which resulted in the lower control with this timing. Silverado is labeled for larger wild oat, and also provides no residual control. Therefore, secondary flushes of wild oat after the POST 1 application timing reduced the late season control with this early application timing. Wild oat can be successfully controlled with herbicides in the Rolling Plains, but producers must consider the size of wild oat at application timing and the herbicide being used. Also, new herbicides that are currently not labeled may increase the ability to control wild oat in this region.

PHYSIOLOGICAL ASPECTS OF TROPICAL SODA APPLE (*Solanum viarum* Dunal) REGROWTH.

N. M. Call, H. D. Coble, and J. F. Thomas. North Carolina State University, Raleigh, NC 27695.

ABSTRACT

Repeated applications of herbicides are necessary to control tropical soda apple (TSA). Adequate control (> 90%) is obtained when mowing and herbicide applications are used in an integrated program. After mature plants were repeatedly mowed in Florida field studies, 40% regrew normally. Plant size and age affected herbicide efficacy in North Carolina trials. After a TSA plant reaches a perennial age, or attains the ability to produce new shoots from root tissue, a translocated herbicide may be necessary for adequate control in lieu of mowing or a contact herbicide. Tropical soda apple regrowth potential may increase with increasing plant size and age. Therefore research was conducted to determine the age at which TSA regrows after top-growth removal and to determine the mechanism of subsequent vegetative regrowth.

Perennial age determination was evaluated in two independent completely randomized studies with four replications. Plant ages evaluated were 14 to 55 days after emergence (DAE) and 1 to 25 DAE, respectively for experiments 1 and 2. At each DAE within the age ranges, plants were cut manually 3 to 4 mm below cotyledonary attachments. At the time of cutting, height from soil line to apical meristem, stem diameter of hypocotyl, and leaf number including cotyledons were recorded. Regrowth was determined qualitatively 3 weeks after cutting. Each experiment was conducted twice and data were combined for preliminary analysis. Data were analyzed using logistic regression analysis for qualitative responses with a 0.05 level of probability. Odds ratios were used for regrowth prediction estimates using height, leaf number, and stem diameter as the dependent variables. Regrowth occurred in 71% and 79% of plants cut 14 to 55 DAE. A higher proportion of regrowth occurred in plants cut 25 DAE or later in trial 1. However, in the second trial regrowth occurred in at least 50% of plants at each DAE. Unexpectedly, regrowth occurred on at least 50% of plants cut at the cotyledonary stage. In the second experiment, plants were cut 1 to 25 DAE and regrowth occurred regardless of leaf number and stem diameter, which were not consistent predictors of regrowth for TSA plants 14 to 55 days old. Stem diameter was generally less effective for regrowth prediction in both experiments. In the second series of trials evaluating regrowth 1 to 25 DAE, regrowth occurred regardless of DAE, stem diameter, and height. Leaf number correlated significantly with regrowth. The odds ratio indicated that for each mm increase in stem diameter, a two-fold increase in regrowth potential resulted. Over both trials, only 8% of plants cut 1 to 25 DAE failed to regrow. Averaged over both trials, 75% of plants cut 1 DAE resulted in normal regrowth.

The mechanism of regrowth was determined by cutting TSA seedlings, 1, 10, and 20 DAE and observing morphological changes with light and scanning electron microscopy. Sixteen plants from each cutting age were harvested each day until 30 days after cutting (DAC) and placed in fixative solution appropriate for light microscopy (8 plants) and scanning electron microscopy (8 plants). Changes in morphology and number of adventitious buds were recorded. Bud number means were separated using Fisher's LSD (0.05). Removing the above-ground foliage of TSA breaks apical dominance and allows adventitious bud development. Each stem developed callus tissue at the stem apex from which buds, clearly adventitious in origin, emerged. Light microscopy revealed that stem stubs did not contain any meristematic tissue at time of cutting. Callused tissue forms as early as 5 DAC regardless of plant age at cutting. By 9 DAC, meristematic tissue and adventitious buds protrude through callused tissue. Stem apices are completely covered with meristematic tissue and adventitious buds 13 to 15 DAC. Leaf primordia and stem apical meristems are present 15 DAC regardless of cutting age. From 12 to 24 adventitious buds form on one plant. Plants cut at 20 DAE have a significantly higher number of adventitious buds than plants cut 10 or 1 DAE, attributed to greater surface area at the cut region.

Regeneration from damaged stem apices allows TSA a survival mechanism in the presence of mechanical and chemical weed management. As early as one DAE, TSA can regenerate via adventitious budding. These data suggest that herbicides must be translocated to root tissue even in seedlings to prevent regeneration that may occur after mowing or the use of a contact herbicide. Additional research is needed to evaluate TSA response to cutting in varying field environments.

DIVERSITY OF RHIZOBACTERIA FROM WEEDS AND CROPS. J. H. Kim, H. D. Skipper, K. Xiong, D. T. Gooden, and J. R. Frederick, Department of Crop and Soil Environmental Science, Clemson University, Clemson, SC 29634-0359.

ABSTRACT

A critical research need in agroecosystems is to understand the interactions between rhizobacteria and plant species. A data base on rhizobacteria from roots of selected crop and weed species is being developed. Periodically, 40 randomly selected bacterial isolates on TSBA from each crop and weed species were identified by GC/FAME analyses. Although *Arthrobacter* and *Bacillus*, both gram-positive, were the major genera from non-rhizosphere soil, they were not major components of the root zone. *Acidovorax* and *Burkholderia*, both gram-negative, were the major genera from soybean and corn rhizospheres, respectively. *Burkholderia* was the major genus from both tropic croton (*Croton glandulosus* var. *septentrionalis* Muell.-Arg.) and yellow nutsedge (*Cyperus esculentus* L.) rhizospheres.

ACKNOWLEDGEMENTS

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EFFECT OF GLYPHOSATE ON SOIL MICROBIAL ACTIVITY. R. L. Haney, S. A. Senseman, F. M. Hons, and D. A. Zuberer, Department of Soil and Crop Sciences, Texas A&M University, College Station, TX 77843.

ABSTRACT

The increasing use of Roundup-Ready crops has sparked concern regarding the environmental impact of the herbicide glyphosate. Glyphosate is foliar applied for post-emergence weed control. Although glyphosate is not directly applied to soil, a significant concentration of material may reach the soil surface during application. The objective of this study was to investigate the impact of glyphosate on soil microbial activity as measured by C and N mineralization. CO_2 evolution increased as glyphosate rate increased. A strong linear relationship existed between C and N mineralization and the amount of C and N added as glyphosate. This indicates a direct stimulation of microbial activity from the addition of glyphosate. The flush of CO_2 from the addition of glyphosate was present after the first day in all glyphosate amended soils and was strongest on the second day. The CO_2 flush returned to background levels by the fourteenth day. This contradicts other studies where C and N mineralization measurements were delayed for several days after addition of glyphosate and sampling depth was not indicated. Discrepancies between these data and earlier work with glyphosate on soil microbial activity (C and N mineralization) may be due to the lower glyphosate rates applied in earlier studies. The rates and subsequent soil concentrations of glyphosate calculated in this study were based on the assumption that glyphosate would not surpass a soil penetration of 2 mm because of the chemical's relatively high adsorptivity and low leachability. Glyphosate significantly stimulated microbial activity as measured by C and N mineralization. Significant differences between herbicide rates were found for both C and N mineralization as well as a strong linear relationship between C and N added vs. C and N mineralized. This data suggests that glyphosate was the source of increased microbial activity.

SURVEY OF FARMLAND UTILIZATION, WINTER ANNUAL GRASS WEED INFESTATIONS AND POST-HARVEST WHEAT STUBBLE BURNING PRACTICES IN NORTH CENTRAL OKLAHOMA. M. A. Barnes, J. R. Roberts, A. E. Stone, and T. F. Peeper, Oklahoma State University, Stillwater, OK 74078.

ABSTRACT

Cheat *(Bromus secalinus)* infestations in the 1997-98 Oklahoma wheat crop were much worse than anticipated. The actual severity of infestations has not previously been surveyed. Additionally, with the implementation of the 1996 FAIR act and "Freedom to Farm", producers enrolled in government programs gained virtually unlimited planting flexibility on their base acreages. Thus, a pre-harvest survey was conducted during May 1998 of three major wheat-producing counties with the primary objective of visually quantifying the extent to which Oklahoma's wheat fields are infested with cheat and other weeds. Wheat was fully headed and in the hard dough stage. Cheat and other weeds were still green and very conspicuous when present. Information was also gained on cropping practices in an area where wheat has traditionally been the major crop.

The survey revealed that Alfalfa, Garfield, and Kingfisher counties had 83%, 89%, and 70% of the wheat fields infested with cheat to some degree. An estimate of crop diversity and utilization within the counties was also obtained from the survey, as well as post-wheat harvest residue management practices. Post-harvest surveying discovered that 4%, 9%, and 7% of the wheat fields in Alfalfa, Garfield, and Kingfisher counties had the stubble burned or had a firebreak tilled around the edge in preparation for burning. Double-cropping practices were also obtained from the second survey. The same fields will be surveyed in 1999 to detect changes in weed infestations and cropping practices.

UTILIZATION OF BASIS GOLD IN SEQUENTIAL AND TOTAL POST WEED CONTROL PROGRAMS IN CORN. R. E. Etheridge, G. N. Rhodes, R. M. Hayes, and T. C. Mueller, Department of Plant and Soil Sciences, The University of Tennessee, Knoxville, TN 37996.

ABSTRACT

The introduction of corn varieties tolerant to herbicides such as glufosinate and glyphosate has made postemergence (POST) weed control programs attractive to producers. However, a lack of information concerning yield and other agronomic traits in the new varieties may encourage producers to plant more proven varieties and therefore rely on traditional weed control practices. POST applications of Basis Gold may be a viable option for weed control in these cases.

Field studies were conducted in 1998 to evaluate the efficacy of Basis Gold alone and in combination with a preemergence (PRE) herbicide and to compare its performance with a "standard" POST program. Corn was planted and produced in accordance with local practices in Jackson, Knoxville, and Tellico Plains, Tennessee. POST treatments were applied when corn was 8" tall and visual control evaluations were made 4-5 weeks after application. Treatments were applied in 15-18 GPA and the POST applications contained crop oil at 1% v/v. The studies were arranged in a randomized block design with 3-4 replications.

Basis Gold alone at 0.79 lb ai/A provided $\geq$ 85% control of signalgrass (*Brachiaria platyphylla*), johnsongrass (*Sorghum halepense*), and cocklebur (*Xanthium strumarium*) whereas the addition of atrazine at 0.5 lb ai/A was necessary to achieve satisfactory control (84%) of pitted morningglory (*Ipomoea lacunosa*). A PRE application of Bicep II Magnum at 2.25 lb ai/A improved sicklepod (*Senna obtusifolia*) control compared to Basis Gold alone (85% vs 68%), but did not improve the efficacy of Basis Gold on other weed species. Basis Gold + atrazine provided better sicklepod control than Accent + atrazine at 0.031 + 1.0 lb ai/A (82% vs 68%) whereas no differences were observed on the other weed species or with respect to grain yield. Basis Gold alone may provide acceptable season-long control of certain weed species and can be applied to conventional and genetically modified corn varieties.

CONFIRMATION OF AN ENZYME-LINKED IMMUNOSORBENT ASSAY TO DETECT FLUOMETURON IN THE ENVIRONMENT. M. W. Shankle, D. R. Shaw, W. L. Kingery, M. Boyette, J. C. Arnold, and M. A. Locke, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762 and USDA-ARS, Southern Weed Science Research Unit, Stoneville, MS 38776.

ABSTRACT

Public concern about environmental issues has increased pressure to provide new information on the fate of herbicides in the environment. Traditionally, herbicide detection has been determined by gas-liquid, high performance-liquid and thin-layer chromatographic methods that are reliable, but expensive and time consuming. Thus a cost-effective method was needed to analyze a large number of samples quickly. This research was designed to evaluate an enzyme-linked immunosorbent assay (ELISA) developed for the Mississippi Delta Management Systems Evaluation Area (MD-MSEA) project to detect fluometuron in the environment. The objective was to compare ELISA efficacy to HPLC for detection of fluometuron concentrations used to model degradation kinetics in soil collected fromepipedons influenced by best management practices (BMPs). Soils include a Dundee silt loam (fine silty, mixed, thermic, Aeric Ochraqualf) collected froma cropped watershed and an adjacent established grass filter strip epipedon (0-2 cm depth); and a Dowling overwash phase (fine, montmorillonitic, thermic, Vertic Epiaquept) from a riparian forest epipedon at Beasley Lake in Sunflower Co., MS.

Field-moist soil (40 g oven dry weight basis) was placed into polypropylene wide-mouth bottles with screw top caps and treated with an aqueous solution of technical grade fluometuron at a rate of 1.75 Fg/g soil. Samples were replicated four times. After herbicide amendment, soil moisture was brought to field capacity (-33 kPa), as determined using a pressure plate apparatus, by the addition of 0.01 *M* $CaCl_2$ solution. Treated samples were weighed and incubated in the dark at 28E C and 50% relative humidity. Samples were aerated every week for 10 min and deionized (D.I.) water was added to replace any water lost. Herbicide degradation was determined on samples that had been frozen 7, 14, 28, 56, and 112 days after treatment (DAT). Each sample was thawed and soxhlet extracted with methanol for 16 hr, evaporated, and brought to a volume of 5 ml with acetonitrile and analyzed by HPLC or diluted with D.I. water and analyzed by ELISA with a detection range of 0.25 to 10 : g/ml.

A linear relationship for HPLC ($R^2 > 0.90$) and ELISA ($R^2 > 0.66$) analysis was observed in all treatments between the natural logarithm of detected fluometuron concentrations in soil (: g/g) regressed against time in days after treatment (DAT). Therefore, fluometuron concentrations were fit to a first-order kinetics model. Data were then subjected to analysis of variance using a mixed model approach to test for treatment by method interactions. Regression coefficients and resulting half-lives were separated between treatments and methods using Fisher's Protected LSD test. The y-intercepts for HPLC and ELISA were: 0.47 and 0.61 for cropped watershed; 0.55 and 0.50 for riparian forest; and 0.51 and 0.51 for established filter strip, respectively. Equivalent y-intercepts were obtained between treatments and the only methods difference was for the cropped watershed treatment. Coefficents of determination (R^2) for HPLC and ELISA were: 0.91 and 0.67 for cropped watershed; 0.97 and 0.92 for riparian forest; and 0.98 and 0.81 for established filter strip, respectively. There were no treatment differences for HPLC analysis, but cropped watershed ($R^2 = 0.67$) was less than other treatments ($R^2 > 0.81$) for ELISA analysis. HPLC and ELISA had different R^2 values for cropped watershed and established strip. HPLC and ELISA predicted fluometuron half-lives (DT_{50}) were: 110 and 112 days in the cropped watershed; 28 and 29 days in riparian forest; and 11 and 11 days in established filter strip, respectively. Results from both techniques were equivalent and indicated shorter half-lives in soil from all BMPs than in soil from the cropped watershed. Correlation analysis of predicted half-lives for both detection methods and soil properties indicated an inverse relationship with soil organic matter, pH, clay, and CEC ($r > 0.75$), and a positive relationship with sand ($r = 0.70$). As soil organic matter, pH, clay, and CEC increased and sand decreased, fluometuron DT_{50} decreased. Results from this confirmatory analysis suggests that the ELISA is an effective method for detecting fluometuron in the environment. Therefore, adoption of this cost effective technique could expeditiously provide new information on environmental concerns and allow continued use of valuable herbicides.

MANAGING ITALIAN RYEGRASS (*LOLIUM MULTIFLORUM*) IN NO-TILLAGE CORN. J. R. Martin and J. D. Green, Department of Agronomy, University of Kentucky, Princeton, KY 42445.

ABSTRACT

Italian ryegrass grows as a cool-season annual grass that matures during May through July in Kentucky. One source of spreading this as a weed is through combines operating along field borders and grass waterways during wheat harvest. The seed of Italian ryegrass may germinate the following fall and evolve into a problem weed in fields that are rotated to no-tillage corn the next spring. Many corn growers have experienced difficulty in controlling this weed with traditional "burndown" herbicides such as paraquat or glyphosate.

A major objective of this research was to compare and evaluate single and sequential applications of "burndown" herbicides for managing Italian ryegrass in no-tillage corn.

Corn was planted in early May. Herbicides were applied either as a single treatment of a preemergence (PRE) spray at planting or as sequential treatments involving early preplant (EPP) sprays about mid-April followed by PRE sprays or PRE sprays followed by a selective postemergence (POST) spray in mid- to late- May when Italian ryegrass regrowth was approximately 8 inches in height. Paraquat at 0.47 lb ai/A plus nonionic surfactant at 0.25% v/v or glyphosate at 1 or 1.5 lb ai/A were applied in EPP or PRE sprays. Atrazine at 1.5 lb ai/A was included in some of the PRE sprays. Nicosulfuron at 0.5 oz ai/A plus crop oil concentrate at 1% v/v was applied as a postemergence (POST) spray overtop corn. Treatments were applied with a CO_2 pressurized backpack sprayer to deliver a spray volume of 10 gallons per acre for glyphosate alone treatments and 26 gallons per acre for all other treatments. Treatments were arranged in a randomized complete block design with 3 replications. Control ratings were made approximately three weeks after the POST spray. Corn was harvested to determine grain yield.

Italian ryegrass control was generally better in 1998 than in 1997. Air temperature was more favorable for ryegrass growth and may have enhanced control of this weed in 1998. A single PRE application of paraquat at 1.5 pt/A alone provided only 18% and 58% control of Italian ryegrass in 1997 and 1998, respectively. Atrazine significantly enhanced "burndown" control only in one instance where it was combined with paraquat in 1997. Glyphosate at 1.5 lb ai/A tended to provide better control than glyphosate at 1 lb ai/A. The sequential treatments of EPP followed by PRE tended to provide better control than most PRE treatments, except those with glyphosate at 1.5 lb ai/A. The sequential paraquat PRE followed by nicosulfuron POST provided significantly better control than paraquat applied alone as a PRE spray.

Most PRE and sequential EPP plus PRE treatments provided sufficient control of Italian ryegrass to avoid yield reductions of corn. However, the poor control observed with paraquat PRE appeared to limit corn yield in 1997. Post applications of nicosulfuron provided sufficient suppression of Italian ryegrass plants that escaped the PRE application of paraquat to avoid significant crop competition and reductions of corn yield.

INFLUENCE OF ROW SPACING IN NO-TILL AND CONVENTIONAL SOYBEAN WEED CONTROL PROGRAMS. J. L. Norris, C. E. Snipes, D. R. Shaw, and S. M. Schraer, 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 at Stoneville, MS, to evaluate the affects of various row spacing in conventional and no-till weed management systems in soybean. Asgrow 5901RR, a Roundup Ready cultivar of the maturity group (MG) V, and Hutcheson, a short stature conventional MG V cultivar, were used in this study. Treatments for the Asgrow 5901RR cultivar were: untreated, a POST application of 1120 g ai/ha glyphosate, and a 1120 g/ha glyphosate POST followed by a second 840 g/ha glyphosate POST application. For the Hutcheson cultivar, treatments included were: untreated, a PRE application of 560 g ai/ha metribuzin plus chlorimuron, and 560 kg ai/ha metribuzin plus chlorimuron PRE followed by 8.7 g ai/ha chlorimuron POST. Row spacings of 46 and 102 cm were used with both cultivars.

Sicklepod [*Senna obtusifolia* (L.) Irwin and Barneby],. pitted morningglory (*Ipomoea lacunosa* L.), and hemp sesbania [*Sesbania exaltata* (Raf.) Rydb. ex A.W. Hill] were the predominant species throughout the study. In both 46 and 102 cm row spacing, the conventional herbicides controlled sicklepod less than the comparable glyphosate treatments 8 weeks after planting (WAP). Pitted morningglory control increased at the labeled rate of glyphosate compared to the reduced rates for both tillage systems in 46 cm rows. Within the conventional system, pitted morningglory control increased in 46 cm vs. 102 cm rows. At the reduced rate of glyphosate, hemp sesbania was controlled better with the conventional herbicide system compared to glyphosate treatments 8 WAP. Control of hemp sesbania was increased by the labeled rate of glyphosate in comparison of the reduced rate. Row spacing did not influence hemp sesbania control with glyphosate.

Yield in the conventional herbicide treatments higher than with to the reduced or labeled rates of glyphosate. Within the Roundup Ready system, there were no yield difference between the reduced and labeled rate inputs.

CORN TOLERANCE AND WEED CONTROL WITH AXIOM IN TEXAS. K. D. Brewer, W. J. Grichar, E. P. Prostko, B. A. Besler, A. T. Palrang, and J. E. Cagle. Texas Agricultural Experiment Station, Yoakum, TX 77995; Texas Agricultural Extension Service, Stephenville, TX 76401; and Bayer Corporation, Austin, TX 78739, and Mill Creek, OK 74856.

ABSTRACT

Field studies were conducted at four locations in south and central Texas during the 1998 growing season to determine corn (*Zea mays* L.) tolerance and weed control with Axiom (fluthiamide + metribuzin) under various soil types and moisture conditions. Preemergence (PRE) treatments in South Texas included Axiom at 15 oz/A, Aatrex 4L (atrazine) at 2.5 pt/A + Axiom at 15 oz/A, Aatrex alone at 2.5 pt/A, Dual II Magnum (S-metolachlor) at 1.65 pt/A, Frontier (dimenthenamid) at 1.72 pt/A, Harness (acetochlor) at 2.25 pt/A, Topnotch (acetochlor) at 5.0 pt/A, and Surpass (acetochlor) at 2.5 pt/A. Treatments in central Texas included Axiom alone at 13 and 15 oz/A, Atrazine 90DF at 0.84 lb/A + Axiom at 11 oz/A, and Atrazine 90DF alone at 19.7 oz/A.

Soil type near Pearsall was a loamy sand (82% sand, 12% silt, 6% clay) with 0.5% organic matter, and pH of 8.1, soil type near Yoakum was a sandy loam (64% sand, 22% silt, 14% clay) with 1.1% organic matter, and pH of 8.1, soil type near Edna was a clay (24% sand, 21% silt, 55% clay) with 1.7% organic matter, and a pH of 5.3, and soil type near Stephenville was a sandy clay loam (62% sand, 14% silt, 24% clay) with 0.7% organic matter and pH of 7.7. Axiom provided > 85% Texas panicum (*Panicum texanum*) control and 75% southern crabgrass (*Digitaria ciliaris*) control. Palmer amaranth (*Amaranthus palmeri*) control was ≥ 98%.

No corn stunting was observed at the Edna or Stephenville location. At Yoakum, when pH was 8.1, severe early season stunt (22%) was evident with the Aatrex + Axiom tank mix. Three weeks later no differences in corn growth were noted. At the Pearsall location (82% sand, pH of 8.1), severe stunting (> 30%) was visible throughout the growing season with Axiom alone and Axiom + Aatrex.

Corn yields with Axiom were reduced at Pearsall when compared with Surpass while Aatrex + Axiom yields were reduced when compared with Dual II Magnum, Frontier, Harness, Topnotch or Surpass. No differences in corn yields were noted at Yoakum while corn was not harvested for yield at Edna or Stephenville due to extremely dry conditions.

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

ABSTRACT

Studies were conducted in 1998 near Washington, LA to evaluate grass and broadleaf weed control and corn injury with Roundup Ultra and Liberty using Roundup Ready and Liberty Link technologies. For the weed control study, treatments included Bicep II at 2.4 qt/A, 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. EPOST and LPOST. The standard treatment of Accent at 0.67 oz/A + Buctril at 16 oz/A EPOST was included for comparison. >Dekalb Exp 363 RR= and >Cargill 7750 LL= corn cultivars were planted March 26 and harvested August 3. Experimental design was a randomized complete block with 4 replications. Early POST applications were made May 4 when weeds were 0.5 to 5 inches tall. Weed heights ranged from 1 to 14 inches when LPOST applications were made May 21. Broadleaf signalgrass [*Bracharia platyphylla* (Griesb.) Nash], smooth pigweed (*Amaranthus hybridus* L.), pitted morningglory (*Ipomoea lacunosa* L.), and prickly sida (*Sida spinosa* L.) control was rated 14 days after treatment.

Broadleaf signalgrass control for all Roundup Ultra and Liberty treatments was at least 95% and greater than for Bicep II applied alone. Smooth pigweed was controlled at least 90% and control was equivalent for all Roundup Ultra treatments, Bicep II alone, and Accent plus Buctril. Liberty treatments provided at least 90% control of smooth pigweed. Delaying Liberty application to LPOST reduced smooth pigweed control compared with EPOST application. Single EPOST Roundup Ultra or Liberty applications controlled pitted morningglory 94 and 100%, respectively, and control was equivalent to that for other Roundup Ultra or Liberty treatments, Bicep II alone, and Accent +Buctril. Prickly sida control with all Roundup Ultra and Liberty treatments, Bicep II alone, and Accent + Buctril was at least 96%. Differences in broadleaf signalgrass and smooth pigweed control observed among herbicide treatments were not reflected in corn yield. A total of 6 inches of rainfall in April, May, and June contributed to variability in yield. Dekalb Exp 363 RR corn, not adapted to the South, yielded as high as 81 Bu/A. In contrast, Cargill 7750 LL, which was grown commercially in Louisiana in 1998, yielded no more than 71 Bu/A.

For the corn tolerance study, Roundup Ultra at 1and 3 qt/A and Liberty at 28 and 84 oz/A (1 and 3x rates) were applied to 5, 7, and 9 leaf Dekalb Exp 363 RR and Cargill 7750 LL corn cultivars, respectively. Corn was planted March 26 and harvested August 4. The experimental design was a randomized complete block with 3 replications. A nontreated weedfree control was included for comparison.

Corn yield for Dekalb Exp 363 RR or Cargill 7750 LL following Roundup Ultra or Liberty applied at the various rates and application timings was equivalent to the nontreated weedfree check. As noted for the weed control study, variability in yield was observed. Highest yield of Dekalb Exp 363 RR was 86 Bu/A compared with 80 Bu/A for Cargill 7750 LL. Under stress conditions due to lack of rainfall, crop injury would be expected to increase. Both corn cultivars appeared to be highly tolerant to the respective herbicides when applied at three times the normal use rate.

In conclusion, single applications of Roundup Ultra at 1.5 pt/A or Liberty at 20 oz/A were as effective in controlling broadleaf signalgrass, smooth pigweed, pitted morningglory, and prickly sida as when applied following Bicep II, Prowl, or Atrazine PRE. Sequential applications of Roundup Ultra or Liberty did not improve weed control when compared with single applications. Single applications of Roundup Ultra and Liberty controlled broadleaf signalgrass at least 96%, smooth pigweed and prickly sida 100%, and pitted morningglory at least 94%. Yields of Dekalb Exp 363 RR or Cargill 7750 LL were not negatively affected by 3 qt/A of Roundup Ultra or 84 oz/A of Liberty when applied at 5, 7, or 9 leaf. Under the low rainfall conditions in 1998, respectable yields were obtained for both cultivars.

WEED CONTROL IN PIGEON PEAS. J. E. Bidlack, S. C. Rao, R. D. Williams, D. Elmendorf, M. Sung, and V. Barabash, University of Central Oklahoma, Edmund, and USDA-ARS, Grazinglands Research Laboratory, El Reno, OK.

ABSTRACT

Proliferation of persistent spring and summer weeds, such as johnsongrass [*Sorghum halepense* (L.) Pers.] and pigweed [*Amaranthus retroflexus* (L.)] introduces an undesirable impediment to pigeon pea production. 'Georgia-2' pigeon peas were evaluated in response to two rates of the following herbicides: Authority (PRE) Cadre (POST), Lexone DF (PRE), and Poast (POST); plus hand-weeded and weedy-check control plots. Field plots were established as a randomized complete block design with three replications and ten treatments at the USDA-ARS Grazinglands Research Laboratory in El Reno, Oklahoma. Pigeon peas were planted on 25 June 1998 and harvested, along with weeds, on 14 October. The most common weed encountered throughout the field was pigweed and thus, those herbicides labeled for control of pigweed were most successful at controlling weed populations. Among pre-emergence herbicide treatments, the high

rate of Lexone DF and Authority were as effective in deterring weeds as the hand-weeded treatments. Both rates of the post-emergence herbicide, Cadre, were effective in controlling pigweed populations. High rates of the pre-emergence herbicide, Lexone DF, and the post-emergence herbicide, Cadre, were just as effective in maintaining pigeon pea populations and total DW as the hand-weeded plots. These results indicate that effective herbicide formulations are available for control of pigweed in pigeon pea production systems.

GRASS CONTROL WITH GRAMINICIDES IN COMBINATION WITH CLORANSULAM (FIRSTRATE).
J. Barnes and L. R. Oliver, Department of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville, AR 72704.

ABSTRACT

Cloransulam is a postemergence (POST) soybean herbicide that controls broadleaf weeds but lacks control of grass species. Since many soybean fields contain both broadleaf and grass weeds, tank mixtures of cloransulam and graminicides would allow producers to control weeds with one POST application. Field and greenhouse experiments were conducted in 1997 and 1998 to evaluate grass weed control potential with cloransulam and graminicide combinations. All experiments were conducted with a factorial arrangement of treatments in a randomized complete block with four replications. The factors in the field experiment consisted of cloransulam applied at 18 and 0 g ai/ha combined with either quizalofop (56 g ai/ha), fluazifop + fenoxaprop (140 + 39 g ai/ha), clethodim (106 g ai/ha), sethoxydim (210 g ai/ha), glyphosate (560 g ai/ha), or no graminicide. Greenhouse Experiment 1 was a repeat of the field study with the addition of the graminicide fluazifop (211 g ai/ha). Greenhouse Experiment 2 was designed to determine if increasing the application rate of the graminicide would alleviate antagonistic interactions. Three rates of quizalofop (56, 77, or 154 g/ha), fluazifop (211, 292, or 583 g/ha), or fluazifop + fenoxaprop (140 + 39, 210 + 59, or 420 +118 g/ha) were mixed with either cloransulam at 18 or 0 g/ha. These rates corresponded to the labeled rates of each herbicide, the labeled tank-mixture rate, and a rate that was double the labeled tank-mixture rate (2X tank-mixture rate), respectively.

In field and greenhouse studies cloransulam could be mixed with labeled rates of clethodim, sethoxydim or glyphosate without antagonizing grass control. Combinations of quizalofop, fluazifop, or fluazifop + fenoxaprop with cloransulam resulted in antagonism of barnyardgrass (*Echinochloa crus-galli*), broadleaf signalgrass (*Brachiaria platyphylla*), large crabgrass (*Digitaria sanguinalis*), and yellow foxtail (*Setaria glauca*) control but did not affect control of johnsongrass (*Sorghum halepense*) or goosegrass (*Eleusine indica)*. Increasing the rate of quizalofop to the tank-mix rate alleviated antagonism of broadleaf signalgrass and barnyardgrass. Increasing the rate of fluazifop or fluazifop + fenoxaprop to the 2X tank-mix rate prevented antagonism of yellow foxtail and broadleaf signalgrass control. Cloransulam can be mixed with glyphosate, clethodim or sethoxydim without reducing grass weed control but should not be mixed with quizalofop, fluazifop or fluazifop + fenoxaprop because of the potential for antagonism of grass control.

MOVEMENT OF TOBACCO MOSAIC VIRUS IN HOST-PARASITE SYSTEMS INVOLVING EGYPTIAN BROOMRAPE (*OROBANCHE AEGYPTIACA*). J. H. Westwood, C. L. Foy, and S. A. Tolin. Department of Plant Pathology, Physiology, and Weed Science. Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.

ABSTRACT

Egyptian broomrape is a parasitic weed that attacks the roots of many important dicotyledonous crop species, and a crucial aspect of the parasite's development is the establishment of vascular connections (via an haustorium) to the host plant. Anatomical and physiological studies have indicated that broomrape forms connections to host xylem and phloem, but little is known about the regulation of transport across the host-parasite interface. Tobacco mosaic virus (TMV) has the ability to move from cell to cell through host plant plasmodesmata and travel long distances through host phloem. TMV (and other viruses) may also move from a host plant into an attached dodder (*Cuscuta* sp.) plant, indicating that vascular connections between host and dodder function like those of the host itself with respect to virus movement. To test whether broomrape shares such open connections with its host, tomato (*Lycopersicon esculentum* Mill.) and tobacco (*Nicotiana tabacum* L.) plants parasitized by broomrape were inoculated with TMV, and virus movement was followed over the course of 15 d. TMV was detected by pressing host and parasite tissues onto S&S 410 paper and probing the resulting prints with antibodies specific for TMV. The results indicated that TMV spread

rapidly in both hosts, and was detected in uninoculated leaves and roots of plants by the earliest harvest time, 5 d after TMV inoculation. TMV was also abundant in these tissues at 10 and 15 d after inoculation, but the virus was never detected in broomrape tissue. This indicates that TMV either does not cross from the host into broomrape, or does not move through broomrape tissue by 15 d after inoculation, suggesting that vascular/plasmodesmatal connections involving broomrape are not compatible with TMV movement. Future research using other viruses and higher resolution techniques will reveal more about TMV movement/exclusion in the broomrape haustorium, and provide more insight into this complex plant-plant interaction.

COMPARISON OF WEED CONTROL SYSTEMS IN TRANSGENIC AND CONVENTIONAL CORN HYBRIDS. H. C. Smith, D. B. Reynolds, and N. W. Buehring. Mississippi State University, Mississippi State, MS, 39762 and Northeast Mississippi Branch Experiment Station, Verona, MS, 38879.

ABSTRACT

Increasing interest in the use of transgenic and herbicide tolerant corn hybrids has raised questions regarding their utility relative to current standard weed control programs in non-transgenic systems. In 1997, field studies were conducted at the Black Belt Branch Experiment Station near Brooksville, MS, and the Northeast MS Research and Extension Center near Verona, MS to compare the Liberty Link system, the Roundup Ready system and the Imi-resistant system to Pioneer 3223 cultivar with a conventional weed control program. All systems included preemergence (PRE) soil and foliar applied herbicides in combination with postemergence (POST) applications to try to achieve season long control of pitted morningglory (*Ipomoea lacunosa L.*) and large crabgrass (*Digitaria sanguinalis L.*). Treatments were arranged in a factorial arrangement in a randomized complete block design with four replications. Experimental units were 12.66 by 40 feet and all applications were applied at 15 gallon per acre. Factor A was herbicide system. Systems included Liberty 1.67 E.C. at 20 oz/A, Lightning 70 DF at 1.28 oz/A, and Roundup Ultra 4 AS at 1 QT/A. Factor B was herbicide or herbicide combination. Visual injury was determined at 7, 14, and 28 days after application. Combinations in the transgenic systems included treatments with a PRE application of 2.4 Qts/A of Bicep followed by the POST system herbicide or a POST tank-mix of 0.75 lbs ai/A atrazine and the POST system herbicide. The standard program was 2.4 Qts/A of Bicep PRE followed by 14 oz/A of Basis Gold POST with a 1% V/V of crop oil concentrate. At 28 DAT, Bicep PRE followed by the POST herbicide systems generally provided pitted morningglory and large crabgrass control equal to that of the standard program at both locations. At 28 DAT, atrazine POST as a tank-mix with POST systems herbicide provided control of pitted morningglory and large crabgrass equal to that of the standard program at the Verona location, but only with Liberty at Brooksville. Pitted morningglory control ranged from 18%-84% and large crabgrass control ranged from 21%-65% at both locations when the POST system herbicides were applied without a residual. Yield of the transgenic/tolerant systems ranged from 71 to 103 bushels per acre compared to 122 bushels per acre by the standard program.
These findings show that residual herbicides are needed in combinations with transgenic POST herbicide systems to provide pitted morningglory and large crabgrass control equal to a standard program.

WEED CONTROL IN EARLY SOYBEAN PRODUCTION SYSTEM. C. D. Elmore and L. G. Heatherly, USDA ARS, APTRU and CGPRU, Stoneville, MS 38776.

ABSTRACT

The Early Soybean Production System (ESPS; early-maturing cultivars planted in April-early May) offers an alternative to the Conventional Soybean Production System(CSPS; MG V and later cultivars planted in May and later) for the midsouthern USA. The ESPS will likely utilize narrow-row culture to accommodate the growth habit of indeterminate cultivars, and thus precludes use of POST cultivation for effective weed control. Thus, PRE and POST applied herbicides, probably broadcast, are a necessity for weed control in the ESPS. The weed control program must have efficacy for annual and perennial broadleaf and grassy weeds. And the program must be cost effective to allow for both high yields and high economic returns. For best results use of the ESPS will probably preclude preplant tillage to allow early planting of soybean in the spring. This is especially true for the clay soils of the Mississippi Delta, which are usually spongy because of the near saturation at planting time in the early spring. This predicates a stale seedbed planting system for ESPS in most cases. The stale seedbed planting system involves use of preplant, foliar applied herbicides to kill existing vegetation at planting. Along with this preplant application subsequent weed management

depends upon a variety of PRE and POST herbicide applications. These will vary with the weed history of the site, cost of materials, price of soybean expected, and the individual desires of the producer. There is no one solution for all sites, and indeed a variety of solutions will work. Some guidelines are offered for options that may be chosen.

HERBICIDE COMPARISONS IN ROUNDUP READY® SYSTEMS IN SOYBEAN. P. R. Vidrine, J. L. Griffin, D. K. Miller, and J. P. Caylor. Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

ABSTRACT

Soybean varieties tolerant to the nonselective herbicide glyphosate, are rapidly increasing in commercial availability. Due to lack of soil residual activity with glyphosate, sequential applications generally provide the most consistent level of weed control, especially with abundant early-season rainfall in Louisiana that can encourage multiple weed flushes. It would be desirable from a grower perspective to delay the initial glyphosate application to allow more weeds to emerge. Delaying treatment allows weeds to be larger, therefore, higher rates of glyphosate may be needed for acceptable control. Delaying initial glyphosate application beyond the 1 to 3 in stage can result in a longer period of weed competition with the crop, which can reduce crop yield. However, like most new technologies, there are concerns about their usage and if they can be considered stand alone methods or do they require support of existing technologies. Under varying environmental conditions and plant sizes, control of some weeds can be difficult with a single herbicide or by using reduced rates of that herbicide. Current research has shown that the use of residual herbicides in a Roundup Ready® program has been variable. However, PRE herbicides applied at planting can control many weeds as well as reducing growth rate, allowing more time for application of a POST herbicide. In general, success of a total POST weed control program with glyphosate is enhanced under drier conditions that discourage weed emergence, allowing for more timely treatment. Under this situation, single or sequential applications have also provided good weed control and subsequent yields comparable to the same programs with a PRE herbicide component. Use of PRE herbicides with some activity on weeds considered difficult to control would be beneficial in improving the overall performance of a Roundup Ready® program and provide a buffer against adverse weather that could prevent a timely POST application.

Three field studies were conducted on soybean at Alexandria in 1998 to evaluate glyphosate at 1 to 2 pt/A and following PRE herbicides metolachlor at 1.67 pt/A, pendamethalin at 0.5 pt/A, imazaquin at 1.4 oz/A, imazaquin + pendamethalin at 1.5 and 3 pt/A, metribuzin at 4 oz/A, metribuzin + chlorimuron ethyl at 4 oz/A, sulfentrazon + chlorimuron at 3.5, 5.8, and 6.4 oz/A, flumetsulam + metolachlor at 2.5 pt/A, and imazaquin + imazethypyr + pendamethalin at 3 pt/A. Treatments were applied in 15 GPA. Soybean variety was Asgrow 5901RR. POST treatments were applied to soybeans approximately 3 wk after planting at the V4 stage. If a second POST treatment followed the first, an interval of 10-14 d was used. Weeds present at the first POST timing included Johnsongrass (SORHA) that ranged in size from 6 to 10 in with 4-10 leaves, entireleaf morningglory (IPOHE) 2-4 in and had 4 to 6 leaves, smellmelon (CUMME) 4 in with 4 leaves, and wild poinsettia (EPHHL) 2 to 4 in with 2 to 6 leaves. At second application timings, weed sizes were essentially the same as above, due to either a new flush of weeds or the weeds were still suppressed from the initial application or both. Visual estimates of weed control were recorded 6 wk after treatment. Treatments were arranged in a randomized complete block design with 3 replications. Data were subjected to analysis of variance and means were separated using Fisher's protected LSD test (P=0.05).

Johnsongrass control was 93% following treatment of glyphosate at 2 pt/A followed by 1 pt/A. However, adding either metolochlor at 1.67 pt/A or imazaquin + pendamethalin at 1.5 pt/A to the above glyphosate treatments increased control to 97%. Morningglory, smellmelon, and wild poinsettia control was 85 to 98% and was similar when treated with a PRE herbicide and then followed by one application of glyphosate at 1.5 pt/A compared with two applications of glyphosate at 1 pt/A followed by 1 pt/A. Yield data indicate similar results following glyphosate applied twice producing 43 bu/A, whereas adding a PRE treatment improved production up to 48 bu/A.

In a second study morningglory control was 97% when either a PRE herbicide was used followed by a POST application of glyphosate at 1.0 pt/A, or when glyphosate at 1 pt/A was followed by an additional 1 pt/A. Soybean yield data show a similar trend as morningglory control.

In the third study morningglory was controlled 89% following a PRE treatment of sulfentrazon + chlorimuron at 6.4 oz/A. Weed control and soybean yield were similar when treated with either a reduced rate of sulfentrazon + chlorimuron at 3.5 oz/A followed by glyphosate at 1 pt/A or glyphosate at 1pt followed by 1 pt/A.

Weed control using soil-applied PRE herbicides at reduced rates in a Roundup Ready® program have been as effective as either full rates or sequential glyphosate applications. Also, the use of soil-applied PRE herbicides can eliminate the need for a second glyphosate application.

EFFECTIVENESS OF BERMUDAGRASS (*CYNODON DACTYLON*) FILTER STRIPS IN HERBICIDE REMOVAL FROM SIMULATED SURFACE RUNOFF. M. C. Dozier, S. A. Senseman, D. W. Hoffman, K. N. Potter, and J. E. Wolfe III, Texas Agri. Exper. Stn., College Station, TX.; Texas Agri. Exper. Stn, Temple, TX.; USDA-ARS, Blackland Research Center, Temple, TX.

ABSTRACT

Combinations of atrazine and metolachlor, applied individually and together as a tank-mix, have proven to be invaluable and economical for control of annual broadleaves and annual grasses of corn and grain sorghum production. Though beneficial, the use of these herbicides pose a risk to surface and groundwater associated with the off-target movement of these herbicides in surface runoff. However, banning the use of atrazine has been projected to adversely impact producer income nationally by $342 million dollars. With this in mind, research is warranted to study better methods of managing the use and off-target losses of atrazine and metolachlor.

One such practice to reduce off-target losses of herbicides is the use of grass filter strips. To better understand the benefits of grass filter strips, a series of experiments were conducted at the Blackland Research Center (BRC) in Temple, TX and the Texas A&M University Farm (TAMUF) in College Station, TX. These experiments included: micro-watershed surface runoff studies at BRC, 1996, and TAMF, 1997; a soil column study at TAMUF, 1998 and a single point adsorption study in 1998. It should be noted that these experiments were conducted under saturated soil conditions to focus the research on the contributions of reducing off-target losses of the two compounds by the bermudagrass.

The micro-watershed runoff study was designed to determine the effectiveness of bermudagrass filter strips in removing atrazine and metolachlor from surface runoff. The two herbicides were added individually and as a tank mix to runoff water and allowed to uniformly flow across small, self-contained watersheds. Nine of the watersheds were composed of bermudagrass and nine were bare, conventional-tilled soil. Each watershed was 1 m by 3 m and enclosed with 18-gauge galvanized steel berms. Runoff was introduced upslope by a calibrated system utilizing flat-fan spray nozzles and a dispersion device designed to produce a sheet flow effect. After crossing the entire plot, runoff was collected at the lower end by a collection device. The runoff was then pumped to a small bucket for sampling at pre-determined time intervals. Next, the runoff was transferred to a larger tank equipped with a pressure transducer wired with a data logger to quantify the volume of runoff collected. Treatments were replicated three times and runoff samples were extracted using solid phase extraction and analyzed for atrazine and metolachlor concentrations using gas chromatography-mass spectromerty.

The soil column study was conducted by extracting intact soil columns from areas covered in bermudagrass and bare, conventional-tilled soil at the TAMUF. Runoff spiked with known concentrations of atrazine and metolachlor were applied individually and together as a tank-mix to each of the soil columns. Treatments were replicated three times and the volume of runoff and leachate measured. Composite samples of the runoff and leachate were extracted and analyzed as outlined above. Soil samples were collected and analyzed for atrazine and metolachlor concentrations.

The final study, of this series, was determining the adsorptive capacity of bermudagrass and the two soils involved in the micro-watershed studies. These soils were Houston Black (BRC) and Weswood (TAMUF). Radio-labeled atrazine and metolachlor, individually and together as a tank-mix, were incubated with one gram of bermudagrass and two grams each of the two soils. Each treatment was replicated four times and the amount of radioactivity for each sample was determined using a Beckman liquid scintillation counter. Kds were then calculated.

Results from the TAMUF micro-watershed exhibited no significant difference in % total herbicide load retained by either the bermudagrass or soil plots when the compounds were applied alone or together as a tank-mix. The soil column study revealed that a significantly greater amount of runoff leached through the soil columns covered in bermudagrass, as compared to, bare soil columns. Finally, it was determined that bermudagrass does have capacity to adsorb both atrazine and metolachlor and the Kds for both compounds were significantly greater for the bermudagrass verses the Weswood soil.

IMPACT OF BROADLEAF HERBICIDES AND ADJUVANT COMBINATIONS ON THE UPTAKE AND TRANSLOCATION OF GLYPHOSATE IN MORNINGGLORY. C. L. Brommer and D. R. Shaw, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Glyphosate is a non-selective, foliar applied herbicide used for broad-spectrum weed control. The use of glyphosate in stale seedbed agronomics has become an option for soybean production. The lack of glyphosate residual activity can be a problem, however; the use of tank mixtures can increase weed control intervals and broaden the spectrum of species controlled. With these tank mixture options, the correct adjuvant must be utilized to maximize foliar penetration of glyphosate.

Three- to four-leaf morningglory plants were treated on the second youngest true leaf with a 10 :l solution containing 0.1 :Ci of ^{14}C-glyphosate. Total glyphosate application (labeled and unlabeled) was 1.1 kg ai/ha. Combinations of the following broadleaf herbicides and adjuvants were evaluated: Kinetic HV, X-77 spreader, Entry, all at 1% (v/v), or no surfactant; 140 g ai/ha imazaquin, 560 g ai/ha metribuzin, 480 g ai/ha metribuzin plus 80 g ai/ha chlorimuron, or no broadleaf herbicide. Plants were harvested 24 and 72 h after treatment. The treated leaf was washed to remove unabsorbed ^{14}C-glyphosate and to calculate total absorption. The remaining plant parts were oxidized to quantify the amount of radioactivity in each section.

Glyphosate uptake was enhanced by all adjuvants 24 h after treatment, but not 72 h after treatment. Combinations of glyphosate with imazaquin + Entry or metribuzin + X-77 increased uptake compared to any other combination 24 h after treatment. Metribuzin and imazaquin both enhanced initial glyphosate uptake when an adjuvant was not used, but not at 72 h. Metribuzin or imazaquin with X-77 increased uptake of ^{14}C-glyphosate compared to any other treatment at 72 h. Any adjuvant + imazaquin enhanced uptake at 72 h compared to glyphosate alone or with an adjuvant. Combining X-77 or Kinetic with metribuzin + chlorimuron enhanced uptake compared to glyphosate alone, or metribuzin + chlorimuron + Entry. Translocation of ^{14}C-glyphosate was similar for all mixtures, except for less translocation with imazaquin + X-77 and glyphosate alone with no adjuvant. At 72 h after treatment, Kinetic + imazaquin or Kinetic + metribuzin + chlorimuron increased ^{14}C-glyphosate translocation compared to other treatments.

AFFORESTATION OF MARGINAL AGRICULTURAL LANDS IN SOUTHERN ILLINOIS: CHALLENGES FOR VEGETATION MANAGEMENT. J. W. Groninger and J. J. Zaczek, Department of Forestry, Southern Illinois University, Carbondale, IL. 62901.

ABSTRACT

Several afforestation efforts are currently underway in southern Illinois. Most often, these consist of mixed oak plantings on lands deemed marginal for agriculture due to low inherent productivity, frequent flooding, or severe erosion potential. Private landowners are attracted to reforestation through incentive programs such as the Conservation Reserve Program (CRP) and Wetlands Reserve Program (WRP). Additionally, state, federal and private conservation agencies and organizations are purchasing former agricultural lands in the Cache River basin for landscape-level restoration efforts. In this region, both private and public parties are more often motivated to undertake these efforts by wildlife benefits than the potential for eventual timber revenue.

Tree survival and growth rates are sometimes disappointing, as is often the case in hardwood afforestation programs under similar conditions. Commonly cited obstacles to forest establishment include soil properties altered by row crop agriculture, high rodent and deer populations, and aggressive competing vegetation. To date, little research has been conducted addressing these issues under the herbivore, soil and competing vegetation associations occurring in southern Illinois.

We are initiating a series of studies to enhance survival and productivity of forest stands with the goal of producing fully-stocked stands in a minimum amount of time following planting. All treatments are designed to fall within the budgetary constraints in place on reforestation incentive programs. These include assessing the need for herbicidal weed control in fallow bottomland sites formerly in soybean production, optimizing planting stock selection, developing low cost

strategies to establish hardwoods in tall fescue-dominated fields, and accelerating crown closure in established stands through vegetation management.

A study designed to assess the impacts of two common herbicide treatments on the long-term growth of planted oak seedlings and competing vegetation composition was installed on WRP lands in the coastal plain physiographic province in Pope County, Illinois. Soils are Ginat and Weinbach silt loams, subject to frequent early and mid-growing season flooding and poor internal drainage. The site was planted in soybeans for at least 30 consecutive years until the fall prior to planting. During March-April 1998, a mixture of 1-0 seedlings of cherrybark (Quercus pagoda Raf.) , Nuttall (Q. nuttallii Palmer), pin (Q. palustris Muenchh.), swamp chestnut (Q. michauxii Nutt.), swamp white Q. bicolor Willd.), and Shumard (Q. shumardii Buckl.) oak were planted mechanically. Two herbicide treatments and untreated control plots were established immediately following planting during early April 1998. Treatments consisted of Sulfometuron (Oust®) at a rate of 1 oz. product/acre and Simazine (Princep®) at a rate of 4 lbs. product/acre. Dominant competing life form and total percent cover were assessed in 1 m^2 plots centered on planted seedlings during July following planting.

At the time of measurement, the impacts of herbicide treatments on percent cover were evident although significant differences among herbicide treatments were not detected. Dominant vegetation was affected by treatment. Vines (primarily morning glory (Ipomoea spp.) and grape (Vitis spp.)) were dominant in the Oust treatment and grasses (primarily giant foxtail (Setaria faberi Herrm.) dominant in the control plots. Simazine resulted in the most equitable distribution of vines and grasses relative to one another. Treatment impacts on tree growth and floral composition will be assessed over the next several years.

BROADLEAF SIGNALGRASS MANAGEMENT SYSTEMS IN CORN. C. L. Stiles, and T. C. Mueller; University of Tennessee, Knoxville.

ABSTRACT

Broadleaf signalgrass is a native weed to the southeastern United States. It is a branched summer annual grass with rooting ability at the nodes. Broadleaf signalgrass is a prolific seed producer and a good competitor for water and nutrients. These characteristics, along with its ability to germinate late into the growing season allows it to be a troublesome weed in corn. The sulfonylureas are commonly used for johnsongrass control, yet they exhibit marginal activity on broadleaf signalgrass. Repeated sulfonylurea applications provided selection pressure which allowed a weed species shift from johnsongrass to broadleaf signalgrass in many areas. Research has indicated that early season broadleaf signalgrass competition in corn out to four weeks after planting (WAP) can reduce yields from 33 to 92%. Therefore, early season weed control may improve yields. The objective of this study was to evaluate broadleaf signalgrass control with both old and new herbicide chemistries in PRE, POST, and PRE + POST systems.

The field study was conducted in Knoxville, TN in 1998 on Sequatchie silt loam with 1.5% organic matter and a pH of 5.3. The study utilized a randomized complete block design with four replications. FFR 797 IT corn was planted on May 15 and PRE applications were made. POST treatments were applied on June 4. The PRE treatment was Bicep II Magnum at 2.1 qt/A. POST treatments included Lightning at 1.28 oz/A, Basis Gold at 14 oz/A, and Aatrex at 4 pt/A. PRE + POST treatments included Bicep II Magnum PRE at the previous rate followed by Accent at 0.67 oz/A and Clarity at 0.53pt/A, Exceed at 1 oz/A and Accent at 0.5 oz/A, and Hornet at 3.2 oz/A and Accent at 0.5 oz/A. POST treatments were applied with 25% NIS v/v excluding Aatrex which included COC at 1 qt/A.

The data showed that Bicep II Magnum PRE and sequentials resulted in excellent (>90%) control. All treatments provided >90% control late season, except Aatrex (38%). Treatments were similar with respect to yield. Overall POST treatments were as effective as PRE and sequential treatments.

EFFECT OF BARLEY STRAW FOR THE CONTROL OF OFF-FLAVOR IN POND-RAISED CATFISH. G. D. Wills, C. S. Tucker, and E. J. Jones, Mississippi Agric. and Forest. Exp. Stn., Stoneville, MS.

INTRODUCTION

Off-flavor is a significant problem in the production of pond-raised channel catfish (*Ictalurus punctatus*) (6). Off-flavor problems of pond-raised catfish in Mississippi most often involve a musty flavor caused by cyanobacterium (blue-green algae), *Oscillatoria chalybea* (3). During warm-season growing conditions, cyanobacteria often exhibit periods of increased reproduction known as algae blooms. When this occurs, blue-green algae frequently increases in mass and produces the chemical, 2-methylisoborneol (MIB) which is readily absorbed through the gills. Consumers can taste the musty flavor of MIB concentrations as low as one part per billion in cooked catfish (3).

Environmental restrictions on the use of synthetic pesticides have encouraged the search for naturally produced compounds, which will inhibit the growth of algae in public water supplies in the United States. In Great Britain, many researchers have found that barley straw (*Hordeum vulgare*) when decomposed under aerobic conditions on the surface of water, will inhibit the growth of blue-green algae in potable water supply reservoirs (1, 2, 4, and 7). Schrader et al. (5) have investigated the properties of many natural compounds to control off-flavor problems in drinking water and freshwater-raised fish as caused by MIB producing algae.

This study was conducted to investigate the use of barley straw for the control of MIB off-flavor in farm-raised catfish.

MATERIALS AND METHODS

Twelve one-acre ponds, 145 by 300 ft (43,500 ft^2 or 4047 m^2) were each stocked in March 1997 with 6000 catfish weighing 1 to 1.25 lb/fish. The fish were fed daily with a high protein food mixture. Four ponds designated A, B, C, and D were treated with barley straw. Eight ponds designated E, F, G, H, I, J, K, and L were maintained as untreated control ponds.

Barley straw was applied in bales which averaged 35 lb (15.9 kg) per bale and provided 0.013 oz/ft^2 (3.9 g/m^2) of pond surface. In each of the treated ponds, barley straw was positioned at the surface of the water inside four floating wire-mesh cages measuring 4 ft by 10 ft by 1 ft deep (1.2 m by 3 m by 0.3 m deep) and positioned 4 to 8 in (10 to 20 cm) deep with Styrofoam floats and anchored at selected locations on the surface of each pond.

Catfish flavor quality was assessed by sensory analysis performed by quality control personnel at Delta Pride Catfish, Inc., Indianola, MS. Flavor quality was ruled on a hedonic scale of 0 to 5 whereby 0 = acceptable and 5 = very unacceptable.

The application of barley straw to the catfish ponds began on April 22, 1998. The taste testing of catfish began on June 4 and continued at approximately 3-wk intervals until October 22, 1998. The specific amounts of barley straw and the arrangement of distribution in the ponds, and the dates in which straw was added and the fish were sampled are given in Table 1.

RESULTS AND DISCUSSION

The results of the catfish flavor-test and of the aerobic/anaerobic condition of the decaying barley straw at various time intervals throughout the treatment period are given in Table. 1.

Throughout the testing period, there were no consistent differences in the flavor of the fish between the fish in the four ponds treated with barley straw and those in the eight ponds with no barley straw. From the beginning of the study, the barley straw was found to decompose primarily by anaerobic respiration as determined by the shiny black color found in the submerged straw at the time of observation. Where barley straw has been found to control blue-green algae, the straw has decomposed aerobically in the water with a light brown color and never a shiny black color (Personal communication, 1997 Newman and Barrett).

Failure to obtain aerobic decomposition of the barley straw is probably due to a combination of daily periods of low ambient dissolved oxygen concentrations in catfish ponds and rapid rates of decomposition of the barley straw. Low concentrations of dissolved oxygen occur every summer night in catfish ponds because high rates of biological activity in intensive fish-culture ponds rapidly deplete the water of oxygen once photosynthesis ceases at dusk. Rapid decomposition of the straw is promoted because water temperatures are warm and pond waters contain abundant nitrogen to support microbial decomposition. The combination of limited availability of oxygen in the water and high rates of oxygen use within the masses of decomposing barley straw resulted in anaerobic conditions within large areas of the mass of barley straw.

Further studies are being developed to increase the oxygen content in water used to decompose barley straw in catfish ponds in an effort to control blue-green algae and ultimately prevent off-flavor of pond-raised catfish.

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Table 1. Effect of floating barley straw for managing blue-green algae off-flavors in pond-raised catfish during 1998[1/] [2/] [3/]

Treatment		Flavor Score[4/]			
Date	Activity	Date	Treated Ponds	Untreated Ponds	
	April				
22-24	Ponds A, B, C, and D were each treated with eight bales of barley straw which was evenly distributed over the surface of the water inside four floating wire-mesh cages measuring 4 ft by 10 ft by 1 ft deep, and suspended 8 in deep with styrofoam floats and evenly spaced on the surface of each pond.				
	May				
13-19	The straw in each cage was stirred from top to bottom. The submerged straw was shiny jet black indicating anaerobic decomposition of the straw.				
	June				
1-3	One bale of barley straw was added to the surface (unstirred) inside each cage in ponds A, B, C, and D.	4	A -- 0 B -- 0 C -- 0 D -- 2	E -- 0 F -- 0 G – 0 H --0	I -- 0 J -- 0 K --0 L --0
8	Straw in each cage was stirred from top to bottom. The submerged straw showed only black, anaerobic decay.	16	A -- 0 B -- 0 C -- 0 D – 3	E -- 2 F -- 0 G --0 H --0	I -- 0 J -- 4 K --0 L --5
16-17	Straw in each cage was stirred from top to bottom. The submerged straw showed only black, anaerobic decay.				
29	In pond C, two cages were raised to a floating depth of 4 inches. The long sides of these cages were tied together and positioned broadside in front of a rotating paddlewheel aerator to receive the flow of aerated water from the wheel.				
	July				
9-15	In pond C, the submerged straw in the cages near the aerator was black in color indicating continuing anaerobic decay. In two of the four cages in ponds A, B, and D, the cages were tied together and positioned in front of the aerators as was done earlier with the two cages in pond C. In the two repositioned cages in each of the four ponds, the black, anaerobically decayed straw was removed and one new bale of barley straw was evenly distributed on the surface of the water in each cage.	2	A -- 0 B -- 0 C -- 0 D -- 0	E -- 4 F -- 0 G -- 0 H -- 0	I -- 0 J -- 3 K -- 0 L -- 3
		16	A -- 0 B -- 0 C -- 0 D -- 0	E -- 0 F -- 0 G -- 3 H -- 0	I -- 0 J -- 3 K -- 0 L -- 3
	Black, anaerobically decayed straw in the two remaining cages in each pond was removed and replaced over the surface with one bale each of new barley straw and positioned evenly spaced on each pond as before.	30	A -- 5 B -- 0 C -- 0 D -- 2	E -- 0 F -- 0 G -- 4 H -- 0	I -- 0 J -- 0 K -- 0 L -- 0
16-17					

Table 1. Effect of floating barley straw for managing blue-green algae off-flavors in pond-raised catfish during 1998[1/] [2/] [3/]

Treatment		Flavor Score[4/]			
Date	Activity	Date	Treated Ponds	Untreated Ponds	
August					
12-14	The straw in each cage showed black, anaerobic decay. One bale of new barley straw was distributed over the surface of existing straw in each cage in ponds A, B, C, and D	13	A -- 4 B - - 0 C - - 0 D - - 0	E -- 0 F - - 0 G - - 2 H - - 0	I -- 0 J - - 0 K - - 0 L - - 3
		26	A -- 2 B - - 0 C - - 0 D - - 2	E - - 0 F - - 0 G - - 3 H - - 0	I - - 0 J - - 0 K - - 0 L - - 0
September					
1-3	All straw showed black, anaerobic decay. One bale of barley straw was distributed over the surface of existing straw in one cage in each pond nearest the aerator.	10	A -- 0 B -- 0 C -- 0 D -- 0	E -- 0 F -- 0 G -- 0 H -- 0	I -- 0 J -- 0 K -- 0 L -- 0
		24	A -- 4 B -- 0 C -- 1 D -- 3	E -- 0 F -- 0 G -- 0 H -- 0	I -- 0 J -- 0 K -- 0 L -- 3
October					
27	All cages were moved to the perimeter of the ponds A, B, C, and D. The submerged straw in all ponds was black in color indicating anaerobic decay.	8	A -- 3 B - - 0 C - - 0 D - - 0	E -- 0 F - - 0 G - - 3 H - - 0	I -- 0 J - - 0 K - - 0 L - - 1
		22	A - - 2 B - - 0 C - - 0 D - - 2	E - - 0 F - - 0 G - - 3 H - - 0	I -- 0 J - - 0 K - - 0 L - - 1

[1/]Twelve one-acre ponds, 145 by 300 ft (43,500 ft^2 or 4047 m^2) were each stocked in March 1997 with 6000 catfish weighing 1 to 1.25 lb/fish and fed daily with a high protein food mixture.
[2/]Bales of barley straw averaged 35 lb/bale and provided 0.013 oz/ft^2 or 3.9 g/m^2 of pond surface.
[3/]Four ponds, designated A, B, C, and D, were treated with barley straw. Eight ponds, designated E, F, G, H, I, J, K, and L, were maintained as untreated control ponds.
[4/]Flavor score is 0 = acceptable and 5 = very unacceptable. Flavor of fish as cooked and evaluated by professional tasters. No level of off-flavor is acceptable for marketing.

THE NOXIOUS WEED PROGRAM OF THE NORTH CAROLINA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES. D. T. Patterson, North Carolina Department of Agriculture and Consumer Services, P. O. Box 27647, Raleigh, NC 27611.

ABSTRACT

North Carolina is one of 35 states that have noxious weed lists. Two other states also regulate the entry and movement of noxious weeds but do not list specific weeds. North Carolina's "Regulations for State Noxious Weeds," adopted under the authority of the North Carolina Plant Pest Law, define noxious weed as "any plant in any stage of development, including parasitic plants, whose presence whether direct or indirect is detrimental to crops or other desirable plants, livestock, land, or other property or is injurious to the public health." Three classes of noxious weeds are defined: Class A – "Any noxious weed on the Federal Noxious Weed List or any noxious weed that is not native to the State, is not currently known to occur in the State, and that poses a serious threat to the State." Class B -- "Any noxious weed that is not native to the State, is of limited distribution statewide, and poses a serious threat to the State." Class C -- "Any

other designated noxious weed." In addition to all Federal Noxious Weeds, the following species or species groups are listed as Class A noxious weeds: African elodea (all species of *Lagarosiphon*); water fern (all species of *Salvinia* except *S. rotundifolia* = *S. minima*); mile-a-minute or tear-thumb (*Polygonum perfoliatum*); swamp stonecrop (*Crassula helmsii*); and water chestnut (all species of *Trapa*). Class B noxious weeds include: Florida betony (*Stachys floridana*), yellow fieldcress (*Rorippa sylvestris*), lythrum(any *Lythrum* species not native to North Carolina, including *L. salicaria*, *L. virgatum*, and hybrids), puncturevine (*Tribulus terrestris*), Canada thistle (*Cirsium arvense*), musk thistle (*Carduus nutans*), plumeless thistle (*Carduus acanthoides*), Eurasian watermilfoil (*Myriophyllum spicatum*), and Uruguay water primrose (*Ludwigia uruguayensis*). No species are currently listed as Class C Noxious Weeds. The following acts are prohibited: The movement of any Class A or Class B noxious weed or infested regulated article into North Carolina; the movement of any Class A noxious weed or infested article within the State; and the movement of Class B noxious weeds or infested articles from specific counties within the State. Regulated articles include soil, sand, gravel, compost, hay, straw, grass sod, nursery stock, soil-moving equipment not cleaned free of soil, and any other conveyance determined to present a hazard of spread of noxious weeds. Five Class A and two Class B noxious weeds currently are targeted for eradication in North Carolina. Witchweed (*Striga asiatica*), an obligate root parasite of corn, sorghum, and other grasses was first identified in North Carolina in 1956. A combined state/federal quarantine and eradication program begun in 1958 has reduced the infested area from 350,000 ac in 27 counties to 7000 ac in 6 counties. Itchgrass (*Rottboellia cochinchinensis*), a robust, profusely-tillering annual grass native to the Old World tropics and subtropics, was first detected in North Carolina in 1984 near a major north/south railroad in Robeson County. The original infestations were essentially eradicated within 4 years, but a few plants are still detected occasionally and destroyed. Tropical soda apple (*Solanum viarum*) is an aggressive, thorny weed of pastures. Native to South America, it was first detected in the United States in 1988 in Florida. It has since been reported from eight southern states including North Carolina, where it was first detected in northern Sampson County in 1995. A second infestation was discovered in southern Sampson County in 1998. Both infestations are traceable to cattle shipped from Florida. About 900 ac of pasture and adjacent woodland were surveyed in 1998, and 382 plants were rogued and destroyed. Small broomrope (*Orobancle ramosa*) is an obligate root parasite of legumes and tobacco. Native to the Old World, it was first reported in North Carolina prior to 1968. Currently, there is an infestation on clover in a 15 ac hay field in Mitchell County. Giant salvinia (*Salvinia molesta*) is a floating aquatic fern, native to South America. Notorious for its ability to clog waterways, it is also popular as an ornamental for water gardens. It was first detected in North Carolina at an aquatic nursery display in 1998 and has subsequently been found at aquatic nurseries, aquatic plant dealers, botanical gardens, and retention ponds in 9 counties. It has not been found in any flowing stream or natural water body in the state and is not considered to be naturalized. All plants detected have been destroyed. Puncturevine, native to the Mediterranean region, is an annual weed of row crops, vegetables, and pastures, named for the ability of its mature fruit to puncture bicycle tires and injure the feet and mouths of grazing animals. It was first reported in North Carolina prior to 1968, and an infestation first detected in Chowan County in 1997 is being eradicated. Purple loosestrife (*Lythrum salicaria*), an aggressive invader of wetlands, is native to Europe. It was reported from western North Carolina prior to 1968. Infestations in Forsyth, Mitchell, and Watauga Counties are being eradicated.

WEED CONTROL SYSTEMS IN ROUNDUP READY® CORN. O. C. Sparks, L. R. Oliver, and J. W. Barnes, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR 72704.

ABSTRACT

Atrazine and cyanazine are members of the triazine family of herbicides. For years residues have been detected in surface and ground water throughout the Midwest. Detection of these residues resulted in the recent discontinuation of the cyanazine label. It would be naive to assume that atrazine, a related chemical compound, would not suffer the same fate just because of its excellent weed control and crop safety in field corn (*Zea mays*). Thus, it is imperative to find alternative herbicide systems. Genetically engineered corn may offer growers another option in weed control.

In 1998, an experiment was initiated at Fayetteville, AR to evaluate weed control systems in Roundup Ready corn utilizing glyphosate to reduce or eliminate atrazine applications. The experimental design was a randomized complete block with four replications. Plots consisted of a single 40-inch row, 27 feet long. On April 16, the plot area was sown with weed seed incorporated to a depth of 0.5 inches. Dekalb Exp 363RR cultivar was planted at 26,400 seed/A, to a depth of 1.5 inches. Corn emerged 15 days later on May 1. Weed control and corn injury ratings were taken at 2, 4, 6, and 9 weeks after emergence (WAE). Roundup Ultra was applied over-the-top in single and/or sequential applications at 1- to 3-inch weeds or 1- to 3-inch weed regrowth, and in conjunction with Fultime, a prepackage mix of acetochlor + atrazine, at 1.35 and 2.7 lb ai/A. Broadcast directed applications of Roundup Ultra were applied with drop nozzles under the canopy after corn reached a free-standing height of 30 inches. All treatments were applied with a CO_2

backpack sprayer, calibrated to 10 GPA. Corn was irrigated with a lateral sprinkler system according to the Arkansas Irrigation Scheduling Program. Data were subjected to analysis of variance, and means were separated by the least significant difference test ($LSD_{0.05}$).

All treatments provided 92% or greater control of common lambsquarters (*Chenopodium album*), large crabgrass (*Digitaria sanguinalis*) and common cocklebur (*Xanthium strumarium*) . Roundup Ultra applied three times at 0.375 lb ai/A gave 80% or greater control of all weed species. The level of control was equivalent to Fultime or atrazine programs. Two Roundup Ultra applications at 0.5 or 1.0 lb ai/A gave greater than 80% control of entireleaf morningglory (*Ipomoea hederacea var. integriuscula*) and velvetleaf (*Abutilon theophrasti*), which was again equal to the atrazine treatments. The yield of two or three applications of Roundup Ultra was equivalent to the atrazine treatments. Three applications of Roundup Ultra allowed maximum application flexibility, with the last sequential application broadcast directed with drop nozzles. No injury or yield reduction was noted. Split applications of Roundup Ultra showed excellent potential for effective weed control and acceptable corn yields.

BIOLOGY AND IDENTIFICATION OF PRICKLY *SOLANUM* SPECIES OF THE SOUTHEASTERN UNITED STATES. C. T. Bryson and N. C. Coile, USDA-ARS, Southern Weed Science Research Unit, Stoneville, MS 38776 and Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Gainesville, FL 32614.

ABSTRACT

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 they also interfere with manual and mechanical harvest efficiency. Since the introduction from South America in the early 1980s and rapid spread of tropical soda apple (*S. viarum* Dunal) initially in Florida and then into Alabama, Georgia, Louisiana, Mississippi, North Carolina, Pennsylvania, South Carolina, Tennessee, and Puerto Rico, prickly nightshades have recently received more interest. Currently two non-native species of prickly nightshades, tropical soda apple and turkeyberry (*S. torvum* Sw.), are listed on the Federal Noxious Weed List. Recently, wetland nightshade (*S. tampicense* Dunal), another non-native invasive, threatens natural areas along several rivers and streams in south-central Florida. Buffalobur (*S. rostratum* Dunal), hairy horsenettle (*S. pumilum* Dunal), horsenettle (*S. carolinense* L.), robust horsenettle (*S. dimidiatum* Raf.), silverleaf nightshade (*S. elaeagnifolium* Cav.) 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 (*S. mammosum* L.), red soda apple (*S. capsicoides* All.), and sticky nightshade (*S. sisymbriifolium* Lam.). Of the twelve prickly nightshade species presented herewith, all are invasive weeds with the exception of hairy horsenettle, which is a narrow endemic of dolomite and gneiss outcrops in Alabama and Georgia. Buffalobur is an annual. The other prickly nightshades are perennials in tropical climates. Only horsenettle, robust horsenettle, silverleaf nightsade, and sticky nightshade produce root systems deep enough to survive extended periods of time below 0 C. Because of the frequent requests for identifications of prickly nightshades, we have developed a diagnostic chart to aid in identification of the native and non-native species that occur in the southeastern United States. Utilizing characteristics alone or in combination, this chart allows the user to identify plants in the vegetative, flowering, and/or fruiting stages. The most useful characters are: 1) type, size, and location of prickles; 2)plant pubescence; 3) flower and fruit color, shape, and size; and 4) unique seed shape, size, color, and characteristics.

HYBRIDIZATION POTENTIAL FROM GLUFOSINATE-RESISTANT RICE LINES TO RED RICE (*Oryza sativa*). W. Zhang, E. P. Webster, D. Y. Lanclos, and J. L. Griffin, Louisiana State University Agricultural Center, Baton Rouge, LA 70803

ABSTRACT

A greenhouse study was conducted in 1998 to evaluate the effect of plant height and maturity on the hybridization potential from glufosinate-resistant rice lines to red rice. A completely randomized design was used with four replications. The glufosinate-resistant rice lines included ‘BNGL HC-11', ‘RS PB-13' and ‘OSH 496-4-R’ The red rice was a ‘strawhull’ Louisiana biotype.

The three rice lines and red rice were seeded in flats and at the 2 to 3 leaf stage, 15 seedlings of red rice and each glufosinate-resistant rice line were transplanted into plastic 75x45x15-cm containers at a spacing of 9 cm. The plants

in each container were arranged so that each rice plant was surrounded by four red rice plants and vice versa. A Crowley silt loam soil with a pH of 5.5 and 1.4% organic matter was used. The plants were grown until seed reached physiological maturity. Days to first and 50% heading, seed head number, and plant height at flowering of the glufosinate-resistant rice lines and red rice were determined.

Red rice began heading earlier than BNGL HC-11 and CPRS PB-13, but later than KOSH 496-4-R. Red rice reached 50% heading 4 to 9 d later than all the rice lines, indicating that red rice reaches physiological maturity later than the glufosinate-resistant rice lines. The number of seed heads of red rice per container was greater than that of the rice lines, indicating more tiller development by red rice. At flowering, red rice was 23 to 24 cm taller than the glufosinate-resistant rice lines. CPRS PB-13 was significantly taller than the other two rice lines, but height difference between red rice and the rice lines was consistent.

At physiological maturity, F1 red rice seeds were collected from each container and air-dried at 20 C for 2 weeks. After drying, one hundred F1 red rice seeds from each container were planted. Germination of the seeds ranged from 36 to 56%. At the 2 to 3 leaf stage, red rice seedlings were treated with glufosinate at 0.56 kg ai/ha using a CO_2 backpack sprayer set to deliver 140 L/ha. Hybridization was determined by the percent survival of the F1 red rice seedlings following glufosinate treatment. At 7 d after glufosinate treatment, no F1 red rice seedling survived, indicating that hybridization had not occurred.

In conclusion, the height difference between red rice and the glufosinate-resistant rice lines may be a barrier for hybridization. However, the simultaneous flowering between red rice and the glufosinate-resistant lines evaluated could increase the potential for hybridization.

EFFECT OF DIFFERENT NOZZLE TYPES AND SPRAY PRESSURES ON DROPLET SIZE AND EFFICACY OF ROUNDUP ULTRA®. E. J. Jones[1], J. E. Hanks[2], G. D. Wills[1], and J. A. Mills[3], Miss. Agric. and Forest. Exp. Stn.,[1] and USDA-ARS[2], Stoneville, MS, and Monsanto Co., Collierville, TN.[3]

ABSTRACT

Field and laboratory studies were conducted to determine the effect of six different spray nozzles on weed control efficacy and spray droplet size of Roundup Ultra®. In the field study, Roundup Ultra® was applied to 6- to 8-inch-tall soybeans (*Glycine max* L.) 'ASGROW 5901 RR' planted in plots of four rows each spaced 38 inches apart, 40 feet long and interspaced with 4- to 5-inch-tall pitted morningglory (*Ipomoea lacunosa* L.) and nodding spurge (*Euphorbia nutans* Lag.), and 4- to 6-inch-tall southwestern cupgrass [*Eriochloa gracilis* (Fourn) A. S. Hitchc.]. Spray nozzles and field spray pressures at 10 gpa were TeeJet Extended Range 110015VS (38 psi), TeeJet Drift Guard 110015VS (40.5 psi), TeeJet Turbo 110015 (42 psi), TeeJet Turbo Flood VS2 (19.5 psi), TeeJet Air Induction 110015VS (38 psi), and Turbo Drop 110-04 (40.5 psi). Roundup Ultra was applied with each spray nozzle at a low rate of 0.38 and a high rate of 0.75 lb ae in 10 gpa. Spray solutions were applied with a tractor-mounted spray boom with eight nozzles spaced 19 inches apart. Each treatment was replicated four times in a randomized complete block design. Ratings were 0 = no effect and 100% = complete kill of plants.

Droplet size was determined for water, and for Roundup Ultra sprayed at 0.38 and 0.75 lb ae/A in 10 gallons of water at 40 psi using each of the above spray nozzles. Droplet size distribution was determined with a Malvern 2600 Lc laser particle analyzer.

Soybeans showed no effect from any treatment. Control was similar with all six spray nozzles for each weedy species. At each the low and the high rate of Roundup Ultra, control of pitted morningglory was 81 to 85% and 91 to 95%, nodding spurge was 90 to 95% and 95 to 100%, and southwestern cupgrass was 95 to 96% and 100%.

Individual spray nozzles produced different levels of "fines" (<105 microns) which are droplets more prone to drift. Among the different spray nozzles, the greatest volume of fine droplets often occurred with the high rate of Roundup Ultra. When spraying at the high rate of Roundup Ultra and 40 psi, the percent volume of spray droplets larger than 105 microns for each spray nozzle was Turbo Drop 97%, Air Induction 94%, Turbo Flood 92%, Turbo 82%, Drift Guard 67%, and Extended Range 51%. At these same spraying conditions, the volume median diameter in microns with each nozzle was Turbo Drop 600, Air Induction 490, Turbo Flood 460, Turbo 220, Drift Guard 150, and Extended Range 110.

Results of this study indicate that the volume of driftable fine droplets of Roundup Ultra can be reduced by altering the design of the applicator spray nozzles without appreciably affecting the efficacy of the herbicide.

POPULATION DYNAMICS OF ALS-RESISTANT COCKLEBUR. A. Kendig and A. Ohmes, University of Missouri Delta Center, Portageville, MO 63873.

ABSTRACT

After the discovery of ALS resistant cocklebur, conflicting recommendations were given. One suggested that no ALS compounds be used after resistant populations had become a problem. The other recommendation suggested that growers could continue to use ALS-inhibiting compounds for the control of other weeds if another herbicide, with a different mode of action on the resistant species was included. This study was conducted to gain insight into population dynamics of several herbicide programs. The primary objective was to evaluate the previously mentioned recommendations. Additional objectives were to determine how fast resistance would build up and to evaluate which programs favored or prevented resistance problems.

A long-term, fixed-plot study was initiated with the following 2 X 4 X 4 factorial treatment scheme. Initial inoculation of ALS-resistant cocklebur of 1) 4 cocklebur per plot or 2) 100 cocklebur per plot; PRE herbicide treatments of 1) metribuzin 2) imazaquin 3) metribuzin plus chlorimuron (Canopy) or 4) No preemergence control; and POST herbicide treatments of 1) bentazon, 2) imazaquin, 3) chlorimuron and 4) No postemergence control. Cocklebur stands were counted after PRE and POST treatments for six years. Plots were larger than normal (20 by 60 feet) and data were collected from the middle 5 by 40 feet. Seed samples were collected each winter, grown in the greenhouse and treated with a double-rate each of imazaquin and chlorimuron to estimate resistant:susceptible proportions. 1998 seed have not been tested.

By 1998, there were no differences between high and low inoculation levels within herbicide programs. This would indicate that populations were equilibrating and that any effects from the initial inoculation levels had culminated. During the first two years there were little to no increases in cocklebur populations in ALS-only herbicide programs. In 1996 (year 3), populations increased greatly in both low-and high inoculation plots and by 1997 (year 4) there were little to no population differences between ALS-only programs and untreated controls. These results largely echo reports from growers who developed ALS resistance problems. These growers often reported that they "noticed" an uncontrolled species in the third year and then had a major control failure in the fourth year of an ALS-based herbicide program. Few differences were observed between respective chlorimuron and imazaquin programs. Bentazon generally provided excellent cocklebur control and there were no indications of population changes when bentazon was combined with ALS-inhibiting, preemergence herbicides. It appears that a highly-effective, non-ALS herbicide could allow the continued use of ALS-inhibiting herbicides for the control of other weeds. Metribuzin provided poor cocklebur control when used alone. When used in combination with an ALS-inhabiting herbicide, populations were suppressed in the early years, however by 1998 (year 5), there were few differences in metribuzin alone and metribuzin followed by an ALS-inhibiting herbicide. Cocklebur populations with metribuzin, imazaquin and low initial inoculation were lower than some other metribuzin-ALS combinations. There were few differences between respective programs using preemergence metribuzin or metribuzin plus chlorimuron (Canopy).

In ALS-only treatments, populations increased rapidly in the third year in BOTH low and high inoculation treatments. By the fourth year there were few differences between ALS-only treatments and untreated controls. By the fifth year there were no differences between high inoculation and low inoculation treatments. Bentazon suppressed the cocklebur populations regardless of preemergence treatment. Metribuzin suppressed cocklebur populations, but generally provided inadequate control. By the By the fifth year there were few differences between metribuzin alone and metribuzin-ALS programs, indicating that metribuzin did not prevent the development of resistant populations. Testing of seed for resistance will be completed this spring. This could provide additional insight into the dynamics; however, preliminary data indicate that plots contain essentially all resistant or all susceptible cocklebur. Because soybeans have highly-effective, non-ALS alternatives for cocklebur control ALS resistance can be managed in this weed-crop combination.

RICE RESPONSE TO IMAZETHAPYR APPLICATION TIMINGS IN WATER-SEEDED CULTURE. J. A. Masson, E. P. Webster, and S. N. Morris. Louisiana State University Agriculture Center, Baton Rouge.

ABSTRACT

A field study was established in 1998 at the Rice Research Station in Crowley, LA to evaluate weed control and rice injury at different application timings and rates with imazethapyr resistant (IR)-rice in a water-seeded culture. IR-rice, '93 AS-3510', was planted on May 22, 1998. The study consisted of a RCB with a factorial arrangement of treatments. Factor A consisted of imazethapyr at 0.063, 0.094, and 0.125 lb ai/A. Factor B consisted of four application timings: 1) PPI, 2) SURFACE 3) PRE-SEED 4) PEG. Factor C consisted of either an EPOST to 3-leaf rice application at 0.063 lb/A, or no EPOST. Plot size was 5' x 20'. Applications were made with a CO_2 backpack sprayer set to deliver 15 GPA at 3 MPH. Barnyardgrass [*Echinochloa crus-gali* (L.) Beauv] and red rice (*Oryza sativa* L.) were visually evaluated at 30 d after EPOST (DAEPOST), while rice injury was evaluated 2, 15, and 30 DAEPOST. Height was measured at 30 DAEPOST. Data were subjected to ANOVA and all possible interactions tested. Treatment differences were compared using Fisher's protected LSD at the 5% level of probability.

At 30 DAEPOST, barnyardgrass and red rice control was at least 90% for all PPI, SURFACE, and PRE-SEED treatments. Single applications of imazethapyr at 0.063 and 0.094 lb/A at PEG controlled barnyardgrass 85 and 87%, respectively. Imazethapyr at 0.094 lb/A at PEG controlled 88% of the red rice. However, when followed by EPOST applications, control was equal to all other treatments.

At 2 DAEPOST, rice injury was at least 25% for a single application of 0.125 lb/A imazethapyr at PEG and for 0.094 and 0.125 lb/A PEG followed by imazethapyr EPOST. The PPI and SURFACE treatments, regardless of rate, injured rice no more than 10%. At 15 DAEPOST, rice injury was more than 20% for all rates applied at PEG followed by an EPOST. All other timings and rates had less than 20% injury. At 30 DAEPOST, the same PEG treatments continued to injure rice with 17 to 26%, compared with the other application timings and rates. Imazethapyr at most rates applied PPI, SURFACE, or PRE-SEED, injured rice less than 10% 30 DAEPOST.

At 42 DAEPOST, imazethapyr at 0.125 lb/A PEG followed by 0.063 lb/A EPOST reduced rice plant height compared to all PPI, SURFACE, and PRE-SEED treatments and a single application of 0.063 lb/A PEG. However, no differences occurred with other PEG treatments.

In conclusion, barnyardgrass and red rice were adequately controlled at all application timings and rates of imazethapyr. However, when imazethapyr was applied to rice at PEG followed by an EPOST treatment of imazethapyr in a water-seeded production system, excessive injury and height reduction occurred. This study indicates that a sequential application of imazethapyr should not be applied within 5 days following the initial application in water-seeded rice, because excessive injury and a height reduction may occur.

TOXICOLOGY OF TOMATINE AND TOMATIDINE IN WEEDS AND WEED PATHOGENS. R. E. Hoagland, Southern Weed Science Research Unit, USDA-ARS, Stoneville, MS 38776.

ABSTRACT

Various secondary plant compounds can interact with fungi and other microorganisms. Some of these interactions against microbes are ascribed to plant defense or phytoalexin action. Saponins (glycosylated steroidal or triterpenoid plant compounds) are common to many plant families, and can inhibit plant and bacterial growth. Many saponins have fungitoxic properties attributed to membraneolytic action on fungal membrane sterols. Tomatine is a saponin (steroidal glyco-alkaloid) produced by tomato (*Lycopersicon esculentus*) that accumulates in stems, leaves, and roots, and has fungitoxic activity. Hydrolytic cleavage of sugar moieties of tomatine can yield tomatidine, and hydrolysis by a pathogen (*Septoria lycopercici*) has been reported as a detoxification mechanism. Similar detoxification mechanisms by fungi have been implicated for analogous saponins such as the avenacins in oat, suggesting this detoxification can be a determinant in fungal host range. Studies were initiated to determine phytotoxic and antibiotic effects of tomatine and tomatidine in several species of plants and fungi, utilizing several bioassay systems.

Three phytotoxicity tests were conducted on several species to evaluate tomatine and tomatidine effects. Spray applications of tomatine (0.5 mM) and tomatidine (0.5 mM) were tested on 4-day-old etiolated seedlings of hemp sesbania, sicklepod, mungbean, wheat, and sorghum. After application, seedlings were grown 72 h in the dark, and then

stem elongation was determined in chemical treatments vs control (water spray). Chlorophyll accumulation of etiolated excised cotyledons or coleoptiles as affected by the compounds was evaluated in the same species. Chlorophyll was extracted in dimethyl sulfoxide and measured spectrophotometrically. Effects of tomatine and tomatidine on electrolyte leakage were measured as conductivity in solutions containing leaf disks of kudzu, wild senna, corn, and palmleaf morningglory. Fungal toxicity of these compounds on plant pathogens (*Alternaria cassiae*, *Colletotrichum truncatum*, and *Fusarium subglutinans*) was evaluated by incorporating either tomatine or tomatidine (each at 0.3 mM) into agar plates. Plates were incubated (28°C) following inoculation, and colony growth was measured after several days.

Tomatine, when applied as a spray to etiolated 4-day-old seedlings of sesbania, sicklepod, mungbean, wheat, and sorghum, was not highly phytotoxic, inhibiting stem elongation by only 7 to 13%. Tomatine was more effective than tomatidine in reducing chlorophyll content in excised etiolated tissues of hemp sesbania, sicklepod, mungbean, wheat, and sorghum. Inhibition of chlorophyll by tomatine ranged from 16 to 89% of control values, whereas inhibition by tomatidine was 0 to 30% of control. Both tomatine and tomatidine increased electrolyte leakage of leaf disks of corn, kudzu, palmleaf morningglory, and wild senna at 24 to 72 h after exposure to the compounds (0.5 mM) and to light (100 :E m^2 s^{-1}). Tomatidine was more effective than tomatine in increasing electrolyte leakage in these species. Both tomatine and tomatidine incorporated into agar at 0.3 mM inhibited the growth of three fungal pathogens. *Alternaria cassiae* was the most sensitive pathogen, and was inhibited 70% by both compounds. Tomatine inhibited *Colletotrichum truncatum* and *Fusarium subglutinans* by 63% and 50%, respectively; while tomatidine inhibited these two pathogens by 50% and 15%, respectively. These natural plant products have some broad range phytotoxicity and antibiotic effects which may be important in plant defense.

EFFECT OF *Pseudomonas syringae* pv. *tagetis* ON WEEDS. H. K. Abbas, B. J. Johnson, C. D. Boyette, W. T. Molin, and D. R. Johnson. USDA-ARS, SWSRU, Stoneville, MS 38776 and Encore Technologies, Minnetonka, MN 55305.

ABSTRACT

The bacterium *Pseudomonas syringae* pv. *tagetis* (PST) has several natural hosts including Canada thistle [*Cirsium arvense* (L.) Scop.], common ragweed (*Ambrosia artemisiifolia* L.), giant ragweed (*Ambrosia trifida* L.), Jerusalem artichoke (*Helianthus tuberosus* L.), marigold (*Tagetes minuta* L.), and sunflower (*Helianthus annuus* L.). We have ivestigated the facilitated host range on 19 species in greenhouse and field studies. Based on a disease rating scale of 0 to 5 where zero equals healthy and 5 equals chlorosis, necrosis and mortality, the species were divided into 6 different groups according to their response to PST: (0) unaffected- soybean [*Glycine max* (L.) Merr.]; (1) very mild effects- dandelion (*Taraxacum officinal* Weber in Wiggers); (2) low susceptibility- foxtail (*Setaria* spp.), and velvetleaf (*Abutilon theophrasti* Medicus); (3) moderate susceptibility- bull thistle [*Cirsium vulgare* (Savi) Tenore], western salsify (*Tragopogon dubius* Scop.), oxeye daisy (*Heliopsis* spp.), mugwort (*Artemisia vulgaris* L.), pineappleweed [*Matricaria matricarioides* (Less.) C.L. Porter], and sow thistle (*Sonchus arvensis* L.), eclipta (*Eclipta prostrata* L.), galinsoga (*Galinsoga* spp.), hawkweed (*Picris hieracioides* L.), common cocklebur, wooleyleaf bursage (*Ambrosia grayi* (A. Nels.) Shinners), beggar's tick (*Bidens* spp.), musk thistle (*Carduus nutans* L.), and horseweed [*Conyza canadensis* (L.) Cronq.]; (4) susceptible- common ragweed, giant ragweed, and Canada thistle; and (5) very susceptible- groundsel (*Senecio vulgaris* L.). Because soybean crops apparently are unaffected by PST, PST is a good choice for the biocontrol of common cocklebur a significant weed problem in soybean fields. Under greenhouse and field conditions, we studied the effects of PST on common cocklebur . Bacteria were grown in liquid shake culture for 36 - 48 hr. Common cocklebur plants 2 - 3 leaf stage were sprayed (1 ml/ plant) with an aqueous suspension of 10^8 cells/ ml with 0.2 % Silwet L-77 (v/v). All inoculated cocklebur were affected, but symptoms and severity varied between field tests and greenhouse tests. Symptoms included chlorosis of new leaves and petioles, necrosis, apical curl, biomass reduction, plant height reduction and mortality beginning within a week and progressing with time. However, in some cases chlorotic plants which survived 14 days until the end of the test recovered, but remained shorter than controls. In greenhouse experiments, plant height and biomass of treated common cocklebur were reduced 50 % and 65 %, respectively, when compared with untreated plants. In the field microplot (0.1 x 0.6 m) experiment, plant height and biomass of treated common cocklebur were reduced 35 % and 55 %, respectively, compared with controls after 2 week. These results indicate that PST has the potential to act as a biocontrol agent for several weed species.

EVALUATION OF IMAZETHAPYR RATES AND APPLICATION TIMES ON RED RICE (*Oryza sativa*) CONTROL IN IMIDAZOLINONE TOLERANT RICE. G. L. Steele, J. M. Chandler, and G. N. McCauley, Texas Agricultural Experiment Station, College Station, TX 77843 and Eagle Lake, TX 77534.

ABSTRACT

Field research was conducted in 1998 near Beaumont, TX to evaluate various rates and application timings of imazethapyr for red rice (*Oryza sativa* L.) control in imidazolinone tolerant rice. Treatments consisted of imazethapyr applied at 0.063, 0.094, 0.125, and 0.156 lb a.i./A. Applications were made at four different crop stages. Preplant incorporated (PPI) treatments were made immediately prior to planting, and incorporated with a field cultivator. Preemergence (PRE) applications were made immediately following planting. Delayed preemergence (DPRE) treatments were applied following the first flush. Postemergence (POST) applications were made 13 days after planting, when the crop was in the 1 to 3 leaf-stage. Visual weed control and crop response ratings were conducted at 13 days after treatment (DAT) of PPI and PRE applications, and 9, 15, 21, and 64 DAT of POST applications. Yield was obtained by harvesting the center four rows of each six-row plot.

At 9 DAT of POST applications, red rice (ORYSA) control for all rates of imazethapyr applied PPI, DPRE, or POST was at least 81%, while PRE treatments controlled ORYSA less than 72%. Crop injury from POST applications ranged from 16 to 48%, and a rate response was observed. By 15 and 21 DAT, ORYSA control remained at least 68% for all treatments. As before, imazethapyr applied PRE controlled ORYSA less than PPI and POST applications, regardless of rate. ORYSA control from POST treatments was at least 91%. However, crop injury was still observed. Later in the season, at 64 DAT, similar ORYSA control trends were observed. All POST treatments and PPI treatments above 0.094 lb/A continued to control ORYSA at least 91%. As before, ORYSA control was lower with PRE applications, regardless of rate. Crop injury was still observed from POST applications, but was less than 13% for all rates. Yield ranged from 2897 lb/A to 3414 lb/A with minimal difference between rates or application timings. All treatments resulted in higher yield than the untreated plots, regardless of rate or application timing. Low yields, regardless of treatment, are the result of a late planting date.

In conclusion, all imazethapyr treatments controlled ORYSA at least 65%, regardless of rate or application timing. ORYSA control from PPI applications was better than PRE treatments for most rates. POST treatments of imazethapyr controlled ORYSA at least 90% throughout the season, regardless of rate. An increase in rate applied POST did not improve ORYSA control, but did increase crop injury. Results indicate that adequate control of ORYSA can be obtained from applications of imazethapyr in imidazolinone tolerant rice.

BIOLOGICAL CONTROL OF KUDZU (*Pueraria montana*) WITH AN ENDEMIC FUNGAL PATHOGEN. C. D. Boyette[1], H. L. Walker[2], and H. K. Abbas[1]; USDA-ARS, Southern Weed Science Research Unit Stoneville, Mississippi[1], and Dept.of Biological Sciences, Louisiana Tech University, Ruston, Louisiana[2].

ABSTRACT

Kudzu [*Pueraria montana* (Lour.) Merr.] is a perennial leguminous vine native to eastern Asia. Kudzu was introduced into the U. S. in the late 1800's, and presently occurs from Florida to New York, westward to central Oklahoma and Texas, with the heaviest infestations in Alabama, Georgia, and Mississippi. It was listed in a report by Congress in 1993 as one of the most harmful nonindigenous plant species in the U. S., and was listed as a noxious weed in 1998.

An isolate of the fungus *Myrothecium verrucaria* (Alb. & Schwein.) (MV) originally isolated from diseased sicklepod (*Senna obtusifolia* L.) exhibited biocontrol potential against leguminous weed species, such as sicklepod (*Senna obtusifolia* L.), and hemp sesbania (*Sesbania exaltata* Rydb. ex A.W. Hill). Kudzu was not tested in those experiments and has not been previously reported as a host of MV. In greenhouse tests, we found that MV is highly virulent against kudzu and that dew was not required for weed control when fungal spores were formulated in 0.2% Silwet L-77 surfactant (SW). In controlled environment tests, disease development was favored by higher temperatures (25-40 C) as compared to lower temperatures (10-20 C), although pathogenesis and mortality occurred at all temperatures that were tested. Disease symptomatology was characterized by necrotic flecking which occurred within 6 h following treatment at incubation temperatures of 30-40^{o}C with slower disease development at lower temperatures. Disease symptoms progressed from inoculated cotyledons and leaves to produce stem lesions within 48h. The fungus sporulated profusely on infected tissue and was easily reisolated.

In replicated field micro-plots (0.5 m^2) transplanted kudzu seedlings in the 2-to 3 leaf growth stage treated with MV at 2×10^7 in 0.2% SW exhibited leaf and stem necrosis within 24 h following inoculation, with mortality occurring within 96 h. After 7 days, 100% of inoculated plants had been killed in plots treated with the fungus/surfactant mixtures. No visible damage was observed on plants in plots treated with the fungus in distilled water only, surfactant only, or untreated, and no dry weight reductions occurred in any of these treatments. Similar results were obtained in a naturally-occurring kudzu population infestation site near Greenwood, MS in July, 1998. Kudzu was controlled 100% after 14 days in plots treated with fungus/surfactant mixtures applied at 2×10^7 conidia/ml, with no visual symptoms or weed control occurring in any other treatment. After 4 weeks, vines from untreated plot margins had begun to spread into treated areas where kudzu had been killed, but no new leaf regrowth occurred on vines that had been killed. In summary, *M. verrucaria* effectively controlled kudzu in the absence of dew over a wide range of temperatures. Excellent weed control was achieved under field conditions where temperatures exceeded 40°C. These results indicate that when properly formulated, *M. verucarria* has potential as a valuable bioherbicide for controlling kudzu.

POSTEMERGENCE WEED CONTROL OPTIONS IN COTTON. M. R. McClelland and J. L. Barrentine. Department of Crops, Soils, and Environmental Sciences, University of Arkansas, Fayetteville, AR 72701.

ABSTRACT

The development of selective postemergence (POST) herbicide technology for broadleaf weed control in cotton has provided producers with a versatile weed management tool for conventional and conservation-tillage cotton. Pyrithiobac (Staple®) can be used on standard cotton cultivars and has soil and foliar activity. Bromoxynil (Buctril®), used with BXN transgenic cultivars, has no residual activity and can be applied to cotton at any stage. Glyphosate (Roundup Ultra®) is used with transgenic Roundup Ready® cotton and can be applied over-the-top through the four-leaf cotton stage. The objective of this research was to evaluate efficacy of these herbicides with and without standard preemergence herbicides in stale seedbed cotton.

The experiment was conducted at Marianna, AR , on a silt loam soil. Beds were hipped and leveled in early April. The test area was overseeded with large crabgrass (*Digitaria sanguinalis*), smooth pigweed (*Amaranthus hybridus*), pitted morningglory (*Ipomoea lacunosa*), and prickly sida (*Sida spinosa*). Each plot was four, 38-in. rows, 40 ft. long. Appropriate cotton cultivars (Roundup Ready®, BXN, and DPL) were planted May 16 into the stale seedbeds. Paraquat was applied as a burndown at planting. Herbicides were applied at 20 gpa with a tractor-mounted or backpack sprayer. Treatments were applied in a factorial arrangement [five POST programs by three levels of preemergence (PRE)] on an RCB design with four replications. Postemergence treatments included: BXN program -- bromoxynil (0.5 lb ai/A) applied early over-the-top (EOT) on a 19-in. band when cotton had 4 leaves, followed by (fb) a standard post-directed (DIR) treatment of cyanazine, 1 lb ai/A + MSMA, 1.5 lb ai/A at the 7-leaf cotton stage (BXN cotton); RU program -- glyphosate (0.75lb ai/A) EOT broadcast fb glyphosate post-directed (Roundup Ready cotton); PYR program -- pyrithiobac (0.063) + surfactant, 0.25%, EOT on a 19-in. band fb a standard DIR treatment (DPL cotton); PYR/BXN program -- pyrithiobac (0.063lb/A) + bromoxynil, 0.38 lb/A EOT + surfactant, 0.25% on a 19-in. band fb a standard DIR treatment; and RU/PYR program-- glyphosate (0.75lb/A) EOT (broadcast) fb pyrithiobac (0.063lb/A) + surfactant, 0.25% at the 7-leaf cotton stage. Quizalofop was applied 7 h before bromoxynil and pyrithiobac alone and tank mixed for grass control. The preemergence (PRE) factors included pendimethalin + fluometuron + paraquat applied at the labeled rate (1 + 1.5 + 0.63 lb/A), at a reduced rate (0.5 + 0.75 + 0.63 lb/A), and no PRE. In addition to post-directed treatments listed, a maintenance treatment of cyanazine + MSMA was applied post-directed July 1 to all plots. Glyphosate was applied with a hooded sprayer as needed to control weeds in row middles.

A heavy weed population was present. Averaged over POST herbicide programs, a PRE application increased control of large crabgrass and smooth pigweed compared to no PRE (95% with labeled PRE vs. 77% with no PRE for large crabgrass and 99 vs 83% for smooth pigweed). The labeled PRE rate enhanced prickly sida control, but there was no difference between no PRE and reduced-rate PRE. Level of the PRE component did not affect control of pitted morningglory (86 to 81%). Grass control was poor with the BXN and RU/PYR programs when no PRE was used. The heavy infestation of grass in plots without PRE was difficult to control with POST alone. The RU program controlled grass without PRE. PRE was necessary for smooth pigweed control with the BXN program (34% control without PRE). Tank mixing pyrithiobac with bromoxynil (PYR/BXN program) controlled pigweed adequately (96%). Prickly sida control was poorest with the RU/PYR program (63%) because it was too large to be controlled by the later application of pyrithiobac. Plants had 2 to 4 leaves at EOT and 4 to 6 leaves at LOT and DIR. Pitted morningglory control was fair to good (80 to 89%) with all programs except RU/PYR without PRE. Rainfall prevented earlier application, which might

have increased control. Seedcotton yields did not differ among POST programs when a PRE was applied. A PRE application with BXN, PYR, and RU/PYR POST programs increased yield.

ROUNDUP READY AND BXN SYSTEMS FOR PERENNIAL WEED CONTROL ON THE TEXAS SOUTHERN HIGH PLAINS. J. D. Everitt, J. W. Keeling, P. A. Dotray, and T. S. Osborne, Texas Agricultural Experiment Station, Lubbock.

ABSTRACT

Producers on the Texas Southern High Plains use preplant incorporated and preemergence herbicides which provide effective control of many annual weed species. However, these herbicides are less effective on perennial weeds such as silverleaf nightshade (*Solanum elaeagnifolium*), woollyleaf bursage (*Ambrosia grayi*), and field bindweed (*Convolvulus arvensis*). Transgenic crops provide producers with several new options to control perennial weeds. The use of Roundup Ultra and Buctril in their respective tolerant cotton varieties provides new options to control many perennial weeds in-season. The objectives of this research were to: 1) evaluate Roundup Ultra and Buctril applications alone or in combination with cultivation for perennial weed control, 2) determine effects of weed control systems on cotton yield and economic returns, and 3) evaluate perennial weed control in the years following applications to determine the long-term control of these weeds.

Field studies were conducted at the Texas Agricultural Experiment Station in Lubbock and Halfway, TX and at the Texas Tech Research Station near New Deal, TX. These locations were selected because of their naturally occurring dense perennial weed populations. The experimental design at each location was a complete randomized block with 3 replications. Plot sizes ranged from 13 ft. by 30 ft. to 26 ft. by 100 ft. and varied by location based on weed densities. Roundup Ultra and Buctril were applied three times throughout the growing season. All herbicide treatments were used with and without cultivation. Roundup Ultra at 0.75 lb ae/A was applied postemergence-topical (PT) and postemergence-directed (PD). Buctril 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. Commercial standard weed control systems were used at each location and compared to the Roundup Ready and BXN systems. Weed control ratings were recorded 14 days after all applications at each location.

Roundup Ultra controlled silverleaf nightshade 72% at the end of the growing season, while Buctril provided 57% control. When cultivation was added to Roundup Ultra and Buctril systems, silverleaf nightshade control increased to 95% and 86%, respectively. Roundup Ultra controlled field bindweed 82% at the end of the season and control increased to 89% when cultivation was added. Buctril controlled field bindweed 40% without cultivation and 72% when cultivation was added. Roundup Ultra controlled woollyleaf bursage 72% at the end of the season, and control increased to 89% when cultivation was added. Buctril controlled woollyleaf bursage 43% without cultivation, and control increased to 78% with cultivation. Cultivation alone did not provide acceptable control any of the perennial weed species evaluated.

Both Roundup Ready and BXN cotton weed control systems increased yields and net returns over weed control costs as compared to cultivation alone for all weed species. Long-term weed control will be evaluated to determine which system provides the greatest reduction in weed populations over time.

MANAGING WEEDS IN LIBERTY LINK COTTON. L. Somerville, R. H. Walker and J. Belcher, AL. Agric. Exp. Stn., Auburn University.

ABSTRACT

Two preliminary field studies were conducted in 1998 in east-central Alabama to evaluate glufosinate weed control efficacy and tolerance of Liberty Link cotton. Glufosinate was applied postemergence at: (1) 0.27, 0.36, and 0.54 lb ai/A to 2-and 4-leaf cotton (2-L, 4-L), (2) 0.27 lb ai/A to 4- and 8-leaf (8-L) cotton following pendimethalin, fluometuron or norflurazon applied preemergence (PRE) at 0.75, 1.25 and 1.25 lb ai/A respectively, (3) or 0.27, 0.36, 0.54 lb ai/A to 8-L cotton following a combination of fluometuron plus norflurazon applied PRE. Weed species evaluated were junglerice, entireleaf morningglory, spiny pigweed and sicklepod. In a second study, glufosinate treatments included (1) single applications at 0.36 or 0.72 lb ai/A to 2-L, 4-L, 8-L cotton, or first bloom (FB), (2) double applications at 0.36 lb ai/A to 2- and 4-L, or 4- and 8-L cotton, (3) triple applications at 0.24 lb ai/A applied to 2-, 4-and 8-L cotton, or 4-8-L

and FB. Pendimethalin was applied PRE over the entire area at a rate of 0.750 lb ai/A. All plots remained weed free throughout the study by cultivation and hoeing.

All weeds were controlled 91% or greater for all species and treatments except for sicklepod which was controlled 87 % when glufosinate was applied at 0.27 lb ai/A to both 2-L and 4-L cotton. Maximum seed cotton yields were obtained with a cultivated and hoed treatment that received glufosinate at 0.27 lb ai/A at 2- and 4-L stages. Equivalent yields were obtained with glufosinate applied at 0.36 or 0.54 lb ai/A to both 2-and 4-L cotton, norflurazon applied PRE followed by glufosinate at 0.27 lb ai/A at both 2- and 4-L stages, or fluometuron plus norflurazon applied PRE, followed by a single application of glufosinate at 0.54 lb ai/A at the 8-L stage. The second study showed there were no detrimental effects on seed cotton yield with any glufosinate rate or stage application. Glufosinate could be applied safely through FB, at rates up to 0.72 lb ai/A.

HARD RED WINTER WHEAT SPECTRAL RESPONSES TO HERBICIDES. A. E. Stone[1], T. F. Peeper[1], J. B. Solie, and M. L. Stone[2], Graduate Research Assistant and Professors, [1]Department of Plant and Soil Science and [2]Department of Biosystems and Agricultural Engineering, Oklahoma State University, Stillwater, OK 74078.

ABSTRACT

The most common technique of assessing crop injury is to use the human eye to visually estimate the severity of damage. However, visual ratings are prone to variation in individual perception of color, intensity of damage, and experience

To investigate the use of optical sensing and quantify herbicide injury on hard red winter wheat, an experiment was begun on October 9, 1998. Jagger hard red winter wheat was planted with a single disc drill in 7 inch row spacings. The experiment was conducted using a randomized complete block design with four replicates and 5 x 25 foot plots. On November 11, 1998 herbicide treatments were applied. Reflectances were recorded at six sites randomly chosen in each plot two days after treatment. Each site was flagged and resample 7 and 12 days after treatment. The samples were illuminated with enclosed 12-volt quartz halogen lamps. Reflectances were measured over the 200 -- 1200 nm wavelength range with an Ocean Optics 2000 dual channel spectrometer.

At this point in the research, several conclusions can be made. Herbicide injury is detectable at a very early date with the spectrometer. Visual ratings are not always accurate estimates of plant health.

We plan to explore the potential for monitoring plant recovery from herbicide injury, and relate the impact of herbicides on ndvi to yield. We are including other herbicides in the research to explore the potential for using remote sensing to identify the herbicide responsible for crop injury.

EFFECTS OF SELECTED ADJUVANTS ON THE HERBICIDAL ACTIVITY OF PELARGONIC ACID. C. L. Foy and H. L. Witt, Department of Plant Pathology, Physiology and Weed Science, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.

ABSTRACT

Experiments were conducted in the greenhouse to evaluate the effects of the adjuvants, X-77, Silwet L-77, Kinetic, Dyne-Amic, Agrimax 3, methylated soybean oil, and Agri-Dex, on the activity of pelargonic acid (Scythe), a nonselective, foliar-applied contact herbicide. Pelargonic acid was applied alone or with adjuvants in spray volumes of 187 and 374 L/ha to green foxtail [*Setaria viridis* (L.) Beauv.] and velvetleaf (*Abutilon theophrasti* Medicus). Pelargonic acid at 0.8 to 6% (v/v), with or without adjuvants, in 187 L/ha did not control green foxtail effectively and only pelargonic acid at 6% + Agrimax 3 provided satisfactory control of velvetleaf. Pelargonic acid at 6.5 and 10% in 374 L/ha was as effective alone as with adjuvants on both species 9 d after treatment (DAT); at 3% efficacy on velvetleaf was improved with certain adjuvants.

INTRODUCTION

Pelargonic acid controls actively growing emerged green vegetation (1, 2). It provides burndown of annual and perennial broadleaf and grass weeds, as well as mosses and other cryptogams. Pelargonic acid does not translocate and burns only plant parts coated with the spray solution (1). New plants emerging from seeds or regrowth of treated vegetation require repeat treatment. Pelargonic acid at 1.5 to 6% (v/v) caused rapid desiccation and necrosis of weed species; however, after 8 to 10 d treated plants began recovery (4). It may be used as a directed spray in deciduous fruit trees and established ornamentals and woody plants (also prior to emergence of desirable ornamentals), prior to establishment of turfgrass or for trimming and edging in established turf, and in noncropland (3). Recommended rates of application are 3 to 10% (v/v) in 700 L/ha spray solution (or spray-to-wet).

Greenhouse experiments were conducted to evaluate the effects of selected adjuvants on the activity of pelargonic acid applied at various rates in spray volumes of 187 and 374 L/ha.

MATERIALS AND METHODS

Green foxtail and velvetleaf seeds were planted in 15-cm diam pots containing ProMix in the greenhouse. Each pot contained approximately 150 green foxtail plants or 10 velvetleaf plants.

Adjuvants tested were X-77 (nonionic surfactant), Silwet L-77 (organosilicone surfactant), Kinetic (blend of organosilicone and nonionic surfactants), Dyne-Amic (blend of organosilicone, nonionic surfactant, and methylated vegetable oil), Agrimax 3 (pyrrolidone surfactant), methylated soybean oil, and Agri-Dex (crop oil concentrate). All adjuvants were included at 0.25% (v/v) except methylated soybean oil and Agri-Dex (1%, v/v).

Treatments were applied using a CO_2-charged, moving belt laboratory sprayer equipped with a single 8001E (Experiment 1) or 8002E (Experiment 2) flat fan nozzle delivering 172 kPa pressure. Treatments were replicated four times (except three times on velvetleaf in Experiment 2).

Experiment 1
Pelargonic acid was applied at 0.8, 1.5, 3.0, and 6.0% (v/v) alone or with the adjuvants in 187 L/ha. Treatments were applied to green foxtail (20 to 25 cm tall and heading) 3 wk after seeding and to velvetleaf (10 to 13 cm tall) 2 wk after seeding. Control ratings (%) were recorded 1 wk after treatment (WAT).

Experiment 2
Pelargonic acid at 3.0, 6.5, and 10% (v/v) alone or with the adjuvants was applied in 374 L/ha. Paraquat at 0.6 kg/ha and glufosinate at 0.8 kg/ha, each plus X-77 at 0.25% (v/v), were included for comparison. Treatments were applied to green foxtail (up to 13 cm tall) and velvetleaf (5 to 8 cm tall) 2 wk after seeding. Control ratings (%) were recorded 1 and 9 DAT.

RESULTS AND DISCUSSION

Experiment 1
Pelargonic acid at the rates tested (alone or with adjuvants) was not effective against green foxtail as indicated by ratings 1 WAT (Table 1). Pelargonic acid at 6% plus Agrimax 3 provided 71% control of velvetleaf. Control with other treatments was 54% or less. Regrowth of treated plants of both species occurred.

Experiment 2
Pelargonic acid at 3% plus all adjuvants except Kinetic and methylated soybean oil was slightly more effective on green foxtail than the herbicide alone at 3% 1 DAT (Table 2). Adjuvants did not affect control 9 DAT.

Pelargonic acid at 3% plus X-77, Agrimax 3, or Agri-Dex was more effective than pelargonic acid alone on velvetleaf 1 DAT (Table 2). At 9 DAT, control was improved with all adjuvants except Kinetic and methylated soybean oil.

Comparisons within a rate of pelargonic acid revealed that the addition of adjuvants to pelargonic acid at 6.5 and 10% did not increase its performance on either species (Table 2). Control 9 DAT (except with pelargonic acid at 6.5% alone or with Kinetic on green foxtail) was equal to that with paraquat and glufosinate which were very effective on both species.

The experiment was maintained and observed for 30 DAT and only paraquat and glufosinate remained effective against green foxtail. Regrowth of velvetleaf plants occurred with pelargonic acid at 3%, with or without adjuvants; little to no regrowth occurred in most pots treated with pelargonic acid at 6.5 or 10%.

In summary, pelargonic acid at 6.5 and 10%, with or without adjuvants, in 374 L/ha spray volume controlled velvetleaf; green foxtail was suppressed initially but regrowth occurred. All adjuvants except Kinetic and methylated soybean oil increased control of velvetleaf 9 DAT with pelargonic acid at 3%, but none increased control of green foxtail. Regrowth of both species occurred. With one exception, pelargonic acid at the rates tested, alone or with adjuvants, in 187 L/ha spray volume gave poor control of both species.

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Table 1. Effect of pelargonic acid without and with adjuvants applied in 187 L/ha on control of green foxtail and velvetleaf one WAT[a].

Rate of pelargonic acid	Adjuvant	Rate	Control	
			Green foxtail	Velvetleaf
%, v/v		%, v/v	%	
0.0	None	-	0 m	0 h
0.8	None	-	0 m	0 h
1.5	None	-	1 lm	1 h
3.0	None	-	18 g-i	9 d-g
6.0	None	-	41 ab	49 bc
0.8	X-77	0.25	0 m	0 h
1.5	X-77	0.25	2 lm	1 h
3.0	X-77	0.25	16 g-j	3 gh
6.0	X-77	0.25	40 a-c	51 b
0.8	Silwet L-77	0.25	0 m	0 h
1.5	Silwet L-77	0.25	2 lm	1 h
3.0	Silwet L-77	0.25	28 d-f	6 e-h
6.0	Silwet L-77	0.25	31 c-e	44 c
0.8	Kinetic	0.25	0 m	0 h
1.5	Kinetic	0.25	1 m	0 h
3.0	Kinetic	0.25	33 b-e	6 e-h
6.0	Kinetic	0.25	43 a	54 b
0.8	Dyne-Amic	0.25	1 lm	0 h
1.5	Dyne-Amic	0.25	14 hk	1 h
3.0	Dyne-Amic	0.25	19 gh	15 d
6.0	Dyne-Amic	0.25	34 a-d	51 b
0.8	Agrimax 3	0.25	0 m	0 h
1.5	Agrimax 3	0.25	9 j-m	1 h
3.0	Agrimax 3	0.25	21 f-h	12 de
6.0	Agrimax 3	0.25	40 a-c	71 a
0.8	Methylated soybean oil	1.0	0 m	0 h
1.5	Methylated soybean oil	1.0	10 i-l	2 gh
3.0	Methylated soybean oil	1.0	25 e-g	10 d-f
6.0	Methylated soybean oil	1.0	40 a-c	51 b
0.8	Agri-Dex	1.0	0 m	0 h
1.5	Agri-Dex	1.0	6 k-m	0 h
3.0	Agri-Dex	1.0	21 f-h	5 f-h
6.0	Agri-Dex	1.0	39 a-c	54 b

[a]Means within a column followed by the same letter are not significantly different at the 5% level according to Duncan's Multiple Range Test.

Table 2. Effect of herbicides applied in 374 L/ha on control of green foxtail and velvetleaf[a]

Rate of pelargonic acid	Adjuvant	Rate	Control			
			Green foxtail		Velvetleaf	
			1 DAT	9 DAT	1 DAT	9 DAT
%, v/v		%, v/v	%			
3.0	None	-	51 j	59 g-i	48 fg	60 g
6.5	None	-	75 e-h	82 b-e	78 b-d	95 ab
10.0	None	-	94 a	96 ab	87 ab	96 ab
3.0	X-77	0.25	66 gh	68 e-h	72 d	87 b-d
6.5	X-77	0.25	80 b-f	84 a-d	83 a-c	96 ab
10.0	X-77	0.25	90 a-c	91 a-c	83 a-c	95 ab
3.0	Silwet L-77	0.25	65 g-i	71 d-g	57 ef	77 ef
6.5	Silwet L-77	0.25	83 a-f	83 a-e	83 a-c	95 ab
10.0	Silwet L-77	0.25	85 a-e	84 a-d	87 ab	95 ab
3.0	Kinetic	0.25	49 j	54 hi	42 g	60 g
6.5	Kinetic	0.25	76 c-g	75 c-f	83 a-c	92 a-c
10.0	Kinetic	0.25	89 a-d	92 ab	85 a-c	96 ab
3.0	Dyne-Amic	0.25	66 gh	64 f-i	57 ef	73 f
6.5	Dyne-Amic	0.25	83 a-f	89 a-c	87 ab	95 ab
10.0	Dyne-Amic	0.25	90 a-c	90 a-c	90 a	95 ab
3.0	Agrimax 3	0.25	64 hi	66 f-i	60 e	84 c-e
6.5	Agrimax 3	0.25	83 a-f	88 a-c	83 a-c	95 ab
10.0	Agrimax 3	0.25	90 a-c	91 a-c	88 ab	95 ab
3.0	Methylated soybean oil	1.0	54 ij	51 i	40 g	53 g
6.5	Methylated soybean oil	1.0	84 a-e	85 a-d	88 ab	93 ab
10.0	Methylated soybean oil	1.0	94 a	96 ab	90 a	96 ab
3.0	Agri-Dex	1.0	70 f-h	69 d-h	62 e	78 d-f
6.5	Agri-Dex	1.0	84 a-e	84 a-e	83 a-c	95 ab
10.0	Agri-Dex	1.0	91 ab	92 ab	87 ab	95 ab
Paraquat (0.6 kg/ha)	X-77	0.25	76 d-h	100 a	75 cd	100 a
Glufosinate (0.8 kg/ha)	X-77	0.25	6 k	100 a	13 h	95 ab
Nontreated	-	-	0 k	0 j	0 i	0 h

[a]Means a column followed by the same letter are not significantly different at the 5% level according to Duncan's Multiple Range Test.

INFLUENCE OF DRIFT RETARDANTS ON EFFICACY, DROPLET SIZE, AND SPRAY PATTERNS OF ROUNDUP ULTRA® HERBICIDE. G. D. Wills[1], J. E. Hanks[2], E. J. Jones[1], and R. E. Mack[3], Miss. Agric. and Forest. Exp. Stn.,[1] and USDA-ARS[2], Stoneville, MS, and Helena Chemical Co., Memphis, TN.[3]

ABSTRACT

Field and laboratory studies were conducted to determine the effect of nine 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 5-inch tall nodding spurge (*Euphorbia nutans* Lag.), 2- to 4-inch tall prickly sida (*Sida spinosa* L.) and smooth pigweed (*Amaranthus hybridus* L.), and 4- to 6-inch tall southwestern cupgrass [*Eriochloa gracilis* (Fourn.) A. S. Hitchc.] arranged in a randomized complete block design. Efficacy was determined by visual ratings where 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 using a single nozzle were determined by applying spray mixtures, similar to field applications, to a 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.

Soybeans showed no effect from any treatment. Nodding spurge, prickly sida, smooth pigweed, and southwestern cupgrass were controlled least at 80 to 94% with Roundup Ultra alone and Roundup Ultra plus HM 9718, HM 9810, HM 9814, and HM 9848. Control was increased to 94 to 100% with Roundup Ultra plus HM 9733-A, HM 9752, HM 9842, HM 9847, and HM 9850.

Spray patterns of the mixtures resulting in the greatest percent control ranged from 34 to 50 inches wide; whereas, the spray patterns of the spray mixtures resulting in the least percent control were each greater than 50 inches wide.

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 spray volume in droplets larger than 105 microns was as follows: water alone -- 56%, Roundup Ultra alone -- 54%, HM 9814 -- 55%, HM 9842 -- 69%, HM 9810 -- 70%, HM 9718 -- 70%, HM 9847 -- 73%, HM 9733-A -- 74%, HM 9850 -- 80%, HM 9848 -- 81%, and HM 9752 -- 86%. The most effective drift retardants mixed with Roundup Ultra which resulted in the greatest percent weed control, the greatest percent volume of spray droplets larger than 105 microns and the best controlled spray patterns were HM 9733-A, HM 9752, HM 9842, HM 9847, and HM 9850.

Table 1. Drift retardants and rates applied.

HM 9718	A proprietary blend of anionic polyacrylamide, hydrotreated petroleum distillate and water (2 oz/100 gal)
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 9810	A proprietary blend of polymers, surfactants, and aliphatic hydrocarbons (1 gal/100 gal)
HM 9814	A proprietary blend of plant nutrients; ammonium nitrate, urea, polymethylene urea, methylene diurea, monomethylol urea, water, and surfactants (10 gal/100 gal)
HM 9842	A proprietary blend of ammonia sulfate and a polyacrylamide polymer (2.5 gal/100 gal)
HM 9847	A proprietary blend of ammonia sulfate, micronutrients, sequestrants, polyacrylamide polymers, and colloidal polymers (9 lb/100 gal)
HM 9848	A proprietary blend of aliphatic hydrocarbons, hexahydric alcohol ethoxylates, fatty acids, phosphate ester buffering agents, and polymeric additives (1 gal/100 gal)
HM 9850	A proprietary blend of ammonia sulfate, polyacrylamide polymers, colloidal polymers, buffering agents, and sequestrants (1 lb/100 gal)

EFFECT OF GLYPHOSATE ON HEMP SESBANIA (*Sesbania exaltata*) INTERFERENCE IN DRILLED ROUNDUP-READY SOYBEAN. J. K. Norsworthy and L. R. Oliver, Department of Agronomy, University of Arkansas, Fayetteville, AR 72704.

ABSTRACT

With extensive glyphosate (Roundup Ultra) use, susceptible weeds will be selectively removed, possibly resulting in a species shift to more tolerant weeds such as hemp sesbania. The objective of this research was to determine the soybean population needed to optimize competitiveness and yield potential following a glyphosate application in drilled soybean. An experiment was initiated at Fayetteville, AR, in 1997 and repeated in 1998 to evaluate the influence of soybean population, hemp sesbania density, and a single glyphosate application on soybean seed yield and hemp sesbania seed production. Delta King 5961 Roundup-Ready soybean was drill seeded. Four weeks after soybean emergence, soybean densities were 200,000, 370,000, and 515,00 plants/ha. Hemp sesbania seed were then planted (equally spaced) at densities of 0, 4, 7 and 16 plants/m^2. Glyphosate at 1.12 kg ai/ha was applied at the V4 soybean growth stage (9- to 12-leaf hemp sesbania) and none. Plant samples were removed from a 0.25-m^2 section of each plot at 2-wk intervals beginning 2 wk after treatment and continuing through soybean flowering. Hemp sesbania and soybean fresh and dry weight, number of plants harvested, and height were recorded fromthe plant samples. Leaf area was sub-sampled from two soybean and hemp sesbania plants when present. The sub-sample data were converted to a whole sample basis for statistical analysis. In 1998, soybean photosynthetic rates were monitored and hemp sesbania and soybean chlorophyll content determined at 2 and 8 wk after treatment (WAT). At soybean and hemp sesbania maturity, plots were trimmed to 1.5 m^2, and seeds harvested. Data were analyzed as a split plot with soybean density as the main plots and hemp sesbania and glyphosate application as subplots with four replications.

Soybean yield was reduced 7 and 33% by 4 and 16 untreated hemp sesbania/m^2 in 1997, but a 31 and 69% reduction occurred in 1998 at comparable densities. In 1997, soybean yield when treated with glyphosate was similar, regardless of hemp sesbania density; however, soybean yield in 1998 decreased with hemp sesbania density, even when treated with glyphosate. Soybean biomass accumulation at all hemp sesbania densities when treated with glyphosate or in the absence of hemp sesbania interference was similar to 515,000 soybean/ha. The rate of untreated hemp sesbania biomass accumulation was greatest at 16 plants/m^2 while hemp sesbania density did not influence biomass accumulation of treated hemp sesbania. Soybean photosynthetic rate was reduced 77% by 16 untreated hemp sesbania/m^2 compared to an equivalent density treated with glyphosate. At all hemp sesbania densities, light interception by hemp sesbania decreased with increasing soybean density. Soybean competitiveness and yield were improved at 515,000 soybean/ha, allowing season-long hemp sesbania control following a single glyphosate application in 1997, but not 1998.

SURVEY OF WEED CONTROL IN OKLAHOMA ALFALFA. M. G. New, J. F. Stritzke, and J. T. Criswell. Oklahoma State Univ., Stillwater.

ABSTRACT

Alfalfa was grown on over 390,000 acres in Oklahoma in 1997. Alfalfa is considered a cash crop, consistently profitable for producers who effectively manage production, economics, storage, and marketing. A survey was initiated in 1997 to compare pest management practices to a similar survey conducted in 1988. The survey will serve as a tool to communicate with producers. It will allow producers the opportunity to discover the concerns across the entire state, opposed to an isolate region.

The objectives of this survey were to determine current weed problems, weed control practices, and other management practices on alfalfa production in Oklahoma in 1997. On May 2, 1997, the survey was mailed to 4,887 alfalfa producers in Oklahoma. Producers were asked to identify the amount of total acres, alfalfa varieties grown, pest management practices, and herbicide use. Other information requested included county, total acres in farming operation, primary sources of information, grazing, and factors considered when selecting a pesticide.

A total of 827 completed and usable survey questionnaires were returned for a response rate of 17%. Alfalfa acreage separated by variety planted was divided into Oklahoma Common (29%), Cimarron (19%), and other varieties (20%). The three most important factors considered when selecting a variety were; production potential (22%), stand life (21%), and insect resistance (14%). The most commonly used herbicide on Oklahoma alfalfa was terbacil (Sinbar). It was used on 32% of the acres, with 29% being applied by ground application. The average percent control for terbacil was 59%. Hexazinone (Velpar) and 2,4-DB were used on 25% and 15% of the alfalfa acres respectively. Winter annual grasses,

summer annual grasses and pigweed (*Amaranthus spp.*) were the most reported weed problems in alfalfa production. The Oklahoma Cooperative Extension Serivice was the primary source of information, while stand longevity was the principal reason herbicides were applied to established alfalfa stands.

CONTROL OF BLACKBERRY IN PASTURES WITH TRICLOPYR AND METSULFURON. J. F. Stritzke and C. H. Koger; Oklahoma State University, Stillwater, OK 74078.

ABSTRACT

Blackberries (*Rubus* spp.) are a major brush problem in central and eastern Oklahoma. They are not controlled with herbicide treatments that are normally used for weed and brush control. Most of the spraying for broadleaf weeds is done in May and early June with low dose-rates of 2,4-D alone, or in combination with dicamba (sold as Weedmaster), or picloram (sold as Grazon P + D). These herbicides are not very active on blackberry. Banvel (dicamba) at 4 quarts/A, Tordon 22K (picloram) at 1 & 2 quarts/A, and Remedy (triclopyr) at 1/2 &1 quart/A were evaluated for blackberry control in research studies initiated in 1985. Treatments were applied in July of 1985 and canopy reduction was estimated 1 YAT. Treatments were reapplied in 1986 since there were more than 50 % stems remaining in most treatments. After two yearly applications, stem reduction with Banvel was only 53 %. Better than 90 % stem reduction resulted with both rates of Remedy. Stem reductions after two annual applications of Tordon 22K were 81 and 82 %, respectively for 1 and 2 quart/A rates.

Current recommendation for blackberry control is to apply 1/2 quart of Remedy/acre in July after the fruiting canes are fully/ developed, and expect to retreat the following year to control the new shoots coming from the rhizomatous roots. Control is usually satisfactory with Remedy when applied to unburned plants, but results are sometimes disappointing on areas that were burned in the spring before Remedy was applied. The labeling of Ally (metsulfuron) for use in pastures and rangelands, and its noted activity on blackberry raised questions about when it should be applied and would it kill the blackberry plants.

In July of 1997, four blackberry-infested areas were selected to compare activity of Remedy and Ally on blackberry. These included one unburned tallgrass prairie site, two unburned bermudagrass sites, and one burned old-logging site in southern Oklahoma. Two herbicides Remedy (1 qt/100 gallons of water) and Ally (1/2 oz/100 gallons of water with 0.25% X-77) were applied in July and September as high volume foliar applications. Each treatment was applied to10 individual clumps by spraying all foliage to point of runoff with a hand operated backpack sprayer. Brownout estimates from July treatments were taken in September. Brownout estimates from September treatments were not taken due to time limitation before frost. In the summer of 1998, canopy reduction estimates of shoots in each clump were estimated for all treatments. If there was 100% canopy reduction of the clump, and there was no new shoots, then that clump was listed as killed.

July applications of Remedy resulted in the best brownout (86-100 %) on all sites. In addition, good canopy reduction (78-81 %) and 40 % clump-kill of blackberry were recorded 1 YAT for both of the bermudagrass sites. Canopy reductions with July applications of Remedy on the spring burned old-logging and unburned tallgrass sites were 73 % and 42 % respectively, with no clumps being killed at either site. September applications of Remedy were comparable to July applications at two sites, but significantly less canopy reduction resulted with September applications at the other two sites. Canopy reductions of blackberry 1 YAT with July applications of Ally were less than 30 % at all sites. Canopy reductions with September applications of Ally were consistently higher (56-76 %). Canopy reductions of blackberry with September applications of Ally were comparable to September applications of Remedy at three sites, and better at the tallgrass prairie site.

July application of Remedy to undisturbed plants is probably still the best choice for chemical control of blackberry. By July, next year's fruiting canes have emerged and represents the time that the plants have the maximum leaf canopy to spray. In most cases, there will be some new shoots coming from the rhizomatous roots of the clumps within one year of spraying. Therefore, to kill the blackberry clumps, it is necessary to retreat any new growth from the clumps in the year following the initial spraying. September applications of Ally would also appear to be a good canopy control option for blackberry, but getting any clump kill will most likely require retreatment.

EFFECTS OF ROUNDUP ULTRA AND CONVENTIONAL HERBICIDES ON YELLOW NUTSEDGE (*Cyperus esculentus*) IN SOYBEAN. D. S. Akin, D. R. Shaw, and G. R. W. Nice, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Yellow nutsedge (*Cyperus esculentus* L.) is a widespread and troublesome perennial weed that can cause substantial yield losses in soybean. Field studies were conducted in 1998 at the Black Belt Branch Experiment Station, Brooksville, MS, to evaluate yellow nutsedge control using conventional herbicide programs, as well as glyphosate at various rates and application timings. Conventional herbicide treatments applied were metolachlor at 2.24 kg ai/ha alone, bentazon at 1.12 kg/ha alone, metolachlor + imazaquin at 0.14 kg/ha followed by bentazon at 0.84 kg/ha, and metolachlor + sulfentrazone at 0.26 kg/ha+ chlorimuron at 0.052 kg/ha followed by bentazon at 0.84 kg/ha. Postemergence applications of bentazon were applied 7 weeks after planting (WAP). Two sequential applications of glyphosate were applied at 3 and 7 WAP at rates of 0.84 followed by 0.56 kg ai/ha, 1.1 followed by 1.1 kg/ha, and 0.42 followed by 0.28 kg/ha. Glyphosate was also applied using three sequential applications at 3, 7, and 10 WAP at rates of 0.84 followed by 0.56 followed by 0.56 kg/ha, 1.1 followed by 1.1 followed by 1.1 kg/ha, and 0.42 followed by 0.28 followed by 0.28 kg/ha. Visual ratings were then used to determine control.

At 3 weeks after planting, metolachlor PRE controlled yellow nutsedge 65% and all other preemergence treatments controlled yellow nutsedge at least 81%. At 6 WAP, control with preemergence treatments was similar to the 3 WAP evaluation, while treatments containing one application of glyphosate controlled yellow nutsedge at least 91%. At 10 WAP, treatments containing two applications of glyphosate controlled yellow nutsedge 70-80%.

At 13 WAP, treatments containing glyphosate with three sequential applications at 0.84 followed by 0.56 followed by 0.56 kg/ha and 1.1 followed by 1.1 followed by 1.1 kg/ha controlled yellow nutsedge at least 87%. The remaining glyphosate treatments controlled yellow nutsedge 73-80%. Metloachlor PRE or bentazon POST alone controlled yellow nutsedge approximately 63%. Control ratings for other PRE/POST combination treatments ranged from 71-77%.

EFFECTS OF PRE-EMERGENT HERBICIDES ON NEWLY SEEDED COMMON BERMUDAGRASS (CYNODON DACTYLON). D. L. Martin, C. C. Evans, and D. D. Dobson. Oklahoma State University, Stillwater, OK 74078.

ABSTRACT

Invasion of common bermudagrass (Cynodon dactylon) turfgrass stands by summer annual weedy grasses during the seedling establishment phase is a serious problem in many regions of the world. Questions exist concerning how early a pre-emergent herbicide can be applied to a bermudagrass stand following seeding without serious injury occurring to the stand. The main objective of this work was to evaluate the effects of commonly used pre-emergent herbicides on recently seeded common bermudagrass.

Studies were conducted at the Oklahoma State University Turfgrass Research Center, Stillwater, OK. The soil type was a sandy loam soil containing 1.1% organic matter and having a pH of 6.6. Methyl bromide was used to fumigate the site prior to research. Experiments were seeded with 'Cheyenne' common bermudagrass (CB) at 0.45 kg of pure live seed ha^{-1} on 19 July 1991 and 16 July 1992. Seed was incorporated by raking in two directions with leaf rakes. Prior to establishment the area had been fertilized with 48.8 kg N ha^{-1}, 9.7 kg P ha^{-1}, 24.3 kg K ha^{-1}. Irrigation was performed by hand with a water breaker during initial establishment, and later through automated sprinklers to provide 1.9 cm water wk^{-1}. Nitrogen was applied at 48.9 kg N ha^{-1} during each growing month throughout the study using a 34-0-0 (N-P-K) source.

Herbicide treatments in1991 consisted of sprayable formulations of DCPA (11.77 kg ha^{-1}), isoxaben (1.49 kg ha^{-1}), dithiopyr (0.56 kg ha^{-1}), oxadiazon (3.36 kg ha^{-1}), pedimethalin (3.36 kg ha^{-1}), quinclorac (1.12 kg ha^{-1}), and prodiamine (0.84 kg ha^{-1}). In 1992 treatments were the same as in 1991 plus additional sprayable treatments of dithiopyr (0.56 kg ha^{-1}) and metolachlor (4.48 kg ha^{-1}) as well as a granular treatment of oxadiazon (3.36 kg ha^{-1}). Treatments were applied to CB at 0, 2, 4, 6, 8, and 10 weeks after planting (WAP). Herbicide x age group plots measured 1.5 m X 1.5 m. The experimental design was a randomized complete block with three replications. Treatments were applied via CO_2 pressurized hand boom with three 8005LP flat fan tips. Spray volume was 514.4 L ha^{-1}. The granular oxadiazon was

applied with a hand held shaker. One hour after application all plots were watered with sufficient volume to wet leaves to the point of complete canopy wetting. Subsequent weekly irrigation was used to move the herbicides into the soil.

Phytotoxicity ratings were collected 2X wk^{-1} for 2 wk on all age groups except 0WAP. Clippings (dry matter yield) were harvested 2X wk^{-1} beginning four DAT until 30 DAT from all age groups except 0 WAP. Mowing height was 1.9 cm. Shoot density (three random samples) was measured at 30 DAT in 1992 on all age group x treatments except 0WAP. Root dry matter was assessed at 30 DAT in 1991 and 1992. An ANOVA was performed on each set of data using a split plot in time treatment design. CB age (WAP) and herbicide treatments were main plots with sampling dates as subplots. An LSD test was used to separate means at the $P < 0.05$ level.

Weather conditions were very optimal and the CB established very rapidly in both 1991 and 1992. Sprayable oxadiazon and quinclorac were phytotoxic to all ages of CB. The effect was most prevalent at 5 DAT with complete recovery by 13 DAT in both 1991 and 1992. Metolachlor was phytotoxic to all ages of CB, and the effect usually lasted through 13 DAT. No other treatments produced a significant phytotoxic effect.

DCPA, quinclorac, prodiamine and oxadiazon (G) did not produce a reduction in clipping yield relative to the control. Isoxaben and oxadiazon sprayable formulation only reduced clipping yields when applied 2WAP in 1991 (reduction by 20 and 21%). Pendimethalin and the low rate of dithiopyr only reduced clipping yields when applied 2WAP in 1992 (reduction by 26 and 44%). The high rate of dithiopyr reduced clipping yields at 2WAP in 1991 (65% reduction) and at all dates in 1992. While not significant, this rate reduced yield at all other WAP in 1991. Metolachlor reduced clipping yields (ave. 73% reduction) of all age groups of CB.

Herbicide treatments did not affect shoot density. Shoot density increased from 0-10 WAP, then declined slightly at 12-14WAP. Root mass was not affected by herbicide treatments. Root mass followed a general trend of increasing from 6-10WAP, declining slightly between 10-12WAP before increasing again between 12-14 WAP in 1991 and 1992.

THE INFLUENCE OF TURFGRASS HERBICIDES ON PURPLE NUTSEDGE (*Cyperus rotundus*) DYNAMICS.
M. W. Edenfield, B. J. Brecke, and J. B. Unruh. West Florida Research and Education Center, Jay, FL.

ABSTRACT

Purple nutsedge (*Cyperus rotundus*) has been identified as one of the most common and troublesome weeds in turf throughout the southeastern US. This perennial plant generally produces numerous seed, but dispersal is primarily by bulbs and chains of tubers since only a fraction of the seed are viable. Conventional purple nutsedge control in turf generally includes multiple herbicide applications. However, effective control is limited because many tubers remain dormant on the tuber chain of actively growing plants thus reducing translocation of many herbicides. There is a lack of information available concerning long-term effects of herbicide treatments on purple nutsedge growth and reproductive ability. This study was conducted to evaluate the impact of selected turfgrass herbicides on purple nutsedge growth and reproductive ability (tuber production).

The experiment was conducted the summer of 1997 and 1998 at the University of Florida West Florida Research and Education Center located near Jay, FL. The study was established in an area naturally infested with purple nutsedge but without turfgrass. Test plots were 10 by 20 ft and were replicated 4 times. Herbicide treatments included an untreated check, metolaochlor PRE at 4.0 lb/A, sulfentrazone PRE at 0.38 lb/A, halosulfuron EP at 0.06 lb/A, imazaquin EP at 0.38 lb/A, MSMA EP at 2.0 lb/A, sulfentrazone PRE at 0.38 lb/A followed by (fb) sulfentrazone EP at 0.13 lb/A, halosulfuron EP at 0.6 lb/A fb halosulfuron LP at 0.03 lb/A, imazaquin EP at 0.38 lb/A fb imazaquin LP at 0.38 lb/A, and MSMA EP at 2.0 lb/A fb MSMA LP at 2.0 lb/A. In addition, each treatment was either left unmowed or mowed at 1.5 in. Data collected included visual weed control ratings where 0 = no weed control and 100 = total weed control. Tuber population was quantified by separating tubers from 0.75 ft^2 by 1 ft deep volume of soil from each plot. Extracted tubers were counted, weighed, planted in soil, and placed in a greenhouse environment to test viability.

In general, sequential herbicide applications provided better control of both purple nutsedge shoots and tubers than single applications. Halosulfuron and sulfentrazone were the most effective against purple nutsedge foliage providing $85% control. Mowing had little impact on purple nutsedge foliar control, however, early season tuber density was reduced by mowing. Herbicides had less impact on tuber production than on above ground growth. Both sulfentrazone and MSMA applied sequentially reduced purple nutsedge tuber production by 80 to 85%. The other treatments reduced tuber number by less than 60%. Sulfentrazone was also effective in reducing tuber viability.

GLYPHOSATE APPLICATION BASED ON WEED LAI VALUES IN SOYBEAN. K. D. Walsh and L. R. Oliver, Department of Agronomy, University of Arkansas, Fayetteville, AR 72701.

ABSTRACT

Research was conducted during the summer of 1998 at the University of Arkansas Main Agricultural Experiment Station in Fayetteville, AR. The experimental design was a regression analysis with data collected from 17 plots per week for 7 weeks. Plots were 6.25 m^2 and were trimmed to 4 m^2 at soybean harvest. Palmer amaranth (*Amaranthus palmeri*), pitted morningglory (*Ipomoea lacunosa*), entireleaf mornigglory (*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 a continuum in weed species densities. The weed seed was incorporated into the soil with a field cultivator. AG5601 RR soybean were planted on June 4, 1998 at two row spacings: 19 cm and 51 cm. Glyphosate was applied over-the-top at a rate of 1.12 kg ai/ha from 9 to 57 days after emergence (DAE) and was repeated, as needed, through the growing season to prevent weed reinfestation. Prior to glyphosate application, plant height, width, and number; leaf number per plant; crop and weed LAI; and crop and weed dry weights were measured from two 0.25 m^2 subplots. LAI and percent ground cover were also visually estimated for the two subplots as well as the entire plot. Data were analyzed using a surface response curve with DAE and total weed LAI as the independent variables and soybean yield as the independent variable.

Based on this data, narrow-row soybean does not offer any advantage over wide-row soybean. Glyphosate applications may be delayed in wide-row soybean longer than in narrow-row soybean. A lower total weed LAI decreased yield later in the season for both row spacings. Thus, early weed interference is extremely critical, or once a weed biomass is accumulated, interference increases rapidly. The critical weed removal period for both row spacings is by 9 DAE for a total weed LAI of 2.5 and 3.0 for narrow and wide rows, respectively. Although larger total weed LAI could be tolerated in both row spacings, the initial glyphosate application should still be applied early in the season in order to achieve a higher soybean yield.

POSTEMERGENCE CONTROL OF NON-TUBEROUS SEDGES IN TURF. J. L. Belcher, R. H. Walker, and G. R. Wehtje. Alabama Agric. Exp. Stn., Auburn.

ABSTRACT

Sedge control in turf has previously focused primarily on yellow (*Cyperus esculentus*) and purple nutsedge (*C. rotundus*). Recently, however, several non-tuberous sedge species have been identified as potential problems. These non-tuberouse species include green kyllinga (*C. brevifolius*) and globe sedge (*C. globulosus*), which are perennials, and annual species such as annual kyllinga (*C. sesquiflorus*) and annual flat sedge (*C. compressus*). Relatively few studies have been published evaluating control of these non-tuberous sedge species.

This study was conducted in the Fall of 1998 to evaluate the efficacy of POST-applied herbicides for control of the above species. Plants were collected from several turf areas, identified by the seedhead, and transplanted into 32-ounce cups containing a sandy loam soil. All plants were clipped to a 3-inch height 50 days after transplanting (3 days prior to treatment). Herbicides and rates (lb ai/A) were: bentazon (1.0), MSMA (2.0), imazaquin (0.38), halosulfuron (0.064), Trimec Plus (2.4) (consisting of MSMA/2,4-D/MCPP/dicamba), Trimec Classic (consisting of 2,4-D/MCPP/dicamba) + sulfentrazone (1.64 + 0.02), sulfentrazone (0.38), imazaquin + MSMA (0.38 + 2.0), and halosulfuron + MSMA (0.064 + 2.0). Herbicides were applied in 30 GPA and a non-ionic surfactant was included at 0.25% v/v. Each treatment was applied either singly or sequentially with the sequential being applied 2 weeks after the initial (WAI). Percent control was visually evaluated at 3 and 5 WAI. Plants were harvested after final rating and dry weights recorded.

No single application was effective in controlling green kyllinga, however 98% control was obtained with two applications of MSMA. MSMA with either 2,4-D/MCPP/dicamba, imazaquin, or halosulfuron provided 89 to 93% control with two applications. Excellent control (>96%) was obtained for globe sedge with all treatments that contained MSMA after a single application. Only the halosulfuron and the 2,4-D/MCPP/dicamba + sulfentrazone treatments failed to provide >80% control after two applications. Annual kyllinga and annual flat sedge were controlled >84% for all treatments with a single application . Dry weights generally supported visual estimates of percent control.

RIMSULFURON: POTENTIAL FOR USE IN SPORTS TURF. R. H. Walker, J. L. Belcher, and J. M. Higgins, Agronomy and Soils Department, Alabama Agric. Exp. Stn., Auburn Univ., AL 36849-5412.

ABSTRACT

Control of annual bluegrass (Poa annua L.) and its biotypes in overseeded bermudagrass (*Cynodon dactylon* L.) turf and the removal of overseeded species to improve transition in the spring are necessary management practices for sports-turf managers in the South. Preliminary research showed that rimsulfuron has potential to be used for the above purposes.

Small-plot, replicated field studies were conducted at Auburn during the spring of 1998 with the objective of evaluating 'Tifdwarf' bermudagrass tolerance and weed control efficacy of rimsulfuron as affected by rate and non-ionic surfactant (NIS). Two bermudagrass sites on native sandy loam soil and managed as a golf putting green were used. Rates of 0, 0.016, 0.032, 0.048 and 0.064 lb. ai/A, with and without NIS at 0.25% v/v were evaluated for control of annual bluegrass and perennial ryegrass (*Lolium perenne* L.). All applications were made using a CO_2 sprayer and a water volume of 30 GPA. NIS improved annual bluegrass control only when rimsulfuron was applied at the two lower rates. Rimsulfuron plus NIS for all rates provided $\geq$95% control of this species 22 days after overseeding (DAO). Control of perennial ryegrass ranged from 90 to 94% with the three higher rates and was not affected by NIS. Bermudagrass injury was acceptable for all treatments and did not exceed 12%. Injury was in the form of chlorosis and slowed growth.

Two experiments on sites identical to the above were conducted fall 1998 with the objective of evaluating annual bluegrass control and effects on overseeded roughstalk bluegrass (*Poa trivialis* L.) and/or perennial ryegrass. At site 1, rimsulfuron (0.048 lb. ai/A) plus NIS was applied alone either 4, 2 or 1 week before overseeding. Rimsulfuron was also applied with fenarimol-based treatments where fenarimol (1.37 lb. ai/A) was applied both 4- and 2-weeks prior to overseeding and rimsulfuron was included at either the 4- or 2-week interval. Overseeding was done on 16 October. Results showed that fenarimol applied 4 weeks before overseeding followed by rimsulfuron plus fenarimol 2 weeks before overseeding provided 90% annual bluegrass control 10 DAO; this declined to 78% at 82 DAO. Rimsulfuron applied 2 weeks before overseeding provided 70% control 10 DAO and 75% 82 DAO. No injury to perennial ryegrass was evident when the interval between application and overseeding was either 2 or 4 weeks. At site 2, rimsulfuron at rates ranging from 0.008 to 0.064 lb. ai/A plus NIS were applied 30 October to control emerged annual bluegrass prior to overseeding 7 days later (6 November) with roughstalk bluegrass and perennial ryegrass. Rimsulfuron provided 87 to 99% annual bluegrass control 38 DAO with rates $\geq$ 0.016 lb. ai/A. Only slight and temporary injury to roughstalk bluegrass was observed. Less injury to overseeded species at this site was probably due to the later planting.

SPECTRUM OF WEED CONTROL IN RICE WITH CLOMAZONE PROGRAMS. E. F. Scherder, R. E. Talbert, L. A. Schmidt, and J. S. Rutledge, Department of Agronomy, University of Arkansas, Fayetteville, AR 72701.

ABSTRACT

Field studies were conducted in 1997 and 1998 to evaluate the performance of clomazone for grass control in a stand-alone program, and in a program approach when broadleaf weeds are present. These studies were conducted at the Rice Research Extension Center at Stuttgart, Arkansas, and the UAPB farm at Lonoke, Arkansas.
All trials were randomized complete blocks, with four replications. Natural weed infestations were evaluated for barnyardgrass and broadleaf signalgrass control as well as planted rows of barnyardgrass, palmleaf morninglory, hemp sesbania, and northern jointvetch. Visual ratings were taken 7, 14, 21, 28, and 60 days after emergence (DAE)

Clomazone alone provided season-long control (95%) of broadleaf signal grass at 0.4 and 0.5 lb ai/A, when applied preplant incorporated (PPI), preemergence (PRE), and delayed-preemergence, (DPRE). Barnyardgrass was controlled (99%) at 0.5 lb ai/A for all application timings with 0.4 lb ai/A showing less control at PPI (85%).

Clomazone at 0.2 and 0.5 lb ai/A DPRE in a herbicide program gave 99% control of barnyardgrass prior to sequential treatments of broadleaf herbicides. This level of control was seen with the following treatments clomazone at 0.2 PRE followed by (fb) bensulfuron at 0.038 lb ai/A + Agri-Dex at 1% V/V pre-flood (PREFLD) and when followed by propanil at 2.25 lb ai/A + molinate at 2.25 lb ai/A + bensulfuron at 0.038 lb ai/A PREFLD. Clomazone at 0.5 lb ai/A DPRE tank mixed with thiobencarb at 4.0 lb ai/A and clomazone tank mixed with quinclorac at 0.375 lb ai/A. Sequential applications included clomazone at 0.5 lb ai/A fb carfentrazone at 0.02 lb ai/A + Ag-98 0.25% V/V PREFLD, clomazone fb propanil at 3.0 lb ai/A PREFLD. The standard treatment was quinclorac at 0.38 lb ai/A DPRE *fb* propanil at 3.0 lb ai/A PREFLD.

Palmleaf morningglory was controlled >96%, with all treatments except clomazone tank mixed with thiobencarb DPRE 18% and clomazone *fb* propanil PREFLD 40%. Hemp sesbania control was 99% for all treatments except for clomazone PRE *fb* bensulfuron PREFLD 55% and clomazone tank mixed with thiobencarb DPRE 0%. Northern jointvetch control was limited to programs that included propanil or quinclorac. Programs containing these herbicides ranged in control from 86%-99% control, comparable to the standard.

Clomazone was shown to provide excellent grass control alone when annual grasses only are present. When broadleaf weed species were present, a program approach will be needed for control. Clomazone in a program provided the same level of control as when used alone for barnyardgrass. Through the use of a program broadleaf weed control could be achieved.

COMBINATIONS OF CLOPYRALID WITH PRE HERBICIDES FOR VIRGINIA BUTTONWEED (*Diodia virginiana* L.) CONTROL. 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

Virginia buttonweed continues to be a serious problem for turfgrass managers. Current recommendations for control of this perennial broadleaf weed include 2,4-D and mixtures of 2,4-D with dicamba, mecoprop, and dichloroprop; however, regrowth of from both seed and the root system has been a problem. Other studies have shown that commonly used PRE herbicides are effective for control of seedling Virginia buttonweed in turfgrass. This study was conducted to determine if clopyralid combinations with dithiopyr, pendimethalin, or oxadiazon are either synergistic or antagonistic for Virginia buttonweed control. Greenhouse experiments were conducted in May and June 1997 to evaluate mixtures of clopyralid with dithiopyr, pendimethalin, or oxadiazon for Virginia buttonweed reduction. Plants were established in the greenhouse from seed collected near Aberdeen, MS. The experimental design was a randomized complete block with a two-factor factorial arrangement of treatments and 5 replicates of each treatment. Factor A was clopyralid at 0, 112, or 224 g ae ha^{-1}. Factor B was the PRE herbicide and consisted of 560 g ai ha^{-1} dithiopyr, 3360 g ai ha^{-1} oxadiazon, 4480 g ai ha^{-1} pendimethalin, or an untreated. At 4 weeks after treatment (WAT) the foliage was excised and the foliage mass determined. The plants were then allowed to regrow from the roots for 4 weeks and at 8 WAT both the foliage and roots mass was determined. All plant parts above the soil were considered 'foliage' and below the soil were 'roots'. The percent reduction in mass was then calculated based on the mass of the untreated. The mass reduction data were subjected to analysis of variance and tested for all possible interactions of experiment and treatment factors. No experiment interaction occurred and all data are averaged over experiments. Since an interaction was found between the treatment factors, Colby's formula was used to evaluate these herbicide combinations for reduction of Virginia buttonweed and treatment combination means were separated using Fisher's Protected LSD (p=0.05). At 4 WAT, 2 combinations were determined to be synergistic for reducing foliage mass. They were 112 g ha^{-1} clopyralid combined with 560 g ha^{-1} dithiopyr or 224 g ha^{-1} clopyralid combined with 4480 g ha^{-1} pendimethalin. At 8 WAT (after regrowth) the only combination that reduced Virginia buttonweed mass in a synergistic manner was 112 g ha^{-1} clopyralid combined with 560 g ha^{-1} dithiopyr. This combination was synergistic for both foliage mass and root mass reduction. All other combinations of clopyralid with PRE herbicides were additive for reduction of Virginia buttonweed root and foliage mass. The synergistic response in Virginia buttonweed control from combining clopyralid and dithiopyr may allow turfgrass managers to both effectively control Virginia buttonweed that is currently growing and slow down the re-infestation of Virginia buttonweed from roots and seed.

ROUNDUP READY COTTON TOLERANCE TO TOPICALAPPLICATIONS OF ROUNDUP ULTRA. R. H. Blackley, Jr., D. B. Reynolds, C. D. Rowland, Jr., and S. L. File, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762.

ABSTRACT

Research has shown that topical applications of Roundup Ultra (glyphosate) on Roundup Ready cotton (*Gossypium hirsutum* L.) after the 4-leaf stage may affect reproductive development. Applications applied after the 4-leaf stage are required by current label restrictions to be post-directed. Equipment type, adjustment, and speed cause variation in post-directing heights.

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 in 1997 at the Plant Science Center near Starkville, MS, to evaluate Roundup Ready cotton tolerance to various topical applications of Roundup.

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 16, 24, and 32 fl oz of Roundup Ultra (glyphosate) at the 6, 9, and 12 node growth stage following a topical application of 32 fl oz of Roundup Ultra at the 3 node stage.

Under these conditions, seed cotton yield was unaffected by off-label topical applications of Roundup Ultra. However, fruiting patterns were affected by off-label applications. Zone 1 seed cotton weight, which consists of sympodial branches fromnodes 4-9, was decreased by all treatment combinations at Stoneville in 1997. Zone 2 seed cotton weight, which consists of sympodial branches fromnodes 10-14, was unaffected by treatments but varied among locations. Zone 3 seed cotton weight, which consists of sympodial branches fromnodes > 15, was increased by 32 oz applications at the 12-node stage following the 32 oz application at the 3 node growth stage compared to the untreated check. Generally, yield reductions in Zone 1 were compensated by increases in Zone 3. Favorable late season weather in 1997 and 1998 may have allowed plants to compensate for early fruiting losses.

ANNUAL BLUEGRASS (*POA ANNUA*) CONTROL IN BENTGRASS FAIRWAYS. F. C. Waltz Jr., L. B. McCarty, J. K. Higingbottom, and B. T. Bunnell. Clemson University, Clemson, SC 29634.

ABSTRACT

Annual bluegrass (*Poa annua*) is a problem in bentgrass (*Agrostis palustris*) fairways. It reduces aesthetic quality and when seedheads are present can affect play of the golf course. Annual bluegrass and creeping bentgrass are cool season turfgrass species, therefore selective control is difficult. Also, once annul bluegrass has perennialized, few control measures have proven acceptable for golf course use. Research objectives were to screen herbicides, labeled turfgrass fungicides, and surfactants in different application strategies for bluegrass control and bentgrass tolerance.

In the fall 1996, screenings were conducted on a bentgrass fairway. Plots were maintained by the staff at Wade Hampton Golf Club in Cashiers, North Carolina. Plots were 1.5 m x 3.0 m in a randomized complete block design with 4 replications. Using a CO_2 backpack sprayer, treatments were applied monthly beginning in September, and concluding in December. Treatments included ethofumesate (0.74 lbs ai/A), ethofumesate (0.74 lbs ai/A) + Urea (6.44 lbs N /A), glyphosate (0.063 lbs ai/A), pelargonic acid (0.066 lbs ae/A), glyphosate (0.03 lbs ai/A) + pelargonic acid (0.033 lbs ae/A), glufosinate (0.016 lbs ai/A), and glufosinate (0.031 lbs ai/A). For all treatments, the September and October applications were applied at 20 gpa. For November and December applications, treatments containing glyphosate, pelargonic acid, and glufosinate were applied at 80 gpa in an attempt to reduce turfgrass injury.

In 1997, treatments were applied to the same fairway on different plots in similar manner as the previous year. However, treatment application timings varied. Glyphosate (0.063 lbs ai/A), diquat (0.031 lbs ai/A) + Optima (0.5% v/v), ethofumesate (1 lb ai/A), and glyphosate (0.063 lbs ai/A) + diquat (0.031 lbs ai/A) were applied in October, November, and December. Clethodim (0.048 lbs ai/A) + Optima (0.5% v/v), clethodim (0.095 lbs ai/A) + Optima (0.5% v/v), and clethodim (0.048 lbs ai/A) + diquat (0.031 lbs ai/A) + Optima (0.5% v/v) were applied only in October. While fluazifop (0.047 lbs ai/A) + Optima (0.5% v/v) and fluazifop (0.047 lbs ai/A) + diquat (0.031 lbs ai/A) + Optima (0.5% v/v) were applied in October and December.

The 1998 evaluations included three separate studies on the same fairway as the previous 2 years. Study 1 was similar to 1996 and 1997 evaluations. Treatments included glyphosate (0.125 lbs. ai/A), diquat (0.031 lbs. ai/A) + Primer (1% v/v), glyphosate (0.125 lbs ai/A) + diquat (0.031 lbs ai/A), fenoxaprop (0.38 lbs ai/A) + triclopyr (1.0 lb ai/A), bentazon (1.5 lbs ai/A), bentazon (1.5 lbs ai/A) + diquat (0.031 lbs ai/A), and Primer (1% v/v). All treatments were applied at 80 gpa in September, October, and November, however the October reapplication for fenoxaprop + triclopyr was omitted due to excessive bentgrass injury. Study 2 treatments were labeled turfgrass fungicides and a plant growth regulator. Treatments included fenarimol (1.021 lbs ai/A), myclobutanil (0.98 lbs ai/A), cyproconazol (0.545 lbs ai/A), paclobutrazol (0.25 lbs ai/A) alone, and combinations of each treatment with paclobutrazol. All treatments were applied in September, October, and November at 20 gpa. Treatments in study 3 were from the sulfonylurea family and included primsulfuron, rimsulfuron, triasulfuron, and chlorimuron. All treatments were applied at two rates (0.016 lbs ai /A and 0.032 lbs ai/A) in September and November at 20 gpa.

For all three years, visual annual bluegrass control ratings were made on a 0% to 100% scale, 0%= no control, 70%= minimal acceptable control, and 100%= no annual bluegrass. Visual bentgrass injury was rated on a 0% to 100% scale, 0%= no injury, 30%= maximum allowable injury, and 100%= complete death.

No treatment provided acceptable ($ 70%) annual bluegrass control at any time. The greatest control (. 50 to 70%) was observed with glyphosate in 1996 and 1998 and with rimsulfuron in 1998.

Bentgrass injury was observed for various treatments and was not consistent from year to year. In 1996 and 1998, glyphosate treated plots had severe bentgrass injury ($ 50%). Yet in 1997, bentgrass injury resulting from glyphosate did not exceed 10%, however rates and delivery volume varied between years. Other treatments that severely injured bentgrass included combinations of clethodim ($ 70%), combinations of fluazifop ($ 70%), fenoxaprop + triclopyr ($ 70%), combinations of a fungicide and paclobutrazol ($ 35%), and both rates of rimsulfuron ($ 35%).

JIMSONWEED (*DATURA STRMONIUM*) INTERFERENCE AND SEEDRAIN DYNAMICS IN COTTON. G. H. Scott, J. W. Wilcut, S. D. Askew, Crop Science Department, North Carolina State University, Raleigh, NC 27695-7620.

ABSTRACT

There have been numerous reports of jimsonweed being a problem weed throughout the Midwest. However, only recently has jimsonweed begun emerging as a problem weed in the Mississippi Delta and Southeastern United States. Jimsonweed is a large plant relative to cotton and competes with the crop extremely well for light while also reducing harvest efficiency. Especially since growth regulators keep cotton at a 36" to 48" maximum height, and jimsonweed frequently reaches heights of 5 ft. or greater. Under optimum conditions one jimsonweed plant can produce over 28,000 seed. Therefore, we feel it is important to determine the seed production of jimsonweed in North Carolina. This allows us to assess the effect of subeconomic jimsonweed populations on seedbank population dynamics. In cotton, yield reductions of 2.4% and 15.1% were reported for 3 plants per 30 row feet. The objectives of the study were as follows: 1) evaluate jimsonweed for competition and interference characteristics in conventional tillage cotton grown in North Carolina, and 2) determine the seed production and seed-rain dynamics of jimsonweed when planted at different densities with cotton.

A field study was conducted in 1998 at Clayton, NC to evaluate interference characteristics and seed-rain dynamics of jimsonweed in Deltapine 51 cotton. A randomized complete block design with 3 replications was used. Jimsonweed seedlings at the cotyledon to 2-leaf stage were planted into plots immediately after cotton planting at the following densities:0, 1, 2, 4, 8, 16, and 32 plants per 30 foot of row. Jimsonweed seedlings were planted on the right side of each of the center two rows of each plot with the outer two rows left as untreated checks for each plot. All plots were kept weed free except for jimsonweed. All jimsonweed seed were harvested as they matured. Height measurements for cotton and jimsonweed were taken weekly until six weeks after planting and bi-weekly for the remainder of the season. Cotton was harvested and lint yields were determined. Data was subjected to ANOVA and regression analysis was performed where appropriate.

Jimsonweed seed rain increased with increasing jimsonweed densities. Seed production at 4 jimsonweed plants per 30 row feet was found to equivalent to approximately 89 million seed/A. This amount of seed production would obviously be a concern for growers, agricultural chemical dealers, and farm managers. Cotton lint yield decreased as jimsonweed density increased. Cotton lint yield was reduced 67.5% with the addition of 4 jimsonweed plants per 30 row feet. The relationship of cotton lint loss to jimsonweed density can be explained by the exponential equation [$y=923.02e^{0.0812x}$] (r^2=0.87). The stem diameters of jimsonweed decreased linearly [$y=-0.0125x+1.2125$] (r^2=0.78) as jimsonweed densities increased. The dry weights of jimsonweed plants also decreased as jimsonweed densities increased. This can be explained by the exponential equation [$y=1.2824e^{-0.0467x}$] (r^2=0.92). This is an indication that intraspecific competition was occurring at high densities. It was also found that it would take only 1.9 jimsonweed plants per 30 row feet to cause a 25% reduction in cotton yield. There was a definite inverse relationship between cotton heights and jimsonweed density This can be explained through the exponential equation [$y=24.749e^{0.0214x}$] (r^2=0.87).

This data indicates jimsonweed is more competitive with cotton in North Carolina than has previously been reported. The data also indicates jimsonweed is also more competitive with cotton in North Carolina than in more southern geographic locations. As a result, the economic thresholds for jimsonweed may need to be reevaluated in North Carolina. The data also shows very prolific seed-rain of jimsonweed in North Carolina. Therefore, the action threshold

must be determined to prevent the buildup of jimsonweed seed throughout the soil seedbank. Future research efforts will include repeating the current study for a year to test the results in different environmental conditions, evaluation of the percent germination of jimsonweed as affected by parent density, and to determine the long-range viability of jimsonweed seed within the seedbank.

EVALUATION OF THE HERB-COTTON DECISION AID PROGRAM WHERE COMMON COCKLEBUR *(XANTHIUM STRUMARIUM)* IS THE DOMINANT SPECIES. E. R. Walker, R. M. Hayes, T. C. Mueller, The University of Tennessee, Knoxville, TN 37901, and J. W. Wilcut, North Carolina State University, Raleigh, NC 27695.

ABSTRACT

With a variety of postemergent (POST) herbicides available and the introduction of transgenic cotton varieties, producers are faced with a number of weed control options (1). HERB-Cotton is a decision aid program based on an economic threshold approach to improving weed management in cotton while potentially reducing POST rates and applications (1). The program considers weed species present, weed size and density, soil moisture, predicted weedfree yield and price per pound of lint, then estimates yield loss functions and treatment efficacies and generates appropriate recommendations.

A field experiment was conducted in 1998 at Jackson, TN, to determine the utility of HERB-Cotton in providing POST recommendations for transgenic and conventional varieties by comparing these recommendations to standard and technology-driven treatments, examining efficacies, yields, and treatment costs. The study was arranged as a split-plot design with cotton varieties as main plots and management systems as subplots. Cotton varieties Stoneville BXN 47, Paymaster 1220 Roundup Ready, and Deltapine 5111 were no-till planted at a seed rate of 15 lb./acre and a row spacing of 38 inches on May19, 1998 in a silt loam soil with a pH of 6.6. A preemergent treatment of Prowl at 2.4 qt./acre + Cotoran at 2.4 pt./acre was applied to the entire study. Input data on weeds including common cocklebur *(Xanthium strumarium*), yellow nutsedge (*Cyperus esculentus*), pitted morningglory (*Ipomoea lacunosa*), and Palmer amaranth (*Amaranthus palmeri*) resulted in HERB-Cotton recommendations of Staple at 1.2 oz./acre + MSMA at 1.33 pt./acre followed by Assure II at 8 oz./acre followed by Buctril at 1 pt./acre for Stoneville BXN 47, Roundup Ultra at 1.5 pt./acre followed by Roundup Ultra at 1.5 pt./acre for Paymaster 1220 Roundup Ready, and Staple at 0.6 oz./acre + MSMA at 1.33 pt./acre followed by Staple at 1.2 oz./acre for Deltapine 5111. Staple at 1.2 oz./acre followed by Bladex at 1.6 pt./acre + MSMA at 2.4 pt./acre POST-directed was a standard treatment for all varieties. The technology-driven treatments were Buctril at 2 pt./acre followed by Buctril at 2 pt./acre for Stoneville BXN 47, Roundup Ultra at 2 pt./acre followed by Roundup Ultra at 2 pt./acre for Paymaster 1220 Roundup Ready, and Staple at 1.2 oz./acre followed by Bladex at 1.6 pt./acre + MSMA at 2.4 pt./acre POST-directed for Deltapine 5111. POST applications were made June 11 to 2-leaf, 4-inch cotton and July 2 to 10-leaf, 14-inch cotton, and POST-directed treatments were applied to 10-leaf, 14-inch cotton on July 2.

Common cocklebur control for all treatments was > 90% 5 weeks after the first POST application. Also, lint yields from all treatments were equal to those of the weedfree plots. However, the HERB-Cotton recommendation treatment costs for Stoneville BXN 47, Paymaster 1220 Roundup Ready and Deltapine 5111 were $53/acre, $32/acre, and $60/acre, respectively, whereas the standard treatment cost was $41/acre. The technology-driven treatment costs for Stoneville BXN 47, Paymaster 1220 Roundup Ready, and Deltapine 5111 were $28/acre, $38/acre, and $32/acre, respectively.

LITERATURE CITED

1. Wilkerson, G. G. 1998. Unpublished information.

SMELLMELON (*Cucumus melo*) AND ENTIRELEAF MORNINGGLORY (*Ipomoea hederacea* var. *integriuscula*) CONTROL WITH STAPLE AND ROUNDUP ULTRA COMBINATIONS IN ROUNDUP READY COTTON. C. H. Tingle and J. M. Chandler, Texas Agricultural Experiment Station, College Station, TX 77843.

ABSTRACT

Field studies were conducted in 1997 and 1998 at the Texas Agricultural Experiment Station in Burleson County, TX to evaluate broadleaf weed control in Roundup Ready cotton with Staple and Roundup Ultra combinations. Treatments consisted of single applications of Staple at 0.6 and 1.2 oz/A and Roundup Ultra at 1.5 pt/A. Each of these treatments was applied alone and in combination with one another. Weed species evaluated consisted of entireleaf morningglory (*Ipomoea hederacea var. integriuscula*) and smellmelon (*Cucumus melo L. var. dudaim Naud.*). Each year, treatments were applied to 3-4 leaf cotton with weeds ranging from 2-5 leaf stages.

In 1997, smellmelon (CUMMD) control was at least 85% for all applications of Staple or Roundup Ultra 17 days after treatment (DAT). CUMMD control was at least 94% with Staple at 1.2 oz/A or Roundup Ultra at 1.5 pt/A. While, 85% control was observed with Staple at 0.6 oz/A. Entireleaf morningglory (IPOHE) control was at least 85% with Staple, regardless of rate, and reduced to less than 60% with Roundup Ultra. No differences were observed in CUMMD control with Staple and Roundup Ultra tank mixtures. CUMMD control was at least 90%, regardless of Staple rate. However, the addition of Staple improved IPOHE control from 50% to 90% compared to Roundup Ultra alone. By 34 DAT, CUMMD control was less than 50% for Staple or Roundup Ultra applications. IPOHE control remained 83% for Staple at 0.6 oz/A and increased to 95% with Staple at 1.2 oz/A. No differences were observed between Staple and Roundup Ultra tank mixtures for CUMMD or IPOHE control. The addition of Staple improved control of both CUMMD and IPOHE compared to Roundup Ultra alone.

In 1998, CUMMD and IPOHE control 17 DAT with either rate of Staple was less than 70%. Control of CUMMD and IPOHE increased to 83 and 80%, respectively with Roundup Ultra applications. No Differences were observed in CUMMD or IPOHE control with tank mixtures compared to Roundup Ultra alone. By 34 DAT, no differences were observed between Staple and Roundup Ultra for CUMMD or IPOHE control. This was also observed with tank mixtures. Control of CUMMD or IPOHE ranged from 77 to 85% for Roundup Ultra applied alone or in combination with Staple.

Differences in control between years fromboth Roundup Ultra and Staple could be attributed to varying environmental conditions. Total rainfall for May through July in 1997 was 9.3 in, but only 0.6 in for 1998. Also, in 1998 excessive temperatures may have influenced control. From these data we can conclude that Staple and Roundup Ultra combinations are needed for the control of actively growing IPOHE and CUMMD.

CROP RESPONSE TO ROUNDUP ULTRA AND LIBERTY SIMULATED DRIFT. J. M. Ellis, J. L. Griffin, S. D. Linscombe, E. P. Webster, and J. L. Godley, Louisiana State University Agricultural Center, Baton Rouge, LA 70803 and R & D Research Farm, Inc., Washington, LA 70589.

ABSTRACT

Roundup Ultra and Liberty are nonselective herbicides used to control annual and perennial weeds in reduced tillage systems and in transgenic crops. The increasing popularity of Roundup (glyphosate)- and Liberty (glufosinate)- resistant crops will increase the likelihood of off-target movement of the herbicides to adjacent fields. In 1998, field experiments were conducted at the Ben Hur Research Farm at Baton Rouge, LA and the Rice Research Station at Crowley, LA to evaluate injury, growth, and yield of soybean and rice exposed to drift rates of Roundup Ultra and Liberty. The experimental design was a randomized complete block with a three-factor factorial arrangement of treatments and four replications. A nontreated control was included for comparison. Drift rates represented 1/128, 1/64, 1/32, 1/16, and 1/8 of the use rates of 32 oz pr/A (1.0 lb ai/A) of Roundup Ultra and 28 oz pr/A (0.38 lb ai/A) of Liberty. The experimental area was kept weed-free throughout the season. Treatments were applied early postemergence (EPOST) to 'DPL 3588' soybean at V3-4 (2-3 fully expanded trifoliates) and 'Cypress' rice at 3-4 leaf or late postemergence (LPOST) to soybean at R1 (first flower) and rice at panicle initiation. Application timings were selected to coincide with time during the crop cycle when drift would most likely occur from cotton and corn fields. A CO_2 backpack sprayer calibrated to deliver 15 gallons/A of spray solution was used to apply herbicide treatments. Data collected included visual soybean and rice injury and height 14 days after treatment (DAT) and crop yield. Data were subjected to analysis of variance and means were separated using Duncan=s multiple range test (p= 0.05).

Soybean injury was observed only when Roundup Ultra was applied EPOST at the 1/8 and 1/16 rates and injury was 35 and 9%, respectively. Liberty injured soybean at the 1/8 and 1/16 rates applied LPOST resulting in 40 and 16% injury, respectively. Soybean height was reduced only when Roundup Ultra at the 1/8 and 1/16 rates was applied EPOST. Although visual injury was observed for some of the Roundup Ultra and Liberty treatments 14 DAT at both application timings, soybean yield was not negatively affected.

Rice injury was observed for Roundup Ultra applied EPOST at the 1/32 rate and higher resulting in 23 to 78% injury. Only the 1/8 rate of Roundup Ultra applied LPOST injured rice (10%). Injury with Liberty occurred at the 1/8 and 1/16 rates applied EPOST and LPOST and injury ranged from 11 to 39%. Rice height was reduced by EPOST applications of Roundup Ultra at the 1/8 and 1/16 rates and Liberty at the 1/8 rate. Height reductions were not noted for LPOST applications. Rice yield was reduced at the 1/8 rate of Roundup Ultra applied EPOST (99%) and LPOST (54%) and the 1/16 rate applied LPOST (33%). Liberty reduced yield at only the 1/8 and 1/16 rates applied LPOST (31 and 14%, respectively).

In conclusion, based on visual injury, soybean was most sensitive to Roundup Ultra applied EPOST and to Liberty applied LPOST. Even with soybean injury as great as 43%, yield was not negatively affected. Based on visual injury, rice was most sensitive to Roundup Ultra applied EPOST. For individual rates of Liberty in most cases, rice was equally sensitive to EPOST and LPOST applications. Of interest is that even though injury to rice from LPOST applications of Roundup Ultra at the 1/8 and 1/16 rates was minimal, yield reductions observed were at least 33%. Although rice was injured by Liberty at the 1/8 and 1/6 rates applied EPOST and LPOST, yield reduction was observed for only the LPOST application.

BIOLOGY AND ECOLOGY OF TROPICAL SODA APPLE (*Solanum viarum* Dunal). C. T. Bryson, and J. D. Byrd, Jr., USDA-ARS, Southern Weed Science Research Unit Stoneville, MS 38776 and Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39759.

ABSTRACT

Tropical soda apple (TSA) has become a pernicious weed of pasturelands, vegetable crops, row crops, forestlands, and urban and natural areas in the southeastern United States. Since its introduction into Florida in the early 1980's TSA has spread into Alabama, Georgia, Louisiana, Mississippi, North Carolina, Pennsylvania, South Carolina, Tennessee, and Puerto Rico. TSA spread is attributed to livestock movement and contaminated composted manure and grass seeds from previously infested areas. Because TSA is classified as a tropical perennial, research was needed to determine survival potential in areas north of Florida. Experiments were established in a containment area near Stoneville, MS (latitude 33^0 25' N) to determine the overwintering survival potential of TSA seeds (Experiment 1) and determine the growth, reproductive potential, and overwintering potential of mature TSA plants (Experiment 2).

<u>Experiment 1:</u> Seeds were placed in nylon mesh bags and sealed with hot glue. On the first Monday in November in 1995, 1996, and 1997, bags containing seeds and intact fruit were placed 1 m above the soil surface, on the soil surface, or buried in a sandy loam soil at depths of 5, 10, and 15 cm. Bags of seed and fruit were retrieved the first Monday of April in 1995, 1996, and 1997. From each sample, three 100 seed samples were placed on a sandy loam soil, covered lightly with soil, and allowed to germinate in trays in the greenhouse at Stoneville, MS. Trays were watered from beneath to prevent soil disturbance. Emerged plants were counted and removed weekly until TSA plant emergence ceased (ca. 6 wk period each year). Data were averaged over years and 14, 10 , 48, 42 and 13% TSA plants emerged from 100, 0, -5, -10, and -15 cm, respectively from seed bags, while 86, 83, 48, 41, and 18% emerged from seed within fruit 100, 0, -5, -10, and -15 cm respectively. Intact TSA fruit enhances the viability of overwintering TSA seeds above the soil surface, but viability was equivalent to seed alone at or below the soil surface because fruit shell degradation occurred during the winter.

<u>Experiment 2:</u> TSA plants were raised in the greenhouse in 10 cm daim pots. Plants 10-15 cm tall were transplanted in the field in rows 2 m apart in mid April of 1995, 1996, and 1997. Plant height, length along the row, width across the row, number of fruits, and total plant weights (including fruit) were recorded in late October each year from 6 TSA plants. Fruit over 2.5 cm diam (before turning yellow) were counted, removed, and weighted from all plants at biweekly intervals during the summer to prevent escape. TSA plant heights were 82, 64, and 72 cm; plant lengths were 237, 173, and 203 cm; plant widths were 275, 163, and 189 cm; plant weights were 9.9, 9.5, and 4.9 kg; and number of fruit were 119, 187, and 128 for 1996, 1997, and 1998, respectively. Plant weights were less in 1998 due to a hotter and dryer than normal summer and because most of the fruit were set and were smaller at the time of harvest. The number TSA plants

emerging the following year were recorded at biweekly intervals starting in May until mid June when the area was sprayed with glyphosate and disked repeatedly. No TSA plants emerged from rootstocks of the previous year in 1996 and 1997, but 83% if TSA plants survived the winter of 1997-1998. The winter of 1997-1998 was warmer than the other two winters (1995-1996 and 1996-1997) and warmer than normal for Stoneville, MS.

From data in these two experiments, TSA seeds survived each year and TSA plants in one of three year were able to survive winter condition near Stoneville, MS. It is apparent that TSA plants have the ability to survive warmer than normal winters at or below latitude 33^{o} N and that TSA will persist as an annual in areas where it cannot survive winters as a perennial.

EFFECT OF ROW SPACING AND SEEDING RATE ON RYE (*SECALE CEREALE*) COMPETITION IN HARD RED WINTER WHEAT. J. R. Roberts, T. F. Peeper, J. P. Kelley, and J. B. Solie. Graduate Research Assistant, Professor, Senior Agriculturist, Department of Plant and Soil Sciences, and Professor, Department of Biosystems and Agricultural Engineering, Oklahoma State University, Stillwater, OK 74078.

ABSTRACT

Feral rye is becoming a serious problem in winter wheat (*Triticum aestivum*) throughout the Great Plains and Western United States. Field research was conducted in Central and North Central Oklahoma during the 1997 - 1998 growing season to evaluate the effect of wheat row spacing and seeding rate on rye (*Secale cereale*) competition in hard red winter wheat. The experiments were planted on October 17 and 30, 1997. ‘Oklon’ rye was hand seeded at 0 and 15 lbs/ac, and incorporated with a field cultivator prior to seeding ‘2163’ wheat at 60, 90, and 120 lbs/ac. A modified grain drill was used to seed the wheat in 4, 8, and 12 inch rows. Light interception (photosynthetically active radiation) was measured above and below the crop canopy and light interception percentage calculated. Small plot combines were used to harvest the rye and wheat. Grain samples of rye and wheat were hand separated to correct for cross contamination, and yields were calculated.

Light interception at the Chickasha site, averaged over row spacing, was greater with rye present. Both row spacing and rye presence affected light interception at Perkins. Seeding more than 60 lbs/ac with little or no rye infestations did not increase wheat yields. With rye present, averaged over row spacing, increasing the seeding rate from 60 to 90 lbs/ac increased wheat yields at Chickasha. At Perkins, increasing the seeding rate increased wheat yield in 4 inch rows, but increasing seeding rate to 120 lbs/ac was required to see increased yield in 8 inch rows. Increasing the seeding rate of 12 inch rows had no affect on wheat yield at Perkins.

Chemical and Physical Properties of New Herbicides

Victor L. Ford, Section Chairman

Company: **DuPont**

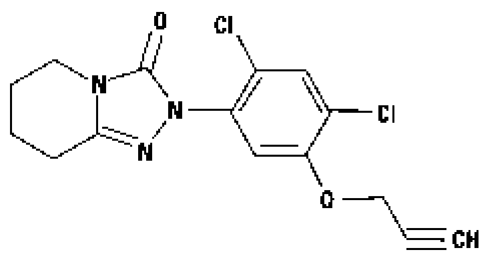
Chemical Name: 2-[2,4-dichloro-5-(2-propynyloxy)phenyl]-5,6,7,8-tetrahydro-1,2,4-triazolo[4,3-a]pyridin-3(2H)-one

Common Name: azafenidin

Trade Name: Milestone Herbicide (USA); Evolus Herbicide (Europe)

Product Name or Number: DPX-R6447

Structural Formula:



Empirical Formula: $C_{15}H_{13}N_3Cl_2O_2$

Physical Form: Solid

Solubility:
Water 16 ppm @ pH 7
n-hexane 13 ppm
methanol 12,000 ppm
acetone 30,000 ppm

Volatility: 2.1×10^{-10} mm Hg

Formulation: Paste-extruded 80% active ingredient, water-dispersible granule.

Toxicity: Oral LD50 rat > 5000 ppm; Dermal LD50 rabbit > 2000 ppm

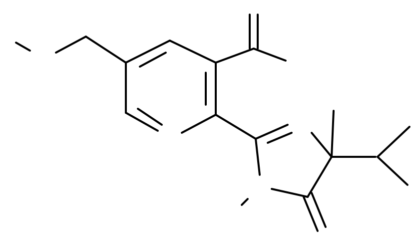
Mode of Action: Inhibits porphyrin biosynthetic pathway which causes the accumulation of a photodynamic porphyrin intermediate that creates a singlet oxygen species in the presence of light that results in cell membrane disruption.

Herbicide Use: Citrus, sugarcane, vineyards, tree fruits, plantation crops, and industrial weed control. Extremely safe on established trees and vines.

Chemical and Physical Properties of New Herbicides

Victor L. Ford, Section Chairman

Company:	American Cyanamid
Chemical Name:	2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-5-(methoxymethyl)-3-pyridinecarboxylic acid
Common Name:	imazamox/AC 299,263
Product Name:	RAPTOR®, MOTIVE™
Structural Formula:	



Empirical Formula:	$C_{15}H_{19}O_4 N_3$
Molecular Weight:	322.40
Physical Form:	Odorless, powdered solid
Melting Point:	166.0-166.7°C (technical)

Solubility:

	g/100 ml solvent
toluene	0.21
acetone	2.93
methanol	6.68
dichloromethane	14.3
water	miscible

Formulation: 1 lb/gl aqueous solution

Toxicology:

Oral LD50 (rat)	>5000mg/kg
Dermal LD50 (rat)	>4000mg/kg
Eye irritation (rabbit)	non-irritating
Inhalation LC50 (rat)	>5 mg/l air
Dermal sensitization (guinea pig)	Nonsensitizer

Herbicide Use: Postemergence at 35-45 g/ha (0.032-0.04 lb ai/A) on soybeans, dry edible legumes, alfalfa, imidazolinone tolerant canola, imidazolinone tolerant wheat

Behavior in Plants: Acetolactate synthase inhibitor

State Extension Weed Control Publications

J. D. Byrd, Jr., Section Chairman

Extension weed identification and control publications for all commodities are listed by state. Publication numbers, titles and ordering sources are provided. Publications that must be purchased are designated with price in parentheses following the title. URL addresses are listed for states that have Extension weed control information on the Internet. This report will be updated each year, and published in the Proceedings.

State: **ALABAMA**

Prepared by: John W. Everest and Mike Patterson

Source: Merrell Hill, Bulletin Room, Alabama Cooperative Extension System, Duncan Hall, Auburn University, Auburn, AL 36849

[1] IPM Information Sheets, 110 Extension Hall, Auburn University, Auburn, AL 36849

Number	Title
CIRCULARS	
ANR-39	Conservation Tillage in Soybeans
ANR-40	Conservation Tillage in Corn
ANR-49	Weed Control in Lake and Ponds
ANR-65	Kudzu: History, Uses, & Control
ANR-104	Controlling Smutgrass in Alabama Pastures
ANR-223	Chemical Weed Control for Noncrop Areas
ANR-322	Weed Control in Home Gardens
ANR-453	Christmas Tree IPM
ANR-465	Weed Control for Commercial Nurseries
ANR-600A	Alabama Pesticide Handbook, Vol. 1 Ag ($15.00)
ANR-600B	Alabama Pesticide Handbook, Vol. 2 Hort ($13.00)
ANR-616	Weeds of Southern Turfgrasses ($8.00)
ANR-715	Cotton Defoliation
ANR-854	Weed Control in Residential Landscape Plantings
ANR-908	Moss and Algae Control in Lawns
ANR-909	Tropical Soda Apple in Alabama
ANR-951	Weed Control Around Poultry Houses and Other Farm Building
ANR-975	Poisonous Plants of the Southeastern United States ($4.00)
ANR-1034	Biological Control of Musk Thistle
INFORMATION SHEETS[1]	
98IPM-2	Commercial Vegetable IPM
98IPM-8	Peach IPM
98IPM-11	Apple IPM
98IPM-22	Weed Control in Commercial Turfgrass
98IPM-27	Pecan IPM
98IPM-28	Forage Crops IPM
98IPM-223	Noncropland IPM
98IPM-360	Peanut IPM
98IPM-413	Soybean IPM
98IPM-415	Cotton IPM
98IPM-428	Corn IPM
98IPM-429	Grain Sorghum IPM
98IPM-458	Small Grain IPM
98IPM-478	Small Fruit IPM
98IPM-590	Weed Control in Home Lawns
98IPM-978	Alfalfa IPM

State:	**ARKANSAS**
Prepared by:	John Boyd
Internet URL:	
Order from:	Dr. Ford Baldwin or Dr. John Boyd, Box 391, 2201 Brookwood Drive, University of Arkansas, Little Rock, AR 72203
[1]	Mr. Albert Squires, Box 391, Little Rock, AR 72203

Number	Title
PUBLICATIONS	
MP-44	Recommended Chemicals for Weed and Brush Control in Arkansas
MP-169[1]	Weeds of Arkansas Lawns, Turf, Roadsides, and Recreation Areas: A Guide to Identification ($5.00)
MP-193[1]	Identifying Seedling and Immature Weeds of Arkansas Field Crops ($2.00)
MP-216	Applying Herbicides to Yards, Gardens, and Other Small Areas
MP-269	Cool Season Lawns for Arkansas
MP-370	Turfgrass Weed Control for Professionals
MP-371	Principles of Turfgrass Weed Control
FS-2004	Alfalfa Weed Control
FS-2023	Weed Control in Wheat
FS-2041	Weed Control in Blackberries and Raspberries
FS-2060	Managing Problem Weeds in Turf
FS-2062	Aquatic Herbicide Use
FSA-2022	Blueberry Weed Control
FSA-2064	Garlic Control in Wheat
FSA-2077	Grape Weed Management
FSA-2078	Strawberry Weed Control
FSA-2079	Fruit Tree Weed Control
FSA-2080	Pasture Weed Control
FSA-2081	Pasture Brush Control
FSA-2085	Non-Cropland Weed Control
FSA-2086	Christmas Tree Weed Control
FSA-2105	Alternative Weed Control for Vegetables
FSA-2108	Endophyte Fescue Control
FSA-2109	Home Lawn Weed Control
FSA-2110	Moss and Algae Control in Lawns
FSA-2111	Herbicide Additives
FSA-6023	Don't Bag Grass Clippings

A weed control chapter is included in each of the following publications:

MP-192	Rice Production Handbook
MP-197	Soybean Production Handbook
MP-214	Corn Production Handbook
-----	Grain Sorghum Production Handbook
-----	Technology for Optimum Production of Soybeans

Information fact sheets for weed problems in commodity groups such as rice, soybean, forage, cotton, etc. are published as necessary. Color posters of weeds in Wheat, Pastures, and Lawns I and II are also available.

State:	**FLORIDA**
Prepared by:	Joan Dusky
Internet URL:	http://hammock.ifas.ufl.edu/
Order from:	Dr. Joyce Tredaway, Extension Weed Specialist, Agronomy Department, 303 Newell Hall, P. O. Box 110500, University of Florida, Gainesville, FL 32611-0500
[1]	Dr. W. M. Stall, Extension Vegetable Weed Specialist, 1255 Fifield Hall, Univ. of Florida, Gainesville, FL 32611-0690
[2]	Dr. D. P. H. Tucker, Extension Citrus Management Specialist, IFAS-AREC, 700 Experiment Station Road, Lake Alfred, FL 33850
[3]	Dr. K. A. Langeland, Extension Aquatic Weed Specialist, Center for Aquatic Plant Research, 7922 NW 71st Street, Gainesville, FL 32606
[4]	Extension Turfgrass Specialist, 1523 Fifield Hall, Gainesville, FL 32611
[5]	University of Florida Publications, P. O. Box 110011, Gainesville, FL 32611-0011

Number	Title
PUBLICATIONS	
SS-AGR-001	Weed Control in Tobacco
SS-AGR-002	Weed Control in Corn
SS-AGR-003	Weed Control in Peanuts
SS-AGR-004	Weed Control in Cotton
SS-AGR-005	Weed Control in Soybeans
SS-AGR-006	Weed Control in Sorghum
SS-AGR-007	Weed Control in Small Grains
SS-AGR-008	Weed Control in Pastures and Rangeland
SS-AGR-009	Weed Control in Sugarcane
SS-AGR-010	Weed Control in Rice
SS-AGR-011	Response of Turfgrass and Turfgrass Weeds to Herbicides
SS-AGR-012	Florida Organo-Auxin Herbicide Rule
SS-AGR-013	Sulfonylurea Herbicides
SS-AGR-014	Herbicide Prepackage Mixtures
SS-AGR-015	Diagnosing Herbicide Injury
SS-AGR-016	Approximate Herbicide Pricing
SS-AGR-017	Plant Growth Retardants Used in Turfgrass Management
SS-AGR-019[4]	Herbicides and Plant Growth Regulator Guide for Turfgrass and Ornamental Producers - 1999
SS-AGR-22	Identification and Control of Bahiagrass Varieties in Florida
SS-AGR-50	Tropical Soda Apple in Florida
SS-AGR-52	Cogongrass (*Imperata cylindrica*) Biology, Ecology and Control in Florida
SS-AGR-58	Tropical Soda Apple Control - Best Management Practices in 1999
SS-ORH-004[4]	1999 University of Florida's Pest Control Recommendations for Turfgrass Managers
A-87-6[3]	Application Procedure for Use of Grass Carp for Control of Aquatic Weeds
A-87-7[3]	Biology and Chemical Control of Algae
A-87-10[3]	Biology and Chemical Control of Duckweed
A-87-11[3]	Chemical Control of Hydrilla
A-87-12[3]	Florida DNA Aquatic Plant Control Permit Program
FS WRS-7	Tropical Soda Apple: A New Noxious Weed in Florida
VC-188[1]	Weed Control in Beans and Peas
VC-189[1]	Weed Control in Cole or Brassica Leafy Vegetables
VC-190[1]	Weed Control in Cucurbit Crops
VC-191[1]	Weed Control in Eggplant
VC-192[1]	Weed Control in Okra
VC-193[1]	Weed Control in Bulb Crops
VC-194[1]	Weed Control in Potato

VC-195[1]	Potato Vine Dessicants
VC-196[1]	Weed Control in Strawberry
VC-197[1]	Weed Control in Sweet Corn
VC-198[1]	Weed Control in Sweet Potato
VC-200[1]	Weed Control in Tomatoes
VC-201[1]	Weed Control in Carrots and Parsley
VC-202[1]	Weed Control in Celery
VC-203[1]	Weed Control in Lettuce, Endive, and Spinach
VC-706[1]	Estimated Effectiveness of Recommended Herbicides on Selected Common Weeds in Florida Vegetables

CIRCULAR, BOOKS, AND GUIDES

280[5]	Turf Herbicide Families and their Characteristics
459[2]	Weed Control Guide for Florida Citrus
676	Weed Control in Centipede and St. Augustinegrass
678	Container Nursery Weed Control
852[4]	Weed Control in Sod Production
1114	Weed Management for Florida Golf Courses
-----[5]	Florida Weed Control Guide ($8.00)
DH-88-05[4]	Turfgrass Weed Control Guide for Lawn Care Professionals
DH-88-07[4]	Commercial Bermudagrass Weed Control Guide
SM-44[5]	Aquatic and Wetland Plants of Florida ($11.00)
SP-35[5]	Identification Manual for Wetland Plant Species of Florida ($18.00)
SP-37[5]	Weeds in Florida ($7.00)
	Florida Weeds Part II ($1.00)
SP-79[5]	Weeds of Southern Turfgrasses ($8.00)

State: **GEORGIA**

Prepared by: Tim R. Murphy

Internet URL: http://www.ces.uga.edu/

Order from: Publications Center, 4-Towers Building, Cooperative Extension Service, The University of Georgia, Athens, GA 30602

[1] Ag. Business Office, Room 203, Conner Hall, The University of Georgia, Athens, GA 30602
Make check payable to: Georgia Cooperative Extension Service

Number	Title
LEAFLETS	
263	Renovation of Home Lawns
400	Musk Thistle and It's Control
425	Florida Betony Control in Turfgrass and Ornamentals
CIRCULARS	
713	Commercial Blueberry Culture
823	Controlling Moss and Algae in Turf
839	Managing Wild Radish in Small Grains
EXTENSION BULLETINS	
643	1999 Georgia Apple Pest Management and Production Guide
654	Weed Control in Noncropland
682	Know Your Herbicide
761[1]	Weeds of the Southern United States ($3.00)
829	Principles and Practices of Weed Control in Cotton
839[1]	Identification and Control of Weeds in Southern Ponds ($1.25)
842	Weed Control in Landscape Plantings
955[1]	Georgia Soybean Culture ($10.00)
978	Weed Control in Home Lawns
984	Turfgrass Pest Control Recommendations for Professionals
986	Forest Site Preparation Alternatives
996	Commercial Watermelon Production
998	Conservation Tillage Crop Production in Georgia
1004	Herbicide Use in Forestry
1005	Georgia Handbook of Cotton Herbicides
1006	Weed Control in Ponds and Small Lakes
1008	Weed Facts: Texas Panicum
1009	Weed Facts: Morningglory Complex
1010	Weed Facts: Sicklepod and Coffee Senna
1019	Cotton Defoliation and Crop Maturity
1023	Herbicide Incorporation
1032	Forestry on a Budget
1043	Weed Facts: Yellow and Purple Nutsedge
1049	Perennial Weed Identification and Control in Georgia
1069	How to Set Up a Post-Emergence Directed Herbicide Sprayer for Cotton
1070	Forage Weed Management
1072	Weed Facts: Florida Beggarweed
1093	Guide to Field Crop Troubleshooting
1098	How to Control Poison Ivy
1100	Peanut Herbicides for Georgia
1107	Commercial Production of Edible Beans and Southern Peas

1118	Non-Chemical Weed Control Methods
1125	Weed Management in Conservation Tillage Cotton
1135	Intensive Wheat Management in Georgia
1138	Conservation Tillage for Peanut Production
1144	Commercial Production of Vegetable Transplants

SPECIAL BULLETINS

8	Agricultural Plant Pest Control
28[1]	Georgia Pest Control Handbook ($15.00)

MISCELLANEOUS

Pub. 46	1999 Georgia Peach Spray and Production Guide
Pub. 377	1999 Georgia Tobacco Growers Guide
Pub. 380	1999 Cotton Production Package
Pub. CSS-97-01	1999 Canola Production Guide
Hdbk. No. 1[1]	Peach Growers Handbook ($25.00)
[1]	Pecan Pest Management Handbook ($20.00)
[1]	Weeds of Southern Turfgrasses ($8.00)

State: **KENTUCKY**

Prepared by: J. D. Green

Internet URL: http://www.ca.uky.edu/

Order from: Dr. J. D. Green, Extension Weed Control Specialist, Department of Agronomy, N-106B Ag. Sci. Bldg-North, University of Kentucky, Lexington, KY 40546

Dr. James R. Martin, Extension Weed Control Specialist, University of Kentucky Research and Education Center, P. O. Box 469, Princeton, KY 42445

Number	Title
AGR-6	Chemical Control of Weeds in Kentucky Farm Crops
AGR-12	Weeds of Kentucky Turf
AGR-78	Weed Control Recommendations for Kentucky Bluegrass and Tall Fescue Lawns and Recreational Turf
AGR-117	Winter Annual Weeds of Kentucky
AGR-118	Summer Annual Broadleaf Weeds of Kentucky
AGR-135	Perennial Broadleaf Weeds of Kentucky
AGR-139	Herbicide Persistence and Carryover in Kentucky
AGR-140	Herbicides with Potential to Carryover and Injure Rotational Crops in Kentucky
AGR-148	Weed Control Strategies for Alfalfa and Other Forage Legume Crops
AGR-172	Weed Management in Grass Pastures, Hayfields, and Fencerows
ID-2	Some Plants of Kentucky Poisonous to Livestock
ID-36	Commercial Vegetable Crop Recommendations
ID-125	A Comprehensive Guide to Wheat Management in Kentucky ($10.00)

State:	**LOUISIANA**
Prepared by:	Dearl E. Sanders and Reed Lensce
Internet URL:	
Order from:	Dr. Dearl Sanders, Knapp Hall, Louisiana State University, Baton Rouge, LA 70803-1900
[1]	Dr. Reed Lensce, Knapp Hall, Louisiana State University, Baton Rouge, LA 70803-1900

Number	Title
PUBLICATIONS	
1365	Control Weeds in Cotton with Preemergence Chemicals in 1999
1366	Control Weeds in Cotton with Postemergence Chemicals in 1999
1481[1]	Control Weeds in Soybeans with Preemergence Chemicals in 1999
1482[1]	Control Weeds in Soybeans with Postemergence Chemicals in 1999
1656	Louisiana's Suggested Chemical Weed Control Guide for 1999
2314[1]	Controlling Weeds in Sugarcane

State:	**MISSISSIPPI**
Prepared by:	John D. Byrd, Jr.
Internet URL:	http://www.ces.msstate.edu/anr/plantsoil/weeds
Order from:	Dr. John D. Byrd, Jr., Department of Plant & Soil Sciences, Box 9555, Mississippi State, MS 39762-9555
[1]	Dr. Marty Brunson, Department of Wildlife & Fisheries, Box 9690, Mississippi State, MS 39762-9690
[2]	Dr. Andy Ezell, Forestry Department, Box 9681, Mississippi State, MS 39762-9681
[3]	Mr. Herb Willcutt, Agricultural & Biological Engineering, Box 9632, Mississippi State, MS 39762-9632
[4]	Dr. Joe Street, Delta Research & Extension Center, P. O. Box 68, Stoneville, MS 38776

Number	Title
INFORMATION SHEETS	
673[1]	Control of Fish Diseases and Aquatic Weeds
803	Grain and Forage Sorghum Weed Control
875	Cotton Postemergence and Layby Herbicides
945	Forages Weed Control in Pastures
962	Soybean Preplant Foliar and Preplant Incorporated
963	Soybean Preemergence Weed Control
1024	Soybean - Management Strategies for Sicklepod
1025[1]	Aquatic Weed Identification and Control--Bushy Pondweed and Coontail
1026[1]	Aquatic Weed Identification and Control--Willows and Arrowhead
1027[1]	Aquatic Weed Identification and Control--Cattail and Spikerush
1028[1]	Aquatic Weed Identification and Control--Pondweed and Bladderwort
1029[1]	Aquatic Weed Identification and Control--Fanwort and Parrotfeather
1030[1]	Aquatic Weed Identification and Control--Frogbit and Watershield
1031[1]	Aquatic Weed Identification and Control--Burreed and Bulrush
1032[1]	Aquatic Weed Identification and Control--White Waterlily and American Lotus
1033[1]	Aquatic Weed Identification and Control--Duckweed and Water Hyacinth
1034[1]	Aquatic Weed Identification and Control--Hydrilla and Alligatorweed
1035[1]	Aquatic Weed Identification and Control--Algae
1036[1]	Aquatic Weed Identification and Control--Methods of Aquatic Weed Control
1037[1]	Aquatic Weed Identification and Control--Smartweed and Primrose
1500	Flame Cultivation in Cotton
1527	Peanut Weed Control Recommendations
1528	Kenaf Weed Control Recommendations
1580	Nonchemical Weed Control for Home Owners
1619	Cotton Preplant and Preemergence Weed Control
-----	Tropical Soda Apple in Mississippi
-----	Tropical Soda Apple in the United States
-----	Management Strategies for Tropical Soda Apple in Mississippi
PUBLICATIONS	
475	Corn Weed Control Recommendations
461	Commercial Pecan Pest Control-Insects, Diseases and Weeds
553	Weed Science for 4-H'ers
1005[2]	Christmas Tree Production in Mississippi
1006[3]	Calibration of Ground Spray Equipment
1091	Garden Tabloid
1100	Soybeans Postemergence Weed Control
1217[4]	Rice Weed Control

1277[2]	Forest Management Alternatives for Private Landowners
1322	Establish and Manage Your Home Lawn
1344	Weed Control in Small Grain Crops
1532	1999 Weed Control Guidelines for Mississippi ($5.00)
1664	Disease, Insect and Weed Control Guide for Commercial Peach Orchards
1744	Weed Control in Home Lawns
1907	Herbicide Resistance Prevention and Detection
1934	Weed Response to Selected Herbicides
1962	Pesticides - Benefits and Risks
2036	Organic Vegetable IPM Guide
2166	Poisonous Plants of the Southeastern United States

TECHNICAL NOTES

MTN-SG[2]	Weed Control in Christmas Tree Plantations
MTN-7F[2]	An Overview of Herbicide Alternatives for the Private Forest Landowner
MTN-8F[2]	Tree Injection: Equipment, Methods, Effective Herbicides, Productivity, and Costs
MTN-11F[2]	Effective Kudzu Control

COMPUTER SOFTWARE

-----	MSHERB ($110.00)

State: **MISSOURI**

Prepared by: Andy Kendig

Internet URL: http://etcs.ext.missouri.edu/publications/xplor/

Order from: Extension Publications, 2800 Maguire, University of Missouri, Columbia, MO 65211

Add $1.00 for shipping and handling with each order.

Number	Title
MP575	Weed Control Guide for Missouri Field Crops ($7.50)
MP581	Weed and Brush Control Guide for Forages, Pastures, and Non-Cropland in Missouri ($5.00)
MP686	Using Reduced Herbicide Rates for Weed Control in Soybeans ($1.00)
G4251	Cotton Weed Control ($0.75)
G4851	Atrazine: Best Management Practices and Alternatives in Missouri ($0.75)
G4856	Aquatic Weed Control in Missouri ($1.00)
G4871	Waterhemp Management in Missouri ($0.50)
G4872	Johnsongrass Control
G4875	Control of Perennial Broadleaf Weeds in Missouri Field Crops ($0.75)

State:	**NORTH CAROLINA**
Prepared by:	Alan C. York, Fred Yelverton, and David Monks
Internet URL:	http://ipmwww.ncsu.edu/agchem/ac8.html
Order from:	Dr. Fred Yelverton or Dr. A. C. York, Crop Science Department, Box 7620, North Carolina State University, Raleigh, NC 27695-7620
[1]	Dr. J. C. Neal or Dr. D. W. Monks, Department of Horticulture, Box 7609, North Carolina State University, Raleigh, NC 27695-7609

Number	Title
PUBLICATIONS	
AG-37[1]	Agricultural Chemicals for North Carolina Apples
AG-146[1]	Peach and Nectarine Spray Schedule
AG-187	Tobacco Information - 1999
AG-208	Identifying Seedling and Mature Weeds in Southeastern United States ($7.00)
AG-331	Peanuts-1999
AG-348	Turfgrass Pest Management Manual ($7.00)
AG-408	1999 Pest Control Recommendations for Turfgrass Managers
AG-417	1999 Cotton Information
AG-427[1]	Weed Control Suggestions for Christmas Trees, Woody Ornamentals and Flowers
AG-437	Weed Management in Small Ponds
AG-438	Weed Control in Irrigation Water Supplies
AG-442	Using Activated Charcoal to Inactivate Agricultural Chemicals Spills
AG-449	Hydrilla, A Rapidly Spreading Aquatic Weed in North Carolina
AG-456	Using Grass Carp for Aquatic Weed Management
B-414	Stock-Poisoning Plants of North Carolina ($5.00)
SGPG No.11	Small Grain Production Guide--Weed Management
-----	North Carolina Agricultural Chemicals Manual ($12.00-Revised yearly)
INFORMATION LEAFLETS	
101[1]	Weed Control in Vegetable Gardens
205B[1]	Weed Control Options for Strawberries on Plastic
325[1]	Peach Orchard Weed Management
643[1]	Weed Control for Bulbs in the Landscape

State: **OKLAHOMA**

Prepared By: Jim Stritzke

Internet URL: http://bubba.ucc.okstate.edu/OSU_Ag/agedcm4h/pearl/agronomy/weeds/weeds.htm

Videotapes: Agricultural Communications, Room 111, Public Information Building, Oklahoma State University, Stillwater, OK 74078

Publications: Central Mailing Services, Publishing and Printing, Oklahoma State University, Stillwater, OK 74078

Number	Title
CIRCULAR	
E-806	Peanut Production Guide for Oklahoma
E-821	Soybean Production and Pest Management Guide for Oklahoma (Publication Fee)
E-827	Commercial Vegetable, Insect, Disease and Weed Control (Publication Fee)
E-832	OSU Extension Agents Handbook of Insect, Plant Disease and Weed Control (Publication Fee)
E-879	Turfgrass Pest Management (Publication Fee)
E-885	Roadside Vegetation Management
E-896	Roadside Research Summary Manual (Publication Fee)
MP-122	Roadside Development and Erosion Control
FACT SHEETS	
1215	Selecting the Proper Nozzle Type and Size for Low Pressure Ground Sprayers
1216	Calibrating a Low Pressure Ground Sprayer
1217	The Low Pressure Ground Sprayer
1218	Pumps for Low Pressure Ground Sprayers
2750	Guide to Effective Weed Control
2751	Weed Control in Agronomic Crops
2755	Bindweed Control in Oklahoma
2758	Weed Control in Rangeland with Herbicides
2761	Chemical Weed Control in Alfalfa
2762	Weed Management in Cotton
2763	Chemical Weed Control in Grain Sorghum
2768	Factors Affecting Herbicide Performance
Reprint 2769	Weed Control in Corn
2770	Weed Control in Winter Wheat
2771	Weed Control in Pastures
2773	Wild Buckwheat Control in Wheat
2774	Cheat Control in Wheat
6008	Weed Control in Vegetables
6015	Weed Control in Home Gardens
Reprint 6242	Weed Control in Pecans, Apples and Peaches
6423	Controlling Grassy Weeds in Home Lawns
Reprint 6424	Suggested Herbicides for Roadside Weed Problems
6601	Broadleaf Weed Control for Lawns in Oklahoma
7450	Safe Use of Pesticides in the Home and Garden
7451	Agricultural Pesticide Storage
7453	First-Aid for Pesticide Poisoning
7454	Check Your Pesticide Label

7457	Toxicity of Pesticides
7458	Integrated Pest Management for Crops in Oklahoma

VIDEOTAPES

VT-315	Herbicide Activity on Crops and Weeds

State:	**SOUTH CAROLINA**
Prepared By:	Ed Murdock
Internet URL:	http://AgWeb.clemson.edu/AgNews/Publications/Pages/pubs.htm
Order From:	Dr. E. C. Murdock, Extension Weed Scientist, Pee Dee Research & Extension Center, 2200 Pocket Road, Florence, SC 29501-9706
[1]	Bulletin Room, Room 82, Poole Agricultural Center, Clemson University, Clemson, SC 29634-0311

Number	Title
CIRCULAR	
463	Small Grain Production Guidelines for South Carolina
569	South Carolina Tobacco Grower's Guide
588	Peanut Production Guide for South Carolina
669	Canola Production in South Carolina
-----[1]	1999 Pest Management Handbook ($25.00)
LEAFLETS	
Forage No. 6	Weed Control in Bermudagrass
Forage No. 9	Weed Control in Tall Fescue
Forage No. 17	Weed Management in Perennial Pastures and Hay Fields

State: **TENNESSEE**

Prepared By: G. Neil Rhodes, Jr. and Darren K. Robinson

Internet URL: http://solar.rtd.utk.edu:80/campuses/utia.html

Order From: Extension Mailing Room, P.0. Box 1071, University of Tennessee, Knoxville, TN 37901

Number	Title
PUBLICATIONS	
956	Lawn Weeds and Their Control
1197	Commercial Fruit Spray Schedules
1226	Weed Management in Ornamental Nursery Crops
1282	Commercial Vegetable Disease, Insect and Weed Control
1521	Hay Crop and Pasture Weed Management
1538	Chemical Vegetation Management on Noncropland
1539	Commercial Turfgrass, Golf Course and Athletic Field Weed Management
1580	1999 Weed Control Manual for Tennessee Field Crops
FACT SHEETS	
PSS 6	Weed Resistance to Herbicides

State: **TEXAS**

Prepared By: Dr. Paul A. Baumann

Internet URL: http://leviathan.tamu.edu:70/7wc/pubs/waisindex/index.inv?weed+control

Order From: Dr. Paul A. Baumann, Extension Weed Specialist, 349 Soil & Crop Sciences, Texas A&M University, College Station, TX 77843-2474

Number	Title
B-1466	Chemical Weed and Brush Control - Suggestions for Rangeland
B-5038	Suggestions for Weed Control in Pastures and Forage Crops
B-5039	Suggestions for Weed Control in Cotton
B-5042	Suggestions for Weed Control in Corn
B-5045	Suggestions for Weed Control in Sorghum
B-6010	Suggestions for Weed Control in Peanuts
L-1708	Wild Oat Control in Texas
L-2254	Common Weeds in Corn and Grain Sorghum
L-2301	Common Weeds in Cotton
L-2302	Common Weeds in West Texas Cotton
L-2339	Field Bindweed Control in the Texas High Plains
L-2436	Silverleaf Nightshade Control in Cotton in West Texas
L-5102	Perennial Weed Control During Fallow Periods in the Texas High Plains

State: **VIRGINIA**

Prepared By: Scott Hagood

Internet URL: gopher://ext.vt.edu:70/11/vce-data

Order From: Virginia Polytechnic Institute and State University, Extension Distribution Center, Landsdowne St., Blacksburg, VA 24061

Number	Title
PUBLICATIONS	
456-016	Pest Management Guide for Field Crops
456-017	Pest Management Guide for Horticultural and Forest Crops
456-018	Pest Management Guide for Home Grounds and Animals

Revised annually ($16.00 per copy, or $45.00 per set)

Weed Survey -Southern States

Horticultural, Pasture, Recreational, and Industrial Subsection
(Vegetables, Citrus, Peaches, Apples, Fruits and Nuts,
Nursery and Container Ornamentals, Alfalfa, Hay,
Pasture, and Rangeland, Aquatic, Turf, Forestry,
Industrial Sites, Power Lines, and Right of Way)

Clyde C. Dowler, Section Chairman

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[7]These estimates are based on the knowledge and experience of these individuals or other specialists within the state with whom they conferred.

Table 1. The Southern States 10 Most Common and Troublesome Weeds in Vegetables

	States		
Ranking	Arkansas	Florida	Georgia
<u>Ten Most Common Weeds</u>			
1	Palmer amaranth	pigweed spp.	Florida pusley
2	pitted morningglory	yellow nutsedge	Southern crabgrass
3	smooth pigweed	common lambsquarter	pigweed
4	entireleaf morningglory	goosegrass	yellow nutsedge
5	sicklepod	panicum	smallflower morningglory
6	hemp sesbania	nightshade	sicklepod
7	cocklebur	common ragweed	Florida beggarweed
8	carpetweed	common purslane	common purslane
9	crabgrass	crabgrass	cutleaf eveningprimrose
10	yellow nutsedge	Florida pusley	purple nutsedge
<u>Ten Most Troublesome Weeds</u>			
1	Palmer amaranth	yellow nutsedge	yellow nutsedge
2	pitted morningglory	purple nutsedge	purple nutsedge
3	smooth pigweed	parthenium	sicklepod
4	entireleaf morningglory	nightshade	Florida pusley
5	sicklepod	morningglory	Southern crabgrass
6	hemp sesbania	eclipta	common purslane
7	cocklebur	common ragweed	pigweed
8	crabgrass	common bermudagrass	Texas panicum
9	southwestern cupgrass	Brazilian pusley	cutleaf eveningprimrose
10	yellow nutsedge	sicklepod	wild radish

Table 1. The Southern States 10 Most Common and Troublesome Weeds in Vegetables (cont.)

	States		
Ranking	Missouri	Puerto Rico	Tennessee
Ten Most Common Weeds			
1	annual grasses	pigweed	large crabgrass
2	amaranthus spp.	nutsedge spp.	smooth pigweed
3	morningglory spp.	crabgrass	carpetweed
4	common cocklebur	junglerice	goosegrass
5		jimsonweed	johnsongrass
6		spiderflower	common ragweed
7		ragweed parthenium	common cocklebur
8		goosegrass	morningglories
9		johnsongrass	yellow nutsedge
10		itchgrass	bermudagrass
Ten Most Troublesome Weeds			
1	common cocklebur	nutsedge spp.	yellow nutsedge
2	puncturevine	ragweed parthenium	hophornbeam copperleaf
3	morningglory spp.	itchgrass	bermudagrass
4		johnsongrass	hairy galinsoga
5		spiderflower	smooth pigweed
6		pigweed	morningglory spp.
7		jimsonweed	common ragweed
8		goosegrass	goosegrass
9		crabgrass	bermudagrass
10		junglerice	large crabgrass

Table 2. The Southern States 10 Most Common and Troublesome Weeds in Citrus.

	States	
Ranking	Florida	Puerto Rico
Ten Most Common Weeds		
1	bermudagrass	guineagrass
2	Guineagrass	crabgrass
3	nutsedge	spreading dayflower
4	signalgrass	nutsedge
5	dayflower	Alexandergrass
6	Florida pusley	balsam apple
7	goatweed	dearly vines
8	Spanish needle	sprangletop
9	balsam apple	wild poinsettia
10	milkweed vine	bermudagrass
Ten Most Troublesome Weeds		
1	Guineagrass	dumbcane
2	torpedograss	balsam apple
3	dayflower	guineagrass
4	Florida pusley	spreading dayflower
5	goatweed	garlic weed
6	lantana	bermudagrass
7	spurge spp.	morningglory spp.
8	balsam apple	sour paspalum
9	milkweed vine	dearly vines
10	wild citron	red sprangletop

Table 3. The Southern States 10 Most Common and Troublesome Weeds in Peaches

	States		
Ranking	Alabama	Arkansas	Georgia
Ten Most Common Weeds			
1	bahiagrass	horsenettle	crabgrass
2	common bermudagrass	greenbriar	cutleaf eveningprimrose
3	horseweed	bermudagrass	Carolina geranium
4	cutleaf eveningprimrose	woody sprouts	bahiagrass
5	blackberry	poison ivy	bermudagrass
6	nutsedge	Virginia creeper	johnsongrass
7	pigweed	trumpetcreeper	pigweed
8	sida spp.	blackberry	Texas panicum
9	crabgrass	dewberry	sida spp.
10	common ragweed	broomsedge	nutsedge spp.
Ten Most Troublesome Weeds			
1	nutsedge	horsenettle	bermudagrass
2	dewberry	greenbriar	bahiagrass
3	bahiagrass	bermudagrass	nutsedge spp.
4	common bermudagrass	woody sprouts	bramble spp.
5	common horsenettle	poison ivy	cutleaf eveningprimrose
6	blackberry	Virginia creeper	camphorweed
7	dallisgrass	trumpetcreeper	johnsongrass
8	cutleaf eveningprimrose	blackberry	horseweed
9	sida spp.	dewberry	curly dock
10	pigweed	broomsedge	Texas panicum

Table 3. The Southern States 10 Most Common and Troublesome Weeds in Peaches (cont.).

	States		
Ranking	Kentucky	Mississippi	North Carolina
Ten Most Common Weeds			
1	tall fescue	Southern crabgrass	crabgrass
2	large crabgrass	goosegrass	bermudagrass
3	foxtail spp.	common bermudagrass	camphorweed
4	goosegrass	dallisgrass	horseweed
5	dandelion	bahiagrass	eveningprimrose
6	broadleaf plantain	horsenettle	asters
7	johnsongrass	broadleaf signalgrass	henbit
8	yellow nutsedge	henbit	sandbur
9	ivyleaf morningglory	annual sedge	Virginia pepperweed
10	trumpetcreeper	wild garlic	lambsquarters
Ten Most Troublesome Weeds			
1	tall fescue	poison ivy	horsenettle
2	yellow nutsedge	horsenettle	yellow nutsedge
3	honeyvine milkweed	trumpetcreeper	bermudagrass
4	bigroot morningglory	Southern dewberry	camphorweed
5	field bindweed	roundleaf greenbriar	horseweed
6	trumpetcreeper	common bermudagrass	eveningprimrose
7	johnsongrass	bahiagrass	sandbur
8	poison ivy	annual sedge	dogfennel
9	blackberry spp.	henbit	maypops
10	horsenettle	common chickweed	annual sedge

Table 3. The Southern States 10 Most Common and Troublesome Weeds in Peaches (cont.).

	States	
Ranking	South Carolina	Texas
Ten Most Common Weeds		
1	bermudagrass	Palmer amaranth
2	johnsongrass	johnsongrass
3	crabgrass	bermudagrass
4	winter annual complex	silverleaf nightshade
5	yellow nutsedge	Texas panicum
6	Rubus spp.	crabgrass spp.
7	morningglory spp.	purple nutsedge
8	pigweed	common ragweed
9	horsenettle	common purslane
10	horseweed	henbit
Ten Most Troublesome Weeds		
1		johnsongrass
2		common bermudagrass
3		yellow nutsedge
4		purple nutsedge
5		Texas panicum
6		field bindweed
7		
8		
9		
10		

Table 4. The Southern States 10 Most Common and Troublesome Weeds in Apples.

	States		
Ranking	Alabama	Arkansas	Georgia
Ten Most Common Weeds			
1	bermudagrass	horsenettle	crabgrass
2	Carolina geranium	greenbriar	bermudagrass
3	horseweed	bermudagrass	henbit
4	Carolina horsenettle	woody sprouts	common chickweed
5	blackberry	poison ivy	Italian ryegrass
6	henbit	Virginia creeper	horsenettle
7	pigweed	trumpetcreeper	common ragweed
8	sida spp.	blackberry	bramble spp.
9	crabgrass	dewberry	pigweed spp.
10	common ragweed	broomsedge	tall fescue
Ten Most Troublesome Weeds			
1	nutsedge	horsenettle	bramble spp.
2	horseweed	greenbriar	horsenettle
3	bahiagrass	bermudagrass	nutsedge spp.
4	common bermudagrass	woody sprouts	pigweed spp.
5	Carolina horsenettle	poison ivy	lespedeza spp.
6	blackberry	Virginia creeper	johnsongrass
7	dallisgrass	trumpetcreeper	smilax spp.
8	cutleaf eveningprimrose	blackberry	poison ivy
9	prickly sida	dewberry	dwarf fleabane
10	pigweed	broomsedge	Virginia creeper

Table 4. The Southern States 10 Most Common and Troublesome Weeds in Apples (cont.).

	States		
Ranking	Kentucky	North Carolina	South Carolina
Ten Most Common Weeds			
1	tall fescue	white clover	bermudagrass
2	large crabgrass	crabgrass	johnsongrass
3	foxtail spp.	morningglory spp.	tall fescue
4	goosegrass	dandelion	croton spp.
5	dandelion	horseweed	yellow nutsedge
6	broadleaf plantain	plantain spp.	Rubus spp.
7	johnsongrass	dallisgrass	morningglory spp.
8	yellow nutsedge	bramble spp.	perennial asters
9	ivyleaf morningglory	fall panicum	horsenettle
10	trumpetcreeper	Virginia creeper	horseweed
Ten Most Troublesome Weeds			
1	tall fescue	white clover	
2	yellow nutsedge	morningglory spp.	
3	honeyvine milkweed	brambles	
4	bigroot morningglory	poison ivy	
5	field bindweed	honeysuckle	
6	trumpetcreeper	greenbriar	
7	johnsongrass	Virginia creeper	
8	poison ivy	horsenettle	
9	blackberry spp.	dallisgrass	
10	horsenettle	yellow nutsedge	

Table 4. The Southern States 10 Most Common and Troublesome Weeds in Apples (cont.).

	States
Ranking	Tennessee
Ten Most Common Weeds	
1	tall fescue
2	large crabgrass
3	common ragweed
4	smooth pigweed
5	dandelion
6	morningglory spp.
7	plantains
8	johnsongrass
9	Carolina horsenettle
10	poison ivy
Ten Most Troublesome Weeds	
1	poison ivy
2	brambles
3	Carolina horsenettle
4	Virginia creeper
5	tall fescue
6	honeysuckle
7	trumpetcreeper
8	cat greenbriar
9	dandelion
10	morningglory spp.

Table 5. The Southern States 10 Most Common and Troublesome Weeds in Fruit and Nuts.

	States		
Ranking	Alabama	Arkansas	Florida
Ten Most Common Weeds			
1	bahiagrass	horsenettle	bermudagrass
2	common bermudagrass	greenbriar	bahiagrass
3	nutsedge	bermudagrass	guineagrass
4	crabgrass	Virginia creeper	sandbur spp.
5	horseweed	trumpetcreeper	crabgrass spp.
6	blackberry	honeysuckle	spatterdock
7	morningglory	dewberry	Virginia creeper
8	prickly sida	blackberry	greenbriar
9	common ragweed	crabgrass	Florida pusley
10	pigweed	cutleaf eveningprimrose	panicum spp.
Ten Most Troublesome Weeds			
1	nutsedge	bermudagrass	greenbriar
2	blackberry	yellow woodsorrel	nutsedge spp.
3	bahiagrass	johnsongrass	guineagrass
4	common bermudagrass	Virginia creeper	lantana spp.
5	morningglory	trumpetcreeper	panicum
6	horseweed	honeysuckle	vaseygrass
7	prickly sida	dewberry	bermudagrass
8	common ragweed	blackberry	bahiagrass
9	pigweed	horsenettle	Spanish needles
10	henbit	woody sprouts	sandbur spp.

Table 5. The Southern States 10 Most Common and Troublesome Weeds in Fruits and Nuts (cont.).

	States		
Ranking	Georgia	Mississippi	North Carolina
Ten Most Common Weed			
1	crabgrass	common bermudagrass	crabgrass
2	bermudagrass	Southern crabgrass	horseweed
3	bahiagrass	goosegrass	horsenettle
4	cutleaf eveningprimrose	fescue	dogfennel
5	johnsongrass	horsenettle	lambsquarters
6	common ragweed	Pennsylvania smartweed	prickly sida
7	Italian ryegrass	common knotweed	dallisgrass
8	bramble spp.	Southern dewberry	bermudagrass
9	morningglory spp.	annual sedge	eveningprimrose
10	sida spp.	annual lespedeza	bramble spp.
Ten Most Troublesome Weeds			
1	bermudagrass	annual sedge	bramble spp.
2	bramble spp.	bahiagrass	poison ivy
3	bahiagrass	horsenettle	yellow nutsedge
4	nutsedge spp.	common bermudagrass	honeysuckle
5	vaseygrass	Pennsylvania smartweed	greenbriar
6	Italian ryegrass	Southern dewberry	horsenettle
7	camphorweed	Southern crabgrass	eveningprimrose
8	cutleaf eveningprimrose	goosegrass	bermudagrass
9	horseweed	Japanese honeysuckle	Virginia creeper
10	johnsongrass	fescue	maypops

Table 5. The Southern States 10 Most Common and Troublesome Weeds in Fruits and Nuts (cont.).

	States
Ranking	South Carolina
Ten Most Common Weed	
1	bermudagrass
2	johnsongrass
3	bahiagrass
4	large crabgrass
5	Carolina geranium
6	barnyardgrass
7	prickly sida
8	cutleaf eveningprimrose
9	Florida pusley
10	blue vervain
Ten Most Troublesome Weeds	
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Table 6. The Southern States 10 Most Common and Troublesome Weeds in Nursery and Container Ornamentals.

	States		
Ranking	Alabama	Arkansas	Florida
Ten Most Common Weeds			
1	woodsorrel spp.	henbit	creeping spurge
2	spurge	chickweed	spotted spurge
3	crabgrass	yellow woodsorrel	woodsorrel
4	common chickweed	prostrate spurge	bittercress
5	bittercress	bermudagrass	cudweed
6	nutsedge	yellow nutsedge	common chickweed
7	annual bluegrass	purple nutsedge	chamberbitter
8	common bermudagrass	crabgrass	eclipta
9	goosegrass	hairy bittercress	crabgrass
10	henbit	annual bluegrass	goosegrass
Ten Most Troublesome Weeds			
1	nutsedge	henbit	bittercress
2	Florida betony	chickweed	common chickweed
3	common bermudagrass	yellow woodsorrel	creeping spurge
4	chamberbitter	prostrate spurge	spotted spurge
5	woodsorrel	bermudagrass	eclipta
6	spurge	yellow nutsedge	woodsorrel
7	bittercress	purple nutsedge	cudweed
8	chickweed	eclipta	Florida pusley
9	henbit	Florida betony	goosegrass
10	crabgrass	horseweed	crabgrass

Table 6. The Southern States 10 Most Common and Troublesome Weeds in Nursery and Container Ornamentals (cont.).

	States		
Ranking	Georgia	Mississippi	Puerto Rico
Ten Most Common Weeds			
1	crabgrass	Southern crabgrass	nutsedge
2	woodsorrel spp.	common bermudagrass	goosegrass
3	spurge spp.	annual bluegrass	red sprangletop
4	common chickweed	annual sedge	plantains
5	henbit	prostrate spurge	purslane
6	nutsedge spp.	henbit	spurge
7	Florida betony	common chickweed	niruri
8	hairy bittercress	common purslane	vernonia
9	Phyllanthus spp.	yellow woodsorrel	tickle grass
10	goosegrass	swinecress	wild hops
Ten Most Troublesome Weeds			
1	nutsedge spp.	prostrate spurge	nutsedge
2	dogfennel	annual sedge	goosegrass
3	dayflower	leafflower	spurge
4	Phyllanthus spp.	yellow woodsorrel	red sprangletop
5	common chickweed	goosegrass	plantains
6	spurge spp.	common bermudagrass	purslane
7	Florida betony	wild garlic	vernonia
8	woodsorrel spp.	nutsedge	niruri
9	goosegrass	eclipta	
10	crabgrass	Florida betony	

Table 6. The Southern States 10 Most Common and Troublesome Weeds in Nursery and Container Ornamentals (cont.).

	States		
Ranking	South Carolina	Tennessee	Texas
Ten Most Common Weeds			
1	spotted spurge	large crabgrass	common chickweed
2	bittercress	goosegrass	prostrate spurge
3	perennial oxalis	prostrate spurge	annual bluegrass
4	eclipta	yellow nutsedge	oxalis
5	groundsel	musk thistle	nutsedge spp.
6	yellow nutsedge	common yellow woodsorrel	henbit
7	crabgrass	hairy bittercress	crabgrass spp.
8	dogfennel	henbit	Palmer amaranth
9	horseweed	common ragweed	eclipta
10		chickweed	sowthistle
Ten Most Troublesome Weeds			
1		spotted spurge	eclipta
2		musk thistle	prostrate spurge
3		mugwort	bermudagrass
4		common yellow woodsorrel	oxalis
5		yellow nutsedge	nutsedge spp.
6		common ragweed	
7		goosegrass	
8		bermudagrass	
9		johnsongrass	
10		smooth pigweed	

Table 7. The Southern States 10 Most Common and Troublesome Weeds in Alfalfa.

	States		
Ranking	Alabama	Arkansas	Georgia
Ten Most Common Weeds			
1	chickweed	crabgrass	crabgrass
2	henbit	goosegrass	little barley
3	annual ryegrass	foxtail	common chickweed
4	crabgrass	henbit	henbit
5	curly dock	common chickweed	shepherd's-purse
6	common bermudagrass	curly dock	curly dock
7	wild radish	smooth pigweed	amaranth spp.
8	bittercress	johnsongrass	wild radish
9	buttercup spp.	mustards	johnsongrass
10	pigweed	buttercup	Italian ryegrass
Ten Most Troublesome Weeds			
1	curly dock	crabgrass	curly dock
2	pigweed	goosegrass	little barley
3	wild radish	foxtail	common chickweed
4	wild mustard	henbit	wild radish
5	henbit	common chickweed	henbit
6	chickweed	curly dock	johnsongrass
7	buttercup spp.	smooth pigweed	Italian ryegrass
8	crabgrass	johnsongrass	amaranth spp.
9	thistle	shepherd's-purse	shepherd's-purse
10	annual ryegrass	buttercup	thistle spp.

Table 7. The Southern States 10 Most Common and Troublesome Weeds in Alfalfa (cont.).

	States		
Ranking	Kentucky	Missouri	South Carolina
Ten Most Common Weeds			
1	common chickweed	perennial broadleaves	wild radish
2	foxtail spp.	perennial grasses	wild mustard
3	large crabgrass	annual grasses	crabgrass spp.
4	henbit	annual broadleaves	common bermudagrass
5	purple deadnettle	bitter sneezeweed	shepherd's-purse
6	dandelion		dock
7	mustard spp.		johnsongrass
8	Philadelphia fleabane		chickweed
9	broadleaf plantain		henbit
10	johnsongrass		cutleaf eveningprimrose
Ten Most Troublesome Weeds			
1	curly dock	perennial broadleaves	wild radish
2	musk thistle	perennial grasses	dock
3	common chickweed	annual grasses	common bermudagrass
4	johnsongrass	annual broadleaves	crabgrass spp.
5	yellow nutsedge	bitter sneezeweed	henbit
6	horsenettle		wild garlic
7	spiny pigweed		
8	dandelion		
9	Philadelphia fleabane		
10	broadleaf plantain		

Table 7. The Southern States 10 Most Common and Troublesome Weeds in Alfalfa (cont.).

	States	
Ranking	Tennessee	Texas
Ten Most Common Weeds		
1	large crabgrass	field sandbur
2	chickweed	pigweed spp.
3	henbit	brome spp.
4	smooth pigweed	green foxtail
5	goosegrass	kochia
6	buckhorn plantain	common ragweed
7	johnsongrass	mustard spp.
8	curly dock	yellow nutsedge
9	spotted spurge	johnsongrass
10	annual ryegrass	bermudagrass
Ten Most Troublesome Weeds		
1	curly dock	field sandbur
2	buckhorn plantain	pigweed spp.
3	cornflower	kochia
4	deadnettle	henbit
5	henbit	mustard spp.
6	chickweed	johnsongrass
7	musk thistle	Texas panicum
8	spotted spurge	green foxtail
9	smooth pigweed	brome spp.
10	annual ryegrass	

Table 8. The Southern States 10 Most Common and Troublesome Weeds in Hay, Pasture, and Rangeland.

	States		
Ranking	Alabama	Arkansas	Florida
Ten Most Common Weeds			
1	crabgrass	buttercup	smutgrass
2	dogfennel	common ragweed	Cyperus spp.
3	blackberry	lanceleaf ragweed	tropical soda apple
4	Carolina horsenettle	persimmon	dogfennel
5	pigweed	crabgrass	vaseygrass
6	common bermudagrass	foxtail	Southern waxmyrtle
7	bahiagrass	dallisgrass	torpedograss
8	buttercup spp.	red sorrel	bluestem broomsedge
9	field sandbur	bitterweed	cactus spp.
10	smutgrass	smooth pigweed	paw-paw spp.
Ten Most Troublesome Weeds			
1	Carolina horsenettle	honeylocust	smutgrass
2	blackberry	blackberry	tropical soda apple
3	smutgrass	pricklypear	dogfennel
4	dallisgrass	horsenettle	Southern waxmyrtle
5	crabgrass	greenbriar	bluestem broomsedge
6	torpedograss	johnsongrass	cactus spp.
7	field sandbur	crabgrass	paw-paw spp.
8	dog fennel	dallisgrass	torpedograss
9	johnsongrass	foxtail	horseweed
10	horseweed	sandbur	Cyperus spp.

Table 8. The Southern States 10 Most Common and Troublesome Weeds in Hay, Pasture, and Rangeland (cont.).

	States		
Ranking	Georgia	Kentucky	Louisiana
Ten Most Common Weeds			
1	crabgrass	foxtail spp.	crabgrass spp.
2	bitter sneezeweed	large crabgrass	broadleaf signalgrass
3	amaranth spp.	musk thistle	foxtail spp.
4	thistle spp.	tall ironweed	curly dock
5	bahiagrass	buttercup spp.	wooly croton
6	buttercup spp.	spiny pigweed	dogfennel
7	broomsedge	wild garlic	spiny amaranth
8	dogfennel	broomsedge	smutgrass
9	horsenettle	curly dock	Rubus spp.
10	johnsongrass	cocklebur	buttercup spp.
Ten Most Troublesome Weeds			
1	bitter sneezeweed	tall ironweed	smutgrass
2	thistle spp.	multiflora rose	bahiagrass
3	amaranth spp.	musk thistle	foxtail spp.
4	crabgrass	purpletop	bluestem broomsedge
5	bahiagrass	blackberry spp.	buttercup spp.
6	dogfennel	buckbrush	Southern waxmyrtle
7	horsenettle	broomsedge	spiny amaranth
8	blackberry spp.	Eastern red cedar	multiflora rose
9	johnsongrass	horsenettle	vaseygrass
10	field sandbur	nimblewill	chinese tallow

Table 8. The Southern States 10 Most Common and Troublesome Weeds in Hay, Pasture, and Rangeland (cont.).

	States		
Ranking	Mississippi	Missouri	Puerto Rico
Ten Most Common Weeds			
1	broadleaf signalgrass	perennial broadleaves	tall albizzia
2	dallisgrass	perennial grasses	cortadera
3	rootknot foxtail	annual grasses	wire weed
4	Southern crabgrass	annual broadleaves	man-better-man
5	Carolina horsenettle	bitter sneezeweed	mallow
6	dogfennel		giant milkweed
7	spiny amaranth		mesquite
8	thistle		casha
9	blackberry		bullgrass
10	broomsedge		thorny sensitive plant
Ten Most Troublesome Weeds			
1	rootknot foxtail	perennial broadleaves	tall albizzia
2	broomsedge	perennial grasses	cortadera
3	Carolina horsenettle	annual grasses	casha
4	boneset	annual broadleaves	mesquite
5	dallisgrass	bitter sneezeweed	mallow
6	dogfennel		wire weed
7	spiny amaranth		man-better-man
8	thistle		thorny sensitive plant
9	perilla mint		Venezuela grass
10	smutgrass		giant milkweed

Table 8. The Southern States 10 Most Common and Troublesome Weeds in Hay, Pasture, and Rangeland (cont.).

	States		
Ranking	South Carolina	Tennessee	Texas
Ten Most Common Weeds			
1	crabgrass	large crabgrass	wooly croton
2	dewberry/blackberry	buttercup	Western ragweed
3	thistle spp.	spiny amaranth	bahiagrass
4	dogfennel	buckhorn plantain	Carolina horsenettle
5	horsenettle	johnsongrass	dallisgrass
6	multiflora rose	Carolina horsenettle	common broomweed
7	broomsedge	common cocklebur	bitter sneezeweed
8	bitter sneezeweed	tall ironweed	silverleaf nightshade
9	johnsongrass	bramble spp.	field sandbur
10	curly dock	musk thistle	crabgrass
Ten Most Troublesome Weeds			
1	Cyperus spp.	Carolina horsenettle	dallisgrass
2	sandbur spp.	buttercup	field sandbur
3	horsenettle	musk thistle	silverleaf nightshade
4	bahiagrass	bramble spp.	Western ragweed
5	dogfennel	curly dock	prickly pear
6	dewberry/blackberry	tall ironweed	Carolina horsenettle
7	bitter sneezeweed	johnsongrass	dogfennel
8	vaseygrass	buckhorn plantain	Texas bullnettle
9	paspalum spp.	spiny amaranth	johnsongrass
10	prickly pear	common cocklebur	common milkweed

Table 9. The Southern States 10 Most Common and Troublesome Weeds in Aquatic.

	States		
Ranking	Alabama	Arkansas	Florida
Ten Most Common Weeds			
1	filamentous algae	waterlily	hydrilla
2	watermilfoil	duckweed	waterhyacinth
3	pondweed	naiad	algae
4	duckweed	willow	torpedograss
5	parrotfeather	watermeal	waterlettuce
6	cattail	filamentous algae	melaleuca
7	Southern naiad	arrowhead	Brazilian pepper
8	waterlily	water primose	common duckweed
9	watershield	coontail	spatterdock
10	coontail	spikerush	fragrant waterlily
Ten Most Troublesome Weeds			
1	hydrilla	cattail	hydrilla
2	alligatorweed	American lotus	waterhyacinth
3	watermilfoil	maidencane	melaleuca
4	Southern naiad	water primrose	algae
5	water willow	common reed	torpedograss
6	pondweed	alligatorweed	Eurasian watermilfoil
7	parrotfeather	spatterdock	cattail spp.
8	coontail	waterlily	maidencane
9	maidencane	smartweed	fragrant waterlily
10	watermeal	water primose	spatterdock

Table 9. The Southern States 10 Most Common and Troublesome Weeds in Aquatic (cont.).

	States		
Ranking	Georgia	Louisiana	Mississippi
Ten Most Common Weeds			
1	filamentous algae spp.	duckweed	blue-green algae
2	cattail spp.	water hyacinth	common duckweed
3	duckweed spp.	spikerushes	giant duckweed
4	waterlily spp.	alligatorweed	Chara spp.
5	parrotfeather	salvinia	Nitella spp.
6	coontail	Southern naiad	smartweeds
7	naiad spp.	maidencane	spikerushes
8	pondweed spp.	pickeralweed	Southern cattail
9	slender spikerush	cattail	alligatorweed
10	willow spp.	Sagitaria spp.	waterhyacinth
Ten Most Troublesome Weeds			
1	watermeal	water hyacinth	blue-green algae
2	filamentous algae spp.	alligatorweed	common duckweed
3	slender spikerush	duckweed	spikerushes
4	hydrilla	hydrilla	pondweed spp.
5	parrotfeather	filamentous algae	naiad spp.
6	naiad spp.	coontail	Southern cattail
7	pondweed spp.	water primrose	Chara spp.
8	waterlily spp.	elodea	Nitella spp.
9	duckweed spp.	salvinia	bladderwort spp.
10	spatterdock	Southern naiad	willow-primrose

Table 9. The Southern States 10 Most Common and Troublesome Weeds in Aquatic (cont.).

	States		
Ranking	Missouri	Puerto Rico	Tennessee
Ten Most Common Weeds			
1	algae	water hyacinth	planktonic algae
2	lilly pods	water lettuce	filamentous algae
3	smartweed spp.	cattail	duckweed
4	cattail	paragrass	pondweeds
5	perennial aquatic grasses	giant rush	Southern naiad
6	rushes	alligatorweed	cattail
7		smartweed	watermeal
8		bulrush	watermilfoil
9		coontail	fragrant waterlily
10			watershield
Ten Most Troublesome Weeds			
1	algae	water hyacinth	filamentous algae
2	perennial aquatic grasses	alligatorweed	watermeal
3	rushes	cattail	duckweed
4		paragrass	watermilfoil
5		giant rush	willow
6		water lettuce	pondweeds
7		smartweed	Southern naiad
8		coontail	fragrant waterlily
9		bulrush	water primrose
10			watershield

Table 9. The Southern States 10 Most Common and Troublesome Weeds in Aquatic (cont.).

	States
Ranking	Texas
Ten Most Common Weeds	
1	swamp smartweed
2	American pondweed
3	common duckweed
4	waterhyacinth
5	blue waterlily
6	cattail
7	hydrilla
8	Eurasian watermilfoil
9	rice cutgrass
10	bushy waterprimrose
Ten Most Troublesome Weeds	
1	filamentous algaes
2	Southern naiad
3	hydrilla
4	Eurasian watermilfoil
5	cattail
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Table 10. The Southern States 10 Most Common and Troublesome Weeds in Turf.

	States		
Ranking	Alabama	Arkansas	Florida
Ten Most Common Weeds			
1	annual bluegrass	crabgrass	goosegrass
2	crabgrass	annual bluegrass	crabgrass spp.
3	goosegrass	dallisgrass	dayflower
4	wild garlic	yellow nutsedge	Cyperus spp.
5	henbit	purple nutsedge	spurge spp.
6	spurge	bermudagrass	pennywort spp.
7	annual lespedeza	white clover	sandbur spp.
8	lawn burweed	lespedeza	bull paspalum
9	nutsedge	henbit	beggarstick
10	chickweed	chickweed	annual bluegrass
Ten Most Troublesome Weeds			
1	Virginia buttonweed	dallisgrass	Cyperus spp.
2	bahiagrass	yellow nutsedge	goosegrass
3	wild violet	purple nutsedge	beggarstick
4	nutsedge	dallisgrass	spurge spp.
5	Florida betony	Virginia buttonweed	pennywort
6	spurge	pathrush	crabgrass spp.
7	annual lespedeza	annual bluegrass	annual bluegrass
8	ground ivy	bermudagrass	Florida betony
9	goosegrass	tufted lovegrass	torpedograss
10	wild garlic	wild garlic	sandbur spp.

Table 10. The Southern States 10 Most Common and Troublesome Weeds in Turf (cont.).

	States		
Ranking	Georgia	Kentucky	Mississippi
Ten Most Common Weeds			
1	crabgrass spp.	large crabgrass	Southern crabgrass
2	dandelion	dandelion	annual bluegrass
3	annual bluegrass	broadleaf plantain	common chickweed
4	bahiagrass	white clover	henbit
5	henbit	common chickweed	dallisgrass
6	common chickweed	wild violet	goosegrass
7	goosegrass	wild garlic	Virginia buttonweed
8	nutsedge spp.	nimblewill	prostrate spurge
9	dallisgrass	dallisgrass	wild garlic
10	wild garlic	tall fescue (clumps)	common dandelion
Ten Most Troublesome Weeds			
1	Virginia buttonweed	annual bluegrass	Virginia buttonweed
2	nutsedge spp.	wild violet	common bermudagrass
3	Florida betony	nimblewill	lawn burweed
4	wild garlic	Virginia buttonweed	prostrate spurge
5	dayflower	Star-of-Bethlehem	bahiagrass
6	annual bluegrass	dallisgrass	goosegrass
7	dallisgrass	large crabgrass	wild garlic
8	violet spp.	common lespedeza	purple nutsedge
9	corn speedwell	tall fescue (clumps)	henbit
10	Phyllanthus spp.	white clover	annual bluegrass

Table 10. The Southern States 10 Most Common and Troublesome Weeds in Turf (cont.).

	States		
Ranking	Missouri	Puerto Rico	South Carolina
Ten Most Common Weeds			
1	crabgrass	bermudagrass	crabgrass spp.
2	goosegrass	sour paspalum	wild garlic
3	annual bluegrass	sensitive plant	dandelion
4	chickweed	garden spurge	plantain spp.
5	henbit	tall fringe rush	annual bluegrass
6	deadnettle spp.	green kyllinga	sandbur spp.
7	dandelion	goosegrass	Cyperus spp.
8	nutsedge spp.	crabgrass	goosegrass
9		fingergrass	chickweed
10			henbit
Ten Most Troublesome Weeds			
1	nutsedge spp.	nutsedge	Cyperus spp.
2		bermudagrass	sandbur spp.
3		sour paspalum	Virgina buttonweed
4		tall fringe rush	dallisgrass
5		green kyllinga	parsley-piert
6		sensitive plant	nimblewill
7		goosegrass	annual lespedeza
8		crabgrass	spurweed
9		fingergrass	wild garlic
10		garden spurge	woodsorrel (yellow)

Table 10. The Southern States 10 Most Common and Troublesome Weeds in Turf (cont.).

	States	
Ranking	Tennessee	Texas
Ten Most Common Weeds		
1	large crabgrass	crabgrass
2	goosegrass	dallisgrass
3	dandelion	goosegrass
4	annual bluegrass	chickweed
5	white clover	henbit
6	chickweed	Virginia buttonweed
7	henbit	K. R. bluestem
8	speedwells	prostrate spurge
9	dallisgrass	annual bluegrass
10	yellow nutsedge	dandelion
Ten Most Troublesome Weeds		
1	Virginia buttonweed	dallisgrass
2	common violet	Virginia buttonweed
3	nimblewill	slender aster
4	India mockstrawberry	yellow nutsedge
5	lovegrass	purple nutsedge
6	dallisgrass	bahiagrass
7	annual bluegrass	dandelion
8	goosegrass	field sandbur
9	large crabgrass	K. R. bluestem
10	white clover	khakiweed

Table 11. The Southern States 10 Most Common and Troublesome Weeds in Forestry.

	States		
Ranking	Alabama	Arkansas	Florida
Ten Most Common Weeds			
1	dogfennel	blackberry	pawpaw-apple
2	common ragweed	hickory	dogfennel
3	horseweed	dogfennel	common persimmon
4	crabgrass	honeysuckle	pigweed spp.
5	broomsedge	sweetgum	saw palmetto
6	blackberry	broomsedge	sandbur spp.
7	goldenrod	pine	holly spp.
8	johnsongrass	horseweed	johnsongrass
9	kudzu	oaks spp.	tickberry spp.
10	camphorweed	maple spp.	
Ten Most Troublesome Weeds			
1	kudzu	blackberry	Pinus spp.
2	wiregrass	broomsedge	Aristida spp.
3	broomsedge	greenbriar	water oak
4	blackberry	hickory	bracken
5	honeysuckle	Japanese honeysuckle	turkey oak
6	dogfennel	pine	goldenrod spp.
7	greenbriar	red maple	saw palmetto
8	goldenrod	sweetgum	dogfennel
9	camphorweed	winged elm	groundselbush
10	common ragweed	wild pear	cactus spp.

Table 11. The Southern States 10 Most Common and Troublesome Weeds in Forestry (cont.).

	States
Ranking	Mississippi
Ten Most Common Weeds	
1	broomsedge
2	johnsongrass
3	horseweed
4	blue vervain
5	dogfennel
6	giant ragweed
7	sweetgum
8	red oak
9	blackgum
10	hickory
Ten Most Troublesome Weeds	
1	sweetgum
2	red oak
3	winged elm
4	broomsedge
5	hickory
6	blue vervain
7	Rubus spp.
8	giant ragweed
9	ironweed
10	kudzu

Table 12. The Southern States 10 Most Common and Troublesome Weeds in Industrial Sites.

	States		
Ranking	Arkansas	Georgia	Missouri
Ten Most Common Weeds			
1	goosegrass	crabgrass	annual grasses
2	crabgrass	common ragweed	annual broadleaves
3	johnsongrass	honeysuckle	
4	bermudagrass	vaseygrass	
5	yellow foxtail	johnsongrass	
6	honeysuckle	dogfennel	
7	vaseygrass	horseweed	
8	horseweed	goosegrass	
9	broomsedge	bermudagrass	
10	privet	kudzu	
Ten Most Troublesome Weeds			
1	trumpetcreeper	kudzu	perennial grasses
2	bermudagrass	trumpetcreeper	perennial broadleaves
3	johnsongrass	Virginia creeper	
4	dallisgrass	bermudagrass	
5	honeysuckle	greenbriar spp.	
6	horseweed	vaseygrass	
7	Virginia creeper	dallisgrass	
8	greenbriar	horseweed	
9	privet	dogfennel	
10	pine	honeysuckle	

Table 12. The Southern States 10 Most Common and Troublesome Weeds in Industrial Sites (cont.).

	States
Ranking	Tennessee
Ten Most Common Weeds	
1	johnsongrass
2	large crabgrass
3	bermudagrass
4	horseweed
5	kudzu
6	dogfennel
7	common ragweed
8	goosegrass
9	honeysuckle
10	goldenrod
Ten Most Troublesome Weeds	
1	kudzu
2	honeysuckle
3	privet
4	trumpetcreeper
5	Carolina horsenettle
6	Virginia creeper
7	bermudagrass
8	goldenrod
9	pokeweed
10	dogfennel

Table 13. The Southern States 10 Most Common and Troublesome Weeds in Power Lines.

	States		
Ranking	Arkansas	Georgia	Missouri
Ten Most Common Weeds			
1	oak spp.	sweetgum	bramble spp.
2	pine	pine spp.	sassafrass
3	sassafrass	oak spp.	persimmon
4	privet	red maple	oak
5	Prunus spp.	kudzu	hickory
6	sweetgum	Prunus spp.	
7	red cedar	yellow poplar	
8	persimmon	black locust	
9	hickory	Nyssa spp.	
10	elm	hickory	
Ten Most Troublesome Weeds			
1	oak spp.	kudzu	sassafrass
2	pine	willows	persimmon
3	sassafrass	privet	oak
4	privet	sweetgum	hickory
5	Prunus spp.	oak spp.	
6	sweetgum	pine spp.	
7	red cedar	black locust	
8	persimmon	hickory	
9	hickory	sourwood	
10	elm		

Table 13. The Southern States 10 Most Common and Troublesome Weeds in Power Lines (cont.).

	States	
Ranking	Puerto Rico	Tennessee
Ten Most Common Weeds		
1	morningglory spp.	sweetgum
2	wild yam	sumac
3	chiggery grapes	kudzu
4	snowflower	oak spp.
5	dearly vines	Eastern red cedar
6	cow itch	tulip poplar
7	tropical kudzu	hickory
8	balsam apple	sourwood
9	butterfly pea	pine spp.
10	noyau vine	locust
Ten Most Troublesome Weeds		
1	wild yam	kudzu
2	morningglory spp.	Eastern red cedar
3	cow itch	privet
4	snowflower	sweetgum
5	dearly vines	locust
6	chiggery grapes	oak spp.
7	noyau vine	sumac
8	balsam apple	hickory
9	butterfly pea	tulip poplar
10	tropical kudzu	pine spp.

Table 14. The Southern States 10 Most Common and Troublesome Weeds in Right of Way.

	States		
Ranking	Alabama	Florida	Georgia
Ten Most Common Weeds			
1	bahiagrass	bahiagrass	bahiagrass
2	goldenrod	hairy indigo	thistle spp.
3	bitter sneezeweed	saltbush	goosegrass
4	common ragweed	dogfennel	vervain spp.
5	vaseygrass	pigweed	tropic croton
6	verbena	Spanish needle	morningglory spp.
7	dogfennel	smutgrass	catchweed bedstraw
8	yellow foxtail	periwinkle	common ragweed
9	thistle	greenbriar	johnsongrass
10	johnsongrass	horseweed	vaseygrass
Ten Most Troublesome Weeds			
1	cogongrass	cogongrass	catchweed bedstraw
2	kudzu	Brazilian pepper	Japanese honeysuckle
3	verbena	Spanish needle	thistle spp.
4	thistle	Australian pine	American burnweed
5	blackberry	napiergrass	kudzu
6	dogfennel	dogfennel	lettuce spp.
7	yellow foxtail	smutgrass	dogfennel
8	vaseygrass	vaseygrass	morningglory spp.
9	horseweed	thistle spp.	horseweed
10	goldenrod	melaleuca	hemp dogbane

Table 14. The Southern States 10 Most Common and Troublesome Weeds in Right of Way (cont.).

	States		
Ranking	Kentucky	Mississippi	Tennessee
Ten Most Common Weeds			
1	johnsongrass	Carolina geranium	johnsongrass
2	Eastern red cedar	field madder	broomsedge
3	broomsedge	catchweed bedstraw	common ragweed
4	musk thistle	wild chervil	honeysuckle
5	tall ironweed	rootknot foxtail	bramble spp.
6	goldenrod	broomsedge	Eastern red cedar
7	teasel	Southern crabgrass	goldenrod
8	foxtail spp.	silver beardgrass	sumac
9	common milkweed	Italian ryegrass	kudzu
10	honeysuckle	fescue	chicory
Ten Most Troublesome Weeds			
1	musk thistle	johnsongrass	musk thistle
2	kudzu	rootknot foxtail	johnsongrass
3	Canada thistle	silver beardgrass	kudzu
4	Eastern red cedar	broomsedge	Eastern red cedar
5	johnsongrass	thistle spp.	sumac
6	tall ironweed	Florida paspalum	honeysuckle
7	broomsedge	Italian ryegrass	bramble spp.
8	trumpetcreeper	redvine	goldenrod
9	honeysuckle	hemp sesbania	broomsedge
10	joepyeweed	fescue	chicory

Economic Loses Due to Weeds in Southern States

Horticultural, Pasture, Recreational, and Industrial

Eric P. Webster, Section Chairman

The following estimates are based on the knowledge and experience of those individuals or other specialists within the state with whom they conferred.

Table 1. Estimated Losses Due to Weeds in **Alabama.**

	Peaches	Pecans	Alfalfa	Hay	Pasture
Cost of Herbicides					
a. Acres	10	30	5	200	250
b. Cost/A	29.00	24.00	15.00	11.00	8.00
c. Value	290	720	75	2200	2000
Loss in Yield					
a. Acres	3	25	10	140	250
b. Cost/A	200.00	45.00	45.00	35.00	25.00
c. Value	600	1125	450	4900	6250
Loss in Quality					
a. Acres	3	25	5	140	20
b. Cost/A	100.00	25.00	45.00	30.00	20.00
c. Value	300	625	225	4200	400
Loss in Extra Land Preparation and Cultivation					
a. Acres	N/A	N/A	4	N/A	N/A
b. Cost/A	N/A	N/A	5.00	N/A	N/A
c. Value	N/A	N/A	20	N/A	N/A
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	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
Grand Totals					
Loss	1190	2470	770	11300	8650

Acres = no. X 1000; Cost/A = $/A; Value = Acres X Cost/A X 1000.

Contributing Author: John Everest

Table 2. Estimated Losses Due to Weeds in **Florida**.

	Aquatics	Peaches/ Pecans	Citrus	Container Ornamentals	In- Ornam
Cost of Herbicides					
a. Acres	355	13	845	22	17
b. Cost/A	125.00	23.00	125.00	470.00	94.00
c. Value	44375	299	105625	10340	1598
Loss in Yield					
a. Acres	N/A	13	845	5	1
b. Cost/A	N/A	515.00	210.00	6000.00	390.00
c. Value	N/A	6695	177450	30000	390
Loss in Quality					
a. Acres	N/A	6	N/A	6	1
b. Cost/A	N/A	300.00	N/A	1560.00	260.00
c. Value	N/A	1800	N/A	9360	260
Loss in Extra Land Preparation and Cultivation					
a. Acres	252	6	N/A	9	13
b. Cost/A	130.00	5.00	N/A	1000.00	350.00
c. Value	32760	30	N/A	9000	4550
Loss in Land Value					
a. Acres	84	1	N/A	5	N/A
b. Cost/A	105.00	50.00	N/A	520.00	N/A
c. Value	8820	50	N/A	2600	N/A
Loss in Increase Cost of Harvesting					
a. Acres	N/A	13	845	10	5
b. Cost/A	N/A	10.00	105.00	230.00	100.00
c. Value	N/A	130	88725	2300	500
Grand Totals Loss	85955	9004	371800	63600	7298

Acres = no. X 1000; Cost/A = $/A; Value = Acres X Cost/A X 1000.

Contributing Author: Joan Dusky

Table 2. Estimated Losses Due to Weeds in **Florida.** (continued)

	Turf	Right of Way	Rangelands	Pasture and Hay	Sweet Corn
Cost of Herbicides					
a. Acres	710	90	4	1500	44
b. Cost/A	30.00	40.00	7.00	6.00	15.00
c. Value	21300	3600	28	9000	660
Loss in Yield					
a. Acres	29	N/A	8700	4000	11
b. Cost/A	118.00	N/A	7.00	10.00	275.00
c. Value	3422	N/A	60900	40000	3025
Loss in Quality					
a. Acres	245	N/A	6800	4000	11
b. Cost/A	310.00	N/A	4.00	8.00	275.00
c. Value	75950	N/A	27200	32000	3025
Loss in Extra Land Preparation and Cultivation					
a. Acres	24	180	2600	200	22
b. Cost/A	16.00	40.00	1.00	5.00	10.00
c. Value	384	7200	2600	1000	220
Loss in Land Value					
a. Acres	37	N/A	N/A	200	N/A
b. Cost/A	118.00	N/A	N/A	14.00	N/A
c. Value	4366	N/A	N/A	2800	N/A
Loss in Increase Cost of Harvesting					
a. Acres	78	N/A	N/A	2000	4
b. Cost/A	20.00	N/A	N/A	5.00	12.00
c. Value	1560	N/A	N/A	10000	48
Grand Totals Loss	106982	10800	90728	94800	6978

Acres = no. X 1000; Cost/A = $/A; Value = Acres X Cost/A X 1000.

Contributing Author: Joan Dusky

Table 2. Estimated Losses Due to Weeds in **Florida.** (continued)

	Tomatoes	Peppers	Cucurbits	Potatoes	Snap
Cost of Herbicides					
a. Acres	38	19.6	52	43.5	31
b. Cost/A	35.00	35.00	20.00	40.00	20.00
c. Value	1330	686	1040	1740	620
Loss in Yield					
a. Acres	4.5	2	10.4	4.4	4.7
b. Cost/A	600.00	1210.00	590.00	240.00	218.00
c. Value	2700	2420	6136	1056	1025
Loss in Quality					
a. Acres	4.5	2	N/A**	8	N/A**
b. Cost/A	600.00	1210.00	N/A**	360.00	N/A**
c. Value	2700	2420	N/A**	2880	N/A**
Loss in Extra Land Preparation and Cultivation					
a. Acres	38	19.6	52	32.6	2
b. Cost/A	160.00*	160.00*	20.00	10.00	10.00
c. Value	6080	3136	1040	326	20
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	1	2	13	2.2	6.2
b. Cost/A	300.00	300.00	300.00	200.00	50.00
c. Value	300	600	3900	440	310
Grand Totals Loss	13110	9262	12116	6442	1975

Acres = no. X 1000; Cost/A = $/A; Value = Acres X Cost/A X 1000.

* methyl bromide cost.
** low quality fruit not marketable thus loss reflected in loss of yield data.

Contributing Author: Joan Dusky

Table 2. Estimated Losses Due to Weeds in **Florida**. (continued)

	Other Vegetables
Cost of Herbicides	
a. Acres	118
b. Cost/A	30.00
c. Value	3540
Loss in Yield	
a. Acres	12
b. Cost/A	450.00
c. Value	5400
Loss in Quality	
a. Acres	5.9
b. Cost/A	450.00
c. Value	2655
Loss in Extra Land Preparation and Cultivation	
a. Acres	30
b. Cost/A	15.00
c. Value	450
Loss in Land Value	
a. Acres	N/A
b. Cost/A	N/A
c. Value	N/A
Loss in Increase Cost of Harvesting	
a. Acres	12
b. Cost/A	175.00
c. Value	2100
Grand Totals	
Loss	14145

Acres = no. X 1000; Cost/A = $/A; Value = Acres X Cost/A X 1000.

Contributing Author: Joan Dusky

Table 3. Estimated Losses Due to Weeds in **Georgia**.

	Peaches	Pecans	Fruits	Vegetables	Alfalfa
Cost of Herbicides					
a. Acres	21.5	155	9.2	158	10
b. Cost/A	25.00	22.00	20.00	25.00	15.00
c. Value	537.5	3410	184	3950	150
Loss in Yield					
a. Acres	8.3	40	3.7	63.2	5
b. Cost/A	300.00	60.00	75.00	225.00	40.00
c. Value	2490	2400	277.5	14220	200
Loss in Quality					
a. Acres	6	40	2	40	6
b. Cost/A	100.00	20.00	60.00	65.00	30.00
c. Value	600	800	120	2600	180
Loss in Extra Land Preparation and Cultivation					
a. Acres	12.4	50	4.6	94.8	2
b. Cost/A	12.00	20.00	15.00	15.00	5.00
c. Value	148.8	1000	69	1422	10
Loss in Land Value					
a. Acres	7	15	2	5	N/A
b. Cost/A	200.00	100.00	100.00	100.00	N/A
c. Value	1400	1500	200	500	N/A
Loss in Increase Cost of Harvesting					
a. Acres	6.2	80	2.3	50	1
b. Cost/A	12.00	12.00	12.00	15.00	5.00
c. Value	74.4	960	27.6	750	5
Grand Totals Loss	5250.7	10070	878.1	23442	545

Acres = no. X 1000; Cost/A = $/A; Value = Acres X Cost/A X 1000.

Contributing Author: Tim R. Murphy

Table 3. Estimated Losses Due to Weeds in **Georgia.** (continued)

	Pasture	Turf	Container Ornamentals	Roadsides	Aquati
Cost of Herbicides					
a. Acres	80	400	3	150	4.5
b. Cost/A	8.00	25.00	450.00	20.00	150.00
c. Value	640	10000	1350	3000	675
Loss in Yield					
a. Acres	500	0.75	0.2	N/A	N/A
b. Cost/A	25.00	4000.00	5000.00	N/A	N/A
c. Value	12500	3000	1000	N/A	N/A
Loss in Quality					
a. Acres	10	100	0.5	40	1
b. Cost/A	20.00	300.00	2000.00	100.00	100.00
c. Value	200	30000	1000	4000	100
Loss in Extra Land Preparation and Cultivation					
a. Acres	N/A	2	1	5	0.5
b. Cost/A	N/A	100.00	1000.00	25.00	100.00
c. Value	N/A	200	1000	125	50
Loss in Land Value					
a. Acres	N/A	10	0.2	N/A	0.5
b. Cost/A	N/A	200.00	100.00	N/A	100.00
c. Value	N/A	2000	20	N/A	50
Loss in Increase Cost of Harvesting					
a. Acres	N/A	2	0.5	N/A	N/A
b. Cost/A	N/A	100.00	200.00	N/A	N/A
c. Value	N/A	200	100	N/A	N/A
Grand Totals					
Loss	13340	45400	4470	7125	875

Acres = no. X 1000; Cost/A = $/A; Value = Acres X Cost/A X 1000.

Contributing Author: Tim R. Murphy

Table 3. Estimated Losses Due to Weeds in **Georgia**. (continued)

	Landscape Ornamentals	Hay
Cost of Herbicides		
a. Acres	25	300
b. Cost/A	50.00	10.00
c. Value	1250	3000
Loss in Yield		
a. Acres	N/A	200
b. Cost/A	N/A	35.00
c. Value	N/A	7000
Loss in Quality		
a. Acres	5	250
b. Cost/A	500.00	30.00
c. Value	2500	7500
Loss in Extra Land Preparation and Cultivation		
a. Acres	0.5	N/A
b. Cost/A	200.00	N/A
c. Value	100	N/A
Loss in Land Value		
a. Acres	0.5	N/A
b. Cost/A	200.00	N/A
c. Value	100	N/A
Loss in Increase Cost of Harvesting		
a. Acres	N/A	N/A
b. Cost/A	N/A	N/A
c. Value	N/A	N/A
Grand Totals		
Loss	3950	17500

Acres = no. X 1000; Cost/A = $/A; Value = Acres X Cost/A X 1000.

Contributing Author: Tim R. Murphy

Table 4. Estimated Losses Due to Weeds in **Kentucky**.

	Alfalfa	Pastures and Hay
Cost of Herbicides		
a. Acres	90	500
b. Cost/A	15.00	10.00
c. Value	1350	5000
Loss in Yield		
a. Acres	100	500
b. Cost/A	25.00	12.00
c. Value	2500	6000
Loss in Quality		
a. Acres	200	500
b. Cost/A	20.00	10.00
c. Value	4000	5000
Loss in Extra Land Preparation and Cultivation		
a. Acres	N/A	N/A
b. Cost/A	N/A	N/A
c. Value	N/A	N/A
Loss in Land Value		
a. Acres	N/A	N/A
b. Cost/A	N/A	N/A
c. Value	N/A	N/A
Loss in Increase Cost of Harvesting		
a. Acres	N/A	N/A
b. Cost/A	N/A	N/A
c. Value	N/A	N/A
Grand Totals		
Loss	7850	1600

Acres = no. X 1000; Cost/A = $/A; Value = Acres X Cost/A X 1000.

Contributing Author: J. D. Green

Table 5. Estimated Losses Due to Weeds in **Mississippi**.

	Turf	Forestry	Right of Way	Fruit and Nut	Pasture
Cost of Herbicides					
a. Acres	450	130	130	1.3	200
b. Cost/A	26.00	65.00	17.50	16.00	4.50
c. Value	11700	8450	2275	20.8	900
Loss in Yield					
a. Acres	N/A	15	N/A	0.012	4
b. Cost/A	N/A	13.00	N/A	650.00	6.00
c. Value	N/A	195	N/A	7.8	24
Loss in Quality					
a. Acres	14	5	N/A	N/A	0.5
b. Cost/A	300.00	3.00	N/A	N/A	6.00
c. Value	4200	15	N/A	N/A	3
Loss in Extra Land Preparation and Cultivation					
a. Acres	N/A	100	161	N/A	2
b. Cost/A	N/A	90.00	25.00	N/A	8.00
c. Value	N/A	9000	4025	N/A	16
Loss in Land Value					
a. Acres	0.1	100	N/A	N/A	N/A
b. Cost/A	70.00	75.00	N/A	N/A	N/A
c. Value	7	7500	N/A	N/A	N/A
Loss in Increase Cost of Harvesting					
a. Acres	N/A	200	N/A	N/A	10
b. Cost/A	N/A	2.0	N/A	N/A	5.50
c. Value	N/A	400	N/A	N/A	55
Grand Totals Loss	15907	25560	6300	28.6	998

Acres = no. X 1000; Cost/A = $/A; Value = Acres X Cost/A X 1000.

Contributing Author: John D. Byrd

Table 6. Estimated Losses Due to Weeds in **North Carolina**.

	Watermelon	Cucumber	Sweet Potato	Potato	Tomato
Cost of Herbicides					
a. Acres	6	20	19	16	1.6
b. Cost/A	45.00	45.00	25.00	25.00	24.00
c. Value	270	900	475	400	38.4
Loss in Yield					
a. Acres	1	8	10	2	0.3
b. Cost/A	500.00	200.00	300.00	200.00	500.00
c. Value	500	1600	3000	400	150
Loss in Quality					
a. Acres	1	7	10	2.5	0.2
b. Cost/A	250.00	250.00	350.00	200.00	300.00
c. Value	250	1750	3500	500	60
Loss in Extra Land Preparation and Cultivation					
a. Acres	10	30	31	16	1
b. Cost/A	100.00	100.00	75.00	10.00	15.00
c. Value	1000	3000	2325	160	15
Loss in Land Value					
a. Acres	1	5	5	1	0.2
b. Cost/A	75.00	75.00	75.00	100.00	500.00
c. Value	75	375	375	100	100
Loss in Increase Cost of Harvesting					
a. Acres	1	5	1.5	1	0.2
b. Cost/A	300.00	300.00	300.00	200.00	300.00
c. Value	300	1500	450	200	60
Grand Totals					
Loss	2395	9125	10125	1760	423.4

Acres = no. X 1000; Cost/A = $/A; Value = Acres X Cost/A X 1000.

Contributing Author: David Monks

Table 7. Estimated Losses Due to Weeds in **Texas**.

	Alfalfa	Hay	Rangelands	Farm Ponds	Irrigati Canals
Cost of Herbicides					
a. Acres	200	3600	87000	840	1000
b. Cost/A	9.00	6.00	16.00	28.00	1000.0
c. Value	1800	21600	1392000	23520	100000
Loss in Yield					
a. Acres	30	900	N/A	N/A	N/A
b. Cost/A	250.00	100.00	N/A	N/A	N/A
c. Value	7500	90000	N/A	N/A	N/A
Loss in Quality					
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 Extra Land Preparation and Cultivation					
a. Acres	2	N/A	N/A	N/A	N/A
b. Cost/A	300.00	N/A	N/A	N/A	N/A
c. Value	600	N/A	N/A	N/A	N/A
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	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
Grand Totals Loss	9300	111600	1392000	23520	100000 0

Acres = no. X 1000; Cost/A = $/A; Value = Acres X Cost/A X 1000.

Contributing Author: Paul Baumann

Table 7. Estimated Losses Due to Weeds in **Texas**. (continued)

	Turf	Citrus	Peaches	Native Pecans	Planted
Cost of Herbicides					
a. Acres	3500	30	8	N/A	10
b. Cost/A	20.00	70.00	45.00	N/A	30.00
c. Value	70000	2100	360	N/A	300
Loss in Yield					
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 Quality					
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 Extra Land Preparation and Cultivation					
a. Acres	N/A	N/A	N/A	40	25
b. Cost/A	N/A	N/A	N/A	10.00	50.00
c. Value	N/A	N/A	N/A	400	1250
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	N/A	N/A	N/A	161	N/A
b. Cost/A	N/A	N/A	N/A	50	N/A
c. Value	N/A	N/A	N/A	8050	N/A
Grand Totals					
Loss	70000	2100	360	8450	1550

Acres = no. X 1000; Cost/A = $/A; Value = Acres X Cost/A X 1000.

Contributing Author: Paul Baumann

Table 7. Estimated Losses Due to Weeds in **Texas**. (continued)

	Apples	Grapes
Cost of Herbicides		
a. Acres	1	7
b. Cost/A	45.00	14.00
c. Value	45	98
Loss in Yield		
a. Acres	N/A	N/A
b. Cost/A	N/A	N/A
c. Value	N/A	N/A
Loss in Quality		
a. Acres	N/A	N/A
b. Cost/A	N/A	N/A
c. Value	N/A	N/A
Loss in Extra Land Preparation and Cultivation		
a. Acres	N/A	N/A
b. Cost/A	N/A	N/A
c. Value	N/A	N/A
Loss in Land Value		
a. Acres	N/A	N/A
b. Cost/A	N/A	N/A
c. Value	N/A	N/A
Loss in Increase Cost of Harvesting		
a. Acres	N/A	N/A
b. Cost/A	N/A	N/A
c. Value	N/A	N/A
Grand Totals		
Loss	45	98

Acres = no. X 1000; Cost/A = $/A; Value = Acres X Cost/A X 1000.

Contributing Author: Paul Baumann

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Valent USA Corporation
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Waldrum Specialities Inc
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Yeadon PA 19050

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
One acre	=	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

*Conversion factors were taken from the “Herbicide Handbook of the Weed Science of America”, Fifth Edition, 1983.

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 x 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

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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	2-chloro-*N*-(2,6-diethyl- phenyl)-*N*-(methoxymethyl) acetamide	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, Atrazine Several others	6-chloro-*N*-ethyl-*N**-(1- methylethyl)-1,3,5-triazine- 2,4-diamine	Novartis, DuPont, others
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
BAY FOE5043	Axiom	*N*-(4-fluorophenyl)-*N*-(1-methyl- ethyl)-2-[[5-(trifluoromethyl)-1,3,4- thiadiazol-2-yl]oxy]acetamide	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	3,5-dibromo-4-hydroxy- benzonitrile	Rhone-Poulenc

HERBICIDE NAMES AND MANUFACTURERS

Common or Code name	Trade name	Chemical name	Manufacturer
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
CGA-248757 (fluthiacet-methyl)	Action	methyl [[2-chloro-4-fluoro-5-[(tetrahydro -3-oxo-1*H*,3*H*-[1,3,4]thiadia=zolo[3,4-a] pyridazin-1-ylidene)amino]phenyl]thio] acetate	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 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	(*E*,*E*)-(±)-2-[1-[[(3-chloro-2-propenyl)oxy]imino]propyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one	Valent USA
Clomazone	Command	2-[(2-chlorophenyl)methyl]-4,4-dimethyl-3-isoxazoli-dinone	FMC
Clopyralid	Curtail, Lontrel	3,6-dichloro-2-pyridine-carboxylic acid	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

HERBICIDE NAMES AND MANUFACTURERS

Common or Code name	Trade name	Chemical name	Manufacturer
2,4-D	Several	(2,4-dichlorophenoxy)acetic acid	Several
2,4-DB	Butoxone Butyrac	4-(2,4-dichlorophenoxy) butanoic acid	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
Dicamba + 2,4-D	Weedmaster	see dicamba + 2,4-D	BASF
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 (MON 15100, 15126,15151, 15172,7200)	Dimension	*S*,*S*-dimethyl 2-(difluoro-methyl)-4-(2-methylpropyl)-6-(trifluoromethyl)-3,5-pyridine-dicarbothioate	Monsanto
Diuron	Karmex, Direx	*N*'-(3,4-dichlorophenyl)-*N*,*N*-dimethylurea	DuPont Griffin
Endothall	Endothal		Peennwalt
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

HERBICIDE NAMES AND MANUFACTURERS

Common or Code name	Trade name	Chemical name	Manufacturer
F-8426	Carfentrazone-ethyl	ethyl 2-chloro-3-[2-chloro-4-fluoro-5-(4-difluoromethyl-4,5-dihydro-3-methyl-5-oxo-1*H*-1,2,4-triazol-1-yl)phenyl] propanoate	FMC
Fenoxaprop	Acclaim, Whip	(±)-2-[4-[(6-chloro-2-benzoxazolyl)oxy]phenoxy] propanoic acid	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
Flumetsulam	Broadstrike	*N*-(2,6-difluorophenyl)-5-methyl [1,2,4]triazolo[1,5-"]pyrimidine-2-sulfonamide	Dow AgroSciences
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
Flumetsulam + trifluralin	Broadstrike + Treflan	see flumetsulam–2,6-dinitro-*N,N*-dipropyl -44-(trifluoromethyl)aniline	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	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
Fomesafen	Reflex	5-[2-chloro-4-(trifluoro-methyl)phenoxy]-*N*-(methyl-sulfonyl)-2-nitrobenzamide	Zeneca

HERBICIDE NAMES AND MANUFACTURERS

Common or Code name	Trade name	Chemical name	Manufacturer
Fosamine	Krenite	ethyl hydrogen (aminocarbonyl)-phosphonate	DuPont
Glufosinate	Ignite Liberty Rely Finale	2-amino-4-(hydroxymethyl phosphinyl)butanoic acid	AgrEvo
Glyphosate	Accord, Rodeo, Roundup, Others	*N*-(phosphonomethyl)glycine	Monsanto
Halosulfuron	Permit Sempra Manage	methyl 5-[[(4,6-dimethoxy-2-pyrimidinyl)amino]carbonylamino-sulfonyl]-3-chloro-1-methyl-1-*H*-pyrazole-4-carboxylate	Monsanto
Hexazinone	Pronone, 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
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	(±)-2-[4,5-dihydro-4-methyl-4-(l-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-3-pyridine-carboxylic acid	American Cyanamid
Imazaquin	Scepter	2-[4,5-dihydro-4-methyl-4-(l-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-3-quinoline-carboxylic acid	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

HERBICIDE NAMES AND MANUFACTURERS

Common or Code name	Trade name	Chemical name	Manufacturer
Isoxaben	Gallery	*N*-[3-(1-ethyl-1-methyl-propyl)-5-isoxazoyl]-2,6-dimethyl-benzamide	Dow AgroSciences
Isoxoben + oryzalin	Snapshot DF Rout	see isoxoben and oryzalin	Dow AgroSciences Scotts
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
Metham	Vapam	methylcarbamodithioic acid	Zeneca
Methyl bromide	Various	bromomethane Corp.	Great Lakes Chem.
Metolachlor	Dual	2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl)acetamide	Novartis
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
Molinate	Ordram	*S*-ethyl hexahydro-1*H*-azepine-1-carbothioate	Zeneca

HERBICIDE NAMES AND MANUFACTURERS

Common or Code name	Trade name	Chemical name	Manufacturer
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	4-chloro-5-(metthylamino)-2-(3-(trifluoromethyl)phenyl)-3(2*H*)-pyridazinone	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
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
Paraquat	Gramoxone Starfire Cyclone	1,1'-dimethyl-4,4'-bi-pyridinium ion	Zeneca
Pelargonic acid	Sythe	nonanoic acid	Mycogen
Pendimethalin	Prowl Pendulum	*N*-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzene-amine	American Cyanamid
Picloram	Tordon	4-amino-3,5,6-trichloro-2-pyridinecarboxylic acid	Dow AgroSciences
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

HERBICIDE NAMES AND MANUFACTURERS

Common or Code name	Trade name	Chemical name	Manufacturer
Prohexadione	----	3,5-dioxo-4-(1-oxopropyl) cyclohexanecarboxylic acid	BASF
Prometon	Pramitol	6-methoxy-*N*,*N**-bis(1-methylethyl)-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
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
Pyrithiobac	Staple	2-chloro--6-[(4,6-dimethoxy-2-pyrimidinyl)thio]benzoic acid	Dupont
Quinclorac	Facet	3,7-dichloro-8-quinoline-carboxylic acid	BASF
Quizalofop	Assure	(±)-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
Sethoxydim	Poast Poast Plus	2-[1-(ethoxyamino)-butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one	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

HERBICIDE NAMES AND MANUFACTURERS

Common or Code name	Trade name	Chemical name	Manufacturer
Sulfentrazone + chlorimuron	Authority BL Canopy XL	see sulfentrazone and chlorimuron	FMC DuPont
Sulfentrazone + clomazone	One-Pass	see sulfentrazone and clomazone	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
Thiazopyr	Dimension Spindle	methyl 2-(difluoromethyl)-5-(4,5-dihydro-2-thiazolyl)-4-(2-methylpropyl)-6-(trifluoro-methyl)-3-pyridinecarboxylate	Rohm & Haas
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
Thiobencarb	Bolero	*S*-[(4-chlorophenyl)methyl] diethylcarbamothioate	Valent USA
Triasulfuron	Amber	2-(2-chloroethoxy)-*N*-[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]benzene-sulfonamide	Novartis
Triasulfuron + dicamba	Rave		Novartis
Tribenuron	Express	2-[[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)methylamino]-carbonyl]amino]sulfonyl]benzoic acid	DuPont

HERBICIDE NAMES AND MANUFACTURERS

Common or Code name	**Trade name**	**Chemical name**	**Manufacturer**
Triclopyr	Garlon, Turflon D	[(3,5,6-trichloro-2-pyridinyl)oxy]acetic acid	Dow AgroSciences
Trifluralin	Treflan, Trifluralin	2,6-dinitro-*N*-*N*-dipropyl-4-(trifluoromethyl)benzeneamine	Dow AgroSciences, others
Trinexapac-ethyl	Primo	ethyl 4-(cyclopropylhydroxymethylene)-3,5-dioxocyclohexanecar=boxylate	Novartis

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