Proceedings of the Southern Weed Science Society 77th Annual Meeting

Hyatt Regency San Antonio Riverwalk
San Antonio, TX
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Table of Contents

Regulations and Instructions for Papers and Abstracts

Regulations

1. Persons wishing to present a paper(s) at the conference must first electronically submit a title to the SWSS web site (http://www.swss.ws/) by the deadline announced in the "Call for Papers".

2. Only papers presented at the annual conference will be published in the Proceedings. An abstract or paper must be submitted electronically to the SWSS website by the deadline announced at the time of title submissions.

3. Facilities at the conference will be provided for LCD-based presentations only.

4. Terminology in presentations and publications shall generally comply with the 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 or trade names may be used. Chemical names will no longer be printed in the annual program. 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.

5. Where visual ratings of crop injury or weed control efficacy are reported, it is suggested that they be reported as a percentage of the nontreated check where 0 equals no weed control or crop injury and 100 equals complete weed control or crop death.

6. Each author is assured of one senior-author presentation, but multiple senior-author submissions will be accepted only as space and time are available. If you have several papers or posters you wish to present, please indicate which is highest priority by adding a note in the comments section on the title submission form

7. Papers and abstracts must be prepared in accordance with the instructions and form provided in the "Call for Papers" and on the SWSS web site. Papers not prepared in accordance with these instructions will not be included in the Proceedings.

Instructions to Authors

Instructions for title submissions, and instructions for abstracts and papers will be available in the "Call for Papers" and on the SWSS website (http://www.swss.ws/) at the time of title or abstract/paper submission.

Word templates will be available on the web to help ensure that proper format is followed. It is important that submission deadlines and instructions are carefully adhered to, as the abstracts are not edited for content.

Typing Instructions-Format

1. Margins, spacing, etc.: Use 8-1/2 x 11" 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 the text. Single space with double space between paragraphs and major divisions. **Do not indent paragraphs.**

2. Content:

Abstracts -	Title, Author(s), Organization(s) Location, the heading ABSTRACT, text of the Abstract, and Acknowledgments. Use double spacing before and after the heading, ABSTRACT.
Papers -	Title, Author(s), Organization(s), Location, Abstract, Introduction, Methods and Materials (Procedures), Results and Discussion, Literature Citations, Tables and/or Figures, Acknowledgements.

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 and bold. Start at the upper lefthand corner leaving a one-inch margin from the top and all sides.

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

Example: Competiiton and control of smellmelon (*Cucumis melo* var. *dudaim* Naud.) in cotton

C.H. Tingle, G.L. Steele and J.M. Chandler; Department of Soil and Crop Sciences, Texas A&M University, College Station, TX 77843.

ABSTRACT

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

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

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

Table and Figures - Place these after literature citations. Single space all tables. Tables should be positioned vertically on the page. Charts and figures must be in black and white.

2024 Awards

Outstanding Young Weed Scientist - Academia
Thomas (Tommy) Butts, University of Arkansas

Dr. Tommy Butts is an Associate Professor, Extension Weed Scientist with the University of Arkansas System Division of Agriculture based out of Lonoke, Arkansas. He started with the Division of Agriculture in 2018. Tommy originally hails from southern Wisconsin where he grew up working on and around small dairy farms. He completed his Bachelor of Science in AgriBusiness at the University of Wisconsin-Platteville (2012), Master of Science in Agronomy-Weed Science at the University of Wisconsin-Madison (2015), and Ph.D. in Agronomy-Weed Science from the University of Nebraska-Lincoln (2018). Tommy's current research and Extension efforts focus on identifying novel weed management strategies through diversified approaches including the use of precision agriculture and application technologies primarily in rice, soybean, and wheat, among other cropping systems. Further emphasis is placed on helping to increase herbicide application knowledge, safety, and effectiveness, while reducing off-target movement, both from ground-based and aerial applications. Tommy has garnered over $4.6 million in total funding from numerous sources including state commodity boards, NSF, USDA-NIFA, and USDA-ARS. In addition, he has authored 55 journal publications, 173 professional meeting abstracts, and 88 peer-reviewed research reports. Tommy has also heavily focused on providing research results directly to stakeholders. This has resulted in the publication of 68 Extension publications, 14 videos, and more than 260 meeting, invited speaker, and field day presentations. Tommy has also initiated innovative outreach methods including the Arkansas Extension Specialist mass text messaging service in which over 410 individuals are subscribed to the "weeds" text list and the Weeds AR Wild podcast series which across its 69 total episodes has received over 25,000 downloads. Tommy has also been active within SWSS serving as the Newsletter Editor since 2021, serving on the Computer Committee, and as Chair of the Student Program Committee (2021-2022). In addition to SWSS, Tommy has also served on committees and provided leadership for ASA, WSSA, SERA-18 Rice Technical Working Group, and the Arkansas Crop Protection Association. Outside of work, Tommy loves spending time with his wife Liberty, his son Brooker (3), and his daughter Brinley (2), whether it be exploring new areas, hiking, or playing in the backyard.

Outstanding Young Weed Scientist - Industry
Peter Eure, Syngenta

Pete Eure is currently the Eastern Region Head for Syngenta Crop Protection Field Development. A native of eastern North Carolina, he was born and raised on a family farm where they grow corn, wheat, soybeans, sorghum, and cotton. Pete received his B.S. and M.S. degrees from North Carolina State University and Ph.D. in Weed Science from the University of Georgia where he conducted research in cotton, peanuts, and vegetables. Pete began his career at Syngenta in 2014 as a Research & Development Scientist in Texas where his responsibilities included the screening of early stage active ingredients as well as conducting product concept evaluations. Pete went on to work as a Technical Product Lead where he managed the development of new weed management concepts for soybeans and cereals and supported currently registered Syngenta herbicides in these crops. Pete is an active member of the Southern Weed Science Society and Weed Science Society of America where he has served in numerous capacities. He currently lives in Greensboro, North Carolina with his wife Tabitha.

Past Winners of the Outstanding Young Weed Scientist Award

Year	Name	University / Company
1980	John R. Abernathy	Texas A & M University
1981	Harold D. Coble	North Carolina State
1982	Lawrence R. Oliver	University of Arkansas
1983	Ford L. Baldwin	University of Arkansas
1984	Don S. Murray	Oklahoma State University
1985	William W. Witt	University of Kentucky
1986	Philip A. Banks	University of Georgia
1987	Kriton K. Hatzios	VPI & SU
1988	Joe E. Street	Mississippi State University
1989	C. Michael French	University of Georgia
1990	Ted Whitwell	Clemson University
1991	Alan C. York	North Carolina State
1992	E. Scott Hagood, Jr.	VPI & SU
1993	James L. Griffin	Louisiana State University
1994	David R. Shaw	Mississippi State University
1995	John C. Wilcut	North Carolina State
1996	David C. Bridges	University of Georgia
1997	L.B. McCarty	Clemson University
1998	Thomas C. Mueller	University of Tennessee
1999	Daniel B. Reynolds	Mississippi State University
2000	Fred Yelverton	North Carolina State
2001	John D. Byrd, Jr.	Mississippi State University
2002	Peter A. Dotray	Texas Tech. University
2003	Scott A. Senseman	Texas A & M University
2004	David L. Jordan	North Carolina State
2004	James C. Holloway	Syngenta
2005	Eric Prostko	University of Georgia
2005	No nominations	--
2006	Todd A. Baughman	Texas A & M University
2006	John V. Altom	Valent USA Corporation
2007	Clifford "Trey" Koger	Mississippi State University
2007	No nominations	--
2008	Stanley Culpepper	University of Georgia
2008	No nominations	--

2009	Jason K. Norsworthy	University of Arkansas
2009	No nominations	--
2010	Bob Scott	University of Arkansas
2010	No nominations	--
2011	J. Scott McElroy	Auburn University
2011	Eric Palmer	Syngenta Crop Protection
2012	Jason Bond	Mississippi State University
2012	Cody Gray	United Phosphorus Inc.
2013	Greg Armel	BASF Company
2013	Shawn Askew	Virginia Tech
2014	Jason Ferrell	University of Florida
2014	Vinod Shivrain	Syngenta
2015	Jim Brosnan	University of Tennessee
2015	No nominations	--
2016	Daniel Stephenson, IV	LSU-Ag Center
2016	Drew Ellis	Dow AgroSciences
2017	Wes Everman	North Carolina State
2017	Hunter Perry	Dow AgroSciences
2018	Ramon Leon	North Carolina State
2019	Peter Dittmar	University of Florida
2020	Kelly Backscheider	Corteva AgriSciences
2021	Muthukumar Bagavathianan	Texas A & M University
2021	Matthew Wiggins	FMC
2022	Michael Flessner	Virginia Tech
2022	Sandeep Rana	Bayer Crop Science
2023	Charles Cahoon	North Carolina State

Outstanding Educator Award
Tom Barber, University of Arkansas

Dr. Tom Barber was born and raised on a small cattle and row-crop farm near Texarkana in Southwest Arkansas. Tom received his B.S. in Agronomy and M.S. in Weed Science from the University of Arkansas under the leadership of Dr. Dick Oliver and Ford Baldwin. In 2001, he transferred to Mississippi State University, where he pursued a Ph.D. in Weed Science under the direction of Dr. Dan Reynolds. Tom accepted his first role as the Extension Cotton Specialist for Mississippi State in 2004 and immediately developed a passion for working one-on-one with cotton producers at the farm level. In 2007, Tom moved back home to Arkansas, where he initially served as the Extension Cotton Specialist with the University of Arkansas System Division of Agriculture until 2012, when he was offered the opportunity to move into a weed science role. He currently holds the split responsibility of Professor/Extension Weed Scientist and Director of the Jackson County Extension Center with the U of A Division of Agriculture. Tom conducts applied weed control research in corn, cotton, grain sorghum, peanut, soybean, and rice to provide accurate recommendations in the areas of herbicide and rate selection, resistant weed management, and alternative control methods for farmers, consultants, and other members of the Arkansas Agricultural Industry. In addition, in 2018, Tom accepted administrative responsibilities to manage research projects and the construction of a new office and meeting facility at the 400-acre Jackson County Extension Center near Newport, AR. Tom has been married to his wife Scharidi for 23 years, and they live in Cabot, AR, with their three sons, Haeden, Kohlton, and Jackson.

Past Winners of the Outstanding Educator Award

Year	Name	University
1998	David R. Shaw	Mississippi State University
1999	Ronald E. Talbert	University of Arkansas
2000	Lawrence R. Oliver	University of Arkansas
2001	James L. Griffin	Louisiana State University
2002	Thomas F. Peeper	Oklahoma State University
2003	Daniel B. Reynolds	Mississippi State University
2004	William Vencill	University of Georgia
2005	John W. Wilcut	North Carolina State University
2006	Don S. Murray	Oklahoma State University
2007	Thomas C. Mueller	University of Tennessee
2008	James M. Chandler	Texas A&M University
2009	William W. Witt	University of Kentucky
2010	Peter Dotray	Texas Tech. University
2011	Eric Prostko	University of Georgia
2012	Gregory Mac Donald	University of Florida
2013	Tim Grey	University of Georgia
2014	Scott Senseman	University of Tennessee
2015	Nilda Roma-Burgos	University of Arkansas
2016	Katie Jennings	North Carolina State University
2017	Jason Norsworthy	University of Arkansas
2018	Stanley Culpepper	University of Georgia
2019	Larry Steckel	University of Tennessee
2020	Stephen Enloe	University of Florida
2021	No nomination	--
2022	Ramon Leon	North Carolina State University
2023	Darrin Dodds	Mississippi State University

Excellence in Regulatory Stewardship Award
Thomas Mueller, University of Tennessee

Thomas C. Mueller is a Professor in the Department of Plant Sciences, the University of Tennessee. He is located on the main campus in Knoxville, which is the flagship campus for the land-grant University for the state of Tennessee. Dr. Mueller was reared on a small diversified grain farm in southern Illinois. He received his BS from the University of Illinois in Agronomy, his MS from the University of Kentucky in Crop Science, and his PhD from the University of Georgia in Crop Science. His graduate studies focused on weed science, specifically how herbicides behave in plants and the environment. He has two primary research areas. The first is the environmental fate of pesticides (especially herbicides) in soils, water systems, and in the air (via drift), and the second is the confirmation and subsequent control of herbicide-resistant weeds (mainly to glyphosate). His main commodities of focus are corn, wheat and soybeans, although he has conducted research in canola, cotton, rice, pastures, turf, native areas (national parks) and various other areas. This diversity in research areas and teaching several undergraduate and graduate courses has imparted a broad perspective, one that realizes that integrated pest management must consider environmental and ecological ramifications of crop production systems. He has published > 130 refereed articles in > 20 different journals. Dr. Mueller has served on an EPA Scientific Advisory Board, has served as an associate editor for Weed Science and Weed Technology, has served on the executive board for the Weed Science Society of America as Secretary, is a former President of the Southern Weed Science Society, and is active in various state, regional, and national programs. He was named a fellow of the WSSA in 2014. Dr. Mueller has instructed > 1100 undergraduate students in a variety of classes, including Weed Management, Agricultural Pesticides, Integrated Pest Management, Pesticide Fate in Soils, Herbicide Physiology, and HPLC Methods and Applications. He has advised 25 graduate students with a 100% placement rate.

Past Winners of the Excellence in Regulatory Stewardship Award

Year	Name	University
2020	Robert Nichols	Cotton Incorporated
2021	Larry Steckel	University of Tennessee

Outstanding Graduate Student Award (MS)
Vipin Kumar, Virginia Tech University

Vipin Kumar was born and raised on a family farm in Haryana, a major agricultural state in Northern India. Vipin learned about crop production while working with his father on his own farm. What began as an unpleasant weekend chore of manual cotton picking soon turned into an appreciation for farmers and agriculture. With his interest in agriculture, Vipin earned a bachelor’s degree in Agricultural Sciences with a major in Agronomy from CCS Haryana Agricultural University, Haryana, India. Among different disciplines, what interested him the most, though, was weed science given its importance in crop production. After his bachelor’s, he worked as a Junior Research Fellow at the Indian Agricultural Research Institute, New Delhi, India for about a year before moving to the United States to pursue a master’s degree. He completed his MS degree at Virginia Tech under the supervision of Dr. Vijay Singh. His master’s research project focused on the evaluation of different cover crops and their termination timings for weed management in corn and control of volunteer cover crop plants. During his master’s, he worked closely with industry representatives, extension agents, and local growers. Vipin enjoys talking with farmers about his research and has presented his research work on various field days. He has authored and coauthored six research articles during his MS. He received the Department’s Outstanding Graduate Student award at Virginia Tech for his MS. Currently, Vipin is pursuing a doctorate degree in weed science at the University of Nebraska, Lincoln under the supervision of Dr. Amit Jhala. He is hoping to continue working with farmers while pursuing his research interest in weed science.

Past Winners of the Outstanding Graduate Student Award (MS)

Year	Name	University
1998	Shawn Askew	Mississippi State University
1999	Patrick A Clay	Louisiana State University
2000	Wendy A. Pline	University of Kentucky
2001	George H. Scott	North Carolina State University
2002	Scott B. Clewis	North Carolina State University
2003	Shawn C. Troxler	North Carolina State University
2004	Walter E. Thomas	North Carolina State University
2005	Whitney Barker	North Carolina State University
2006	Christopher L. Main	University of Florida
2007	No nomination	--
2008	No nomination	--
2009	Ryan Pekarek	North Carolina State University
2010	Robin Bond	Mississippi State University
2011	George S. (Trey) Cutts, III	University of Georgia
2012	Josh Wilson	University of Arkansas
2013	Bob Cross	Clemson University
2014	Brent Johnson	University of Arkansas
2015	Garret Montgomery	University of Tennessee
2016	Chris Meyer	University of Arkansas
2017	John Buol	Mississippi State University
2018	Zachary Lancaster	University of Arkansas
2019	Swati Shrestha	Mississippi State University
2020	Lawson Priess	University of Arkansas
2021	Nick Hurdle	University of Georgia
2022	Delaney Foster	Texas Tech University
2023	Tristen Avent	University of Arkansas

Outstanding Graduate Student Award (PhD)
Sarah Kezar, Texas A&M University

Sarah Kezar of Syracuse, IN, graduated cum laude from Oklahoma State University in 2018 with a B.S. in Plant & Soil Science and a double minor in Agricultural Economics and Animal Science. Research was a primary interest during her time at Oklahoma State University, followed by barrel racing on the collegiate rodeo team. It was not until junior year that she switched from majoring in Animal Science and undergraduate research with feedlot cattle to majoring in Plant & Soil Science and studying canola and wheat cropping systems as a Wentz and Sitlington research scholar. Sarah continued to a M.S. at Oklahoma State University, under the direction of Dr. Josh Lofton, and her research on soybean reproduction losses and potential for recovery resulted in authoring or co-authoring 4 peer-reviewed journal publications and 4 extension publications. In May 2020, she graduated summa cum laude and was awarded Outstanding M.S. Student by the Department of Plant & Soil Sciences, Graduate Professional Student Government Association, and the Graduate College. Thereafter, she joined Dr. Muthukumar Bagavathiannan's lab at Texas A&M University to give weed science a try! Her dissertation research focused on the efficacy of integrated weed management programs for Palmer amaranth in cotton by leading a Cotton Belt-wide 16 site-year study and evaluating new approaches to target weed reproduction with the use of chemical gametocides or red light. For her research, she received the TAMU University Merit Fellowship, the ASA-CSSA-SSSA Encompass Fellowship, and the Foundation for Food and Agriculture Research Fellowship which, with matching support from Cotton Incorporated, funded her Ph.D. program. The opportunity to be involved in the weed science community as the SWSS Graduate Student Org. Vice-President/President and WSSA Graduate Student Org. Vice President/President is something she is most thankful for, along with the friendships and mentorship along the way. She is also appreciative of the 2021 SWSS Endowment Enrichment Scholarship to tour Bayer in St. Louis and the 2022 WSSA Travel Enrichment Scholarship to learn about various USDA agencies in Washington, D.C. Sarah successfully defended her dissertation in March 2023 and was awarded the Outstanding Ph.D. Student by the Texas Plant Protection Association and the Gerald O. Mott Award from the CSSA. From her time at Texas A&M University, Sarah has published 22 abstracts from scientific presentations, has 7 authored or co-authored peer-reviewed journal publications expected from her dissertation research, and successfully conceptualized and wrote a NIFA-AFRI Post-Doctoral grant.

Past Winners of the Outstanding Graduate Student Award (PhD)

Year	Name	University
1998	Nilda Roma Burgos	University of Arkansas
1999	A. Stanley Culpepper	North Carolina State University
2000	Jason K. Norsworthy	University of Arkansas
2001	Matthew J. Fagerness	North Carolina State University
2002	William A. Bailey	North Carolina State University
2003	Shea W. Murdock	Oklahoma State University
2004	Eric Scherder	University of Arkansas
2005	Ian Burke	North Carolina State University
2006	Marcos J. Oliveria	Clemson University
2007	Wesley Everman	North Carolina State University
2008	Darrin Dodds	Mississippi State University
2009	Sarah Lancaster	Texas A&M University
2010	Tom Eubank	Mississippi State University
2011	Sanjeev Bangarwa	University of Arkansas
2012	Edinalvo (Edge) Camargo	Texas A&M University
2013	Kelly Barnett	University of Tennessee
2014	James McCurdy	Auburn University
2015	Sushila Chaudhari	North Carolina State University
2016	Reiofeli Algodon Salas	University of Arkansas
2017	Misha Manuchehri	Texas Tech University
2018	Sandeep Rana	Virginia Tech
2019	Nicholas Basinger	North Carolina State University
2020	John Brewer	Virginia Tech
2021	Sam Rustom	Louisiana State University
2022	Maria Zaccaro-Gruener	University of Arkansas
2023	Taylor Randell-Singleton	University of Georgia

Fellow Award
Jason Norsworthy, University of Arkansas

Jason Norsworthy earned his B.S. in Plant Sciences – Agronomy from Louisiana Tech University in 1995 and his M.S. and Ph.D. in Plant Sciences – Weed Science from the University of Arkansas in 1997 and 2000, respectively. After six years on the faculty at Clemson University, he returned to the University of Arkansas in 2006 as a Distinguished Professor with tenure in the Crop, Soil, and Environmental Sciences Department. He holds the endowed Elms Farming Chair of Weed Science and teaches courses in Principles of Weed Control, Integrated Pest Management, and Weed Science Practicum.

Dr. Norsworthy has supervised 42 M.S. students, 9 Ph.D. students, and 9 Postdoctoral Associates, and currently advises 8 M.S. students, 3 Ph.D. students, and 3 Postdoctoral Associates. His students and former Postdoctoral Associates have received over 650 awards. He has authored or co-authored more than 350 refereed journal publications, holds an H-index of 53, and has secured over $19 million in research funding. His research, which spans applied and basic studies on various row crops, involves collaborations with global research and development companies, universities, and governmental entities. His innovative work includes seven U.S. patent submissions and numerous internal patent applications.

Dr. Norsworthy is a sought-after speaker on weed management, particularly on herbicide-resistant weeds, having delivered six international keynote addresses. His publication on best management practices for mitigating herbicide resistance is the most cited in the weed science field for over a decade.

For his research and educational accomplishments, the Arkansas Association of Cooperative Extension Specialists recognized Dr. Norsworthy as Researcher of the Year in 2011, and he was presented the Outstanding Researcher Award by the Arkansas Chapter of Gamma Sigma Delta in 2015. He received the Australian Orator Award for the Herbicide Resistance Challenge in 2013 and was awarded the Outstanding Educator Award by the SWSS and Researcher of the Year by the University of Arkansas System Division of Agriculture in 2017. In 2011, Dr. Norsworthy and colleagues received the John W. White Team Award from the University of Arkansas System Division of Agriculture for their efforts on glyphosate-resistant Palmer amaranth. In 2017, the University of Arkansas Extension Service honored Dr. Norsworthy and colleagues with the Extension Excellence State Team Award for their dicamba research and educational efforts. In 2018, he was named Fellow of the WSSA, received the Outstanding Researcher Award from WSSA, and was co-author of the Outstanding Paper published in the Weed Technology journal. Most recently, Dr. Norsworthy was named the recipient of the Spitze Land Grant University Faculty Award for Excellence in 2021. He has served on the Southern Weed Science Board of Directors and the Weed Science Society of America Board of Directors. Dr. Norsworthy has been an active SWSS member for more than 25 years. During this time, he has served on the Board of Directors, hosted the 2012 Southern Weed Contest, chaired the Site Selection Committee, and several additional committees. Dr. Norsworthy served as an Associate Editor for the peer-reviewed journal Weed Technology from 2002 to 2011 and has since been serving as Editor-in-Chief for the journal.

Fellow Award
Nilda Burgos, University of Arkansas

Nilda Roma-Burgos received a B.S. Agriculture-Soil Science degree from the Visayas State College of Agriculture, Philippines in 1983 and her M.S. and Ph.D. degrees in Agronomy from the University of Arkansas, Fayetteville in 1994 and 1997, respectively. She was Field Biologist for Zeneca Ag Products from 1997-1998 and served as Faculty at the University of Arkansas since October 1998. Dr. Burgos conducts research on basic and applied aspects of weed physiology, molecular weed biology, ecology, and transcriptomics with emphasis on weed adaptation to herbicide selection pressure and abiotic stress. She is also conducting research on weed management and investigating new herbicidal compounds and adjuvants, specifically, nano-based adjuvant technology. She has taught Principles of Weed Control (2000-2006), Weed Physiology and Herbicide Resistance in Plants in alternate years (1999-2009), Physiology of Plant-Herbicide Interaction on odd years since 2015, Ecology and Morphology of Weedy and Invasive Species since 2011; team-taught Weed Science Practicum and co-coached the University of Arkansas Weed Team since 1999; and team-taught Advanced Crop Science since 2014. Dr. Burgos was one of the pioneering UA Faculty Team that established the Global Community Development Service Project in Belize in 2006 and served as mentor for students participating in this program from 2007 to 2011. She also initiated the International Research Experience Program for the UA College of Agriculture, implemented in 2012-2016. She has served as Major Advisor or co-Advisor of 23 M.S. and 28 Ph.D. students; advised 13 undergraduate honors student research; served on 49 graduate student committees; and mentored 18 visiting scientists. Dr. Burgos has served as Secretary and Chair of the SWSS Resistance Committee over several years; Secretary and Chair of the SWSS Foundation; member of the Outstanding Young Scientist Award Committee; member of the SWSS Weed Contest Committee across several years; Editor of the SWSS Proceedings; Associate Editor of the Weed Science journal. She led the assembly and co-edited the Special Issue on Research Methods in Weed Science and a special issue on Weedy Rice. She was elected as Secretary-Treasurer of the International Weed Science Society (2008-2012), Vice-President of IWSS for 2012-2016, served as President of IWSS for 2016-2022, and IWSS Board member until 2024. Dr. Burgos has served as resource speaker and invited lecturer (>30 times) for seminars, trainings, workshops, or conferences in various countries including Bolivia, Brazil, China, Costa Rica, India, Indonesia, Israel, Nicaragua, Peru, Spain, Thailand, the Philippines, Uruguay, and Vietnam. She had delivered 37 invited presentations for local/regional educational outreach and Extension workshops. She has authored and co-authored 145 refereed journal articles, 10 book and book chapters, and more than 10 extension/nontechnical publications.

Past Winners of the Distinguished Service Award
(Renamed Fellow Award in 2015)

Year	Name	University/Company
1976	Don E. Davis	Auburn University
1976	V. Shorty Searcy	Ciba-Geigy
1977	Allen F. Wiese	Texas Agric. Expt. Station
1977	Russel F. Richards	Ciba-Geigy
1978	Robert E. Frans	University of Arkansas
1978	George H. Sistrunck	Valley Chemical Company
1979	Ellis W. Hauser	USDA, ARS Georgia
1979	John E. Gallagher	Union Carbide
1980	Gale A. Buchanan	Auburn University
1980	W. G. Westmoreland	Ciba-Geigy
1981	Paul W. Santelmann	Oklahoma State University
1981	Turney Hernandez	E.I. DuPont
1982	Morris G. Merkle	Texas A & M University
1982	Cleston G. Parris	Tennessee Farmers COOP
1983	A Doug Worsham	North Carolina State University
1983	Charles E. Moore	Elanco
1984	John B. Baker	Louisiana State University
1984	Homer LeBaron	Ciba-Geigy
1985	James F. Miller	University of Georgia
1985	Arlyn W. Evans	E.I. DuPont
1986	Chester G. McWhorter	USDA, ARS Stoneville
1986	Bryan Truelove	Auburn University
1987	W. Sheron McIntire	Uniroyal Chemical Company
1987	No nominations	--
1988	Howard A.L. Greer	Oklahoma State University
1988	Raymond B. Cooper	Elanco
1989	Gene D. Wills	Mississippi State University
1989	Claude W. Derting	Monsanto
1990	Ronald E. Talbert	University of Arkansas
1990	Thomas R. Dill	Ciba-Geigy
1991	Jerome B. Weber	North Carolina State University
1991	Larry B. Gillham	E.I. DuPont
1992	R. Larry Rogers	Louisiana State University
1992	Henry A. Collins	Ciba-Geigy
1993	C. Dennis Elmore	USDA, ARS Stoneville
1993	James R. Bone	Griffin Corporation
1994	Lawrence R. Oliver	University of Arkansas
1994	No nominations	--
1995	James M. Chandler	Texas A & M University
1995	James L. Barrentine	DowElanco
1996	Roy J. Smith, Jr.	USDA, ARS Stuttgart
1996	David J. Prochaska	R & D Sprayers

1997	Harold D. Coble	North Carolina State University
1997	Aithel McMahon	McMahon Bioconsulting, Inc.
1998	Stephen O. Duke	USDA, ARS Stoneville
1998	Phillip A. Banks	Marathon-Agri/Consulting
1999	Thomas J. Monaco	North Carolina State University
1999	Laura L. Whatley	American Cyanamid Company
2000	William W. Witt	University of Kentucky
2000	Tom N. Hunt	American Cyanamid Company
2001	Robert M. Hayes	University of Tennessee
2001	Randall L. Ratliff	Syngenta Crop Protection
2002	Alan C. York	North Carolina State University
2002	Bobby Watkins	BASF Corporation
2003	James L. Griffin	Louisiana State University
2003	Susan K. Rick	E.I. DuPont
2004	Don S. Murray	Oklahoma State University
2004	Michael S. DeFelice	Pioneer Hi-Bred
2005	Joe E. Street	Mississippi State University
2005	Harold Ray Smith	Biological Research Service
2006	Charles T. Bryson	USDA, ARS, Stoneville
2006	No nominations	--
2007	Barry J. Brecke	University of Florida
2007	David Black	Syngenta Crop Protection
2008	Thomas C. Mueller	University of Tennessee
2008	Gregory Stapleton	BASF Corporation
2009	Tim R. Murphy	University of Georgia
2009	Bradford W. Minton	Syngenta Crop Protection
2010	No nominations	--
2010	Jacquelyn "Jackie" Driver	Syngenta Crop Protection
2011	No nominations	--
2011	No nominations	--
2012	Robert Nichols	Cotton Incorporated
2012	David Shaw	Mississippi State University
2013	Renee Keese	BASF Company
2013	Donn Shilling	University of Georgia
2014	Tom Holt	BASF Company
2014	Dan Reynolds	Mississippi State Univsity
2015	Bobby Walls	FMC Corporation
2015	John Harden	BASF Corporation
2016	No award	--
2017	James Holloway	Syngenta Crop Protection
2018	Scott Senseman	University of Tennessee
2018	Jerry Wells	Syngenta Crop Protection
2019	John Byrd	Mississippi State University
2020	Greg MacDonald	University of Florida
2020	Cletus Youmans	BASF Corporation
2021	David Jordan	North Carolina State University

2021	Henry McLean	Syngenta Crop Protection
2022	Peter Dotray	Texas Tech University
2022	Henry McLean	University of Georgia
2023	Larry Steckel	University of Tennessee
2023	Gary Schwarzlose	Bayer CropScience

Past Winners of the Weed Scientist of the Year Award
(Renamed Fellow Award in 2015)

Year	Name	University
1984	Chester L. Foy	VPI & SU
1985	Jerome B. Weber	North Carolina State University
1986	No nominations	--
1987	Robert E. Frans	University of Arkansas
1988	Donald E. Moreland	USDA, ARS, North Carolina
1989	Roy J. Smith, Jr.	USDA, ARS, North Arkansas
1990	Chester McWhorter	USDA, ARS, Mississippi
1991	Ronald E. Talbert	University of Arkansas
1992	Thomas J. Monaco	North Carolina State University
1993	A. Douglas Worsham	North Carolina State University
1994	Stephen O. Duke	USDA, ARS, Mississippi
1995	Lawrence R. Oliver	University of Arkansas
1996	William L. Barrentine	Mississippi State University
1997	Kriton K. Hatzios	VPI & SU
1998	G. Euel Coats	Mississippi State University
1998	Robert E. Hoagland	USDA, ARS, Mississippi
1999	James H. Miller	U.S. Forest Service
2000	David R. Shaw	Mississippi State University
2001	Harold D. Coble	North Carolina State University
2002	No nominations	--
2003	John W. Wilcut	North Carolina State University
2004	Gene D. Wills	Mississippi State University
2005	R. M. Hayes	University of Tennessee
2006	James L. Griffin	Louisiana State University
2007	Alan C. York	North Carolina State University
2008	Wayne Keeling	Texas A&M University
2009	W. Carroll Johnson, III	USDA, ARS, Tifton
2010	Don S. Murray	Oklahoma State University
2011	Krishna Reddy	USDA, ARS, Mississippi
2012	Daniel Reynolds	Mississippi State University
2013	Barry Brecke	University of Florida
2014	No nominations	--
2017	James Holloway	Syngenta Crop Protection

Past Presidents of the Southern Weed Science Society

1948-49	C.A. Brown	1986-87	H.M. LeBaron
1949-50	E.C. Tullis	1987-88	R.L. Rogers
1950-51	O.E. Sell	1988-89	L.B. Gillham
1951-52	G.M. Shear	1989-90	L.R. Oliver
1952-53	D.A. Hinkle	1990-91	J.R. Bone
1953-54	W.B. Ennis, Jr.	1991-92	J.M. Chandler
1954-55	W.C. Shaw	1992-93	J.L. Barrentine
1955-56	G.C. Klingman	1993-94	A.D. Worsham
1956-57	W.B. Albert	1994-95	P.A. Banks
1957-58	E.G. Rogers	1995-96	S.O. Duke
1958-59	R. Behrens	1996-97	B.D. Sims
1959-60	V.S. Searcy	1997-98	R.M. Hayes
1960-61	R.A. Darrow	1998-99	R.L. Ratliff
1961-62	W.K. Porter, Jr.	1999-00	D.S. Murray
1962-63	J.T. Holstun, Jr.	2000-01	L.L. Whatley
1963-64	R.F. Richards	2001-02	J.E. Street
1964-65	R.E. Frans	2002-03	J.W. Wells
1965-66	D.E. Wolf	2003-04	W.W. Witt
1966-67	D.E. Davis	2004-05	J.S. Harden
1967-68	R.A. Mann	2005-06	D.R. Shaw
1968-69	W.L. Lett, Jr.	2006-07	J.A. Driver
1969-70	J.B. Baker	2007-08	D.W. Monks
1970-71	D.D. Boatright	2008-09	A.M. Thurston
1971-72	J.R. Orsenigo	2009-10	D.B. Reynolds
1972-73	T.J. Hernandez	2010-11	T.J. Holt
1973-74	A.F. Wiese	2011-12	B.J. Brecke
1974-75	W.G. Westmoreland	2011-12	2012-13
1975-76	P.W. Santlemann	2014-15	S.A. Senseman
1976-77	A.J. Becon	2015-16	B. Minton
1977-78	G.A. Buchanan	2016-17	P. Dotray
1978-79	C.G. Parris	2017-18	G. Schwarzlose
1979-80	M.G. Merkle	2018-19	B. Scott
1981-82	J.B. Weber	2019-20	James Holloway
1982-83	J.E. Gallagher	2020-21	Eric Webster
1983-84	C.G. McWhorter	2021-22	Cletus Youmans
1984-85	W.S. McIntire	2022-23	Darrin Dodds
1985-86	R.E. Talbert	223-224	

Dedication of the Proceedings of the SWSS
Dr. Gilbert Neil Rhodes, Jr.

With the highest amount of respect, the Southern Weed Science Society dedicates the 2024 proceedings to Dr. Gilbert Neil Rhodes, Jr., weed scientist and Professor Emeritus with The University of Tennessee. Neil died on April 27, 2024. Neil was long time active member of the Southern Weed Science Society and Weed Science Society of America. Widely regarded as an accomplished weed scientist and dedicated public servant to Tennessee agriculture, his long career touched four decades. Neil was a second-generation agricultural professional, following his late-father Gilbert N. Rhodes, Sr. as a faculty member with The University of Tennessee, both working with the Tennessee Extension Service. Neil was raised in Maryville, TN, graduated from Alcoa High School in 1973. Later, Neil earned his B.S. and M.S. degrees from The University of Tennessee, followed by his PhD degree in Crop Science (weed science) from North Carolina State University in 1982. Neil was an extension weed scientist with North Carolina State University, field representative with Rohm and Haas in Mississippi, and then returned to The University of Tennessee in 1985 to join the faculty in the Plant Sciences Department. Neil was appointed Head of the Plant Sciences Department in 2001 and served in this role through 2008. From that point until his retirement in 2021, Neil served Tennessee agriculture primarily as an extension weed scientist.

Neil's impact as a weed scientist and agricultural professional was acknowledged by his peers by him receiving the Weed Science Society of America Outstanding Extension Worker Award in 2004, Southern Weed Science Society Excellence in Regulatory Stewardship Award in 2018, named Fellow by the Southern Weed Science Society in 2019, and recipient of the Webster Pendergrass Award from The University of Tennessee Institute of Agriculture in 2019 for his impact in teaching, research, and extension. Neil's service to Tennessee agriculture was highlighted by him being named honorary member of the Tennessee Agricultural Production Association (TAPA) in 2021.

Neil was an approachable weed scientist who related well to all he met. He approached his profession with a shrewd intellect, keen sense of humor, and calm, measured demeanor. Neil's vision of service and contributions to agriculture and the weed science discipline are best illustrated by Neil's own words spoken in 2021, in the form of a personal testimony, when named Honorary Member of TAPA:

"I am a weed scientist and plant physiologist, and my work developed economically viable and environmentally sustainable weed management systems. Weed scientists use what they know about crops and the weeds themselves to do this. In the larger scheme, weeds limit production by competing for nutrients, water, space, and light. So, we are focused on producers having available the most effective management techniques. Stewarding crop protection is critical to safeguarding the environment and keeping farmers in business. It is in the best interest of the agricultural industry and consumers to make sure weed management practices, especially the use of chemicals, are properly administered."

Neil is survived by his sister Judy Rhodes Effler, her husband Larry and many cousins. He was preceded in death by his father, Gilbert N. Rhodes, Sr., mother, Ruth Jackson Rhodes and many aunts, uncles and grandparents. Memorial gifts can be sent to support Middlesettlements United Methodist Church, 2729 Middlesettlements Rd, Maryville, TN 37801 or the Tom Hatcher Charity, P. O. Box 743, Alcoa, TN 37701-0743.

Past Dedication of the Proceedings of the SWSS

Year	Name	University or Company
1973	William L. Lett, Jr.	Colloidal Products Corporation
1975	Hoyt A. Nation	Dow Chemical Company
1978	John T. Holstun, Jr.	USDA, ARS
1988	V. Shorty Searcy	Ciba-Geigy
1995	Arlen W. Evans	DuPont
1997	Michael & Karen DeFelice	Information Design
1999	Glenn C. Klingman	Eli Lilly and Company
1999	Allen F. Wiese	Texas A&M University
2004	Chester G. McWhorter	USDA-ARS
2004	Charles E. Moore	Lilly Research Laboratories
2008	John Wilcut	North Carolina State University
2008	Larry Nelson	Clemson University
2012	Jacquelin Edwards Driver	Syngenta Crop Protection
2015	Paul Santelmann	Oklahoma State University
2016	Ted Webster	USDA-ARS
2017	Dennis Elmore	USDA-ARS
2018	Timothy R. Murphy	University of Georgia
2019	Dr. John Ray Abernathy	Texas Tech University

List of SWSS Committee Members
January 31, 2024 - January 31, 2025

Note: Duties of each Committee are detailed in the Manual of Operating Procedures, which is posted on the SWSS website at http://www.swss.ws

100. SOUTHERN WEED SCIENCE SOCIETY OFFICERS AND EXECUTIVE BOARD

100a. OFFICERS

President	Todd Baughman	2025
President Elect	Eric Palmer	2025
Vice-President	Shawn Askew	2025
Secretary-Treasurer	Hunter Perry	2023-2025
Editor (Proceedings)	Paul Tseng	2023-2025
Immediate Past President	Eric Castner	2025

100b. ADDITIONAL EXECUTIVE BOARD MEMBERS

Member-at-Large - Academia	Charlie Cahoon	2023-2025
Member-at-Large- Industry	Adam Hixson	2023-2025
Member-at-Large - Academia	David Russell	2024-2026
Member-at-Large- Industry	Matthew Wiggins	2024-2026
Representative to WSSA	Pete Dotray	2023-2025

100c. EX-OFFICIO BOARD MEMBERS

Constitution and Operating Procedures	Carroll Johnson	2024-2026
SWSS Business Manager	Kelley Mazur	2021-2025
Student Representative	Navdeep Godara	2024-2025
Director of Communications	Justin Calhoun	2024-2026

101. SWSS ENDOWMENT FOUNDATION

101a. BOARD OF TRUSTEES – ELECTED

President	Jason Bond	2020-2025
Secretary	Sandeep Rana	2021-2026
	Lauren Lazaro	2022-2027
	Lawson Priess	2023-2028
	Connor Webster	2024-2029
Graduate Student Rep	Tristen Avent	2024-2025

101b. BOARD OF TRUSTEES - EX-OFFICIO

Greg McDonald	Past President of Endowment Foundation Board of Trustees
Kelley Mazur	SWSS Business Manager

102. AWARDS COMMITTEE PARENT (STANDING) - The Parent Awards Committee shall consist of the immediate Past President as Chairperson and each Chair of the Award Subcommittees.

Eric Castner*	2025	Larry Steckel	2025	John Brewer	2025
Eric Prostko	2025	Sandeep Rana	2025	Joey Williams	2025

The Awards Subcommittees shall consist of six members including the Chair, serving staggered three- year terms with two rotating off each year.

102a. SWSS Fellow Award Subcommittee

Eric Prostko*	2025	Gary Schwarzlose	2026	Jason Norsworthy	2027
Peter Dotray	2025	Larry Steckel	2026	Nilda Burgos	2027

102b. Outstanding Educator Award Subcommittee

Larry Steckel*	2025	Darrin Dodds	2026	Tom Barber	2027
Tim Grey	2025	Ramon Leon	2026	Jason Bond	2027

102c. Outstanding Young Weed Scientist Award Subcommittee

Sandeep Rana*	2025	Charlie Cahoon	2026	Pete Eure	2027
Jim Brosnan	2025	Scott Nolte	2026	Chris Leon	2027

102d. Outstanding Graduate Student Award Subcommittee

John Brewer*	2025	Nic Basinger	2026	Zachary Treadway	2027
John Buol	2025	Luis Avila	2026	Jenny Dudak	2027

102e. Excellence in Regulatory Stewardship Award Subcommittee

Joey Williams	2025	Matt Goddard	2026	Garrett Montgomery	2027
Frances Meeks	2025	Dan Reynolds	2026	Tom Mueller	2027

103. COMPUTER APPLICATION COMMITTEE (STANDING)

Sarah Kezar*	2025	Gary Schwarzlose	2026	Muthu Bagavathiannan	2027
Shawn Askew	2025	Hannah Wright-Smith	2026	Justin Calhoun	2027
Kelley Mazur – SWSS Business Manager					

104. CONSTITUTION AND OPERATING PROCEDURES COMMITTEE (STANDING)

W. Carroll Johnson*	2024-2026

105. FINANCE COMMITTEE (STANDING) - Shall consist of the Vice President as Chair and President- Elect, Secretary-Treasurer, Chair of Sustaining Membership Committee, and others as the President so chooses, with the Editor serving as ex-officio member.

Shawn Askew* (VP)	2025
Eric Palmer (Pres. Elect)	2025
Hunter Perry (Sec-Treas.)	2025
Tim Adcock (Sustaining Mem.)	2025
Gary Schwarzlose	2025
Darrin Dodds	2025
Paul Tseng (ex-officio)	2025
Kelley Mazur – SWSS Business Manager	

106. GRADUATE STUDENT ORGANIZATION

President	Navdeep Godara	2025
Vice President	Megan Mills-Singletary	2025
Secretary	Tanner King	2025
Weed Resistance & Technology Comm. Rep	Hannah Lindell	2025
Endowment Committee	Tristen Avent	2025
Social Chair/Student Program Committee	Sarah Chu	2025
Student Program Committee	Sydney Baker	2025

107. WEED RESISTANCE AND TECHNOLOGY STEWARDSHIP (STANDING)

Alabama	Steven Li		North Carolina	Charlie Cahoon
Arkansas	Jason Norsworthy		Oklahoma	Liberty Gavin
Florida	Gre MacDonald		South Carolina	Matthew Cutulle
Georgia	Eric Prostko		Tennessee	Larry Steckel
Kentucky	Travis Legleiter		Texas	Pete Dotray
Louisiana	Daniel Stephenson		Virginia	Michael Flessner*
Mississippi	Luis Avila		Puerto Rico	Wilfredo Robles
Missouri	Justin Calhoun		Grad. Student Rep	Hannah Lindell

109. LEGISLATIVE AND REGULATORY COMMITTEE (STANDING)

Shawn Askew*	Chair & Vice-President	2025
Lee Van Wychen	(ad hoc) WSSA Science Policy Executive Director	2025
Janice MacFarland	(ad hoc) Chair of the WSSA Science Policy Comm.	2025
Mark VanGessel	(ad hoc), EPA liaison	2025
Charlie Cahoon	Member-at-Large - Academia	2025
Adam Hixson	Member-at-Large - Industry	2025
David Russell	Member-at-Large - Academia	2026
Matthew Wiggins	Member-at-Large - Industry	2026

110. LOCAL ARRANGEMENTS COMMITTEE - (STANDING)

Matthew Cutelle*	2025	Charleston, SC
Larry Steckel	2026	Nashville, TN
TBD	2026	TBD

111. LONG-RANGE PLANNING COMMITTEE (STANDING) –
Shall consist of the Past-Past President (chair), Past-President, President, and President-Elect.

Darrin Dodds (Chair-Elect) *	2025
Eric Castner	2026
Todd Baughman	2027
Eric Palmer	2028

112. MEETING SITE SELECTION COMMITTEE (STANDING) - Shall consist of six members and the SWSS Business Manager. The members will be appointed by the President on a rotating basis with one member appointed each year and members shall serve six-year terms. The Chairmanship will rotate to the senior committee member from the geographical area where the meeting will be held.

Ben McKnight* (SW)	2025	Michael Flessner (SE)	2027	Darrin Dodds (MS)	2029
Stanley Culpepper (SE)	2026	Kelly Backscheider (TN)	2028	Eric Castner (OK)	2030
Kelley Mazur – SWSS Business Manager					

113. NOMINATING COMMITTEE (STANDING) - Shall be composed of the Past President as Chair.

Eric Castner*	2024

114. PROGRAM COMMITTEE – 2024 MEETING (STANDING)

Eric Palmer*	2025
Shawn Askew	2026
TBD	2027

117. RESOLUTIONS AND NECROLOGY COMMITTEE (STANDING)

Joey Williams*	2025	David Russell	2026	Ryan Edwards	2027

118. SOUTHERN WEED CONTEST COMMITTEE (STANDING) open to all SWSS members

Mississippi	T. Bararpour		Missouri	J. Calhoun
Alabama	S. Li		North Carolina	W. Everman
Arkansas	N. Burgos		Oklahoma	L. Gavin
Florida	G. MacDonald		South Carolina	M. Cutulle
Georgia	N. Basinger		Tennessee	Matthew Wiggins* T. Mueller
Kentucky	T. Legleiter		Texas	P. Dotray
Louisiana	C. Webster		Virginia	S. Askew
Ad Hoc - Current	B. Kirksey		Puerto Rico	W. Robles

119. STUDENT PROGRAM COMMITTEE (STANDING)

Hannah Wright-Smith*	2025	
Lawson Priess	2026	
Taylor Randell-Singleton	2027	
Sydney Baker	2025	Graduate Student Organization Rep. – Ex-officio member

120. SUSTAINING MEMBERSHIP COMMITTEE (STANDING)

Kelly Backsheider*	2025	Eric Castner	2026	Greg Steele	2027
Ray Kelley	2025	Joey Williams	2026	Ryan Edwards	2027
James Holloway	2025	Cletus Youmans	2026	Pete Eure	2027

121. CONTINUING EDUCATION UNITS COMMITTEE (SPECIAL)

AL - Steve Li	2025		MO – Justin Calhoun	2025
AR - Tom Barber	2025		NC – Charlie Cahoon	2025
FL - Calvin Odero	2025		OK – Swati Shrestha**	2025
GA – Nic Basinger	2025		SC - Alan Estes	2025
KY – Travis Legleiter	2025		TN – Bruce Kirksey*	2025
LA – Daniel Stephenson	2025		TX - Jacob Reed	2025
MS -Te-Ming Paul Tseng	2025		VA – Shawn Askew**	2025

*Chair
**CEU's not provided by that state

SWSS Board of Directors Meeting Minutes

SWSS Board of Directors Meeting
September 6, 2023
San Antonio, TX

Attendees (virtual and in-person):
Eric Castner, Carroll Johnson, Todd Baughman, Paul Tseng, Hunter Perry, Charlie Cahoon, Darrin Dodds, Eric Palmer, Luke Etheridge, Adam Hixon, Gary Schwarzlose, Pete Dotray, Kelly Mazur, Mason Castner, Pete Eure

Call to Order:
Meeting started at 12:57 pm. Todd motioned to approve the agenda, and Peter seconded. No opposition.

Secretary's Report:
Motion to approve previous meeting minutes mailed out by Eric C. Luke seconded the motion. No opposition.

Financial Update:
Kelly shared the balance sheet with the BOD. Money is moved from the money market account to checking to pay the bills and then remaining money is moved back to the money market. Discussed moving money market account(s) to potentially RBC since it offers over 4%. Kelly will investigate further and we will discuss again on Thursday. Kelley also shared the Profit and Loss sheet for June 1, 2023, to present.

Proceedings Update:
Proceedings were sent out the previous week with some minor edits received. Edits were incorporated and sent back out to the BOD. Committee listing on the website needs to be updated (Kelly). Paul reached out to 20 authors with missing abstracts (6 from TAMU). About half of the authors responded. Todd motioned to approve the proceedings, and Carroll seconded. No opposition. A question was raised about how we will handle proceedings in 2024. Historically, SWSS kept their own proceedings. Todd recommended following the same historical approach. Peter asked what is currently done if someone submits an abstract but doesn't present at the meeting. Carroll said ultimately it might fall on the editor since they are the ones going through the trouble to contact people to determine what is included.

WSSA Update (Peter Dotray):
ESA committee (multiple divisions) discussed the importance of members getting involved in what should be included going forward, structure, etc. The herb strategy division identified several points to ensure the point system established is accurate for the various regions represented. There was also a discussion around herb use in different crops (paraquat) with bad audio on the meeting. Todd suggested the herb movement component involves more runoff as opposed to other types of off-target movement. Todd noted that middle America and Latin America were more heavily represented. WSSA is writing a letter, but there was trouble filling in gaps due to audio. Discussion around the "old noxious weeds" committee. Discussion around

CAST representatives and papers coming forward to help prevent the next invasive plant. There will be a 5-part series on the ESA. Discussion around fire-tolerant invasive species. Discussion around the publication committee. Income is down due to reduced manuscript submissions.

CAST Proposal:
Eric received a call from CAST representatives (Chris Boomsma and Kent ?). SWSS is the only regional society not involved in CAST. Carroll reviewed the proceedings of past meetings, and SWSS was concerned at the time about finances. The question was whether the society benefited from being a member of CAST. In 2010, WSSA was active and a big supporter, so the argument was made to pull out of CAST. Todd shared his account of the situation at the time. Todd noted WWSS is an associate member and NEWSS and NCWSS are full members. Carroll believes at least an associate membership in CAST would ensure appropriate representation. Discussion about creating a board position for CAST if we decide to join. It's not required but can be considered.

Constitution and Operating Procedures Update (Carroll):
Discussion around renaming the Newsletter Editor position, and the elimination of the Research and Historical Committees.

2026 Site Selection:
The 2026 meeting will be in Nashville. Two locations identified: Sheraton Music City and Grand Hyatt Nashville. Chattanooga options didn't work out. Kelly shared the comparison sheet between the two Nashville options. Some fees can be reduced if other targets are achieved (e.g., meet food and beverage minimum and get a discount in another area). Site selection favored Sheraton Music City after a significant amount of discussion about the pros and cons of each location. Eric motioned to approve Sheraton Music City as the 2026 location. Charlie seconded. No opposition.

SWSS/WSSA Meeting Planning

Program Chair Update:
There will be four symposia: Biocontrol of weeds, Labeling, Herbicide-resistant weeds, and Adjuvants. The student contest will include a joint poster contest, and SWSS students will be pulled out for a Single Slide Talk contest. There will be a 15-minute oral contest for SWSS only. Todd proposed Greg, a wildlife and landscape photographer, as a keynote speaker for the Opening Session. Donald Brown (former FFA president) from the Brown Ranch may also be an option. The call for papers should come out in the next week or so and run from mid-September through early November. Tuesday is historically devoted to student contests, but it may not be this year due to the size of the meeting. The Endowment Enrichment Scholarship presentations may be given in a special session or during the awards ceremony. Potentially 200 posters (40-50 boards). Mason discussed the graduate student luncheon. The plan is to eat together in San Antonio, with the cost covered by WSSA. Mason needs a firm date with a 1.5-2-hour timeslot. A 90-minute slot is preferred according to Eric and Kelley. Mason and others agree that later in the meeting would be best for the luncheon, so contests are behind the students. Keynote speakers (perspectives from hiring managers) were discussed. They are looking to find speakers from

different areas of weed science (industry, academia, USDA, etc.). The GSA is also interested in reserving a meeting room where students can get a professional headshot done.

Local Arrangement Update:

Tours are being planned, including a tequila tasting. Potential ideas include botanical gardens and a "behind the scenes" at a local fresh market. Top Golf will take place. A large number of participants require a significant amount of space. For 200 people, it starts at $20K (full-floor). Consider renting a half-floor. Discussion around reducing total costs by charging students a small fee and regular members a larger fee to participate. The BOD will contact the Endowment and ask them to confirm/agree to the board proposal/conditions regarding the Top Golf event. They will have a week to respond with an answer/approval. Carroll recommends following up with WSSA to ensure full transparency. A motion was made, but Carroll motioned to kill the motion. Todd seconded. The theme for the joint meeting has not been decided yet.

Graduate Student Update:

See above.

Website Update:

The registration process needs to be crystal clear on the website since distribution of funds is partly based on proper registration. It is recommended to include this information in the newsletter and send an email to the membership on how to register.

Motion to Adjourn:

Todd seconded the motion. No opposition.

Old Business:

None

New Business:

None

Adjourn

SWSS Board of Directors Meeting

Sunday, January 21, 2024

Hyatt Regency Riverwalk, San Antonio, TX

Attendees:

Kelly Mazur, Greg McDonald, Tommy Butts, Mason Castner, Todd Baughman, Adam Hixon, Hunter Perry, Darrin Dodds, Gary Schwarzlose, Pete Eure, Eric Palmer, Carroll Johnson, Michael Flessner, Eric Castner, Peter Dotray, Charles Cahoon, Pratap Devotka, Lee van Wychen

Call to Order:

Eric – 3:30 pm. Carroll motioned to approve the agenda, and Todd seconded. No opposition.

Secretary's Report:
Hunter emailed minutes prior to the meeting. Todd approved and Carroll seconded. No opposition.

Program Update (Todd):
Everything appears to be good to go. He asked all Chairs to get with Todd. He will download presentations. There will be some changes to the program due to last-minute cancellations. Pete Eure asked how to handle removing someone from the program who cannot attend. Todd will get with the editor, and it will be indicated as withdrawn.

Student Contest (Todd/Pratap):
There were a few snags regarding the student competition. Last summer, we voted and presented our option to the board in September. Issues from the past two weeks were resolved, and we will continue with what was voted on in the summer SWSS BOD meeting. There will be poster (SWSS and WSSA students) and Single Slide (SWSS and WSSA students) contests, and SWSS 15-minute oral sessions (SWSS only) in the 2024 meeting. Four MS and five PhD sections in the poster contest. Todd provided SWSS vs. WSSA student makeup in each poster section. Eric elaborated on the society breakouts by showing the excel file with titles. Discussion around combining SWSS and WSSA in individual sections to make them large enough to compete (e.g., some sections only have 2-4 SWSS students). Todd motioned to combine MS sections 3 and 4 to reduce MS to only three sections (7, 8, and 9 students each). If any section falls to 5 or fewer students, there will only be a 1st place awarded. For the PhD sections, all five will be regrouped into three sections. Todd motioned to group 1 and 4, 3 and 5, and group 2. Carroll seconded. No opposition. Significant discussion around arranging posters and SST.

Proposed Bylaws Changes (Carroll):
Carroll provided a summary of changes, including eliminating the Research and Historical Committees. The Committee Structure Report was mailed to the BOD on December 15, 2023. The changes will be reviewed by members at the Business Meeting during the conference. Carroll motioned to approve the proposed changes, and Todd seconded. No opposition.

Nominations Update (Kelly):
Elections will take place during the business meeting. There are two nominees for President-Elect (Charles Cahoon and Adam Hixon) and two for Secretary (Luke Etheridge and Pete Eure). No additional nominations were received.

Local Arrangements Update (Kelly):
Everything is set, including options for activities and events. There was a discussion about the budget. Kelly is organizing an event at Top Golf and a tour that includes the market and gardens. These events will require separate fees to cover costs. A discussion was held regarding whether the Top Golf event could be subsidized and the options for student participation. Kelly is working on these details and will communicate with members before the meeting.

WSSA Update (Peter Dotray):
WSSA is planning for their meeting in Denver next year. Membership numbers and publication status were discussed, and the impact of CAST membership was highlighted.

Website and Registration Update (Kelly):
The website and registration process are working well. Kelly noted the importance of clear communication on the registration process and the need for ongoing updates.

Adjournment:
Eric motioned to adjourn the meeting at 5:00 pm. Todd seconded. No opposition.

SWSS Board of Directors Meeting
Date: January 25, 2024
Location: Live Oak Room, Hyatt Regency Riverwalk, San Antonio, TX

Attendees:
Todd Baughman, Kelley Apodaca, Pete Dotray, Hunter Perry, Eric Castner, Gary Schwarzlose, Charles Cahoon, David Russel, Adam Hixon, Pratap Devotka, Shawn Askew, Lee van Wychen, Eric Palmer, Carroll Johnson, Navdeep Godara, Paul Tseng, Matthew Cuttle

Secretary Report:
- Hunter read the minutes from Monday's meeting.
- Motion to approve minutes by Eric C, seconded by Charles. Approved.

Program Chair Update (Todd):
- Primary complaint: temperature in rooms (too hot).
- Issues with the app need to be addressed for future events.
- Sessions and meetings were well-attended.
- One student had issues with her presentation; a suggestion was made to develop a policy to cover contestants.
- Coffee breaks were too short.

Business Update (Kelley):
- Total registrants: 608 (130 regular SWSS, 89 student SWSS, 38 purchased regular $75 membership).
- Donations during registration: $345.
- Kelley will provide updated numbers once all information is available.

Student Contest Update (Pratap):
- Overall, the contest went well.
- Issues: small room sizes, pointer visibility on screens, long student sessions, abstract submission problems, and student requests to update slides.
- Moderators should keep doors closed to reduce noise.
- Consider providing printouts of posters and abstracts to judges.

Local Arrangements (Luke):

- Not present. Matthew Cutelle (2025 Local Arrangements) attended and asked general questions about 2025.

GSO Update (Navdeep):

- Confusion about reaching Top Golf; some students were unclear about the event details.
- 22% of members received head shots.
- The combined luncheon was well-received.
- New GSO officers announced; 75 SWSS students voted.
- Suggestion to have group photos of universities and individual programs.

Old Business:

- Eric C suggested a follow-up meeting to delve into Thursday's topics.
- Justin Calhoon agreed to serve as Director of Communications. Motion by Eric C, seconded by Charlie Cahoon. Approved.

New Business:

- Eric P inquired about summer board meeting dates, avoiding overlap with the weed contest at Virginia Tech.
- VT to contact about potential financial assistance from the Endowment.

Adjournment:

- Motion to adjourn by Charles at 12:42, seconded by Shawn. Approved.

SWSS Spring Board Meeting
Date: March 11, 2024
Time: 2 PM Central

Attendees:
Carroll Johnson, Navdeep Godara, Todd Baughman, David Russell, Charlie Cahoon, Peter Dotray, Michelle Breton (IMI), Eric Castner, Shawn Askew, Matthew Wiggins, Justin Calhoun, Eric Palmer, Kelley Apodaca

Call to Order:

- Called to order by Todd Baughman.

Approval of Agenda:

- Motion by Eric Castner, seconded by Carroll Johnson. Approved.

Minutes:

- Previous minutes have not been received. They will be approved along with today's minutes.

Old Business:

- Kelley will distribute financials and old minutes.

- Palmer suggested releasing the program earlier to aid travel plans and consider a new system for building the program.
- Baughman noted that some rooms were too hot; need to remind the hotel for future events. Issues with inconsistent equipment across rooms were noted.
- Askew proposed promoting group photos with a dedicated photographer, potentially funded by sponsorship.
- Kelley reported registration numbers and financials; final numbers and additional details will be provided before the summer board meeting. Kelley and Eric will address unregistered past members.
- Officer candidates discussed; lists to be updated and sent to Baughman.

New Business:

- Godara proposed expanding social media accounts to better reach students and society. Motion by Calhoun, seconded by Johnson. Discussion included concerns about frequency and professionalism. Amended to include the creation of a Social Media MOP. Motion carries.
- Castner discussed endowment enrichment and the potential need for a dedicated slot for MS students. Further discussion planned for the summer board meeting.
- Askew provided an update on the SWSS weed contest, scheduled for August 7.
- Kelley to create a doodle poll for the summer board meeting. Charlie will provide contact information for local arrangements.
- Hunter will send old minutes to Baughman for approval, and Charlie will send today's minutes to Hunter.

Adjournment:

- Motion to adjourn by Askew, seconded by Palmer. Approved.

2024 SWSS Committee Report Compilation

Sustaining Membership Committee Report

Committee Name : Sustaining Membership
Committee Chair: Tim Adcock
Committee Members: Name, Term Ending

Tim Adcock*	2024	Kelly Backsheider	2025	Eric Castner	2026
Scott Nolte	2024	Ray Kelley	2025	Joey Williams	2026
Michael Flessner	2024	James Holloway	2025	Cletus Youmans	2026

The following companies paid WSSA Sustaining Memberships at the indicated level in 2022 and 2023.

Membership Level	2022	2023
Platinum ($10,000 +):	**Syngenta**	**Syngenta**
Gold ($5,000-$9,999):	**Corteva Agriscience FMC**	**Corteva Agriscience FMC**
Silver ($2000-S4,999)	**BASF**	**BASF Cotton Inc.**
Bronze ($200-$1,999)	**Adama AMVAC Chemical Corp. Belchim Crop Protection Bellspray, Inc. Blue River Tech Diligence Technologies, Inc. Greenleaf Technoligies K-I Chemical USA Inc. Nichino America PBI/Gordon Corp. TeeJet Technologies The Scotts Company UPL Valent**	**Bellspray, Inc. Blue River Tech Diligence Technologies, Inc. Nichino America Nutrien The Scotts Company UPL Winfield United**
Total:	**$39,700.00**	**$35,900.00**

Final Sustaining Member support for 2023 was $35,900. This was down by $3,800 from the previous year. The difference was due largely to the reduced number of companies in the Bronze membership level that participated in 2023.

Many thanks are due to the hard work of the committee to maintain Sustaining Membership support at a high level in a difficult environment.

Tim Adcock, Chair

Constitution and Manual of Operating Procedures Committee Report

During 2023, the Manual of Operating Procedures was continually reviewed and edited. When possible, minor changes were made with the approval of the SWSS Board of Directors.

Three changes to the SWSS Constitution were identified and approved by the SWSS Board of Directors.

1. **Rename the Newsletter Editor to 'Director of Communications'**. This change better describes the expanded duties of this position that now include outreach efforts on social media. This position will continue to publish the SWSS Newsletter, along with the expanded duties.
2. **Remove the SWSS Research Committee from the list of standing committees**. The primary duty associated with the Research Committee was the SWSS Weed Survey. This survey has been expanded to include all regions and is now conducted by the Director of Science Policy, Dr. Lee Van Wychen.
3. **Remove the SWSS Historical Committee from the list of standing committees**. In general terms, this committee was tasked with archiving SWSS Proceedings and records of activity with Iowa State University. These records are now automatically archived on the SWSS website.

These changes were finalized by a vote of approval by the SWSS membership at the annual business meeting on 22 January 2024.

Respectively submitted;

W. Carroll Johnson, III
Chairman – SWSS Constitution and Operating Procedures

2024 Finance Committee Report

January 22, 2024

SWSS posted a gross income of $134,320.39 for period June1, 2023 – January 12, 2024, against total expenses $137,602.95 for a net operating income over this same time period of - $3,282.56. Total assets for SWSS total $268, 287.23. These assets are divided across several accounts including a checking, two RBC accounts, and a money market account.
The AHB checking account has $13, 473.99, RBC Hussman (investment fund) $13, 248.25, RBC Investments and CD's- $237,486.66, and Money Market - $4,078.33. RBC investments posted an annual gain of $11,642.76. Money market account posted a gain of $137.19. Following summer board meeting Finance Committee voted to break several low interest CD's and reinvest money into two CDs with higher than 5% return.

- $50,000 moved to a 6-month CD @ 5.4% - matures 5/30/24 - $2,700.
- $50,000 moved to a 12-month CD @ 5.2% - matures 11/27/24 - $2,600.

Upon maturity, finance committee would like to reinvest money into a non-callable CD with a similar maturity.

2023 Baton Rouge meeting Expenses: $89,952.63. Registration fees: $83,270.49 ($6,682.14). Attendance 163 members + 95 students = 258 total.

- F&B and AV costs have skyrocketed post-covid so site selection will be important to drive higher attendance of future meetings.

2024 Meeting
608 total registrations (SWSS and WSSA)
108 SWSS registrations + 89 students
38 WSSA registrations that added the $75 SWSS membership option

Respectfully Submitted,
Eric Palmer

SWSS Weed Contest Program Committee Report for 2023

Overview: The National Weed Science competition was held in Union City, TN on July 25-27, 2023. This event was hosted by Bayer Crop Science, with local arrangements being handled by Garret Montgomery, Joey Williams, and Matthew Wiggins. There were 27 universities from the US and Canada represented at the competition. A total of 217 total contestants, 64 undergraduates and 153 graduate students, participated this year. Over 120 individuals served as a volunteer to help make this contest a success.

ITEMS OF BUSINESS:

1. **SWSS Contest Participation:**

Year	Universities	Contest Participants		Total Participants
		Graduate	Undergrad	
2023	10	52	7	59
2022	11	57	9	66

2. **Student Contest Overview**
   a. The contest followed the official rules in place for the National Weed Science Contest.
   b. Students competed in weed identification, application technology (written exam and team calibration), identification of unknown herbicides, and problem solving.
   c. Individual and team scores were tabulated and redistributed to the contestants after the awards ceremony.

3. **WSSA Awards**
   a. Graduate

Award	Name(s)	University
1st place team	Jared Smith, Tristen Avent, Pamela Carvalho-Moore, Samuel Noe	University of Arkansas; Team A
1st place individual	Jared Smith	University of Arkansas
1st place weed ID	Jared Smith	University of Arkansas
1st place team sprayer calibration	Kayla Broster, Antonio Tavares, Jake Patterson, Amy Wilber	Mississippi State; Team 1

1st place written problems	Tristen Avent	University of Arkansas
1st place problem solving	Marcelo Zimmer	Purdue
1st place unknown herbicide*	Tristen Avent, Jared Smith, & Alex Mueth	University of Arkansas; University of Arkansas; Purdue

*Three-way tie for first place unknown herbicide

b. Undergraduate

Award	Name(s)	University
1st place team	Curtis Vanrooy, Stephanie Fletcher, Noelle Adams, Joe Rastapkevicius	University of Guelph; Team 1
1st place individual	Cody Lehman	Penn State
1st place weed ID	Rhet Baxley	University of Arkansas
1st place team sprayer calibration	Alisha Sherman, Sophie Van Den Borre, Kaitlin Woods, Lucy McNiven	University of Guelph; Team3
1st place written problems	Yudai Takenaka	University of Illiniois Urbana-Champaign
1st place problem solving	Jillion Ohm	University of Guelph
1st place unknown herbicide	Ethan Whitmoyer	Penn State

4. SWSS Awards

a. Graduate

Top Individual Graduate Students		
Place	**Name**	**School**
1st	Jared Smith	University of Arkansas
2nd	Tristen Avent	University of Arkansas
3rd	Maria Carolina Souza	University of Arkansas
4th	Pamela Carvalho-Moore	University of Arkansas
5th	Tanner King	University of Arkansas
6th	Cole Woolard	University of Arkansas
7th	Gustavo Silva	Texas A&M
8th	Samuel Noe	University of Arkansas
9th	Wade Reiter	Auburn University
10th	Hannah Lindell	University of Georgia

1st Place by Contest		
Contest	**Name**	**School**
Weed Identification	Jared Smith	University of Arkansas
Unknown Herbicide Identification*	Tristen Avent/Jared Smith	University of Arkansas
Problem Solving	Jared Smith	University of Arkansas

Individual Calibration	Tristen Avent	University of Arkansas

* Tie for unknown herbicide identification

Team Calibration Results		
Place	**Names**	**School**
1st	Kayla Broster, Antonio Tavares, Jake Patterson, Amy Wilber	Mississippi State; Team 1
2nd	Wade Reiter, Annu Kumari, Akashdeep Singh, Claudia Ann Rutland	Auburn
2nd *	Ubaldo Torres, Joe Johnson, Purushottam Gyawali, Megan Schill	Texas A&M; Team B

* Tie for second place

Top Overall Teams		
Place	**Names**	**School**
1st	Jared Smith, Tristen Avent, Pamela Carvalho-Moore, Samuel Noe	University of Arkansas; Team A
2nd	Maria Carolina Souza, Tanner King, Cole Woolard, Juan Velasquez	University of Arkansas; Team B
3rd	Kayla Broster, Antonio Tavares, Jake Patterson, Amy Wilber	Mississippi State University; Team 1

b. Undergraduate

Top Individual Undergraduate Students		
Place	**Name**	**School**
1st	Colton Fuller	University of Tennessee-Martin
2nd	Tyler Ward	University of Tennessee-Martin
3rd	Lorna Stemen	University of Tennessee-Martin

1st Place by Contest		
Contest	**Name**	**School**
Weed Identification	Rhet Baxley	University of Arkansas
Unknown Herbicide Identification	Colton Fuller	University of Tennessee-Martin
Problem Solving	Colton Fuller	University of Tennessee-Martin
Individual Calibration	William Yates	Auburn

Team Calibration Results		
Place	**Names**	**School**
1st	Colton Fuller, Tyler Ward, Ali Prince, Lorna Stemen	University of Tennessee-Martin

Top Overall Teams		
Place	**Names**	**School**
1st	Colton Fuller, Tyler Ward, Ali Prince, Lorna Stemen	University of Tennessee-Martin

5. **Contest Awards**
    a. Contest awards were presented at the awards banquet on July 26, 2023
    b. Plaques were awarded to National and Regional winners.
    c. The Broken Hoe trophy is currently full and is currently getting redesigned to be able to accommodate future contest winners.
    d. The original Broken Hoe trophy will be auctioned at the annual SWSS meeting in San Antonio, TX.
6. **Future Contests**
    a. Virginia Tech has agreed to host in 2024 in Blacksburg, VA
    b. Nutrien is considering hosting in 2025 in Winterville, MS

2024 SWSS Long-Range Planning Committee Report

Jan. 22, 2024

Mr President,

In 2023/24 the SWSS Long-Range Planning committee includes the Past President (Darrin Dodds), the President (Eric Castner), President-Elect (Todd Baughman), and myself (Past Past President and LRPC Chair).

Our committee is responsible for recognizing issues, short or long-term, affecting the general health and vitality of the SWSS. At this time we would like to focus on one issue, finances.

The LRPC recognizes the assets of the SWSS have been in decline for over 10 years, and we are expressing concerns that without changes in income or expenses, the society is on track to run out of funds, approximately in 2038. The current deficit is about $25,000 per year.

We wish to express five ideas the board should discuss to lower relative expenses. Some of these ideas could take effect within a year, some might never. While there are certainly many ways to reduce detailed expenses, each of these could result in significantly closing the annual deficit we currently are experiencing. All of us as members have numerous opportunities to speak up and attempt to "stop the bleeding", this is not something that occurred in only the past 5 years.

Some of these ideas likely need voting on by the membership. Many of these would be affected by current society contracts.

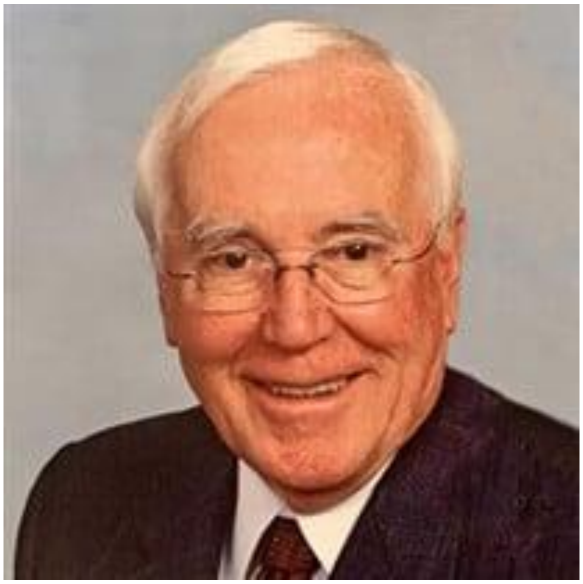
1. The Weed Contest could be shared between other societies [*such as SWSS in 2026, NCentral in 2027, and possibly a 3rd society in 2028*]. Essentially: a rotation between two or more societies. This could not only relieve the societies of expenses, but also allow more efficiencies in planning the contest.
2. Should two regional weed science societies consider a merger.
3. Should registration fees be increased $200/per regular member/ year by 2025.
4. Should a virtual meeting be considered every 3-5 years. Virtual meetings help significantly reduce expenses for the society and members.
5. Would there be a need to reduce salaried personnel, and could this be more efficient within a newly merged society?

Sincerely,

Clete Youmans (Chair of the SWSS LRPC)

WSSA In Memoriam 2023 Report

These are the members of the society who's passing I am aware of in the past year.



Jay LaMar Anderson, our beloved husband, father, and grandfather, passed away in Logan, Utah, on June 17, 2023 and was reunited with his parents and younger brother, Larry, just two hours after the annual Anderson Family Reunion was held nearby.

LaMar was born in Madison, Wisconsin, on April 22, 1931 to Melvin and Ruth Crittenden Anderson while Melvin was in graduate school. When LaMar was three, the Anderson family moved to Idaho Falls where he lived until he enrolled at Utah State Agricultural College in 1949. He graduated with a degree in horticulture in 1955, after also serving a two-year mission in Australia for The Church of Jesus Christ of Latter-day Saints. While at Utah State, he completed the ROTC program and upon graduation was commissioned a second lieutenant in the U.S. Army Artillery. He began active duty in July 1955 and served a sixteen-month tour in Korea during his two years in the Army.

While attending Utah State, he met Geraldine Olsen of Paradise, Utah in an English class, and they were married in the Logan LDS Temple on October 17, 1955. Following his military service, LaMar and Jeri moved back to Madison, Wisconsin, where LaMar attended graduate school at the University of Wisconsin and received a Ph.D. in plant pathology in 1961. LaMar studied under the same major professor as his father. LaMar was hired as a professor at Utah State University out of graduate school. For forty-five years, he conducted research in fruit production, taught various courses, and mentored undergraduate and graduate students. In 1994, he received the Outstanding Faculty Award from Utah State University, and the following year, he received the Distinguished Professor Award from the College of Agriculture. He was a fellow of both the American Society for Horticultural Science and the Western Society of Weed Science and served as president of the Utah State University faculty association. Together, LaMar and Jeri traveled to numerous countries attending scientific conferences and conventions.

One of LaMar's favorite classes to teach was floral design, and his flower arrangements were featured at many university and family celebrations. The USU floral design team competed at the national level, where several individual members won awards.

LaMar was involved in many community organizations. He was active in scouting for over sixty-five years. LaMar served as president of the Cache Valley Council and as a Wood Badge course director, and received the Silver Beaver award. He was a long-time member of Kiwanis and served as president of the

Logan Kiwanis Club, Governor of the Utah-Idaho District, and a trustee of the Kiwanis International Foundation. LaMar served as area vice president of the National Sons of Utah Pioneers and co-president, with his wife, Jeri, of USU Emeriti, and was a member of the Old Main Society. He also delivered meals-onwheels for several years.

He was an active member of The Church of Jesus Christ of Latter-Day Saints his entire life and served as a Bishop of a university ward, a high councilor, and a scout leader. For many years, he served as an ordinance worker in the Logan Temple, along with Jeri, and also as a missionary on Temple Square in

Salt Lake City, where he gave tours of the gardens atop the conference center. While traveling, LaMar enjoyed visiting as many temples as possible.

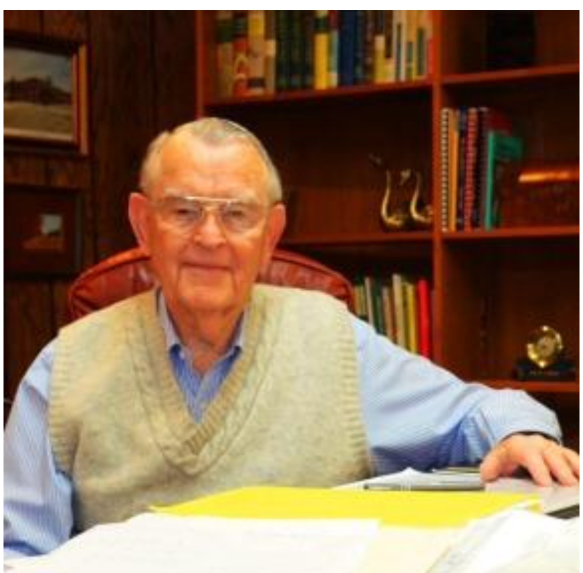
The family enjoyed LaMar's culinary skills, which included Swedish and gingerbread pancakes, homemade waffles, and Dutch oven cookouts.

Dad was eager to help his children develop their talents and was proud of their accomplishments. He regularly assisted with schoolwork, helped deliver early-morning Sunday papers for several years, attended numerous swim meets and dance and piano recitals, and accompanied his sons on many scout outings. He was a willing provider for his family and expanded our life experience through family trips and outings. Dad had a strong testimony of the Gospel and fostered our spiritual growth through his example, ordinances, and by faithfully writing his missionaries.

For his final seven years, LaMar battled Parkinson's disease. He enjoyed fighting off the effects of the illness with Rock Steady Boxing classes at The Worx, where he made many friends with his coaches and classmates.

LaMar and Jeri have recently been living at Terrace Grove Assisted Living Center. The family would like to thank the many aids, nurses, and staff, who were always kind, patient, and professional and whom they consider extended members of their family.

He is survived by Jeri, his wife of sixty-seven years, and his four children: Marc (Diana) of Fruit Heights, Denise (Wayne) Hardy of Providence, Kraig of Logan, and Kurt (Jana) of Logan, along with eighteen grandchildren, sixteen great-grandchildren, and three of his brothers (Jon, Robert, and Doug).



Will Dockery Carpenter. Science, agriculture, and philanthropy lost a respected contributor when Dr. Will D. Carpenter passed away at age 93. Will Dockery Carpenter, born July 13, 1930, in Moorhead, Mississippi, died on August 15, 2023, in Chesterfield, Missouri, his residence for his entire adulthood.

Dr. Carpenter was a Research Chemist at the Monsanto Company for 34 years and he and a respected team worked tirelessly for over 20 years to guarantee the signing and ratification of the Chemical Weapons Treaty. Dr. Carpenter was an American scientist and philanthropist, who after earning a Ph.D. in plant physiology at Purdue University in 1958, began a 34-year professional career at Monsanto Company, during which time he headed the teams that tested and brought to market Lasso and Roundup. Because of his extensive knowledge and his notable participation in the Chemical Manufacturer's Association, Carpenter became deeply involved in the efforts to obtain a worldwide chemical weapons treaty from 1978 through 2003. He was the primary representative for the American Chemical

Manufacturers Association during those successful negotiations that led to the signing and ratification of the Chemical Weapons Convention,. testifying numerous times before Congress and working with chemical companies worldwide to help bring them on board with the terms of the treaty. Out of that convention, the Organisation for the Prohibition of Chemical Weapons was formed, an organization that won the 2013 Nobel Peace Prize. After the formation of the OPCW, Carpenter was named as the U.S. representative to the Scientific Advisory Board. He was awarded The AAAS Hilliard Roderick Prize for Excellence in Science, Arms Control, and International Security. in 1992 for his participation on the Chemical Weapons Convention.
Dr. Carpenter was preceded in death by his beloved wife, Hellen Evelyn Dodd Carpenter. He is survived by his daughter, Hellen Celeste Carpenter Cox (Rick); son, Will Aubrey Carpenter (Zonnya); grandchildren, Melissa Nicole St John, Robert Chamberlain St John, Harper Lydan Cox, Rachel Owen Carpenter, Hannah Elizabeth Carpenter, Danielle Aubrey Carpenter, Will Evan Carpenter, and Alexander Naismith Carpenter, and great-grandchildren, Heather St. John, Leilah Rudd, and Phoenix St John. He was also preceded in death by his father, Horace Aubrey Carpenter; his mother, Celeste Brian Carpenter; his brother, Horace Aubrey Carpenter, Jr.; and his sisters, Anice Carpenter Powell, Alma Carpenter Abdo, Celeste (Tiny) Carpenter Sullivan, Maryella Carpenter Greenway.
In lieu of flowers, the family requests that contributions be made to the Alzheimer's Association or the organization or church of the donor's choice.
A broader look at Dr. Carpenter's life and accomplishments can be viewed at his website: https://willdcarpenter.wordpress.com

Paul Cavers. Paul Brethen Cavers, Professor Emeritus, Western University Department of Biology, died peacefully on April 18, 2023 at Manor Village in London, Ontario at the age of 85. He is survived by his loving wife of almost 62 years, Joan. He will be forever loved by his daughters Glenys, Brenda (Richard Campbell), Alison (Pierre Morin) and son Bruce (Nadira) and nine grandchildren, Matthew, Rachel, Aaron, Thomas, Sarah, Emilie, Benoit, Alina and Nora. Paul will be missed by his brother Pete and wife Cindy and sister-in-law Enid and husband Maurice Corbett as well as several nieces, nephews and their children.

Paul was born in Toronto, Ontario January 18, 1938 to Clarence and Rita Cavers, raised in Toronto and attended University of Toronto Schools. He studied at Ontario Agricultural College (University of Toronto) earning his BSA in Agronomy. Following his graduation in 1960 he received an Agricultural Institute of Canada award to continue his studies at the University College of North Wales in Bangor. He returned to Canada in 1961 to marry Joan Goudge, who had just graduated from Ontario Veterinary College. Joan and Paul were married on June 3, 1961 and spent their first years of marriage in Bangor, where Paul completed his PhD.

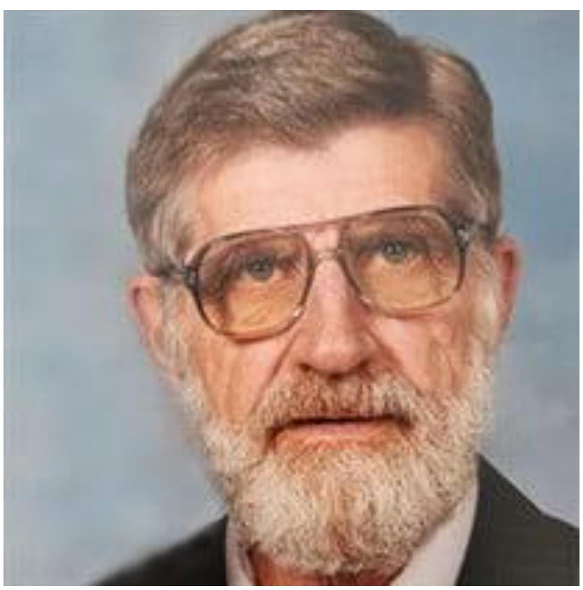
In 1963, Paul and Joan moved to London, Ontario where Paul began his 40 year career of teaching and research in the Biology Department at the University of Western Ontario. During his time at Western, Paul supervised 45 graduate students, served on a multitude of committees and societies, and as an editor for several journals. Paul received numerous awards throughout his career, including Outstanding Contributor with Canadian Weed Society, Outstanding Teacher Award from the Weed Science Society of America, and the Mary Elliott Award for service as well as the Lawson Medal for lifetime contribution to the Canadian Botanical Association. He was especially proud of his contributions to the formation of the Canadian Botanical Association, Biology of Canadian Weeds and his time as chair and editor of the Monograph Publishing Program.

Paul's career allowed him to travel, speak and conduct research around the world. During a sabbatical in England in 1971-72, Paul earned his Diploma of Imperial College (Master's Degree). On sabbatical in 1987-88 he studied thistles at the Commonwealth Scientific and Industrial Research Organization in Canberra, Australia.

Paul and Joan attended St. George's Anglican Church together for over 50 years, where he served as church warden, president of the BAC, sidesman, and lay assistant. Paul was also past-president of the Diocesan Brotherhood of Anglican Churchmen.

Cremation has taken place. A funeral service to give thanks for the life of Paul will be held at St. George's Anglican Church, 227 Wharncliffe Road North, London, at 11 a.m. on Tuesday, May 2, 2023. Visitation will be held at the church for one hour prior to the service.

In lieu of flowers, please consider a donation, in memory of Paul, to the St. George's Century Building Fund, 227 Wharncliffe Road North, London, ON N6H2B6. Arrangements entrusted with A. Millard George Funeral Home, 519-433-5184. Online condolences, memories and photographs shared at www.amgfh.com.



David Gerhardt Davis passed away Saturday, March 25, 2023, at the age of 87, in his home in Fargo, North Dakota.

Dave was born on July 21, 1935, to Zachary and Evelyn (Overbeck) Davis in Dickinson, ND. He was the youngest of his three siblings. Following his high school graduation from Dickinson Central High School, he continued his education with a BS and MS in Botany from North Dakota State University. During his time at NDSU, he was a charter member, treasurer, and faculty advisor of the NDSU Chapter of Tau Kappa Epsilon. Dave took a break from his education to serve in the United States Air Force as a Weapons Fusing Systems Specialist from 1956-1959. Following his military service, he attended Washington State University, earning a Ph.D. and his post-doctorate from the University of Minnesota, Minneapolis. Graduation was followed by a 3-month backpacking trip in Europe. He began his employment as a Plant Physiologist in 1967 with the Department of Agriculture.

During his time as a plant physiologist, Dave served as an Adjunct Professor of Botany, including teaching the first ever course on plant tissue culture at NDSU. He was a member of the American Science of Plant Biology, The Weed Science Society of America, member and program organizer of the Leafy Spurge Symposium for the Great North Plains, as well as other national and international societies in botany, weed control, and cell biology. He also had many publications. After 33 years, he retired in 2000.

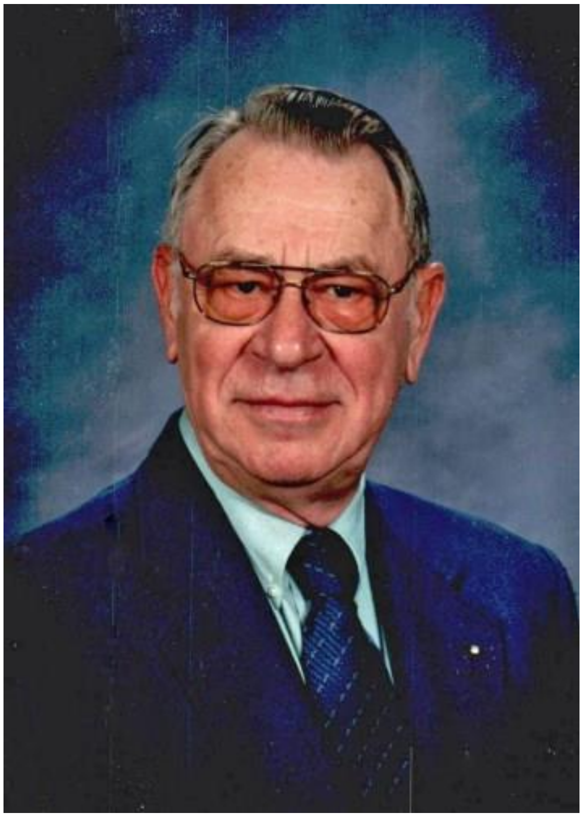
Dave met the love of his life, Phyllis Miller, after a blind date through a mutual friend. Their first date was a night of dancing at the High 10. After about nine months of dating, they were married on February 18, 1972, at the Miller family farm. They spent the next four years traveling, dancing, and loving life in Fargo, ND. They welcomed their son, Blair, in 1976 and Anthony in 1979. About 2 1/2 months after Anthony was born, Dave's job took him on a sabbatical for a year, where he worked at the Weismann Institute of Science, Rehovot, Israel.

Dave had a love for travel and adventure. He and Phyllis visited five continents and all 50 states. The summers were filled with family road trips in the car, where they visited about every battlefield in the United States. Dave enjoyed dancing (he really could waltz like no other), exploring, gardening, reading (he was never without a book), backpacking, skiing, and spending time with his family. He really enjoyed spending his retirement as a grandpa to Ryan, Jack, Brandon, Rose, and Violet.

Dave's sense of humor and silly faces will be missed by his family: his wife, Phyllis (Fargo); sons, Blair and his wife Wendy (Chicago, IL), Anthony and wife Lisa (Davenport, ND); and his grandchildren, Ryan, Jack, Brandon, Rose, and Violet.

He was reunited in Heaven with his parents, siblings, Raymond Davis, Norman Davis, and Marjorie Hill.

In lieu of flowers, please make a donation in memory of Dave to Hospice of the Red River Valley or Senior Helpers-Fargo.



Ronald E. Doersch, age 87, passed peacefully at home on Sunday, June 11, 2023. He was born on Sept. 13, 1935, in the town of Centerville, near Cleveland, Wis., the son of Vernon and Lavina (Siggelkow) Doersch.

Ron was raised on a Manitowoc County Century dairy farm and Wisconsin agriculture remained dear to his heart his entire life. He attended a rural grade school and graduated from Sheboygan Central High School in 1953. Ron was united in marriage with Caroline E. Franz on July 13, 1957, at St. John's UCC Schwartzwald Church. He graduated from the University of Wisconsin-Madison with B.S. and M.S. degrees in Soil Science and a Ph.D. in Soil Science and Plant Physiology in 1963.

He joined the faculty of the UW-Madison college of Agricultural and Life Sciences, Department of Agronomy, with responsibilities for statewide UW extension weed management education programs. Ron was particularly proud of the Pesticide Applicator Certification program that he developed for the state of Wisconsin which became "The Model" for many other states. He served as President of the North Central Weed Science Society in 1978, and was named an honorary member in 1983. He received numerous other recognitions including the Weed Science Society of America Extension Award, the UW Extension, Distinguished Service Award, Wisconsin Agribusiness Council and Wisconsin Fertilizer and Chemical Association Distinguished Service Awards. Ron served as chair of the Department of Agronomy during the last four years of his career and retired in 1993, after proudly serving Wisconsin's agricultural community for over 30 years. Ron was an active member of Middleton Community United Church of Christ, served as Moderator in 2012, and was active on many church committees. He dedicated many years to the maintenance of a six-acre meadow that surrounds the church.

Ron thoroughly enjoyed bass fishing at "the lake" with his children and grandchildren and eagerly looked forward to annual bass fishing trips to the Missouri Ozarks with colleagues. Ron found great pleasure and pride in watching the academic and athletic pursuits of his children and grandchildren.

Ron is survived by his loving wife of nearly 66 years, Caroline (Carrie); four children, Randall (Jennifer) Doersch of Colorado Springs, Colo., Rodney (Robyn) Doersch of Pleasant Prairie, Wis., Karla (Mark) DeCramer of Germantown, Wis., and Russell (Marla) Doersch of Pinckney, Mich.; ten grandchildren, Allison and Jeffrey Doersch, Alexandra and Tessa Doersch, R.J., Derek and Shea DeCramer, and Blake, Morgan and Nolan Doersch; and two great-grandchildren, Gjoska Gudjonsdottir Doersch and Calder Doersch. He is also survived by sister, Rosann and brother-in-law, (Frederick) Jacobi of Manitowoc, Wis.; and many nieces and nephews.

Celebration of life services will be held on Monday, July 10, 2023, at MIDDLETON COMMUNITY CHURCH, 645 Schewe Road, Middleton, Wis., with visitation at 12 noon, and service at 2 p.m. with reception to follow. Private burial will take place at Middleton Junction Cemetery.

In lieu of flowers, the family requests memorial gifts be directed to the Middleton Community Church, 645 Schewe Road, Middleton, WI 53562 (www.Middletonucc.org), or the Ronald E. Doersch Scholarship Fund, #132060002, Department of Agronomy, UW-Madison (checks should be made payable to "Doersch Scholarship Fund" and mailed to UW Foundation, US Bank Lockbox, P.O. Box 78807, Milwaukee, WI 53278-0807, or online at www.supportuw.org/giveto/DoerschFund).

Online condolences may be made at www.gundersonfh.com.

John Ray Frank, 86, New Market, died July 4, 2023, at Citizens Care and Rehabilitation Center of Frederick due to complications from diabetes. He was born June 12, 1937, at the Washington Homeopathic Hospital in Washington DC, to John Wilford and Edith Baldwin Frank. He was married to Carol Thobois Frank for over 50 years, until her death in 2010.

Ray graduated from Washington-Lee High School in 1955, earned a BA in Horticulture from the University of Maryland, College Park in 1960, and an MA in Environmental Biology from Hood College in 1975.

Ray served in the US Army for two years and worked for more than 34 years with the US Department of Agriculture and the US Army, mostly at Fort Detrick. During his career, he published 186 research articles, specializing in weed control, including using ornamental plantings to limit weed growth.

He was a member of several scientific societies including the Weed Science Society of America and the Northeastern Weed Science Society.

After retirement, Ray spearheaded the ornamental plant research .pest management component of the IR-4 Project.

The family will hold a visitation on Monday, July 10, 2023, from 10 to 11 a.m. and a Funeral Service from 11 a.m. to Noon. at Stauffer Funeral Home-Frederick in Frederick, MD. Interment will be at Mount Olivet Cemetery in Frederick from 2:30 to 3:30 p.m. In honor of Ray's memory, please consider a donation to the Alzheimer's Association.

Charles Gilliam, 70, passed away peacefully on Tuesday, September 19, 2023. He is survived by his wife of 52 years, his two children and their spouse, brothers and sisters, and eight grandchildren who were all near and dear to his heart and the love of his life.

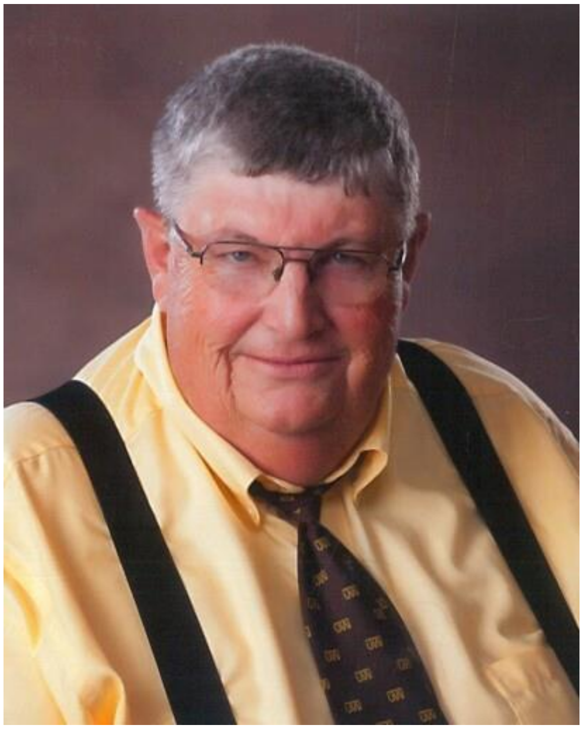
Charles was born in Lexington, Tennessee and grew up on the family farm hoeing and picking cotton and learned to love the outdoors and especially hunting and fishing. He attended The University of Tennessee at Martin, earning a B.S. degree in Agricultural Education and continued his education at Virginia Tech University, earning both a M.S. and Ph.D. degree in Horticulture. After spending three years as a faculty member at Ohio State University, Charles joined the faculty at Auburn University in 1980 spending 38 years of his career in the Horticulture Department. There, he served numerous roles including as Department Head from 2000 to 2005. In Auburn, he was an active member of Lakeview Baptist church and shared his faith openly throughout his career.

During his tenure at Auburn, Charles was active in numerous professional societies including the Weed Science Society of America, American Society for Horticultural Sciences, Southern Nursery Association, and especially the International Plant Propagator's Society Southern Region where he won the Sidney B. Meadows Award of Meric and was a Fellows Award recipient, the highest honors bestowed by the Society.

Charles main area of research was in nursery weed control and alternative substrates for the container nursery industry. He published numerous scholarly and professional articles, made countless presentations, both at professional societies and at different grower or industry events. He took great pride in being able to present highly technical information into an easy to understand format and stressed the importance of communication to his students. He loved helping and working with growers, and the weed management principles that he shared decades ago are still being practiced to this day. Charles was beloved by his students who he would invite to his home for dinner, the famous annual fishing tournament, and would always make sure they had plenty of vegetables from his home garden. He made a tremendous impact on the horticultural industry and his students' lives and will be missed but never forgotten.

Keith (KC) Carl Hamilton passed away on March 26, 2023 after a brief illness. He was 94 years old. He is survived by his loving wife Pat of 70 years, 3 sons (Bill/ Sylvia, Kim, Patrick/Monica), 8 grandchildren (Crystal, Joel/Emily, Nicole/Adam, Paul/Anna Mae, Lisa/Greg, Sarah/Kevin, Tim/Rebecca, Kristin) and 6 great grandchildren (Miles, Bode, Theo, Jones, Lyla, Ruthie). He was preceded in death by his parents (Vern and Gladys), sister (Ginger) and brother-in-law (Bill). Keith grew up in Fox Lake, WI. After a stint in the Navy Air Force during WWII, he received his Bachelors, Masters, and Doctorate of Philosophy from the University of Wisconsin. Keith taught Plant Sciences for 36 years at the University of Arizona in the College of Agriculture; he conducted pioneering weed science research, resulting in over 300 scientific publications. He was a Fellow and President of the Western Society of Weed Science. He was an avid outdoorsman, an expert hunter/fisherman, and a keen windsurfer. Pat and Keith spent many weekends in the White Mountains. He loved the Santa Catalina mountains and hiked nearly every trail with his wife and sons. He also adored squirrels, so whenever you see a squirrel, think of

Keith. There are no services planned at Keith's request. You may make a donation to the Cooper Center for Environmental Learning, or a charity of your choice in his honor as an alternative to flowers.



Stephen Douglas Miller,77, passed away December 21, 2023, in Cheyenne, WY at the Davis Hospice Center. He was born March 27, 1946, in Greeley, CO.

Steve is survived by his wife, Bonnie; sons, Jason (Jamie) Wichita, KS, Eric (Stacy) Cheyenne, WY; sister, Dianne Brown, Johnstown, CO; grandchildren, McKinley, Addyson, and Henry; and numerous nieces and nephews.

Steve was preceded in death by his parents, Dorothy Jane Miller and Niles Stephen Miller, and brother-in-law, Gregory Brown.

Steve grew up in Platteville, CO, spending time on the family dairy farm. He shared many stories of playing with his cousins and working with his grandpa, uncle, and dad. Steve decided early on that milking cows was not for him.

Steve graduated from Valley High School, Platteville, CO (1964). He obtained his BS (1968) from Colorado State University, Fort Collins, CO. Steve attended North Dakota State University, Fargo, ND, earning his MS (1970) and PhD (1973). For 12 years, Steve enjoyed a faculty appointment at NDSU.

In 1984, Steve joined the faculty at the University of Wyoming in Laramie. He was academic advisor to 65 graduate students (39 earning their MS and 26 their PhD). He was dedicated to the research of weed control in crops at the UW Research Stations. Steve published more than 70 research articles in peer-reviewed journals. He was a member of the Western Society of Weed Science (President 1993), the North Central Weed Science Society (President 2006), and the Weed Science Society of America. Steve worked closely with the Wyoming Weed & Pest Council. He was well known and respected among fellow scientists and crop producers across the western states. In 2005, he was appointed Associate Dean, College of Agriculture, and Director of UW Research Stations. Steve retired in 2010, after 26 years with UW. To some, Steve was more than a professor or mentor. He was a larger-than-life man in suspenders. He wasn't afraid to get dirty, and loved to be out in the fields, working alongside his students. Steve never had trouble being heard, his booming voice was unmistakable.

During his career, Steve was honored to receive many awards for his dedication to research and teaching. Most noteworthy: UW, George Duke Humphrey Distinguished Faculty Award (1993); UW College of Agriculture and Natural Resources, Vanvig Distinguished Lifetime Achievement Award (2012); NDSU College of Agriculture, Distinguished Alumni Award (2007); and CSU Department of Soil and Crop Sciences, Honored Alumni Award (2019). When accepting the Vanvig award, Steve was quoted as saying, "There's got to be a better way of controlling weeds than a hoe. That seed was planted in me early since I was helping weed the beet fields when I was little. That's why I went into agronomy."

Steve and Bonnie were married in 1969. They loved playing bridge with Dorothy and Niles at the family cabin in Colorado. Steve enjoyed playing cards and games with family and friends. He enjoyed watching the boys' sports teams and going to the park. He followed football, basketball, hockey, and golf. He loved being with his grandchildren, going to auctions with Bonnie, spoiling his beloved cats, and tending to the yard and flower beds. Steve was an avid collector of vintage cast iron farm toys.

In honor of Steve's wishes, no funeral or memorial service will be held. The family expresses their deepest appreciation to the staff at Davis Hospice Center for the compassionate care they provided to Steve.

Memorials can be made to Davis Hospice Center, 6000 Sycamore Rd, Cheyenne, WY 82009, or to The Western Society of Weed Science to assist graduate student travel to weed research meetings. Visit https://wsweedscience.org/annual-meeting-2024, and scroll down to the Dr. Steve Miller Memorial Donation link.

A list of contributions, honors, and awards was also shared which I would like to include here:

- Outstanding Contributions to No-till Farming, Manitoba-ND Zero-till Association (1984)
- **Outstanding Weed Scientist, Western Society of Weed Science (1991)**
- Superior Service Award, Beet Sugar Development Foundation (1992)
- George Duke Humphrey Award, University of Wyoming (1993)
- **President, Western Society of Weed Science (1993)**
- **Fellow, Western Society of Weed Science (1995)**
- **Fellow, North Central Weed Science Society (1996)**
- **Fellow, Weed Science Society of America (1998)**
- Meritorious Service Award, American Society of Sugar Beet Technologists (1999)
- **Harold P. Alley Award, Wyoming Weed & Pest Council (2003)**
- **President, North Central Weed Science Society (2006)**
- Distinguished Alumni, North Dakota State University College of Agriculture, Food Systems, and Natural Resources (2007)
- Andrew Vanvig Distinguished Lifetime Achievement Award, University of Wyoming College of Agriculture & Natural Resources (2012)
- Honored Alumni Award, Colorado State University Department of Soil and Crop Sciences (2019)

Thomas (Tom) Buntin Threewitt, Sr., 79, of Garnett, Kansas, passed away peacefully with family by his side on Monday, May 15, 2023.

He was born in West Frankfort, Illinois on April 5, 1944, to William Edward and Loa (Buntin) Threewitt where he grew up on a crop and livestock farm in Aiken, Illinois and developed a love for agriculture.

In 1961, Tom married his high school sweetheart, Nancy and his career took them to Larned, KS where they raised their four children, Tommy, Susan, John and Becca, on their farm. He took extreme pride in his five grandsons, Trey, Seth, Gabe, Zeke and Izzy, spoiling them and rarely missing a sporting event.

Tom's 'grandson responsibilities' on the farm were many. Tractor rides, keeping the pool clean (especially for Fourth of July festivities), watching SpongeBob and learning how to walk around legos just to name a few. As a matter of fact, in order to visit his grandkids more often, he would set up work field plots close to where the grandsons lived. He would hide the grandson's Christmas present purchases from Nancy to ensure everyone was surprised, but that usually meant duplicate presents under the tree. After the move to Garnett and the grandsons got older, Stumpy the squirrel, who lived in Tom & Nancy's front yard, became one of his new responsibilities. Stumpy ran all over their yard every day, so Tom kept his eye on his new tail-less friend.

He received his Bachelor's of Science in Plant Science (1966) and Master's of Science in Weed Control (1968) from Southern Illinois University and his Ph.D. in Weed Science from University of Illinois in 1972.

Tom began his career as a field research representative in Kansas for the newly merged company of Ciba-Geigy, staying through several mergers and name changes, retiring from Syngenta after 32 years. He then established his own consulting and contract research company, PACA Ag, LLC. Where does the name PACA come from? His 2nd oldest grandson, Seth, struggled to say "Papa" and it always came out as "Paca" and the other grandsons adopted the same name for him.

Tom was involved with the development of the Kansas CCA program, serving on the board for 6 years with one year as the President. He was a member of many other industry organizations including Kansas Agricultural Retailers Association, North Central Weed Science Society, Western Society of Weed Science, Weed Science Society of America and Council for Agricultural Science and Technology. Tom's expertise and work ethics earned him an invaluable reputation with his peers in both industry and academia.

Tom is survived by his wife Nancy; his four children Thomas B. Threewitt Jr., K. Susan (Justin) Macy, John Threewitt, and Becca Brown; five grandsons Thomas "Trey" B. Threewitt III, Seth W. Threewitt, Gabriel Brown, Ezekiel Brown, and Israel Brown; his sister Patsy (Carroll) Bolen; sisters-in-law Paula (Steven) Arthur, and Clara (Greg) McClean; and many nieces and nephews.

In lieu of flowers and plants, the family requests memorial contributions to the Anderson County FFA chapter through a GoFundMe Account (Thomas B. Threewitt, Sr. Obituary - AC KS FFA) or can be mailed to Feuerborn Family Funeral Service, 219 S. Oak St. Box 408, Garnett, KS 66032.

Condolences may be sent to the family at www.feuerbornfuneral.com

Raymond D. William. October 1, 1946 – July 23, 2023. Ray William was born to Ray and Betty (née Elizabeth Andersen) William on October 1, 1946 in Denver, Colorado. With his family, he moved to Washington state in 1955.

He graduated from Sumner High School in 1964. He was very active in 4-H with projects in horticulture, leadership, communications, and large and small animals. He worked at the WSU Puyallup Research and Extension Center beginning in high school.

He was granted a B.S. degree in Horticulture by Washington State University in 1968. He was a member of FarmHouse Fraternity, president of the College of Agriculture, and was named Aggie of the Year in 1968.

Afterwards, he participated in the International 4-H Youth Exchange (IFYE) in Ceylon, later renamed Sri Lanka, for 6 months.

He married Nancy Garber on June 21, 1969, a recent WSU graduate. He was granted a M.S. in Horticulture, and after 2 years' research in Brazil, he was also granted a Ph.D. in Horticulture by Purdue University in 1974.

His initial professional position was at The Asian Vegetable Research and Development Center (AVRDC) near Tainan, Taiwan, Republic of China (ROC). He and Nancy lived at the center for 2 ½ years.

He served on the faculty at the University of Florida for 3 years. Ray joined the faculty as a Cooperative Extension Specialist in the Department of Horticulture at Oregon State University in January 1980. He and his family lived in Malawi while Ray worked at the Bvumbwe Agricultural Research Station (BARS) from 1986-1988. They returned to Corvallis where he resumed his work at OSU.

Ray was an active member of the professional associations: American Society for Horticultural Science (ASHS) and the Weed Science Society of America (WSSA). After retiring in January 2007, he increased his volunteer activities to include Furniture Share, Stone Soup, Corvallis Sister Cities in Uzhhorod, Ukraine and Gondar, Ethiopia, Benton Habitat for Humanity Repair, and church. He and Nancy moved to Sun City Roseville, California in July 2020.

His survivors include his wife, Nancy; daughter Kamala (Brad Stewart Antelope, CA) and sons, Andrew and Alex; daughter-in-law, Monica (West Bloomfield, MI) and children, Haven, Miriam and Danielle. Their son, Brian, predeceased him in 2019. His brothers, David and Tom, and many cousins also survive him.

He created the Raymond D. William Teaching Innovation Fund at WSU Vancouver. Memorial contributions can be made to student scholarships in the Horticulture Departments at WSU or OSU, or to First United Methodist Church Roseville. Ray was a body donor to UC Health School of Medicine.

A memorial service will be held on Sunday, August 20 at 2 PM at the First United Methodist Church in Roseville, CA.

Proceedings Editor Report

Report by: Paul Tseng

Proceedings Editor's Report of the 2023 Meeting

The 2023 Southern Weed Science Society (SWSS) meeting took place in Baton Rouge, LA, from January 23-26, 2023. The 2023 Proceedings featured 295 pages and included 215 abstracts. For comparison:

- **2022:** 253 pages, 265 abstracts (Autin, TX)
- **2021:** 276 pages, 165 abstracts (virtual format)
- **2020:** 362 pages, 252 abstracts (Biloxi, MS)
- **2019:** 357 pages, 241 abstracts (Oklahoma City, OK)
- **2018:** 429 pages, 293 abstracts (Atlanta, GA)
- **2017:** 425 pages, 229 abstracts (Birmingham, AL)
- **2016 (WSSA/SWSS joint meeting):** 639 pages, 505 abstracts (San Juan, PR)
- **2015:** 397 pages, 253 abstracts (Savannah, GA)
- **2014:** 398 pages, 259 abstracts (Birmingham, AL)
- **2013:** 387 pages, 274 abstracts (Houston, TX)
- **2012:** 375 pages, 277 abstracts (Charleston, SC)
- **2011:** 515 pages, 342 abstracts (San Juan, PR)
- **2010:** 365 pages, 245 abstracts (Little Rock, AR)
- **2009 (WSSA/SWSS joint meeting):** 588 pages (Orlando, FL)
- **2008:** 315 pages (Jacksonville, FL)
- **2006:** 325 pages (San Antonio, TX)
- **2005:** 363 pages (Charlotte, NC)

The 2023 Proceedings included a total of 219 presentations, comprising 95 poster sessions and 124 oral presentations. It also featured the Presidential Address, a list of committees and their members, and minutes from the January and summer board meetings. Additionally, it contained reports from the Program Chair, Editor, Business Manager, Legislative & Regulatory Committee, Director of Science Policy, Graduate Student Contest, Weed Resistance & Technology Stewardship, Endowment, Nominating, Site Selection, Manual of Operations Procedures, and Necrology. The document concluded with the award winners and abstracts.

2024 MEETING ABSTRACT

A Quest for Herbicide Control of Windmillgrass (*Chloris spp*.) and White Tridens (*Tridens albescens*) in Reduced-Tillage Crop Systems. Reagan Noland*[1], Brad Easterling[2], Clay Cole[1], Nick Dickson[3], Josh Blanek[4], Sarita Short[5], Morgan McCulloch[4], Gregory Wilson[4]; [1]Texas A&M AgriLife Extension, San Angelo, TX, [2]Texas A&M AgriLife Extension Service, Garden City, TX, [3]Texas A&M AgriLife Extension Service, Roby, TX, [4]Texas A&M AgriLife Extension Service, San Angelo, TX, [5]Texas A&M AgriLife Extension Service, Brady, TX (319)

Warm-season perennial grass species including windmillgrasses (*Chloris* spp.) and white tridens (*Tridens albescens*) have become problematic weeds in reduced-tillage systems across much of western Texas. Over the course of three years, eleven herbicide efficacy trials were coordinated spanning six counties in West Central Texas, including summer and fall application timings. Herbicide treatment selection was informed by ongoing assessment and adjustment over the years. Treatments were therefore unique within each year and timing, and comprised various rates, combinations, or sequences of glyphosate, fluazifop, quizalofop, clethodim, fenoxoprop, pinoxaden, topramezone, mesotrione, paraquat, and/or MSMA. In some trials, the effects of water conditioners, adjuvants, or tank mix partners (dicamba and 2,4-D) were also evaluated. All trials were arranged as randomized complete block designs with three or four replications. Across trials, most treatments were largely ineffective, with the exception of sequential applications of glyphosate. Across four sites in early fall (September) of 2022, greatest control was achieved with two applications of glyphosate (1.3 kg a.e. ha^{-1}) + AMS (2% v/v) two weeks apart, which resulted in 89% and 80% control of white tridens and windmillgrass, respectively. In 2023 (two sites) the same treatment applied in May achieved >90% control and a higher rate of sequential doses (glyphosate (2.7 kg a.e. ha^{-1}) + AMS (2% v/v) two weeks apart) was included and resulted in >95% control. Inclusion of dicamba (558 g a.e. ha^{-1}) also reduced glyphosate efficacy on these grass species at both sites in 2023.

Integration of Drip Irrigation and Herbicides on Weed Management in Cotton in India.
Samunder Singh*; Director Agronomy, MICADA, Haryana, India, Hisar 125001, India (321)

Integration of Drip Irrigation and Herbicides on Cotton in India Samunder Singh and Satbir Singh Kadian Director Agronomy and Administrator, MICADA, Haryana India Sam4884@gmail.com ABSTRACTCotton is the most important crop that provides food, feed, fiber, cooking oil, livestock feed and generates income and employment for millions of farmers and industry workers in India and thus called white gold. India is the second largest producer of cotton (one fourth of total global cotton production) thanks to the introduction of Bt cotton, though area is four times than China and productivity is almost five times lower as around 67% of India's cotton is rain-fed. Other than moisture stress, weeds and pest pressure is the main reason for low productivity. Haryana is the 2nd largest producer of cotton in the north India with a production share of 6% and provides employment to 1 mn people with export of US$3 bn annually. However, in recent years, production and yields have declined significantly, posing a challenge for the country's agriculture and textile sectors. Though cotton is grown under irrigated conditions in Haryana, water stress in the hot months of April to June and huge weeds pressure from July to September rainy months with lack of a suitable POE herbicide takes a heavy toll on productivity. Experiments were conducted for two years (2022-2023) at farmer's fields, integrating micro irrigation and herbicides. Cotton was planted at 120 X 60 cm in fields ranging from 0.8-8.8 ha at different locations. PRE pendimethalin was applied at 0.3 and 0.5 kg/ha through drips and 1.5 kg/ha manual sprays in mini sprinklers and flood irrigation systems followed by POE grassy herbicides. Irrigation was applied either through tube-wells, canal or solar electric pumps installed on water ponds. Liquid fertilizers were applied through drip. Observations were recorded on crop growth, weed control efficacy, number of branches and bolls/plant, boll weight and yield. Pink boll worm infestation during 2023 and dry season after July reduced seed cotton yield from 14 to 40%. PRE pendimethalin 0.3 kg was less effective compared to 0.5 kg through drip and increased seed cotton yield by 90% over check. Drip irrigation resulted in 65% water saving over flooding and 37% over mini sprinkler and saved 30-40% nutrients with 33% higher yield over flood and 16% over mini sprinklers during 2023. Plant height, main/sub branches, boll number/plant and boll weight was significantly higher in drip irrigation.

Weed Control Measures and Biochar Impact on Productivity of Lowland Rice (*Oryza sativa* L.) Varieties in Northern Nigeria. Musa A. Mahadi*, D B. Ishaya, A. B. Ahmed, I. Y. Amapu; Ahmadu Bello University, Zaria, Zaria, Nigeria (322)

Rice husk is an agricultural waste, which can be processed into biochar as an ameliorant to improve soil quality and crop productivity. Biochar has the potential to be combined with synthetic fertilizers for intensive rice production. Research was conducted in the wet seasons of 2020 and 2021 in the northern Guinea Savanna and Sudan Savanna ecological zones of Nigeria to determine suitable post-emergence herbicide rates and biochar application on lowland rice varieties. Treatments consisted of six herbicide rates, Solito (Pretilachlor + Pyribenzoxim) at 0.5, 1.0, and 1.5 kg a.i. ha^{-1} and Orizo plus (2, 4 - D Amine + Propanil) at 1.0, 1.25 and 1.75 kg a.i. ha^{-1}, biochar, and a control (no biochar), and two lowland rice varieties viz; FARO 44 (SIPPI) and JAMILA a local cultivar. The treatments were arranged in a split-plot design, where herbicide rates and biochar were allocated to main plots while lowland rice varieties were assigned to subplots, in three replications. The plot was marked out into basins of 3 x 4 m in size with a border spacing of 0.5 m between the plots and 1 m between replicates. The results obtained from the trial indicated weed cover score and weed dry weight were significantly decreased by the weed control treatment compared with weedy check plots. Hoe weeding at 3, 6, and 9 WAS followed by Pretilachlor + Pyribenzoxim at 0.5, 1.0 and 1.5 kg a.i. ha^{-1} and 2, 4 - D Amine + Propanil at 1.0, 1.25 and 1.75 kg a.i. ha^{-1} had significantly higher values for crop growth rate and shoot dry matter in Samaru and Kadawa respectively. Similarly, yield parameters such as 1000- Paddy weight and paddy yield were significant at both locations. Based on the results obtained from these trials, herbicide application of Pretilachlor + Pyribenzoxim at 1.5 kg a.i. ha^{-1} and 2, 4 - D Amine + Propanil at 1.75 kg a.i. ha^{-1} gave better weed control over the lower rates and weedy check at Samaru and Kadawa respectively. However, in both locations and years, where hoe-weeded control gave more effective and season-long weed control. Application of 100 kg N, 50 kg P_2O_5, and 50 kg K_2O ha^{-1} of fertilizer enhanced the performance of rice in terms of crop growth, yield attribute, and paddy yield when compared with the half rate of 100 kg N, 50 kg P_2O_5, and 50 kg K_2O ha^{-1} plus 2 t ha^{-1} of Biochar at both locations.

Substituting Atrazine with Herbicide Programs Incorporating Amicarbazone in Grain Sorghum. Michael R. Dodde*[1], Jason K. Norsworthy[1], Matthew C. Woolard[1], Tanner A. King[2], Ryan S. Henry[3]; [1]University of Arkansas, Fayetteville, AR, [2]University of Arkansas Division of Agriculture, Fayetteville, AR, [3]UPL NA Inc., Fort Wayne, IN (323)

Atrazine, a widely utilized herbicide in grain sorghum for controlling grass and broadleaf weeds before and after emergence, is facing a proposed reduction in its preemergence (PRE) application rate by the Environmental Protection Agency (EPA) in response to environmental concerns. The proposed rate is 1,344 g ai/ha/year, dropping from 2,242 g ai/ha/year. Therefore, research was conducted in 2023 at the Milo J. Shult Agricultural Research and Extension Center in Fayetteville, AR, to determine if amicarbazone-containing PRE herbicide programs offer similar weed control without injuring grain sorghum. A randomized complete block design experiment was established with four replications. Treatments were all applied PRE and included amicarbazone, metribuzin, and atrazine alone and in combination with S-metolachlor plus mesotrione. Injury and weed control data for multiple weed species were collected for 5 weeks after grain sorghum emerged. Amicarbazone (490 g ai/ha) plus *S*-metolachlor (1,785 g ai/ha) plus mesotrione (178.5 g ai/ha) controlled Palmer amaranth (*Amaranthus palmeri*) (>95%) and broadleaf signalgrass (*Urochloa platyphylla*) (>97%) 5 weeks after treatment (WAT). This level of control was comparable to atrazine (1,344 g ai/ha) plus *S*-metolachlor (1,785 g ai/ha) plus mesotrione (178.5 g ai/ha). Both treatments never caused more than 7% injury to grain sorghum, and no differences between these treatments occurred. When comparing atrazine alone to amicarbazone alone, weed control was often comparable for the two treatments. Based on these results, amicarbazone should be further evaluated and shows promise as a replacement for atrazine in grain sorghum.

Rice Cultivar Tolerance to a Three-Leaf Fluridone Application. Maria Carolina C R Souza*[1], Jason K. Norsworthy[2], Matthew C. Woolard[2], Tanner A. King[3], Mason C. Castner[2], Jared T. Smith[2], Thomas R. Butts[4]; [1]University of Arkanas, Fayetteville, AR, [2]University of Arkansas, Fayetteville, AR, [3]University of Arkansas Division of Agriculture, Fayetteville, AR, [4]University of Arkansas, Lonoke, AR (324)

Palmer amaranth is a major weed in rice fields, especially furrow-irrigated rice, due to the non-flooded conditions, which let it germinate and grow throughout the season. The herbicide options to control Palmer amaranth in this crop are very limited since this weed has shown resistance to herbicides targeting nine sites of action. Fluridone was first labeled in rice in 2023, offering a new site of action with a promising Palmer amaranth control. Nevertheless, further investigation is needed to evaluate the tolerance of rice to this herbicide. Thus, this research evaluated the tolerance of twelve rice cultivars to fluridone applied at the 3-leaf growth stage. The experiment was conducted in 2022 and 2023 at the Pine Tree Research Station near Colt, Arkansas, and it was organized as a randomized complete block design, with three fluridone rates and four replications. The herbicide was applied at 0 (nontreated check), 168, and 336 g ai/ha. The following cultivars were tested: CLL15, CLL16 (Clearfield®), RT7321 FP, RT7521 FP (FullPage®), PVL02 (Provisia®), RTv7231 MA (Max-Ace®), DG263L, Diamond, Titan, Jupiter, XP753, and Lynx (conventional). The cultivar Lynx was tested just in 2022. Injury ratings were collected 1 and 4 weeks after treatment (WAT), and rough rice grain yield was determined at harvest. In 2022, minimal injury was observed. In 2023, the injury was higher, particularly at 4 WAT, where the cultivars DG263L and PVL02 exhibited the greatest injury levels (38% and 36%, respectively). Regarding yield, there was no yield penalty for any of the cultivars tested in 2022. However, in 2023, there was a yield loss for the cultivar DG263L at both rates compared to the control and for the cultivar RTv7231 MA at the highest rate. These results indicate that some cultivars are more susceptible to injury from fluridone than others. Additionally, if substantial injury occurs following fluridone applications to rice, yield loss is likely to occur.

Developing a Machine Learning-Based Weed Detection and Localization Framework for Targeting Weed Escapes in Rice. Bholuram Gurjar*[1], Vijay Kumar[2], Steve Kalssen[2], Virender Kumar[2], Muthukumar V. Bagavathiannan[1], Jerico Stefan R. Bigornia[2]; [1]Texas A&M University, College Station, TX, [2]International Rice Research Institute, Los Baños, Philippines (325)

Escaped weed management is crucial in rice to minimize seedbank contributions and prevent potential future weed infestations. Additionally, weed escapes can hinder harvesting operations and reduce seed quality. The aim of this research was to create a robust rice weed dataset and develop a weed detection and localization algorithm for site-specific weed management in rice in the Philippines. The specific objective was to identify and locate escaped weeds in rice crops using drone imagery and machine learning (ML) techniques. The drone RGB imagery was collected from various rice varieties at the International Rice Research Institute. The weed species targeted in were gooseweed (*Sphenoclea zeylanica*), purple nutsedge (*Cyperus rotundu*), junglerice (*Echinochloa colona*), Chinese sprangletop (*Leptochloa chinensis*), and false daisy (*Eclipta prostrata L*). The You Only Look Once (YOLO) machine learning architecture was used for the detection of these weed escapes in rice. We compared 16 different architecture variants from YOLO v3, v5, v7, and v8 on low-resolution drone images. The results showed that the YOLO model has the potential to detect escape weeds in rice, achieving the highest detection accuracy of 70% to 75% for all weed species. After detecting weeds in the image, an algorithm was developed to transform the center pixel of the weed plant from the image into longitude and latitude for site-specific weed management. The transformed coordinates have an error of 30 to 40 cm in both longitude and latitude directions. However, these findings demonstrate the potential of using deep-learning models and UAS for site-specific management of weed escapes in rice. Future improvements will focus on enhancing the accuracy of weed localization and weed detection.

Investigation of Waterhemp (*Amaranthus tuberculatus*) Control Utilizing Sequential and Overlapping Residual Herbicides in Early Planted Soybean in Kentucky. Travis Legleiter*; University of Kentucky, Princeton, KY (326)

The agronomic benefits and potential yield increases in early planted soybean are pushing farmers across Kentucky to plant soybean earlier in the growing season. In Kentucky, soybean have traditionally been planted in late April and May, while the trend is showing more soybean being planted in March and early April. Previous work at the University of Kentucky on early planted soybean showed that the use of residual herbicides at a March or April soybean planting timing were not as effective in controlling waterhemp (*Amaranthus tuberculatus)* emerging in May as the same residuals applied at a May soybean planting date. Research was implemented at the University of Kentucky Research and Education Center in Princeton Kentucky in 2022 and 2023 to evaluate the use of an overlapping postemergence residual herbicide application in comparison to a traditional sequential residual herbicide application. An early April planting date was targeted for both years but was only achieved in 2023 with a planting date of April 11, 2023. Sustained cold and wet soil conditions in 2022 delayed planting until April 29, which would not be considered an early soybean planting date in respect to this research. A soybean variety with resistance to 2,4-D, glyphosate, and glufosinate was planted in both years. Treatments consisted of five soil residual herbicides applied at soybean planting followed by a postemergence application of 2,4-D, glyphosate, fomesafen, and S-metolachlor at either the overlapping residual or sequential residual application timing. All overlapping residual applications were made at 21 days after soybean planting regardless of presence or absence of weeds; whereas the sequential treatments were based on when the largest waterhemp in a treatment reached 10 cm in height. Evaluations of weed control and waterhemp density at soybean canopy and soybean harvest indicated that in both years the use of a sequential postemergence residual herbicide application resulted in greater overall control than the use of an overlapping postemergence residual herbicide application. Further investigation of the two years revealed that while overall weed control in 2023, when soybean were planted in early April, was achieved with the sequential postemergence residual application, the number of waterhemp plants present at the time of the sequential application was significantly greater as compared to densities at the overlapping residual application timing. Overall, this research revealed that the use of sequential residual herbicide application on soybean planted during the typical soybean planting window of late April through May will provide successful control of waterhemp and does not adversely increase the risk of herbicide resistance in comparison to the overlapping residual herbicide approach. Conversely, in early planted soybean the use of a sequential residual herbicide application while ensuring superior weed control in the season, increased herbicide resistance selection pressure to the foliar herbicides applied as compared to the overlapping residual herbicide application approach. Further research comparing a two pass herbicide program with a sequential residual timing, as was evaluated in this study, and a three pass overlapping residual program with an additional postemergence herbicide application is warranted to evaluate balancing both short term weed control and long term herbicide resistance management in early planted soybean.

Wild Oat Wheat Interference Affected by Acid Soils. Joan Campbell*, Traci Rauch; University of Idaho, Moscow, ID (327)

Effect of soil pH on weeds growing with crops is being assessed near Moscow, Idaho. A field with soil pH of 4.3 was amended with 2 tons/acre calcium carbonate (lime) in 2017 in randomized strips. The experiment was placed across the strips of lime/no lime. The experiment is a 2 by 2 by 2 factorial with two varieties, two levels of soil pH, and wild oat vs no wild oat. Plots are 1.2 by 11 m. Wild oat was planted in half the plots. The experiment has four replicates and is duplicated in time. Net CL (aluminum susceptible) and Seahawk (aluminum tolerant) are the spring wheat varieties. Wild oat population is measured and light penetration through the canopy is measured for 4 weeks. Wheat grain yield is assessed at harvest. In 2022, wild oat population was 30 and 14 panicles per m-row comparing no lime to lime and 28 and 15 panicles per m-row comparing Seahawk to Net CL. Grain yield was similar among lime and no lime Seahawk and limed Net CL, at 2604, 2608, and 2695 kg/ha, respectively. Grain yield was 557 kg/ha for Net CL not limed. In 2023, wild oat populations were 15 and 21 plants per m-row with lime and no lime, respectively. Wild oat populations were 13 and 23 plants per m-row with Seahawk and Net CL, respectively. In 2023, there was no variety by lime interaction. Seahawk and Net CL averaged 1658 and 840 kg/ha, respectively. Grain yield was 1928 and 570 kg/ha for limed and no lime, respectively.

Response of Difficult-to-Control Palmer Amaranth Populations to Fluridone and Diflufenican. Jason K. Norsworthy*[1], Matthew C. Woolard[1], Maria Souza[1], Tom Barber[2], Tommy Butts[2]; [1]University of Arkansas, Fayetteville, AR, [2]University of Arkansas, Lonoke, AR (328)

Palmer amaranth remains one of the most competitive and troublesome weeds of agronomic crops throughout the midsouthern United States. Its resistance to nine sites of action complicates the selection of effective herbicides in some fields. Metabolic resistance in Palmer amaranth is of utmost concern because weed control failure can result even when there has been no previous field use of a particular herbicide. With the recent registration of fluridone in rice and the label submission of diflufenican as a premixture with other herbicides, both for control of Palmer amaranth, research was conducted under greenhouse conditions to evaluate the sensitivity of Palmer amaranth populations to these herbicides applied preemergence. Twenty-two populations were chosen based on difficulty in control with other herbicides along with a commonly used susceptible standard. Each population was sown into trays containing a silt loam soil, and treated with fluridone at 168 g/ha or diflufenican at 120 g/ha. A nontreated control for each was included. At 14 days after treatment, data collected included plant numbers with at least one true leaf and aboveground biomass. An additional experiment using a similar setup quantified the response of three populations and the susceptible standard to a range of fluridone and diflufenican doses. Four populations had fewer survivors and less biomass when treated with fluridone than with diflufenican. Over the 23 Palmer amaranth populations, survival ranged from 0 to 49% for fluridone and 0 to 63% for diflufenican. Biomass reduction ranged from 14 to 100% for fluridone and 41 to 100% for diflufenican. Three populations were 9.8- to 16.9- and 4.2- to 8.9-fold less sensitive to fluridone and diflufenican, respectively, based on 50% biomass reduction relative to the susceptible standard. These results show that there is tremendous variability in the sensitivity of Palmer amaranth populations to preemergence-applied fluridone and diflufenican. Even though fluridone was recently labeled at 168 g/ha for use in rice, populations already exist for which the herbicide will unlikely provide effective control. Evaluation of diflufenican and fluridone in combination with other herbicides on these difficult-to-control populations is now needed.

The Silver Bullet That Wasn't: Rapid Agronomic Weed Adaptations to Glyphosate in North America. Christopher A. Landau[1], Kevin W. Bradley[2], Erin E. Burns[3], Michael L. Flessner[4], Karla L. Gage[5], Aaron Hager[6], Joseph T. Ikley[7], Prashant Jha[8], Amit J. Jhala[9], Paul Johnson[10], Bill Johnson[11], Sarah Lancaster[12], Travis Legleiter[13], Dwight Lingenfelter[14], Mark Loux[15], Eric J. Miller[16], Jason K. Norsworthy[17], Mike Owen[8], Scott A. Nolte[18], Debalin Sarangi[19], Peter H. Sikkema[20], Christy L. Sprague[3], Mark VanGessel[21], Rodrigo Werle[22], Bryan G. Young[23], Martin Williams*[24]; [1]University of Illinois, Crop Sciences, Urbana, IL, [2]University of Missouri, Columbia, MO, [3]Michigan State University, East Lansing, MI, [4]Virginia Tech, Blacksburg, VA, [5]Southern Illinois University Carbondale, Carbondale, IL, [6]University of Illinois, Urbana, IL, [7]North Dakota State University, Fargo, ND, [8]Iowa State University, Ames, IA, [9]University of Nebraska Lincoln, Lincoln, NE, [10]South Dakota State University, Brookings, SD, [11]Purdue University, West Lafayette, IN, [12]Kansas State University, Manhattan, KS, [13]University of Kentucky, Princeton, KY, [14]Penn State University, University Park, PA, [15]Ohio State University, Columbus, OH, [16]Southern Illinois University, Carbondale, IL, [17]University of Arkansas, Fayetteville, AR, [18]Texas A&M AgriLife Extension, College Station, TX, [19]University of Minnesota, St. Paul, MN, [20]University of Guelph, Ridgetown, ON, Canada, [21]University of Delaware, Georgetown, DE, [22]University of Wisconsin-Madison, Madison, WI, [23]Purdue University, Brookston, IN, [24]United States Department of Agriculture, Agricultural Research Service, Urbana, IL (329)

Singular solutions to difficult problems can sound great. Glyphosate-resistant (GR) corn, cotton, and soybean commercialized near the end of the 20th century allowed in-crop use of glyphosate, a broad-spectrum, non-selective herbicide. Some believed the technology would completely solve weed control problems in GR crops. Several factors, including initially high glyphosate efficacy, led to a simplification of weed management systems that relied heavily, in some cases exclusively, on glyphosate for weed control. Adoption of glyphosate use on GR crops in North America, and abandonment of other weed management tactics, was extensive and rapid. How did that work out? We analyzed data from thousands of glyphosate evaluation trials from 24 institutions across the U.S.A. and Canada from 1996 to 2021. Throughout North America and for every major weed species analyzed, mean weed control with glyphosate decreased over time. Furthermore, variability in weed control increased over time. Today, continued deterioration of glyphosate performance has rendered the herbicide largely ineffective as a stand-alone treatment. The analyses illustrate the rapid adaptations of agronomically important weed species to glyphosate, the most widely used herbicide in the world. Rather than seeking the next singular solution to solve today's weed problems, we argue for diverse, multi-faceted strategies that delay weed adaptation to current and future management tactics.

Weed Management for Camelina and Field Pea Intercrops. Shaun Sharpe*[1], Christina Eynck[1], Michelle Hubbard[2], Lana Shaw[3]; [1]Agriculture and Agri-Food Canada, Saskatoon, SK, Canada, [2]Agriculture and Agri-Food Canada, Swift Current, SK, Canada, [3]South East Research Farm, Redvers, SK, Canada (330)

Building resilient agro-ecosystems is critical for long-term sustainable farming. Intercropping introduces a crop community with varying environmental tolerance and plasticity to respond to a variable and changing climate. Camelina is an alternative oilseed for Canadian Prairie production, has good tolerance for problematic canola pathogens and insects, and good competitiveness against weeds. Camelina's upright growth habit compliments the vine habit of field peas, a common Saskatchewan pulse crop. The study objective was to evaluate integrating chemical and cultural weed management strategies for pea and camelina intercrops. Experiments were conducted at the Saskatoon Research and Development Centre farm in 2022 and 2023. The experimental design was a three-factor factorial arranged as a randomized complete block. The first factor was ethalfluralin (yes/no), the second factor was cropping system (peas, camelina, or intercrop), and the third factor was planting date (standard/late). Peas were seeded to achieve 80 plants/m2 while camelina was seeded at 550 seeds/m2. Camelina and pea stand densities were not affected by ethalfluralin application or intercropping in 2022 or 2023. Planting date had no effect on crop stand density in 2022 but in 2023, higher stand counts for both crops were produced by the later seeding date. Plant stands increased from 78 to 102 plants/m2 across camelina mono- and intercropped, and 40 to 62 plants/m2 in the pea monocrop only. Weed densities were low throughout the trial in 2022 (1 to 4 plants/m2) so populations were supplemented in 2023 with kochia and wild oat. Ethalfluralin reduced weed densities by 50% in 2022 and 92 to 99% in 2023. In 2022, camelina yield was affected by a planting date and cropping system, where delaying planting reduced yield from 129.8 to 95.8 g/m2 while intercropping reduced yield from 122.4 to 103.2 g/m2. Pea yield was influenced by a planting date and cropping system interaction, where highest yields were for monocrop peas at the first planting date (124.0 g/m2), monocrop peas at the second planting date (81.6 g/m2), and then intercropped peas across both planting dates (29.7 to 31.8 g/m2). Camelina was the dominant component of the 2022 intercrop and the season was characterized by dry growing conditions.

Current Weed Management Tools, Challenges, and Opportunities for the New Winter Oilseed Crops Camelina, Carinata, and Pennycress. Mark L. Bernards*[1], Ramon G. Leon[2]; [1]United States Department of Agriculture, Agricultural Research Service, Morris, MN, [2]North Carolina State University, Raleigh, NC (331)

One of the sustainability goals of the airline industry is a 50% reduction in greenhouse gas emissions by 2050 (relative to 2005). This will require a massive increase in the production of new oilseed crops dedicated for aviation biofuels. Adding a winter annual oilseed crop to rotations where fields are historically winter fallow will help meet this demand, and will provide environmental (reduced erosion and nutrient loss) and agronomic benefits (increased soil health) common to winter cover crops. Three potential winter oilseed crops being developed through multi-institution collaborations are camelina (*Camelina sativa*), carinata (*Brassica carinata*) and pennycress (*Thlaspi arvense*). Camelina, also known as gold-of-pleasure or false flax, appears best adapted to the extreme cold of the upper Midwest. Carinata, also known as Ethiopian mustard, is currently adapted to survive the winters of the Southeastern U.S. Both camelina and carinata have been grown as crops for thousands of years in Europe and Ethiopia, respectively. Production of each in North America has been limited, primarily as short-season summer annual crops to diversify small-grain rotations in the Great Plains. Field pennycress, a common weed in temperate climates, is undergoing domestication using mutagenesis and gene-editing. Varieties with improved oil profiles (low erucic acid) and that are non-dormant and non-shattering are being grown commercially on a limited basis in central Illinois. Pennycress has also been grown successfully in research trials in the eastern and northern Corn Belt. Each of these crops has the potential to be grown on millions of hectares in the U.S., but widespread adoption will require effective and affordable weed management options. First, there is limited data on herbicide carryover risk from potential rotation crops (corn, soybean, wheat, cotton, peanut). Research is needed to identify herbicides that do not pose a risk when a winter oilseed is planted within 90-120 days of application, and support from registrants will be needed to update labels of suitable products. Second, successful weed management in an oilseed crops will depend on effective stand establishment and rapid canopy closure. General establishment and growth guidelines have been published by groups promoting adoption of these crops, but there is need to refine agronomic recommendations based on studies conducted across a broader range of environments. Third, a few herbicides are labeled for camelina and carinata because they are part of EPA's Canola/Rapeseed crop subgroup (20A), but only quizalafop is labeled for pennycress. Work to identify other suitable herbicides and herbicide use strategies, with support from herbicide registrants willing to add these crops to product labels, will be helpful to promote farmer adoption. Fourth, there is a need for data describing the effect growing these winter oilseeds may have on weed management in the following rotation crop. If they are beneficial in suppressing troublesome summer annual weeds through residue or compounds released into the soil, they may provide economic benefits in addition to the sale of the oilseed to incentivize grower adoption.

Exploring the Use of Biochar for Carbon Banding Applications in Grass Seed Production Systems. Clint M. Mattox*; United States Department of Agriculture, Agricultural Research Service, Corvallis, OR (332)

Carbon banding consists of applying a layer of activated carbon (AC) over the seed furrow at the time of planting. The AC protects the seed by absorbing a preemergent herbicide that is soon after applied to the field. In Oregon grass seed production systems, AC has historically been used; however, locally produced biochar made from the pyrolysis of conifer-based residues may provide a climate-smart alternative to AC. To explore the differences between biochar and AC as carbon-banding sources in a field setting, a randomized complete split-plot design experiment replicated four times was implemented in Corvallis, Oregon. The study was repeated three times in different locations on 20 October 2022, 25 April 2023, and 6 October 2023. Perennial ryegrass was sown at a rate of 13.2 kg per hectare on 30.5 cm row spacings. Carbon source applied at 28.0 kg per hectare was the whole-plot factor with three levels: AC, mixed-conifer source biochar, and a non-treated control. Seven levels of preemergent herbicides comprised the sub-plot factor applied at the following rates: diuron (2.692 kg ai ha^{-1}), pronamide (0.289 kg ai ha^{-1}), EPTC (4.908 kg ai ha^{-1}), a combination of flumioxazin (0.035 kg ai ha^{-1}) + pyroxasulfone (0.045 kg ai ha^{-1}), rimsulfuron (0.053 kg ai ha^{-1}), indaziflam (0.015 kg ai ha^{-1}), and a non-treated control. Preemergent herbicides were applied one to three days after carbon applications with timing corresponding to rainfall forecasts. Regarding crop safety, a significant interaction between carbon source and herbicide in all three experiments suggests carbon sources perform differently depending on herbicide chemistry. No significant differences between AC and biochar were observed, although biochar did not perform better than no carbon in multiple instances. Results suggest that mixed-conifer biochar is a promising alternative to AC although more experiments are needed to determine effective carbon rates for each herbicide.

Beyond Borders: the Undesired Journey of Transgenes Flow from Corn to Teosinte. Luan Cutti*[1], Guilherme Menegol Turra[2], Estéfani Sulzbach[2], Paula Sinigaglia Angonese[3], Catarine Markus[2], Eric L. Patterson[1], Todd A. Gaines[4], Aldo Merotto[2]; [1]Michigan State University, East Lansing, MI, [2]Federal University of Rio Grande do Sul, Porto Alegre, Brazil, [3]Federal University of Rio Grande do Sul, Porto Alegrw, Brazil, [4]Colorado State University, Fort Collins, CO (333)

Teosinte (*Zea mays* subsp. *parviglumis*) is the ancestral species of corn and is a recently emerging weed around the world. The genetic similarity between teosinte and corn allows for transgenes to flow from corn to teosinte; however, this possibility has been dismissed as unlikely to occur in nature. Our team discovered herbicide-resistant teosinte in Brazil growing near GMO corn. The objective of this study was to find the origins of herbicide resistance in this teosinte population. We discovered these plants were highly resistant to the herbicides glyphosate and glufosinate-ammonium. Using molecular techniques, we identified five genotypes mixed in the resistant population, with individual plants carrying combinations of *cp4-EPSPS*, *mEPSPS*, *pat*, and *Cry1F* transgenes. The presence of *cp4-EPSPS* and *mEPSPS* in a single teosinte biotype indicates at least two separate outcrossing events with transgenic corn as there are no commercial corn lines carrying both transgenes. The transgene-constructs were mapped to Chr01, Chr02, and Chr06 of corn and teosinte. In addition, the herbicide-resistant teosinte had corn domestication alleles at three genes: *tb1*, *UPA2*, and *Gl15* which control plant architecture; the formation of branches, the leaf angle, and the vegetative transition. However, teosinte does not have the domestication allele at the *tga1* locus, associated with naked grains trait. Our work shows that there is gene flow from corn to teosinte and hybrid teosinte plants carrying both herbicide and insect resistance transgenes exist in the wild; threatening the biodiversity of teosinte and our ability to control the spread of GMO traits.

Severe Tolpyralate Sensitivity in Corn: Scope and Genetic Basis. Martin Williams*[1], Nicholas Hausman[2], Ana I. Saballos[3], Christopher A. Landau[4], Matthew Brooks[1], Pat Flannery[5], Bill Tracy[5], Charlie Thompson[6]; [1]United States Department of Agriculture, Agricultural Research Service, Urbana, IL, [2]USDA, Urbana, IL, [3]Global Change and Photosynthesis Research, US Department of Agriculture, Agricultural Research Service, Urbana, IL, [4]University of Illinois, Crop Sciences, Urbana, IL, [5]UW-Madison, Madison, WI, [6]IFSI, Tolono, IL (334)

Tolpyralate, a relatively new inhibitor of 4-hydroxyphenylpyruvate dioxygenase, has a record of excellent tolerance in all types of corn. A report of severe corn injury led to the following objectives: 1) identify the nature and potential scope of tolpyralate sensitivity, and 2) determine the genetic basis of tolpyralate sensitivity. Early research showed methylated seed oil or nonionic surfactant in the spray volume, essential for weed control, facilitates severe corn injury. Field observations identified a total of 49 sweet corn and field corn inbreds with moderate to severe sensitivity to tolpyralate. Evidence suggests tolpyralate sensitivity is conferred by a single recessive gene which was subsequently mapped in one inbred to the Chr05: 283,240 - 1,222,909 bp interval. Severe sensitivity to tolpyralate exists in sweet corn and field corn germplasm when the herbicide is applied according to label directions. Tolpyralate should only be used on hybrids derived from inbreds with tolerance to the herbicide. Corn seed companies should consider eliminating alleles that render corn germplasm sensitive to tolpyralate from breeding populations and inbreds.

Examining the Competitive Dynamics Between *Parthenium hysterophorus* and Two Crops (*Zea mays* and *Gossypium hirsutum*) in Israel. Sahar Malka*[1], Hanan Eizenberg[2], Maor Matzrafi[3], Ran Nisim Lati[4], Assaf Distelfeld[5]; [1]Department of Plant Pathology and Weed Research, Agricultural Research Organization – Volcani Institute, Newe-Ya' ar Research Center., Mei Ammi, Israel, [2]Agricultural Research Organization (ARO), Newe Yaar Research Center, Ramat Yishay, Israel, [3]Department of Plant Pathology and Weed Research, Agricultural Research Organization (ARO), Newe Ya'ar Research Center, Ramat-yishay, Israel, [4]Department of Plant Pathology and Weed Research, Newe Ya' ar Research Center, Agricultural Research Organization (ARO) - Volcani Center, Ramat Yishay, Israel, [5]Department of Evolutionary and Environmental Biology, Faculty of Natural Sciences and the Institute of Evolution, University of Haifa, Haifa, Israel (335)

The impact of weeds on crop plants is influenced by various factors; weed density, weed type, and the specific crop being cultivated. *Parthenium hysterophorus* (Asteraceae) is a noxious weed species that has invaded over 50 countries globally. This plant has a high seed production potential, and it can grow up to 2m tall. In Israel, it was first detected in 1980 at Tirat-Zvi, located in eastern-northern Israel. In recent years, there has been an increasing concern about the spread of this weed in agricultural regions across the country. Here, we examine the competitive abilities of two *P. hysterophorus* populations, Tirat Zvi (TZ), a well-established population, and Ha'hotrim (HT), which represents a new introduction site. Furthermore, we have compared the competitive dynamics of both populations with two crops, corn (*Zea mays*) and cotton (*Gossypium hirsutum*). The experiments took place in a glasshouse, using 60L Styrofoam boxes. Crop plants were grown with transplanted seedlings at low and high weed density (six or twenty-two plants per $0.25m^2$, accordingly). For the control treatment, weed or crop plants were grown alone. Biomass and height of both weed crop plants were measured at the end of the experiment. Our results show that 92 days after transplanting, weight of cotton plants grown with low density of HT plants was higher then of those grown under low density of TZ plants (t-test, p=0.0298). The average weight of cotton plants grown in low density was 50% lower than control and in high density 70% lower than control. However, under high density of *P. hysterophorus* no significant differences were observed between the two populations. Examining the weight of corn plants under competition, no significant differences for both densities and different *P. hysterophorus* populations. Interestingly, corn plants grown with high density of TZ plants where shorter compared to those grown under low density (t-test, $p=1.08e^{-5}$). From these results we can assume TZ population plants are a stronger competitor against both corn and cotton crops. We may also conclude that cotton plants are more sensitive to *P. hysterophorus* competition compared to corn plants. The differential responses of corn and cotton plants to competition highlight the importance of crop selection in areas with high *P. hysterophorus* infestation.

The Monetary Cost of Glyphosate-Resistant Weeds on Major Field Crops Grown in Ontario.
Peter H. Sikkema*, Nader Soltani; University of Guelph, Ridgetown, ON, Canada (337)

Limited information exists on the global economic impact of glyphosate-resistant (GR) weeds. The objective of this manuscript was to estimate the potential yield and economic loss from uncontrolled GR weeds in the major field crops grown in Ontario, Canada. The impact of GR weed interference on field crop yield was determined using an extensive database of field trials completed on commercial farms in southwestern Ontario between 2010 and 2021. Crop yield loss was estimated by expert opinion (weed scientists and Ontario government crop specialists) when research data were unavailable. This manuscript assumes that crop producers adjust their weed management programs to control GR weeds, which increases weed management costs but reduces crop yield loss from GR weed interference by 95%. GR volunteer corn, horseweed, waterhemp, giant ragweed, and common ragweed would cause an annual monetary loss of (in millions of Can$) $172, $104, $11, $3, and $0.3, respectively, for a total annual loss of $290 million if Ontario farmers did not adjust their weed management programs to control GR biotypes. The increased herbicide cost to control GR volunteer corn, horseweed, waterhemp, giant ragweed, and common ragweed in the major field crops in Ontario is estimated to be (in millions of Can$) $17, $9, $2, $0.1, and $0.02, respectively, for a total increase in herbicide expenditures of $28 million annually. Reduced GR weed interference with the adjusted weed management programs would reduce farm-gate monetary crop loss by 95% from $290 million to $15 million. This study estimates that GR weeds would reduce the farm-gate value of the major field crops produced in Ontario by Can$290 million annually if Ontario farmers did not adjust their weed management programs, but with increased herbicide costs of Can$28 million and reduced crop yield loss of 95% the actual annual monetary loss in Ontario is estimated to be Can$43 million annually.

Investigation of Suspected Dicamba Resistance in Waterhemp and Palmer Amaranth Populations. Aruna V. Varanasi*, Chandrashekar C. Aradhya, Jeffrey Herrmann, John Willis, Steven Callen, Jenny Krebel, Joshua Fischer, Graham Head; Bayer CropScience, Chesterfield, MO (338)

XtendiMax® herbicide with VaporGrip® Technology is a dicamba formulation registered by the United States Environmental Protection Agency (US-EPA) for use in dicamba-tolerant soybean and cotton with certain conditions of registration. It includes evaluation of product performance inquiries from growers regarding reduced weed control efficacy by XtendiMax herbicide in the field. Following an herbicide resistance management plan for XtendiMax herbicide for screening suspected weed resistance, we identified a Palmer amaranth (*Amaranthus palmeri* S. Watson) accession and a waterhemp (*A. tuberculatus* Moq. Sauer) accession in dicamba-tolerant soybean fields from Kansas (KS) and Iowa (IA), respectively, to evaluate the level of reduction in dicamba efficacy and/or confirm resistance. The accessions were tested initially with XtendiMax at 560g ae ha^{-1} and 1120g ae ha^{-1} rates, followed by two rounds of whole plant dose-response studies using two sensitive accessions as controls for each species in the greenhouse. The dose-response assays were conducted with 0, 1/32×, 1/16×, 1/8×, 1/4×, 1/2×, 1×, and 2× the label rate of 560g ae ha^{-1} for sensitive controls and 0, 1/16×, 1/8×, 1/4×, 1/2×, 1×, 2×, and 4× the label rate for test accession and evaluated for percent injury and dry biomass 21 days after herbicide application. Based on the GR_{50} values from dry biomass, the Palmer amaranth accession was found to be 3.2- and 2.7-fold resistant, whereas the waterhemp accession indicated a 19.2- and 5.3-fold resistance relative to the two controls, respectively. This study confirmed the first report of dicamba resistance in Palmer amaranth in KS and waterhemp in IA.

First Year Results of a Multi-State Evaluation of Harvest Weed Seed Control. Michael L. Flessner*[1], Muthukumar V. Bagavathiannan[2], Steven Brian Mirsky[3], Mark VanGessel[4], Ian Burke[5], Eli C. Russell[1], Eugene P. Law[6], Sarah A.d. Chu[2], Jessica E. R. Kalin[5]; [1]Virginia Tech, Blacksburg, VA, [2]Texas A&M University, College Station, TX, [3]USDA ARS, Beltsville, MD, [4]University of Delaware, Georgetown, DE, [5]Washington State University, Pullman, WA, [6]University of Delaware, Beltsville, MD (340)

The GROW (Getting Rid Of Weeds) network has embarked on a multi-state, on-farm evaluation of harvest weed seed control (HWSC) in rotations that include wheat as well as corn/soybean rotations. For wheat, grain harvest with or without (+/-) HWSC is the only treatment imposed. For corn/soybean, treatments include +/- HWSC and +/- cover crops (CC). For data presented herein, HWSC was implemented with a Redekop Seed Control Unit (SCU) in wheat and an integrated Harrington Seed Destructor (iHSD) in corn/soybean. All experimental sites have a minimum of three replications per treatment in a randomized complete block design. Plot sizes are at least 27 m by 91 m and combine traffic is controlled within plots. Only two sites of each crop rotation were available for analysis at this time with a single implementation of HWSC in 2022 and evaluations based on data collected in 2023. For sites with corn harvested in 2022 and evaluated in soybean in 2023, results were mixed, likely due to modest cover crop biomass (<1,000 kg ha-1) and limited weed seed capture with a corn header, as well as low weed pressure at one site. Conversely, for sites with soybean harvested in 2022 and evaluated in corn in 2023 just prior to the over-the-top herbicide application (about 4 weeks after planting), Palmer amaranth (Amaranthus palmeri) density was reduced >96% and 66% at the Virginia (VA) and Delaware (DE) sites, respectively. At the VA site, additional weeds were present including large crabgrass (Digitaria sanguinalis), common ragweed (Ambrosia artemisiifolia), and other weeds; total weed density was reduced 95% by +HWSC/±CC, -HWSC/+CC, or +HWSC/-CC compared to -HWSC/-CC. When evaluated just prior to harvest in 2023 at the VA site, +CC reduced total weed density by 70% compared to -CC regardless of HWSC treatment, and +HWSC reduced total weed density by 65% compared to -HWSC regardless of CC treatment. Conversely, the DE site +HWSC increased in Palmer amaranth 74% compared to -HWSC at harvest regardless of CC. In wheat harvested in 2022 and evaluated in wheat in 2023, ±HWSC did not influence Italian ryegrass (Lolium perenne ssp. multiflorum) density at either site at either evaluation time. +HWSC reduced total weed density (comprised mostly of common chickweed (Stellaria media), followed by henbit (Lamium amplexicaule), other weeds, and Italian ryegrass) by 58% when evaluated just prior to the over-the-top herbicide application in late February at the VA site. Henbit was reduced 73% from +HWSC at the Texas site. Combine performance data indicate that seed impact mills increase fuel consumption, but combine travel speed is not reduced on class 8 or greater combines. Trials across many other locations are on-going and will be conducted for multiple, consecutive years, which is critical for depleting weed seed bank over time with these tactics.

Confirmation of a Three-way (Thifensulfuron, Atrazine and Glyphosate) Herbicide Resistant Population of Palmer Amaranth (*Amaranthus palmeri*) in North Carolina. Ronel J. Argueta*[1], Eric Jones[2], Diego J. Contreras[1], Jackson W. Alsdorf[1], Wesley Everman[1]; [1]North Carolina State University, Raleigh, NC, [2]South Dakota State University, Brookings, SD (341)

Atrazine has historically been efficacious herbicide in North Carolina, where almost every hectare of corn receives a pre- and postemergence application. In 2016, a farmer in Washington County North Carolina reported a control failure on *Amaranthus palmeri* S. Watson (Palmer amaranth) in a corn field treated with atrazine. The objectives were to evaluate the response of the putative atrazine-resistant population from Washington County (R) at different atrazine rates and determine effective herbicides to control the putative atrazine resistant population. Two atrazine-susceptible populations from Edgecombe County (S) and Johnston County (S) were used susceptible controls The experimental design was completely randomized with four replications. Atrazine was applied at 0, 56, 177, 560, 1770, 5600 and 17,700 g ai ha^{-1} and included crop oil concentration (1% v v^{-1}). Treatments were applied to plants 7.6 to 9 cm in height. Plant survival was evaluated 21 days after treatment. The LD_{50} for each population were calculated from a three-parameter log-logistic model. A resistance ratio was calculated for each atrazine-susceptible population. The LD_{50} value was 1354 g ai ha^{-1} for R population. The R/S were 6.8 to 8.7 compared to the S populations. The Washington County population has evolved atrazine resistance. Subsequently, these *A. palmeri* populations were treated with 7 herbicide modes of action for further characterization under similar conditions and evaluations. All populations exhibited resistance to thifensulfuron and glyphosate with survival =70% and =30%, respectively. 2,4-D and dicamba provided variable control on all populations. The population is resistant to thifensulfuron, atrazine and glyphosate.Nomenclature: 2,4-D; dicamba; thifensulfuron; glyphosate; palmer amaranth, *Amaranthus palmeri.* Keywords: Atrazine, Washington County, resistant population

Protoporphyrinogen Oxidase Inhibitor (Group 14)-resistant Kochia (*Bassia scoparia*) in Canada. Charles M. Geddes*; Agriculture and Agri-Food Canada, Lethbridge, AB, Canada (342)

Kochia [*Bassia scoparia* (L.) A.J. Scott] is a halophytic summer-annual tumbleweed that can cause substantial yield losses in several major crops grown in western North America. Its abundance has grown in western Canada in recent decades due, in part, to rapid evolution and spread of herbicide resistance. Kochia populations are known to exhibit resistance to acetolactate synthase inhibitors [Herbicide Resistance Action Committee (HRAC) Group 2], auxin mimics (HRAC Group 4), photosystem II inhibitors (HRAC Group 5), and the 5-enolpyruvylshikimate-3-phosphate synthase inhibitor glyphosate (HRAC Group 9). Here we report the fifth herbicide mode of action to which kochia can exhibit resistance, the protoporphyrinogen oxidase (PPO) inhibitors (HRAC Group 14). In 2021, poor control of a kochia population was observed following treatment with pre-plant glyphosate + sulfentrazone + carfentrazone followed by post-plant pre-emergence glyphosate + carfentrazone + bromoxynil in a tame mustard field in west-central Saskatchewan. Since the field had been treated with sulfentrazone each of the two years prior, there was reason to suspect that the kochia was PPO inhibitor-resistant. Mature kochia seeds collected from the field were planted under controlled-environment, and the seedlings were treated with saflufenacil at 50 g ai ha^{-1}. Surviving kochia plants were grown in the greenhouse under isolation for one generation, in addition to two susceptible control accessions, to control for differences in parental environment. The second generation accessions were subjected to separate whole-plant dose-response bioassays with a range of PPO inhibiting-herbicides including foliar-applied saflufenacil, tiafenacil, carfentrazone, pyraflufen-ethyl, and acifluorfen, and soil-applied sulfentrazone and flumioxazin. The accession from west-central Saskatchewan exhibited resistance to all of these PPO-inhibiting herbicides compared with two susceptible controls, with the exception of foliar-applied acifluorfen; the only active ingredient tested from the diphenyl ether family. Therefore, PPO inhibitor-resistant kochia exhibits broad cross-resistance to PPO-inhibiting herbicides with the likely exception of the diphenyl ethers.

From Liberty® 280 (Racemic Glufosinate Ammonium) to Liberty® ULTRA (L-Glufosinate Ammonium) Herbicide, Powered by Glu-L™ Technology. Liam J. Vincent[1], Eric C. Schultz[1], Alice L. Harris[1], Marcel P. Kienle[2], Ryan B. Aldridge[1], Samuel Willingham[3], Ingo Meiners[1], Siyuan Tan*[4]; [1]BASF, Rtp, NC, [2]BASF, Limburgerhof, Germany, [3]BASF, Durham, NC, [4]BASF, Cary, Nc 27519, Usa, NC (384)

Glufosinate ammonium has been utilized as a postemergence herbicide in glufosinate tolerant cropping systems for nearly 30 years. To this point, all glufosinate herbicides registered for use in the United States have been in the form of a racemic mixture, including Liberty® 280 herbicide from BASF. Racemic mixtures of glufosinate contain a 1:1 ratio of D-glufosinate and L-glufosinate enantiomers. The L-isomer of glufosinate has herbicidal activity while the D-isomer has negligible herbicidal activity as it does not inhibit glutamine synthetase (GS), the target enzyme. For years it has been known that the two enantiomers have existed together in racemic mixtures; however, a resolved isomer form of L-glufosinate ammonium has never been commercialized in the United States. Pending registration, BASF intends to launch Liberty® ULTRA Herbicide, Powered by Glu-L Technology in 2024. Liberty ULTRA herbicide is the resolved isomer of L-glufosinate ammonium, and Glu-L Technology is the patent protected manufacturing process by which the D-isomer of glufosinate is enzymatically transformed into the herbicidally active L-isomer to create a resolved isomer of L-glufosinate ammonium. Liberty ULTRA is an improved version of Liberty 280 with innovations from both chiral chemistry and formulation chemistry. Field trials were conducted from 2021 to 2023 to compare weed control efficacy between Liberty ULTRA and Liberty 280. Liberty ULTRA at 370 g ai ha^{-1} demonstrated incremental improvement in overall weed control efficacy compared to Liberty 280 at 654 g ai ha^{-1}. Field trials were also conducted in 2022 and 2023 to compare Liberty ULTRA to several generic racemic glufosinate products. Liberty ULTRA at 370 g ai ha^{-1} achieved better weed control than all tested generic racemic glufosinate at 654 g ai ha^{-1}. Liberty ULTRA herbicide will also feature the Liberty Lock formulation which improves spray droplet retention, increases droplet spreading and ultimately drives more active ingredient into weed leaves compared to generic glufosinate. Liberty ULTRA will have a higher L-glufosinate concentration in the formulation compared to other glufosinate formulations which enables a 25% reduction in application use rate when compared to Liberty 280. The application use rate reduction will mean that customers will be able to make more applications, serve more customers and cover more acres from the same tote or bulk tank compared to most racemic glufosinate herbicides. Liberty ULTRA Herbicide, Powered by Glu-L Technology and the Liberty Lock formulation represents the future of glufosinate for BASF for effective broad spectrum weed control in glufosinate tolerant crops.

Development of a Quizalofop-p-ethyl and Glufosinate-ammonium Premix: the Rest of the Story. Richard K. Zollinger*[1], Gregory R. Armel[2], Gary T, Cundiff[3], Daniel Kunkel[4], Joseph A. Bruce[5], Peter J. Porpiglia[6]; [1]Amvac Chemical Company, Spokane Valley, WA, [2]AMVAC Chemical Corporation, Rocky Mount, NC, [3]AMVAC Chemical Corporation, Cleveland, MS, [4]AMVAC, Plainsboro, NJ, [5]AMVAC Chemical Corporation, Glen Carbon, IL, [6]AMVAC Chemical Corporation, Newport Beach, CA (385)

Developed by AMVAC Chemical Company, a soluble liquid formulation was created through ProLease™ Technology containing 27.6 g/L of quizalofop-P ethyl plus 280.4 g/L of glufosinate-ammonium. Postemergence applications for nonselective control of emerged grass and broadleaf weeds can be made up to early bloom glufosinate-tolerant canola (*Brassica napus*), up to 14 days before flower glufosinate-tolerant cotton (*Gossypium herbaceum*), up to bloom soybean (*Glycine max*), and V2 to V6 glufosinate- and quizalofop-P-ethyl-tolerant corn (*Zea mays*). Applications can also be banded and/or directed postemergence spray or spot spray treatment in pome fruit (crop group 11-10) and stone fruit (crop group 12-12), except NY. The premix use rates are from 496 to 968 g/ha on 8 cm tall broadleaf weeds and 13 to 76 cm tall grass weeds. The premix controlled weeds equal to or greater than a tank-mix of commercial formulations of quizalofop-P ethyl and glufosinate-ammonium applied at equivalent active ingredient rates between 7 to 14 days after application. The premix did not influence broadleaf weed control as compared to glufosinate applied alone but grass control increased compared to quizalofop-p ethyl applied alone. Peak herbicide activity of the premix occurred 7 to 14 days after application. The premix was optimized when applied after soil-residual herbicides or tank-mixed with a Group 15 herbicide or applied in sequential applications. Optimum weed control occurred when applied with a spray volume containing medium to course textured spray quality with petroleum oil concentrate plus ammonium sulfate adjuvants. Reduced control of grass weeds occurred when applied with 2,4-D or dicamba but antagonism was removed when the premix was applied 1 day before or 7 days after the broadleaf herbicide. The premix may be mixed with other registered pesticides but antagonism of grass control may occur with some products, particularly herbicides in Group 2, 4, 6, and 14. Reduced weed control occurred when applied in very coarse, extremely coarse, and ultra coarse spray quality. The premix does not provide residual weed control. Crop response from the premix was usually negligible but was often influenced by adverse weather conditions (e.g., temperature, humidity, etc.) which is consistent with normal response to glufosinate-ammonium applied alone. The premix is near unique as containing a non-cereal graminicide with a systemic postemergence broadleaf herbicide and the only premix containing glufosinate-ammonium with a systemic grass herbicide.

Storen: A New Corn Herbicide in 2024 That Provides Clean Rows and Clear Results. Kyle Russell*[1], Tom Beckett[2], Mark J. Kitt[3], Nathan H. Haugrud[4]; [1]Syngenta Crop Protection, Houston, TX, [2]Syngenta Crop Protection, Greensboro, NC, [3]Syngenta Crop Protection, LLC, Greensboro, NC, [4]Syngenta Crop Protection, LLC, Fargo, ND (386)

Storen™ is a herbicide from Syngenta Crop Protection delivering broad-spectrum control of annual grasses and key broadleaf weeds in field corn, seed corn, yellow popcorn, and sweet corn. Storen is a ZC (capsule-suspension) formulation that combines four active ingredients, mesotrione, bicyclopyrone, *S*-metolachlor, and pyroxasulfone as well as the safener benoxacor in a convenient premixture. The robust rates of these four active ingredients are designed to work together to provide maximum broad-spectrum residual weed control. The herbicide is optimized for preemergence and postemergence crop safety when used according to the label. Storen is labeled for use in fine and medium textured soils with a wide application window from pre-plant to before corn reaches V8 leaf stage on field corn and seed corn. Storen provides control of 74 weed species including annual grasses and many small-seeded broadleaves such as waterhemp (*Amaranthus tuberculatus*) and Palmer amaranth (*Amaranthus palmeri*) as well as numerous key large-seeded broadleaf weeds such as common and giant ragweed (*Ambrosia artemisiifolia, A. trifida*), morningglories (*Ipomoea* sp.), velvetleaf (*Abutilon theophrasti*), and common cocklebur (*Xanthium strumarium*). In field testing, Storen has consistently provided up to three weeks longer residual control of weeds compared to other leading corn herbicides which protects corn from weed competition and results in a 4 to 5 bu/A grain yield advantage.

Storen Herbicide – Consistent and Long-Lasting Residual Weed Control in Corn. B. David Black*[1], Scott E. Cully[2], Mark J. Kitt[3], Thomas H. Beckett[3]; [1]Syngenta Crop Protection, LLC, Searcy, AR, [2]Syngenta Crop Protection, LLC, Marion, IL, [3]Syngenta Crop Protection, LLC, Greensboro, NC (387)

Storen™ is a selective herbicide for weed control in field corn, seed corn, yellow popcorn and sweet corn. Storen contains ratios of S-metolachlor, pyroxasulfone, mesotrione, bicyclopyrone, and the safener benoxacor that are optimized to provide extended residual weed control in corn. Field trials were conducted over several seasons both in crop and in bare-ground situations to evaluate Storen for residual weed control and consistency of weed control compared to Acuron®, Acuron® Flexi and other corn herbicide premixtures in one-pass and two-pass weed control programs. Results show that Storen provides more consistent and longer lasting residual control of difficult to control weeds like *Amaranthus palmeri*, *Amaranthus tuberculatus* and other problematic broadleaf and grass weeds in corn.

What's New in Industry. James C. Holloway Jr*[1], Eric W. Palmer[2], Mark J. Kitt[2], Thomas H. Beckett[2], Cristin Weber[3]; [1]Syngenta Crop Protection, LLC, Jackson, TN, [2]Syngenta Crop Protection, LLC, Greensboro, NC, [3]Syngenta Crop Protection, Normal, IL (388)

No abstract is needed for What's New in Industry.

Development of Convintro™ Brand Herbicides for Managing *Amaranthus* Species in Corn and Soybean: Field Performance Update. John Buol*, Carl Coburn, Richard Leitz, Zewei Miao, Emily Scholting; Bayer, St. Louis, MO (389)

The continued development and spread of herbicide resistance constitutes a major threat to the efficiency and profitability of corn and soybean production. Weeds such as some Amaranthus species have developed resistance to multiple herbicide modes- and sites- of action and are among the most challenging broadleaf weeds in North America. Bayer CropScience is developing a herbicide technology that features the use of diflufenican, a herbicide from a new site of action for control of Amaranthus spp in corn and soybean production systems in North America, pending registration with the U.S. EPA and Canada PMRA. Given the increasing challenge of managing herbicide-resistant weeds, diflufenican is being evaluated in field trials in North America for residual activity on Amaranthus spp. and crop selectivity in soybean and corn. A preliminary update on diflufenican development will be given featuring performance data from field trials. Pending registration with the U.S. EPA and Canada PMRA, diflufenican would enable a new weed management tool that should be used in combination with other weed management practices as part of an integrated weed management plan.

Intrava DX: A New Herbicide for the U.S. Corn Acre. Ryan S. Henry*[1], Thomas Mudd[2], Cody J. Gray[3]; [1]UPL NA Inc., Fort Wayne, IN, [2]UPL NA Inc., Minneapolis, MN, [3]UPL NA Inc., Peyton, CO (390)

A successful weed management program in corn to maintain yield potential involves reducing or eliminating weed interference though the mid-vegetative stage of development; however, mitigating the development of weed resistance requires a full-season, multi-year plan. As part of an IWM strategy, the chemical portion needs to be diverse and effective for successful outcomes. UPL NA, Inc. is developing a new herbicide product called Intrava™ DX, which is pending registration with the U.S. EPA. Intrava™ DX is a pre-mixture herbicide consisting of HRAC Group 5 active ingredients amicarbazone and metribuzin. UPL herbicides containing amicarbazone have been utilized globally in corn and sugarcane for several years, while amicarbazone use in the U.S. has been limited to turf systems. Intrava™ DX will allow growers to have an unique and effective pre-plant or pre-emergence herbicide in corn and is pending registration with the U.S. EPA.

Estimating Cover Crops Weed Suppression in Row-Middles of Citrus Orchards. Miurel T. Brewer*[1], Sarah L. Strauss[2], Carlene A. Chase[3], Brent A. Sellers[4], Davie M. Kadyampakeni[2], Ramdas Kanissery[5]; [1]University of Florida, Lake Alfred, FL, [2]University of Florida, Gainesville, FL, [3]University of Florida, Horticultural Sciences Department, Gainesville, FL, [4]University of Florida, Ona, FL, [5]University of Florida - IFAS, Immokalee, FL (474)

A study was conducted in Southwest Florida to evaluate the effectiveness of using cover crops as a sustainable weed management strategy in citrus production. The study was carried out in two citrus groves with mature HLB-affected trees, and two cover crop mixes were tested against a grower standard control that used paraquat for weed management. The cover crop mixes consisted of legume and non-legume species, and non-legume species only. Cover crop and weed density data were collected two months after seeding the cover crop mixes. In the spring of 2020, 2021, and 2022, fresh and dry biomass and the density of the cover crops and weeds were collected. Results showed that both cover crop mixtures were effective in suppressing weeds by 86 to 99% compared to the grower standard control, and there were no significant differences between the two cover crop mixes. The cover crops reduced the number of weeds and weed biomass by 95 to 99% in citrus row middles compared to the grower standard control. However, the effectiveness of the cover crops varied in different growing seasons due to differences in germination and establishment of the cover crops.

Exploring the Efficacy of New Herbicides for Postemergence Control of Italian Ryegrass in Hazelnut Orchards. Joshua W. Miranda*, Marcelo L. Moretti; Oregon State University, Corvallis, OR (475)

Herbicide resistance in Italian ryegrass presents a significant and escalating challenge in hazelnut orchards, leading to escalated management costs. Recently registered postemergence herbicides, tiafenacil (a protoporphyrinogen oxidase-inhibiting herbicide) and florpyrauxifen-benzyl (a synthetic auxin), offer potential solutions for hazelnut weed control. However, the effectiveness of these new herbicides in controlling Italian ryegrass remains largely unexplored in existing literature. Field studies conducted from 2021 to 2023 assessed the efficacy of tiafenacil and florpyrauxifen-benzyl on Italian ryegrass in hazelnut orchards. Tiafenacil, applied individually at 25, 50, 75, or 150 g ai ha^{-1}, exhibited inconsistent control of Italian ryegrass, depending on the experimental site and year. In 2021, Italian ryegrass control with tiafenacil (50 to 150 g ai ha^{-1}) was comparable to glufosinate (1,150 g ai ha^{-1}). While in 2022, tiafenacil at 50 g ai ha^{-1} controlled 22% of Italian ryegrass in a different site. In 2023, Italian ryegrass control with tiafenacil ranged from 20 to 60% among five sites, which never surpassed control with glufosinate and clethodim at 135 g ai ha^{-1}. Tiafenacil effectiveness was likely influenced by resistance to glufosinate, clethodim, glyphosate, paraquat or their combination depending on the experimental site. In most cases, mixtures of tiafenacil with glufosinate or clethodim exhibited better performance, reducing Italian ryegrass inflorescence compared to each herbicide applied individually. In contrast, florpyrauxifen-benzyl at 29 g ai ha^{-1}did not control Italian ryegrass across all sites, despite its grass activity. While the florpyrauxifen-benzyl alone was ineffective in controlling Italian ryegrass, its mixture with clethodim, diuron, rimsulfuron, glufosinate, glyphosate, did not compromise their individual performances. This suggests the potential for growers to combine florpyrauxifen-benzyl with specific herbicides, expanding the spectrum of controlled weeds in hazelnut orchards. These findings highlight the importance of herbicide mixtures to manage resistance, emphasizing the need for diversified approaches in weed control to mitigate the impact on hazelnut orchard sustainability.

Improved Herbicide Selectivity in Tomato by Safening Action of Benoxacor, Fenclorim, Melatonin and 2,4,6 - Trichlorophenoxyacetic Acid. Dante Elias*[1], Tabata Raissa De Oliveira[2], Antonio Augusto Correa Tavares[3], Varsha Varsha[4], Josiane C. Argenta[1], Te-Ming (Paul) Tseng[5]; [1]Mississippi State University, Starkville, MS, [2]Mississippi State University, Starkville, Ms, MS, [3]University of Nebraska-Lincoln, North Platte, NE, [4]Department of Plant and Soil Sciences, Mississippi State University, Starkville, MS, [5]Mississippi State University, Mississippi State, MS (476)

Safeners are vital for protecting crops by enhancing their ability to metabolize various compounds, including herbicides. They primarily work by increasing the crop's tolerance to herbicide damage, activating herbicide-metabolizing proteins, and aiding in their detoxification. This study aimed to investigate the chemical effects of benoxacor, fenclorim, 2,4,6-T, and melatonin safeners in tomato cultivation, focusing on injury reduction and tissue protection. The experiment followed a randomized factorial design (5x4) with four replications, examining the effects of herbicides (dicamba, 2,4-D, metribuzin, and sulfentrazone at 1/100) and safeners (benoxacor, fenclorim, melatonin, 2,4,6-T, and a control). Treatments were applied to the aerial parts of tomato seedlings, and visual injury was evaluated at 7, 14, and 21 days after application (DAA). Biomass measurements were taken at 21 DAA. Results showed that pre-treating tomato seeds with 2,4,6-T, melatonin, and fenclorim significantly decreased injury at 7 DAA (25, 25, and 23% injury, respectively). Benoxacor and control treatments resulted in 33 and 32% injury, respectively. At 21 DAA, tomato plants exhibited over 50% injury with all herbicide and safener combination, with the exception of 2,4,6-T safener, which resulted in the least injury (48%, average of all herbicides). Understanding plant defense mechanisms and the protective effects of safeners, such as benoxacor, fenclorim, 2,4,6-T, and melatonin, can enhance the health and resilience of tomato plants, offering valuable insights for effective weed management. This research highlights the potential of pre-treatment with 2,4,6-T, melatonin, and fenclorim to reduce injury, while the application of melatonin, benoxacor, and 2,4,6-T can increase dry biomass, with implications for improving crop health and productivity in tomato farming.

IR-4 Weed Science Update - Food Crops. Roger B. Batts*; IR-4 Project HQ, NC State University, Raleigh, NC (477)

IR-4 Weed Science Update – Food Crops. Roger B. Batts. IR-4 Project, NC State University, Raleigh, NC Residue projects IR-4 data submitted to EPA led to over 340 new specialty crop uses in 2023, including new or expanded uses for rimsulfuron, trinexapac, ethalfluralin, fluazifop, fomesafen, and acifluorfen. Rimsulfuron uses were approved for pomegranate and edible peel tropical and subtropical small fruits. Trinexapac-ethyl now has established tolerances for both forage and hay clover. Fluazifop approvals include low growing berries, leafy brassica greens, chives, citrus, stone fruits, leaf petiole vegetables, green onions, papaya, head and stem brassicas, and arugula. Fomesafen uses include bulb vegetables, cucurbit vegetables and fruiting vegetables. Glufosinate approvals include grass forage and hay as well as medium to large tropical and subtropical fruits, both edible and inedible peel types. Edamame and low growing berries now have established tolerance for acifluorfen. IR-4 submitted two herbicide data petitions to EPA in 2023 (pyridate and dimethenamid). These submissions could potentially lead to more than 50 new published uses. Twenty-one new herbicide magnitude-of-residue studies began in 2023. They include clethodim on avocado, olive and rice, Ethephon on hazelnut, fluazifop on succulent pea and summer squash, fluroxypyr on mint, glufosinate on peanut and strawberry, indaziflam on asparagus, pyridate on sweet corn, rimsulfuron on avocado, s-metolachlor on perennial peanut, tiafenacil on blueberry, cucumber, mint, pepper and tomato, and uniconazole on greenhouse basil and mint. Nineteen new herbicide and PGR residue studies are scheduled to begin in 2024. These include clethodim on fig, Ethephon on ginseng, ethofumesate on swiss chard, flumioxazin + pyroxasulfone on cucumber, squash and cantaloupe, indaziflam on camas, linuron on mint, stevia and green onion, mesotrione on sesame, metribuzin on potato, NAA on plum and hazelnut, s-metolachlor on carinata and field pennycress, and tolpyralate on hazelnut, blueberry and sweetpotato. Product Performance projects Generating Product Performance (efficacy and crop safety) data to support registration of pest management tools in specialty crops continues to be an important and expanding part of the IR-4 annual research plan. The number of on-going herbicide Product Performance studies in 2023 was thirty-four, including nearly 100 individual trials. The 2024 Performance research plan for herbicides and plant growth regulators includes twenty-seven continuing or new studies (nearly 70 individual trials). Integrated Solutions projects IR-4's Integrated Solutions (IS) Program is structured to assist specialty crop growers outside of the traditional single product/single crop residue and product performance research. IS research efforts focus on crop-pest combinations to address solutions in these four areas, 1) pest problems without solutions, 2) resistance management, 3) products for organic production and 4) pesticide residue mitigation. In 2023, there were seven active IS projects with herbicides and plant growth regulators (18 individual trials), three of which will continue in 2024. Four new weed control IS studies will begin in 2024 (9-10 individual trials), including agave, camelina, pumpkin and hemp.

Evaluating Sweetpotato (*Ipomoea batatas)* Tolerance to Herbicides Applied Post-transplant.
Stephen J. Ippolito*, Katherine M. Jennings, David W. Monks, David L. Jordan, Levi D. Moore, Adrienne M. Gorny; North Carolina State University, Raleigh, NC (479)

Weed competition with sweetpotato can reduce yield. In addition, competition for light and other resources can leave crops more vulnerable to infection by pathogens such as nematodes. Limited herbicides are registered for use in sweetpotato, especially POST-transplant. Therefore, field studies were conducted to determine the effect of herbicides applied POST-transplant to sweetpotato on sweetpotato growth, yield, and quality. Study design was a randomized complete block and treatments were replicated four times. Treatments were arranged in a 3 x 2 x 2 factorial arrangement in which the whole plot factors consisted of herbicide (nontreated, tolpyralate 29.2 g ai ha^{-1}, pyridate 696 g ai ha^{-1}), application timing (at 1 or 12 days after transplanting), and the addition or absence of *S*-metolachlor (1070 g ai ha^{-1}) in the tank mix. Foliar injury from tolpyralate and pyridate was relatively low and mostly transient with injury from all treatments < 8% by 4 wk after transplanting. Total yield (sum of canner, no. 1, and jumbo grades) for all treatments was similar to the nontreated. Tank mixing *S*-metolachlor significantly reduced marketable yield but did not have a significant effect on total yield. Tolpyralate and pyridate are not registered for use in sweetpotato and have the potential to be registered for weed management POST-transplant.

Evaluating Spring-Seeded Cover Crop Termination Timing for Weed Control in Watermelon. Kurt M. Vollmer*[1], Thierry E. Besancon[2], Carrie Mansue[3]; [1]University of Maryland, Queenstown, MD, [2]Rutgers University, Chatsworth, NJ, [3]Rutgers University, Mays Landing, NJ (480)

Weeds reduce yields in plasticulture production systems. Weeds growing between rows can compete with the crop, interfere with harvest, and serve as hosts for plant pathogens and other pests. Previous research has shown spring-seeded cover crops seeded in between plastic rows can provide weed suppression in conjunction with an effective herbicide at cover crop termination. However, it may take several weeks to obtain sufficient cover crop biomass for season-long weed suppression, and certain weeds may become too large prior to cover crop termination. The main objective of this project was to evaluate weed control and watermelon yield in response to the termination timing of an oat cover crop planted between plasticulture rows. The trial was conducted as a split plot design with four replications. Whole plots consisted of cover crop termination timing with paraquat (560 g ha^{-1}) at either boot or heading stage of spring oat and subplots included either a spring oat cover crop seeded between rows or no cover crop. Trials were conducted at the Wye Education and Research Center in Queenstown, MD, and at the Rutgers Agricultural Research and Extension Center in Bridgeton, NJ. Results showed that oat stage at termination had no effect on weed biomass, cover crop biomass and average watermelon marketable weight. An oat cover crop reduced weed seed density 47% compared to no cover crop 35 days after treatment, and weed biomass 75% at 115 days after seeding. The effects of cover crop termination timing and the presence of a cover crop did not affect total watermelon yield and fruit count. However, treatments containing a cover crop yielded 62% more marketable fruit and larger fruit (6.1 kg) compared to no cover crop treatments (4.7 kg). These results suggest that an oat cover crop can be terminated as early as the boot stage without sacrificing weed control efficacy and crop yield. This study corroborates past studies showing the use of a spring seeded oat cover crop between rows in plasticulture production systems reduces weed competition and improves watermelon yield in addition to reducing the number of herbicide applications required for weed control.

Glufosinate and 2,4-D Choline as Novel Postemergence Herbicides in Blackberry Production.
Matthew B. Bertucci*, Rachel C. Woody-Pumford, Ali Ablao; University of Arkansas, Fayetteville, AR (481)

Two field studies assessed blackberry injury and yield responses to treatment with various applications of glufosinate or 2,4-D choline, respectively. In Fayetteville, blackberries were assessed for tolerance to treatment with glufosinate (1.97 or 3.93 kg a.i. ha^{-1}) or saflufenacil (1.97 kg a.i. ha^{-1}). Herbicides were applied to four plant plots containing newly planted blackberry plugs (var. 'Ponca') as shielded sprays and as directed sprays in 2022 then repeated as directed sprays prior to primocane emergence and finally postharvest in 2023. Treatments were replicated 4 times and compared to a nontreated control. Blackberry plants were visually assessed for crop injury 7, 14, 30, and 60 days after treatment (DAT) for each application. Yield data were collected on marketable berry yield, cull yield, and average berry weight at each harvest. In 2022, no crop injury exceeded was observed following shielded sprays, and only very minor injury (2.5 to 3.0%) was observed at 14 DAT in the lower canopy of banded sprays of glufosinate. Blackberry marketable yields were not reduced by saflufenacil or the low rate of glufosinate; however, the high rate of glufosinate reduced marketable yield by ~28% relative to the nontreated control. A separate study in Clarksville, AR assessed mature, well-established blackberry plants (var. 'Ouachita') injury and yield responses to treatment with 2,4-D choline (1.6 kg a.e. ha^{-1} or 3.2 kg a.e. ha^{-1}). Each rate was applied in 2022 and 2023 in three sequential sprays: directed spray over plant crowns prior to bud break, followed by banded spray approximately 14 days after primocane emergence, followed by a directed spray 30 days postharvest. Treatments were replicated 4 times and compared to a nontreated control. Crop injury ratings were assessed 15 and 30 DAT following each herbicide application. Yield data were collected similarly to the previous study. No crop injury was observed as a result of dormant applications of 2,4-D choline. Low levels of injury (1 to 6%) were observed 15 and 30 DAT with banded sprays of 2,4-D choline, likely due to suckers intercepting the systemic herbicide. Yields were unaffected by herbicide treatment for marketable yields or berry weights at any harvest. These findings provide evidence that 2,4-D choline and glufosinate would be safe for use in blackberry plantings at these rates and timings and would afford blackberry growers two critical new postemergence herbicide options.

Weed Control with Saturated Steam in Organic Highbush Blueberry (*Vaccinium corymbosum*). Rafael M. Pedroso*[1], Marcelo L. Moretti[2]; [1]University of Sao Paulo, Piracicaba, Brazil, [2]Oregon State University, Corvallis, OR (482)

Weed management is often identified as a predominant and costly problem in organic blueberries. Geotextile weed fabrics, or woven polyethylene, are predominantly used in organic blueberry fields to suppress weeds growing in the planting rows. Weeds, such as *Convolvulus arvensis* L., grow at the base of the blueberry plants or through openings and the edges of the weed fabric, requiring hand weeding. This study evaluates the integration of saturated steam (SS), rotary brush (RB), and organic herbicides for weed control in blueberries. Dose-response studies indicated that the SS applied at 121 C and 7,400 L ha^{-1} of steam resulted in over 90% control and reduction of dry weights of *C. arvensis*. When treatments were directed to the base of blueberry plants, SS at 7,400 L ha^{-1} controlled *C. arvensis* at 80% 28 days after treatments and was comparable to hand-weeding, and *C. arversis* regrowth was observed on both treatments. Both treatments performed better than capric plus caprylic acid (CC) (33.2 kg ai ha^{-1}) or ammonium nonanoate (AN) (24.3 kg ai ha^{-1}). Four repetitive basal applications of SS up to 29,600 L ha^{-1} over two consecutive years caused minimal and transient damage to new basal shoots of 'Elliot' and 'Duke' blueberry, not affecting shoot cross-sectional-area compared to nontreated. In contrast, basal application of AN treatments damaged or killed basal shoots. When treatments were applied to the edge of the weed fabric, SS (7,400 L ha^{-1}) reduced weed biomass by 42 to 93% 28 days after treatment compared to nontreated. RB reduced weed biomass by between 72 and 99% in all experiments, while CC acid and AA reduced biomass by 18 to 54%. A partial budget analysis indicated that SS and RB were 3- and 6.5-fold cheaper than organic herbicides. Integrating mechanical (RB) and physical (SS) improved weed control. Despite improved weed control, the RB weeder damaged the weed fabric where preexisting wholes were present, and it generated dust, increasing the chances of fruit contamination. SS was safe for both the weed fabric and the blueberry, but the weed regrowth following treatment and the copious amounts of water required hindered its feasibility.

Yellow Nutsedge and Canada Thistle Response to Electricity and Mowing. Luisa C. Baccin*, Marcelo L. Moretti; Oregon State University, Corvallis, OR (483)

Managing the extensive root systems of perennial weeds is crucial for effective weed control. Electric Weed Control (EWC) offers a novel approach by applying electricity through the weed's foliage and moving energy through its root system. This research focuses on assessing the effectiveness of EWC, mowing, and their combination in controlling yellow nutsedge and Canada thistle. A single EWC application at 30 or 60 MJ ha^{-1} controlled 26 to 30% of nutsedge 56 days after initial treatment. Controlled improved with two EWC applications at 15 MJ ha^{-1} (48%) or three at 10 MJ ha^{-1} (69%). Mowing followed by EWC performed better than EWC followed by mowing in most cases. EWC resulted in smaller tubers and reduced tuber viability by 38 to 62% compared to 85% in nontreated. Additionally, EWC applied two or three times reduced tuber vigor, resulting in the lowest dry weight of emergent plant tubers in the greenhouse. Canada thistle was best controlled by mowing, followed by EWC (82%) and three applications of EWC at 10 MJ ha^{-1} (86%). The enhanced effectiveness observed in the combination of mowing followed by EWC and the repeated applications of EWC at higher speeds holds the potential for nonchemical control of perennial weeds. Further research is needed to evaluate the long-term effect of EWC on weed composition and its costs, thus paving the way to identify a cost-effective low-input weed management program.

Does the Critical Weed Free Period for Transplanted Hemp Depend on Weed Species Involved? Harlene M. Hatterman-Valenti*, Brock Schulz, Mason Hill, Avery Shikanai, Collin Auwarter; North Dakota State University, Fargo, ND (484)

There is a growing demand for hemp-derived products in the US but because of the crop's previous designation as a Schedule 1 Substance and history of criminalization, there is limited University-produced information describing best production practices. The research objective was to define the critical weed-free period for transplanted floral hemp. Two field trials were conducted again in 2023 at an outlying Agriculture Experiment Station near Prosper, ND. Three cultivars (Bubbatonic, Sour Space Candy, and Quick Spectrum) were seeded in a greenhouse approximately five weeks prior to transplanting on June 14. Plants were transplanted on 0.9 m centers with 1.8 m between rows as a randomized complete block design with critical weed free period and cultivar as factors with four replications. The annual trial had a distribution primarily of broadleaves wild mustard (Sinapis arvensis), redroot pigweed (*Amaranthus retroflexus*), waterhemp (*A. tuberculatus*), eastern black nightshade (*Solanun ptychanthum*) common lambsquarters (*Chenopodium album*) as well as grasses green foxtail (*Setaria viridis*) and barnyard grass (*Echinochloa crus-galli*). The perennial trial was predominantly Canada thistle (*Cirsium arvense*). Treatments were weed-free (weekly weed removal all season), 0 (nontreated), 1, 2, 4, & 6 wks. Plants were harvested October 20 and air-dried for 2 wks before bucking leaf and floral biomass from stems. Results from 2022 and 2023 were quite different due to timely rainfall and lack of rain, respectively. Hemp stem diameter, stem number, plant weight:height ratio, and dry biomass yield responses to the number of weed-free weeks for annual weeds and perennial weeds were generally similar except that the slope for dry biomass yield and plant weight:height ratio in response to the number of weed-free weeks was steeper with annual weeds in 2023, suggesting that with the lack of rainfall there was less competition with annual weeds later in the season. Hemp plant height response to the number of weed-free weeks for annual weeds and perennial weeds was completely opposite in 2022 with a decrease in plant height as the number of weed-free weeks increased for annual weeds while plant height increased as the number of weed-free weeks increased for perennial weeds. Results indicated that the height differences were due to the plant allocation of photosynthates in response to water availability. Results suggest that the weed-free period of annual versus perennial weeds is most important when rainfall during the growing season is limited for transplanted floral hemp.

Implementing Digital Multispectral 3D Scanning Technology for Rapid Assessment of Hemp (Cannabis Sativa L.) Weed Competitive Traits. Matthew A. Cutulle*[1], Gursewak Singh[2], Lynn M. Sosnoskie[3], Michael L. Flessner[4], Harlene M. Hatterman-Valenti[5], Karla L. Gage[6]; [1]Clemson University, Charleston, SC, [2]Clemson University, Clemson, SC, [3]Cornell University, Geneva, NY, [4]Virginia Tech, Blacksburg, VA, [5]North Dakota State University, Fargo, ND, [6]Southern Illinois University Carbondale, Carbondale, IL (485)

The economic significance of hemp (Cannabis sativa L.) as a grain, fiber, and flowers is rising steadily. However, due to the lack of registered herbicides for use on hemp, growers have limited weed management options. Slow-growing hemp varieties can be outcompeted by weeds for sunlight, water, and nutrients. Therefore, growers need to use Integrated Weed Management (IWM) strategies that may be easily adopted for effective weed control. To solve these challenges, novel approaches are required to identify quantitative phenotypes and explain the genetic basis of important weed-competitive traits. These advances will facilitate the screening of germplasm with high performance characteristics in resource-limited environments such as crop-weed competition. Plant height and canopy architecture may affect crop-weed competition. However, manually measuring these parameters is a time-consuming process. Therefore, digital phenotyping tools were adopted to address this challenge. The PlantEye (PE) laser scanner was selected as the high-throughput phenotyping technology for evaluation of plant architecture, which has been optimized for a range of crops and trusted to be reliable and highly accurate, but it has not been tested for crops like hemp with different growth habits and height differences. In this study, the suitability of PE was evaluated at the Clemson University Coastal Research and Education Center to screen diverse hemp genotypes. We performed a range of validation tests for morphological features (digital biomass and plant height). Significant correlation ($P < 0.001$) between digital biomass and manually measured biomass ($r = 0.89$) as well between digital height and manually measured height ($r = 0.94$) observed, indicated a high precision and usefulness of 3D multispectral scanning in measuring morphological traits. These results increased our confidence in the accuracy of the system and drastically reduced the amount of time-intensive destructive measurements needed to monitor biomass increase over time.

Exploring Warm-Season Turfgrass Tolerance to Natural Alternative Weed Control Methods.
Jacob W. Taylor*, Lambert B. McCarty, Timothy Stoudemayer; Clemson University, Clemson, SC (433)

Interest in using "natural" or "organic" alternatives for weed control has increased, with concerns about using certain synthetic products and weeds like annual bluegrass (aka, Poa), developing widespread herbicide resistance for various herbicidal modes of action. Typically, these "natural" products are non-selective; most are either salt- or acid-based. Salt-based products generally cause severe desiccation in treated plants, whereas acids disrupt/degrade cuticles, contaminating cellular content. A field study was conducted at Clemson University to evaluate warm-season turfgrass tolerance of several nontraditional, "natural" products and their effectiveness for weed control.Treatments were applied to warm-season turfgrasses, including common bermudagrass (*Cynodon dactylon*), centipedegrass (*Eremochloa ophiuroides*), St. Augustinegrass (*Stenotaphrum secundatum*), a course-bladed (empire/palisades) zoysiagrass (*Zoysiagrass japonica* Steud. x *Zoysia matrella* (L) Merr.), and a fine-bladed (royal) zoysiagrass (*Zoysiagrass japonica* Steud. x *Zoysia matrella* (L) Merr.). This study included 12 different treatments, products and rates screened included: untreated control, Suppress herbicide (480 oz/a), clove oil + Dawn (384 oz/a), Weed Zap (384 oz/a), Avenger Weed Killer (1140 oz/a), Fiesta Turf Weed Killer (300 oz/a), Ecologic Weed & Grass Killer (384 oz/a), Weed Pharm (100% v/v), FinalSan (20% v/v), Sythe (10% v/v), Vinegar (1 gal/1000 sq. ft.) + Salt (8 oz/1000 sq. ft.) + Dawn (1 oz/1000 sq. ft.), and Axxe (10% v/v). All products were applied during the summer/early fall with a CO_2-pressurized backpack sprayer at 187 L/ha (20 gal/ac).Treatments were assessed visually for turf phytotoxicity (0 to 100% where 0% = no phytotoxicity, 30% = maximum acceptable level, and 100% = complete turfgrass death) and visual weed control (0 to 100% where 0% = no control and 100% = complete control) 1, 7, 14, and 21 days after treatment (DAT). Turf phytotoxicity observed after some treatments appeared to be visually similar to the burndown observed after using a non-selective herbicide such as glyphosate. Phytotoxicity was most significant at 1 DAT with acetic acid (vinegar) causing the greatest phytotoxicity to the fine-bladed zoysiagrass. However, all turfgrasses recovered with phytotoxicity below the maximum acceptable level by 14 DAT. None of the treatments visually provided significant control, and the results were short-lived. Therefore, these products do not appear to be suitable alternatives for synthetic herbicides used for control. They are not nearly as effective and may potentially cause temporary damage to the desired turf.Additional research is needed to investigate application timing and rate for optimal control and evaluate new products as they become available.

Late Season Poa Annua Control on Non-overseeded Tifeagle Green - Glufosinate Vs. Diquat.
Derrick H. Taylor*, Lambert B. McCarty, Timothy Stoudemayer; Clemson University, Clemson, SC (434)

A field study was conducted at Clemson University to examine the effects of glufosinate and diquat as a post-control of *Poa annua* on a TifEagle bermudagrass green (*Cynodon dactylon* x *C. traansvalensis germplasma)*. The study used three rates of diquat at 0.5pt/a, 1pt/a, and 2pt/a. The glufosinate was also evaluated at three rates of 13.68fl oz/a, 27fl oz/a, and 41fl oz/a. Both Diquat and glufosinate had excellent control over the Poa over the course of observation. The lowest rate of diquat and glufosinate showed no difference from the control initially but ended at a similar rate of control has the higher dosages. Green up was evaluated on April 18 and May 2. On April 18 the glufosinate rate of 41fl oz/a had a lower rate of green up than all the other treatments. Whereas on May 2 the diquat at 0.5pt/a at a higher rate of green up.

Unraveling the Mechanism of Quinclorac Resistance in Smooth Crabgrass (*Digitaria ischaemum*). Claudia A. Rutland*[1], Todd A. Gaines[2], Eric L. Patterson[3], Luan Cutti[4], Brian Zeka[5], Victor Llaca[6], Jinesh Patel[7], Sejal Patel[7], Joseph S. McElroy[7]; [1]Auburn University Department of Crop, Soil, and Environmental Sciences, Auburn, AL, [2]Colorado State University, Fort Collins, CO, [3]Michigan State University, East Lansing, MI, [4]Federal University of Rio Grande do Sul, Porto Alegre, Brazil, [5]Corteva, Johnston, IA, [6]Corteva Agriscience, Johnston, IA, [7]Auburn University, Auburn, AL (435)

Quinclorac is a unique synthetic auxin herbicide known for its grass-in-grass specificity, as other synthetic auxins only provide control over broadleaf species while leaving grasses unharmed. Thus, quinclorac is a useful turfgrass herbicide as it provides grass-in-grass control in turfgrass stands and also control of select broadleaf weeds. Resistance to quinclorac in smooth crabgrass has been previously identified, but the full mechanism of resistance is still unknown. Auxin functions as the regulator for the degradation of AUX/IAA proteins, and target-site mutations have been identified in other synthetic auxin herbicides in many of these AUX/IAAs. Research was conducted in order to determine if a specific AUX/IAA within smooth crabgrass has causative mutation which endows resistance to quinclorac. Herein we performed a comparative analysis of resistant and susceptible smooth crabgrass populations using Trinity and Trinotate to identify potential mutations within all copies of the AUX/IAA gene family. A novel genome was also produced, which allowed us to perform a differential gene expression (DGE) study to identify any other genes that may be up or down-regulated between the resistant and susceptible lines. A point mutation located outside the degron was identified with potential for conformational change within the active site of the AUX/IAA protein. DGE analysis is currently being conducted, but if the mutation is the causative mechanism, it is not expected to yield any biologically important differentially expressed genes. As of this writing, no metabolic genes of importance (Cytochrome P4050s, GSTs, ABC Transporters) have been identified as differential expressed

Sources of Error Associated with Targeted Application Equipment. Shawn Askew*, John M. Peppers; Virginia Tech, Blacksburg, VA (436)

Precision weed management in turfgrass and ornamental landscape systems is utilized to offset chemical costs, reduce nontarget plant injury, and to control potential herbicide-resistant weed escapes. Targeted application devices (TAD) are regularly marketed for use in turfgrass and ornamental landscape systems, but no scientific characterization of their fluid output has limited TAD use to nonselective herbicides. Five commonly-utilized TAD were evaluated to test for variability in fluid output within a given device and between evaluated devices. Fluid output for all evaluated devices ranged from 3.2-6.9 kL ha-1 and were orders of magnitude higher than typical broadcast spray output. The evaluated devices significantly varied between models, and high levels of variability were detected within a given model. Variance of output from devices with large fluid reservoirs was driven by reservoir fill level, with more fluid output decreasing linearly as reservoir fill level decreased. Additionally, when airlock was not maintained during application, fluid output was ~178% greater than when airlock was maintained. Average force, maximum force, contact time, and fluid output following 25 applications was measured from five TAD users. Contact time was highly correlated (R2=0.93) to fluid output, with fluid output increasing as contact time increased. Subsequent economic analysis indicated the maximum percent weed coverage ha-1 at which TAD use is economically equivalent or less than broadcast application is 3, 8.1, 4.3, and 0.1% with iron HEDTA, acetic acid, methiozolin, and glyphosate, respectively. These data indicate fluid output from TAD can widely vary between devices and within a given device. The primary sources of variability are reservoir fluid fill level, reservoir airlock, and duration of application.

Smooth Crabgrass and Goosegrass Control During Bermudagrass Establishment. Navdeep Godara*[1], Daewon Koo[1], Hannah Wright Smith[2], Shawn Askew[1]; [1]Virginia Tech, Blacksburg, VA, [2]University of Arkansas, Little Rock, AR (437)

Weed control options for troublesome weeds are limited during the establishment of hybrid bermudagrass through sprigging due to rising herbicide resistance concerns. Research experiments were conducted in Blacksburg, VA in 2023 to evaluate goosegrass and smooth crabgrass control and tolerance of bermudagrass sprigs to postemergence herbicides applied 3- to 5 weeks after sprig establishment. Treatments included a nontreated control, handweeding, foramsulfuron, foramsulfuron + quinclorac, mesotrione + metribuzin, quinclorac, sulfentrazone + metribuzin, sulfentrazone + quinclorac, thiencarbazone + foramsulfuron + halosulfuron, topramezone + quinclorac, 2,4-D + MCPP + dicamba + carfentrazone, and 2,4-D + MCPP + dicamba + carfentrazone + quinclorac. Quinclorac-based treatments reduced smooth crabgrass cover and shoot density. Topramezone + quinclorac injured bermudagrass sprigs 86% at 14 d after treatment (DAT) and also reduced shear strength to 17 Nm at 28 DAT. Quinclorac-based treatment transiently injured bermudagrass sprigs >20%, but turf recovered completely after 28 DAT. Mesotrione + metribuzin and topramezone + quinclorac treatments reduced goosegrass cover and shoot density. Thiencarbazone + foramsulfuron + halosulfuron and topramezone + metribuzin caused minimal or transient phototoxicity to several cultivars of bermudagrass turf and did not negatively impact turf establishment.

Investigating Herbicide Strategies for Doveweed (*Murdannia nudiflora*) Control. Bridgette C. Johnson*, Joseph S. McElroy; Auburn University, Auburn, AL (438)

Doveweed (Murdannia nudiflora) is a monocot weed commonly found in turfgrass across the United States, presenting a challenge due to its late germination compared to other annual weeds, with germination typically occurring in June and July. This late germination complicates the use of preemergence herbicides designed for earlier germinating crabgrasses (Digitaria spp.) Imazaquin, an imidazolinone-based postemergence herbicide that inhibits acetolactate synthase, has shown effectiveness in controlling doveweed. However, its efficacy, along with other postemergence herbicides, can vary due to difficulties in absorption through the weed's waxy cuticle. To address this, research was conducted to assess the control of doveweed in warm-season turfgrass using imazaquin, metsulfuron-methyl (MSM), Surepyc IQ (a product containing imazaquin and sulfentrazone), and Celsius (a product containing dicamba, iodosulfuron-methylsodium, and thiencarbazone-methyl). Various application rates (imazaquin at 0.25, 0.38, 0.50 kg ai/ha; MSM at 0.012, 0.019, 0.025 kg ai/ha; Surepyc IQ at 0.25, 0.375 kg ai/ha; and Celsius at 0.50, and 0.25 kg ai/ha) and methods, including single and multiple sequential applications applied three weeks apart, were tested. All imazaquin with MSM or sulfentrazone controlled doveweed > 75% 84 days after the initial treatment (DAIT). However, MSM and imazaquin alone controlled doveweed < 75%. We theorized that adequate root absorption is needed for imazaquin control. Therefore, we conducted a second study evaluating soil vs. foliar exposure to imazaquin and atrazine in a greenhouse pot study. Atrazine exhibited 100% control when applied through foliar, soil, or a broadcast method exposing the herbicide to soil and foliage. Imazaquin also achieved 100% control through foliar and soil applications individually. Surprisingly, the broadcast application with imazaquin did not result in complete control, and the plants showed signs of recovery three weeks after the treatment. These data suggests that imazaquin or atrazine soil exposure can aid doveweed control.

Will Robotics Revolutionize Weed Control in Turf? Juan Romero*, Shawn Askew; Virginia Tech, Blacksburg, VA (439)

Will robotics revolutionize weed control in turf? By Juan Romero and Shawn D. Askew The turfgrass industry is challenged by labor shortages, herbicide resistant weeds, and ever-increasing regulatory burden on new pesticide technologies. Autonomous sprayers and robotics could address several of these challenges. Autonomous mowers and golf ball pickers have gained popularity in recent years. With recent advances in artificial intelligence (AI), autonomous systems of increasing complexity are under development. Such systems could address weed control issues by allowing alternative treatments to conventional herbicides that are administered via individual plant treatment (IPT). Historically, many technologies used in turfgrass management are influenced by production agriculture. Autonomous systems are widespread in production agriculture with robotics systems employed in harvest and aerial reconnaissance. Weed control technologies are also under development that utilize computer vision and optical weed recognition. Such systems are employed for "smart sprayers" currently under development by several companies but only a few are under product testing. In turf, only a few companies have products under development or marketed. For example, Small Robot Company and Ecorobotix have developed autonomous vehicles that kill weeds using electrodes or with precision sprays. Dandytek is the only company that offers an autonomous robot for weed control in lawns. Virginia Tech is evaluating laser and cryogenic weed control technologies based on potential robotics applications. By addressing escaped weeds, the technology could be transformative in the area of herbicide resistance management. Targeting weeds via machine vision, however, may lead to mimicry since many important turfgrass weeds are inherently similar to turfgrass. Autonomous systems also come with issues related to public safety and job displacement. These autonomous systems that use IPT are expected to augment but not replace existing weed control technologies.

Mid- to Late-Season Post-Emergent Control of Virginia Buttonweed. Adam Gore*, Lambert B. McCarty, Timothy Stoudemayer; Clemson University, Clemson, SC (440)

Mid- to Late-Season Control of Virginia Buttonweed A.W. Gore[1], L.B. McCarty[1], T. Stoudemayer[1]; [1]Clemson University, Clemson, SC, 29634-0310 ABSTRACT Virginia buttonweed (*Diodia virginiana* L.) is a perennial, warm-season, broadleaf plant that is considered one of the most common and difficult weeds to control in turf areas of the world. Control is complicated, in part, by its various potential propagation methods including below-ground seed production and adventitious rooting of cut stems or roots. In this study, Virginia buttonweed growing within a mix of common (*Cynodon dactylon* (L.) Pers) and hybrid bermudagrass (*C. dactylon* (L.) Pers x *C. transvaalensis* Burtt-Davy) was treated with 2,4-D + dicamba + MCPP [Trimec Classic] (4.68 L ha^{-1}), 2,4-D + trifloxysulfuron [Monument 75DF] (0.56 kg ai ha^{-1} + 31.5 g ha^{-1}) , 2,4-D + dicamba + MCPP + sulfentrazone [Surge 2.18L] (3.8 L ha^{-1}), 2,4-D + dicamba + fluroxypyr [Escalade 2 4.4L] (2.34 L ha^{-1}), and 2,4-D + dicamba + clopyralid [Millennium Ultra 2] (2.34 L ha^{-1}) followed by a second application 42 days after initial treatment (DAIT). Bentazon [Basagran T&O 4L] + Monument 75DF (3.51 L ha^{-1} + 31.5 g ha^{-1}) and Basagran T&O 4L + metsulfuron 60DF (3.51 L ha^{-1} + 70.05 g ha^{-1}) was applied once at end of growing season on date of second application of treatments containing 2,4-D. Control of Virginia buttonweed (%) was measured bi-weekly over span of 12 weeks following initiation. Canopy coverage (%) of Virginia buttonweed was observed the following year preceding and following two additional treatment applications. Prior to the second application of products containing 2,4-D (51 DAIT) in year 1, all treatments provided 99% or greater control with treatments containing dicamba providing statistically better control 14 and 42 DAIT. At 72 DAIT for 2,4-D containing treatments and 27 DAIT for bentazon-containing treatments, Basagran T&O 4L + metsulfuron provided similar control to 2,4-D products. Following season regrowth was greatest in bentazon treated plots (>50% canopy coverage), however canopy coverage of all treated plots was <3% 20 days after additional treatment. Results suggest the potential for long-term control of Virginia buttonweed with mid- and late-season applications of products containing 2,4-D with additional treatment in following season. Combination of bentazon and metsulfuron also provide successful control and serve as alternative modes of action to control Virginia buttonweed, though reapplications will be needed. Buttonweed eradication is currently elusive with a single yearly approach, requiring at least two consecutive treatments years to adequately overcome its multiple means of regrowth/reinfestation.

Use of Glufosinate, Imazapyr, and Glyphosate to Control Hardwoods in Pine Plantations.
Andrew W. Ezell*[1], Andrew B. Self[2], John E. Ezell[3]; [1]Mississippi State University, Miss. State, MS, [2]Mississippi State University-Department of Forestry, Grenada, MS, [3]Mississippi State University, Starkville, MS (487)

A total of 15 treatments were applied to hardwoods and natural pines in a pine plantation. Three replications of each treatment were utilized. All hardwood stems in each plot were recorded by species and height class prior to treatment application and again one year after treatment. Of particular interest was the comparison of treatments using imazapyr only, glufosinate only, and those that combined glufosinate with imazapyr. While the imazapyr only treatments were extremely effective in controlling the hardwood species on the site, the treatments with glufosinate only were less effective on hardwoods.

A Comparison of Imazapyr, Glufosinate and Glyphosate for Control of Natural Pines. John E. Ezell*[1], Andrew B. Self[2], Andrew W. Ezell[3]; [1]Mississippi State University, Starkville, MS, [2]Mississippi State University-Department of Forestry, Grenada, MS, [3]Mississippi State University, Miss. State, MS (488)

A total of 13 treatments were applied to naturally occurring loblolly pines in a pine plantation. Three replications of each treatment were installed. Different glufosinate products were compared as well as different rates of application. Natural pines in the treatment plots were recorded by height class prior to application and again at one year after treatment. Overall, glufosinate was very effective at controlling natural pines in all height classes tested.

Controlling Natural Pine with Site Preparation Applications Using Vastlan, Vista XRT, Garlon XRT, Accord XRT, Glufosinate Ammonium, and Chopper GEN2. Andrew B. Self*[1], John E. Ezell[2], Andrew W. Ezell[3]; [1]Mississippi State University-Department of Forestry, Grenada, MS, [2]Mississippi State University, Starkville, MS, [3]Mississippi State University, Miss. State, MS (489)

A total of seven treatments were applied in a recently harvested area as site preparation to evaluate the efficacy in controlling natural pines on the site. Any hardwood species in the treatment plots were also evaluated. A total of three replications were utilized for each treatment. All woody species in the treatment plots were recorded by species and height class prior to application and again at one year after treatment. Efficacy of each treatment for controlling natural pines will be presented.

Efficacy of Controlling Wilding Pine During Forestry Site Preparation with Non-Glyphosate Options in the Upper Coastal Plain of Georgia. David C. Clabo*[1], David Dickens[2]; [1]University of Georgia, Tifton, GA, [2]University of Georgia Warnell School of Forestry & Natural Resources, Statesboro, GA (490)

Alternatives to glyphosate for wilding loblolly pine (*Pinus taeda*) control continues to be an area of research interest for forestry chemical site preparation in the southeastern United States. Mechanical site preparation does not offer long-term woody vegetation control while continuing to increase significantly in cost, and site preparation burning can often be limited due to smoke management concerns, liability issues, suitable weather days, manpower, etc. making chemical site preparation the primary method to control unwanted, genetically unimproved wilding pines prior to pine planting. The objective of this study was to examine mid-summer chemical site preparation alternatives to glyphosate for control of wildling loblolly pine. A field trial was installed in a recently clearcut loblolly pine stand located in the Upper Coastal Plain Region in Turner County, Georgia. The stand had no recent history of prescribed fire following thinning and had developed an understory of seedling and sapling loblolly pine ranging from six inches to greater than 9 feet tall and averaging 2.75 feet tall. Prior to establishment of the trial, the site averaged 10,811 wilding loblolly pine stems per acre between six inches and nine feet tall. Six treatments plus an untreated control were applied on July 26, 2022 with 0.5% v/v methylated seed oil in 15 gallons of water per acre. All treatments contained two-pound acid equivalent (ae) imazapyr applied at either 21 or 32 ounces per acre and one of the seven treatments contained four-pound ae glyphosate applied at four quarts per acre for comparison purposes. Treatments were applied using a Model 4F CO_2 sprayer with a single KLC-9 nozzle (Bellspray, Inc. R&D Sprayers, Opelousas, LA) to simulate a heavy aerial application over vegetation less than nine feet tall. Experimental units were 30 x 30 ft with internal 10 x 20 ft sampling plots. Assessments were made during early July 2022 prior to treatment application and 30, 60, 120, and 365 days after application (DAT). Data were analyzed as a randomized complete block design with blocking used to account for soil series differences across the site. The dependent variable was percent control (percent control = 1 – cumulative height growth pre-treatment/cumulative height growth at 30, 60, 120, and 365 DAT x 100). Results revealed significant ($p<0.001$) percent control treatment differences at 30, 60, 120 and 365 DAT compared to the pre-treatment (0 DAT) assessment. After thirty days, the treatments containing imazapyr, glufosinate and saflufenacil (treatment 5) gave 99.2% control, and imazapyr plus glyphosate (treatment 6) provided 95.7% control. These were the only two treatments that differed statistically from the control. After 60 days, all six chemical site preparation treatments had significantly better control than the control treatment with control ranging from 46.3% in the imazapyr (21 oz/ac), 6.29 ae ester triclopyr (48 oz/ac), and 2.78-pound ae ester fluroxypyr (21 oz/ac) tank mix (treatment 3) to 100% control in treatment 5. Improved control was observed across treatments after 120 days and ranged from 61.4% in treatment 3 to 100% in treatments 5 and 6. One year after application, control ranged from 63.4% in the imazapyr and choline triclopyr tank mix (treatment 1) to 100% in treatments 5 and 6. Treatment 4, which was identical to treatment 3 except that treatment 4 contained 64 oz/ac of the 6.29 ae ester triclopyr was statistically similar (79.4% control) to treatments 5 and 6 after one year. The tank mix consisting of imazapyr and glufosinate offered excellent early post-application wilding loblolly pine control that was identical to the imazapyr and glyphosate industry standard. Herbaceous weed control in the treatments that received herbicide lasted through 120 DAT, while woody control through 365 DAT was 11% coverage or less for the herbicide treatments compared to 28.5% for the control.

Control of Hemp Dogbane (*Apocynum cannabinum*) Using Auxinic Herbicides for Pasture and Right-of-Ways. Kayla L. Broster*[1], John D. Byrd, Jr.[1], Thomas H. Duncan[2], Chris R. Gregory[2]; [1]Mississippi State University, Mississippi State, MS, [2]Mississippi State University, Starkville, MS (491)

Hemp dogbane (*Apocynum canabinum*) a native wildflower of North America is widely spread in many habitats, including rights-of-way, non-cropland, roadsides, and pastures. It's underground root structures and perennial growth pattern makes it a hardy species that can be difficult to control where undesirable. Although it may be desirable to pollinators, it's noted toxicity for livestock lends reason for control in pastures and hay production fields. Most studies on hemp dogbane and herbicide response were previously conducted in the Midwest, rather than the southeastern United States. Field studies in Clay Co., Mississippi were performed to evaluate the response of hemp dogbane to auxinic herbicides, and the multiple formulations of triclopyr available on the market. This study started with two locations with applications in 2020 to 2022, a third location added in 2022 with repeated application in 2023, and a fourth location added in 2023. Locations included well established populations of dense hemp dogbane in a hay production field, fallow field (2020-2022), and two roadside areas (one 2022-2023 and one 2023). Prior to application individual stem counts were collected using 2 one-meter squares per plot to determine population density and change after each application. Eighteen treatments were created of nine herbicides at the labelled max rate and the half rate application of each herbicide. Herbicides evaluated included: Vastlan (triclopyr choline salt) at 4.67 and 2.34 L ha^{-1}, Remedy Ultra (triclopyr butoxy ester) at 4.67 and 2.34 L ha^{-1}, Garlon 3A (triclopyr triethylamine) at 6.23 and 3.12 L ha^{-1}, Trycera (triclopyr acid) at 6.52 and 3.26 L ha^{-1}, MezaVue (aminopyralid + picloram + fluroxypyr) at 2.34 and 1.17 L ha^{-1}, DuraCor (aminopyralid + florpyrauxifen-benzyl) at 1.46 and 0.73 L ha^{-1}, Method (aminocyclopyrachlor) at 1.32 and 0.66 L ha^{-1}, Surmount (picloram + fluroxypyr) at 7.01 and 3.5 L ha^{-1}, and Tordon K (picloram) at 4.67 and 2.34 L ha^{-1}. The applications were made when hemp dogbane were juvenile and prior to bud onset, with a CO_2 pressurized backpack sprayer calibrated to deliver 281 L ha^{-1} with a four-nozzle boom, equipped with XR8003 tips. General plant injury ratings were made at two and four weeks after application (WAT). Data analysis included an ANOVA using R Studio (Version RStudio 2022.07.1) comparing treatments across location and year, with mean separation of a = 0.05 using Fisher's LSD. Locations and years were analyzed separately when found to be different. At the fallow field and hayfield locations differences in response were observed at 4 WAT between treatments, with differences in response between each year. Differences in stand reduction were only observed at the hayfield location between years of 2020 and 2021, with DuraCor at 1.46 L ha^{-1} resulting in less stand reduction than all other treatments. Differences in treatment response at the roadside locations were observed, with no differences in response across year observed. At each location DuraCor resulted in less herbicide injury on hemp dogbane. Responses to Method varied by location and year but resulted in reduced hemp dogbane injury at the fallow field, the hayfield in 2020, and both roadside locations. Hemp dogbane responses to auxin herbicides may be dependent on population, environmental factors, or other management factors, which may result in changes in control from year to year. However, observations from this study encourage the use of Surmount, MezaVue, Remedy, or Trycera for hemp dogbane management.

Influence of Liquid Urea Ammonium Nitrate When Co-applied with Hexazinone for Smutgrass (*Sporobolus jacquemontii*) Control. Sudip Regmi*[1], Brent A. Sellers[2], Jose Dubeux[3], Temnotfo Mncube[2]; [1]MS Student, Department of Agronomy, University of Florida, Phalewas, Nepal, [2]University of Florida, Ona, FL, [3]University of Florida, Mariana, FL (493)

Smutgrass (*Sporobolus* spp.) is an invasive species that can quickly dominate bahiagrass (*Paspalum notatum* Fluggé) pastures, especially in central and South Florida. Hexazinone is the only selective herbicide labeled for smutgrass control in bahiagrass pastures; however, its expensive nature, injury to bahiagrass, and inconsistent control due to environmental factors necessitate the evaluation of other approaches to improve efficacy. Two field experiments were conducted in 2022 and 2023 to evaluate the bahiagrass response (smutgrass-free pasture) and smutgrass control (> 50% cover) with the co-application of hexazinone and nitrogen. Hexazinone at 0.56 and 1.12 kg ai ha^{-1} was applied with liquid urea ammonium nitrate (UAN; 32%) at 0, 14, 28, 42, and 56 kg ha^{-1} in May, July, or September as early, mid, and late season applications, respectively. A non-treated control was also included. The time of application and UAN rate significantly impacted bahiagrass biomass. Increasing the nitrogen rate resulted in a linear increase of bahiagrass biomass of at least 7 kg ha^{-1}. Furthermore, applications of hexazinone with nitrogen at 56 kg ha^{-1} resulted in >100% of the non-treated control, indicating that the addition of nitrogen with hexazinone will promote bahiagrass recovery. The time of application and hexazinone rate significantly influenced smutgrass control. Smutgrass control was maximum at the mid-season season with at least 60% smutgrass control; however, no significant control was observed under varying rates of nitrogen. The results suggest that optimizing smutgrass control by co-applying hexazinone with nitrogen will enhance bahiagrass biomass through increased competitive ability and ground cover, ultimately recovering the pasture. However, the co-application of nitrogen and hexazinone does not appear to result in increased smutgrass control.

Wilding Loblolly Pine (*Pinus taeda*) Control Using Imazapyr and Glufosinate Tank Mixes.
David C. Clabo*[1], E David Dickens[2]; [1]University of Georgia, Tifton, GA, [2]University of Georgia, Athens, GA (494)

In recent years, glufosinate has emerged as a viable forestry site preparation herbicide for control of wilding loblolly pine, and it is often tank mixed with imazapyr to improve long-term control of deciduous trees and shrubs. Additional refinement on glufosinate tank mixes, application rates, and surfactant rates are needed to inform managers and landowners on efficient wilding pine chemical site preparation prescriptions. Previous work has suggested that late season (November) applications with 2 lb acid equivalent (ae) imazapyr and higher rates of methylated seed oil (MSO) can offer equivalent or better control than the same imazapyr and glufosinate rates applied earlier in the growing season (July). Flumioxazin has shown promise for improving wilding pine control when tank mixed with glufosinate and imazapyr during July applications, but it has not been tested with different glufosinate and MSO rates applied late during the growing season (October and November). The objectives of this study were to (1) examine glufosinate efficacy in controlling wilding loblolly pine with and without imazapyr, (2) quantify the impact that MSO rate has on tank mix efficacy, and (3) assess if tank mix additions such as flumioxazin improve wilding pine control. A field trial was installed in a recently clearcut loblolly pine stand located in the Upper Coastal Plain region in Turner County, Georgia. The stand had no recent history of prescribed fire following the most recent thinning and developed an understory of seedling and sapling loblolly pine prior to the clearcut harvest. The site averaged 7,449 loblolly seedling and sapling stems per acre between six inches and nine feet tall with an average height of 3.6 feet tall. Nine herbicide treatments plus an untreated control were applied on November 4, 2022. All herbicide treatments were applied in 15 gallons of water per acre. Treatments were applied using a Model 4F CO_2 sprayer with a single KLC-9 nozzle (Bellspray, Inc. R&D Sprayers, Opelousas, LA) to simulate a heavy aerial application (helicopter) over vegetation less than nine feet tall. Experimental units were 30 x 30 ft with internal 10 x 20 ft sampling plots. Assessments were made during September and October 2022 prior to treatment application and 30, 60, 120, and 365 days after application (DAT). Data were analyzed as a randomized complete block design with blocking used to account for soil series differences (Cowarts and Fuquay soils) across the site. The dependent variable was percent control (percent control = 1 – cumulative height growth pre-treatment/cumulative height growth at 30, 60, 120, and 365 DAT x 100). Results revealed significant ($p<0.001$) percent control treatment differences at 30, 60, 120 and 365 DAT compared to the pre-treatment (0 DAT) assessment. Wilding pine control continually increased from 30 to 120 days after treatment, but dropped slightly at one year due to a combination of new germinants from nearby parent pine trees and growth of partially killed stems during spring and summer of 2023 (usually this situation involved individual pines that were partially shielded by other vegetation during spraying). After one year, treatment 1, which contained 1.5 lb active ingredient (ai) per acre glufosinate, 0.625 lb ai per acre imazapyr and 64 oz per acre MSO offered the greatest wildling pine control at 95.4% while treatment 3, which contained 1.5 lb ai per acre glufosinate, 0.125 lb ai flumioxazin, 0.625 lb ai per acre imazapyr and 64 oz per acre MSO was statistically similar and averaged 91.3% control. Treatments that did not contain glufosinate and treatments that contained glufosinate but did not contain imazapyr showed statistically decreased control. Treatments without glufosinate had negative control after one year. In addition, treatments that had the highest labeled rate of glufosinate (1.5 lb ai per acre) and the highest tested rate of MSO (64 oz per acre) performed best. Flumioxazin does not appear to significantly add to wilding pine control with imazapyr and glufosinate forestry site preparation tank mixes.

Sandbur Distribution and Sensitivity to Recommended Herbicides in East Texas. Zachary S. Howard*[1], Scott A. Nolte[2]; [1]Texas A&M, College Station, TX, [2]Texas A&M AgriLife Extension, College Station, TX (495)

A variety of *Cenchrus* species (spp.) are found throughout the United States and include a set of troublesome weeds that appear in pastures and hayed areas. These species encompass both annual and perennial biotypes. There is a gap in knowledge about how to effectively manage these perennial plants in the field. Survey efforts have been made throughout hay and pasture areas in East Texas to assess the identity of these species and to assess their sensitivity to nicosulfuron + metsulfuron methyl and glyphosate at various rates in the greenhouse in their annual form. Field studies have been performed to observe programs for the management of annual and perennial plants. Results from field studies indicate programs involving sequential applications of indaziflam with post emergent applications of glyphosate will effectively reduce populations withing one growing season.

EPA's Draft Herbicide Strategy 101. Lindsay A. Roe*[1], Cameron H. Douglass[2]; [1]Environmental Protection Agency, Washington, DC, [2]USDA, Washington, DC (391)

In July 2023, EPA released a draft herbicide strategy, which represents a step towards better protecting endangered species in the continental 48 states from the use of conventional herbicides in agricultural areas while helping to ensure the continued availability of these important pesticide tools. The public comment period for this draft "Herbicide Strategy" has passed, and EPA is working towards the development of a final Herbicide Strategy for release by the end of May 2024. In this presentation a high-level overview of the draft Herbicide Strategy framework and some common themes of comments received during the public comment period will be discussed.

Endangered Species Act Committee: What Have We Done and What Are We Doing? Bill Chism*[1], Cameron H. Douglass[2]; [1]Retired from U.S. Environmental Protection Agency, Point Of Rocks, MD, [2]USDA, Washington, DC (392)

The Endangered Species Act (ESA) was designed to protect threatened and endangered species and their critical habitat. The Environmental Protection Agency (EPA) will consider ESA impact for future registration and reregistration decisions. This presentation will describe the ESA Committee's work such as: describing the ESA review process in a webinar, a workshop at the WSSA 2023 annual meeting to collect suggestions from the EPA, Fish and Wildlife Service, National Marine Fisheries Service, and USDA on the ways the WSSA could help with ESA data collection, and the soon to be activated ESA communications webpage on the WSSA website.

Endangered Species Act Committees: Suggestions to Prepare for Future Changes. Bill Chism*; Retired from U.S. Environmental Protection Agency, Point Of Rocks, MD (393)

The Endangered Species Act (ESA) was designed to protect threatened and endangered species and their critical habitat. The Environmental Protection Agency (EPA) will consider ESA impact for future registration and reregistration decisions. The EPA released a draft Herbicide Strategy proposal that in some agricultural areas will require applicators take measures to reduce spray drift and runoff/erosion. The presentation will describe ways growers, pesticide applicators, and crop consultants can prepare for potential new label requirements to reduce drift, and runoff/erosion.

Using Engagement and Collaboration to Bring Local Knowledge of Agriculture to National Pesticide Decisions. Leah M. Duzy*[1], Stephanie Binns[2], Ashlea R. Frank[1], Bernalyn McGaughey[1], Caydee Savinelli[3], Jeff Smith[4], Frank Wong[5]; [1]Compliance Services International, Lakewood, WA, [2]BASF Corporation, Washington, DC, [3]Syngenta Crop Protection Inc., Greensboro, NC, [4]Valent U.S.A LLC, San Ramon, CA, [5]Bayer Crop Science, Chesterfield, MO (394)

While there are numerous challenges to complying with the Endangered Species Act (ESA) for pesticide registrations and registration review, one major challenge is the exchange of local and regional information with people making decisions thus limiting fully informed decision making. For over 25 years, the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) Endangered Species Task Force (FESTF) has been involved in pesticide and endangered species data aggregation and delivery. Over these years, FESTF's core mission of data collection, aggregation, and delivery has also allowed us to define additional efforts responsive to information needs. FESTF is focusing efforts aimed at understanding and collecting data at the local level, organized through regional collaborations (e.g., FWS staff, agricultural stakeholders, and conservation program staff), and delivered to the national level to inform pesticide registration decisions. Complimentarily, FESTF continues efforts supporting information and data exchange on national level decisions – particularly building a record for learnings derived by local and regional projects. By learning through regional collaborations, informing local end-users of listed species and pest management interactions affecting their decisions, and capturing to the extent possible data useful both at the national and individual operational scale, FESTF is facilitating exchange of information between the local and national-level and providing data and engagement important to decisions at both levels. Regional collaborations will focus on established relationships and networks that are common at the regional scale and are needed to access local experts and end-users as well as provide insight into national needs. Additionally, FESTF's efforts have also focused on providing stakeholders with the background information needed to provide substantial comments on EPA's decisions. The objective of this presentation is to highlight the engagement and collaboration efforts being undertaken by FESTF and how data are used to inform these efforts to bring local knowledge of agriculture to national pesticide decisions.

Understanding the Relationships Between Cover Cropping and Conservation Tillage Practice and the Use of 2,4-D, Atrazine, and Glyphosate by Field Corn and Soybean Growers. Cameron H. Douglass*[1], Laura Dodson[1], Michelle Ranville[1], Rebecca Nemec[1], Fengxia Dong[1], Ryan Olver[2]; [1]USDA, Washington, DC, [2]Tokyo International University, Tokyo, Japan (395)

Herbicides are important tools used by US growers to ensure optimal yields, and also to facilitate the adoption of conservation practices such as no- and reduced-tillage and cover cropping. In response to a shifting pesticide regulatory landscape, there has been increased interest in understanding the relationship between conservation practice adoption and herbicide usage, especially for 2,4-D, atrazine and glyphosate. To improve our understanding of the relationships between usage of these three herbicides and the adoption of no- and reduced-tillage and cover cropping, USDA researchers relied on a combination of analytical approaches and data from recent Agricultural Resource Management Phase II Surveys (ARMS) produced by USDA's National Agricultural Statistics Service. Traditional statistical mean comparison tests were initially used to describe overall trends in both adoption of no- and reduced-tillage and cover cropping by US corn and soybean growers specifically, and then also to analyze usage of the three herbicides by those same growers. Finally, Classification and Regression Trees (CART) analyses were employed on the same data to robustly infer the strength of the relationships between the usage of 2,4-D, atrazine and glyphosate, and the adoption of no- and reduced-tillage and cover cropping by US corn and soybean growers.

Bayer's CropKey Approaches to Unlock the Future of Sustainable Crop Protection. Bianca Martins*, Bodo Peters; Bayer, Frankfurt, Germany (396)

Society expects industry to employ the brightest minds and use the most sophisticated tools to create sustainable crop protection solutions addressing todays and future challenges in agriculture. While a fast-growing world population triggers the need for increased crop yields using less resources like water, land, and energy, agricultural issues including climate change, soil deterioration, weed adaptation and herbicide resistance (particularly metabolic resistance), are already a global reality. Therefore, Bayer is pushing beyond established standards to unlock breakthrough approaches and design entirely new, sustainable crop protection solutions. These innovative approaches are referred to as "CropKey", combining latest data-driven technologies and advances in life sciences to move from incremental innovation found through traditional methods to truly transformative molecules with new modes of action. CropKey is based on a combination of Target Based Discovery – the lock – and Profile Driven Discovery – the key. The computational target discovery is based on systems biology and omics, powered by high-end modelling tools and artificial intelligence. Taking advantage of massive amounts of data and machine learning, Bayer has been able to accelerate and improve data generation through increased accuracy towards the identification of new, pest specific target proteins. The Profile Driven Discovery uses computational virtual screening and digital chemistry to design molecules that bind to target proteins, changing and/or inhibiting its activity, and therefore, the weed itself. CropKey approaches also enable us to design and model molecules with an outstanding sustainability profile in terms of environmental and human safety. Overall, the shift in the way Bayer is driving research and development led, so far, to 30 potential new targets, 10 validated targets and 2 pipeline projects, including herbicides. The new way of researching for new weed control solutions encompasses a commitment to novel, cutting-edge technologies towards enhancing the pipeline, reflecting Bayer's dedication to staying at the forefront of sustainable, resistance breaking and efficient crop protection solutions.

What's in a Name? A Committee Review of the Composite List of Weeds. Theresa Piskackova*[1], Karla L. Gage[2], Joan Campbell[3], Lauren M. Lazaro[4], Eugene P. Law[5], Christina Taliga[6]; [1]Czech University of Life Sciences Prague, Prague 6 - Suchdol, Czechia (Czech Republic), [2]Southern Illinois University Carbondale, Carbondale, IL, [3]University of Idaho, Moscow, ID, [4]Blue River Technology, Sunnyvale, CA, [5]University of Delaware, Beltsville, MD, [6]USDA-NRCS, Lincoln, NE (420)

The common names of plants carry a significant amount of information without needing a lengthy description; this provides an efficient shorthand for scientists and stakeholders to communicate about a plant when it is a name based on a common understanding. There are often many common names that can refer to the same plant, or a single common name that refers to multiple different species, and some plants are without a common name at all. When we consider global communication and far-reaching databases, it becomes very relevant to consider 1) A need for more diligence in standardization (otherwise face increased database management and risk of lost data from dropped cross-referencing) AND 2) the loss of local heritage which provides useful meaning through various common names. The developments in online databases and reclassification of plant taxonomy by phylogenetic relationships have changed the accessibility and role of the list of standardized plant names compiled by the WSSA. As part of an attempt to reconcile WSSA and USDA common names for weedy plants, the WSSA Standardized Plant Names Committee recently concluded an extensive review of the Composite List of Weeds common names and had small changes approved to about 10% of the list of over 2800 distinct species. Some specific examples will be discussed.

2023 Common Problems Survey of Southern Row Crop Extension Weed Specialists. Eric P. Prostko*; University of Georgia, Tifton, GA (421)

One of the many duties of a university extension weed specialist is to troubleshoot field problems that occur at the farm level. Traditionally, this has been accomplished with in-person field observations. However, in today's time, troubleshooting can also occur via text and/or e-mail using high quality digital images. In April 2023, 21 southern extension row crop weed specialists from 14 states were surveyed to rank the following specific troubleshooting problems on a scale of 1 to 5 (1 = most common, 5 = least common): off-target movement; sprayer contamination; mixing/jug errors; herbicide carryover look-alikes; and true herbicide carryover. When averaged over the 21 specialist responses, the following rankings were obtained: off-target movement = 1.9; sprayer contamination = 2.1; mixing/jug errors = 3.3; herbicide carryover look-alikes = 3.6; and true herbicide carryover = 4.2. Off-target movement was ranked #1 by 57% of the specialists. True herbicide carryover was ranked #5 by 57% of the specialists. Generally, differences in the troubleshooting rankings between specialists were related to the herbicides commonly used and the different crops grown within each state. These specific troubleshooting problems could be minimized by implementing optimum off-target movement reduction practices, properly cleaning pesticide application equipment, discarding unlabeled pesticide containers, conducting routine soil fertility/nematode tests, and following labeled crop rotation restrictions.

Developing a Decision Support System to Assist Farmers in Incorporating Multiple Effective Modes of Action. Breanne D. Tidemann*[1], Gregory Innes[1], Christine Cock[2], Charles M. Geddes[3]; [1]Agriculture and Agri-Food Canada, Lacombe, AB, Canada, [2]Agriculture and Agri-Food Canada, Summerland, BC, Canada, [3]Agriculture and Agri-Food Canada, Lethbridge, AB, Canada (422)

A standard best management practice for management and mitigation of herbicide resistance is the use of tank mixes that incorporate multiple effective modes of action. Farmers have expressed frustration in trying to determine if they are utilizing multiple effective modes of action, particularly compounded by unclear marketing. To attempt to assist in the implementation of this strategy we are developing a decision support system that will be available to farmers. This system utilizes the Health Canada database of pesticides, and first filters that database to current herbicides. There is then pre-processing steps needed to standardize weed names, and herbicide nomenclature, as well as a manually developed database of tank-mix partners. This step could not be automated due to diversity in herbicide label design. The system will allow producers to select a weed of interest, identify any known herbicide resistance, select a crop and select a herbicide. From there a list will be generated of registered or supported tank mixes that would provide multiple effective modes of action on that weed species in that particular crop. The system is currently still under development.

Effective PRE and POST Programs for Weed Control in Glyphosate/Glufosinate/2,4-D-Resistant Soybean in New York. Vipan Kumar*[1], Lynn M. Sosnoskie[2], Mike Stanyard[3], Mike Hunter[4]; [1]Cornell University, Ithaca, NY, [2]Cornell University, Geneva, NY, [3]Cornell University, Newark, NY, [4]Cornell University, Watertown, NY (423)

Glyphosate-resistant (GR) common waterhemp has recently been identified in the northeastern United States, including New York and Connecticut. The evolution of GR waterhemp is a serious concern for producers in the region and warrants alternative herbicide strategies for its management. The main objective of this research was to determine the effectiveness of various preemergence (PRE) and postemergence (POST) herbicides for GR common waterhemp control in 2,4-D/glyphosate/glufosinate-resistant (Enlist E3) soybeans. To fulfill this objective, two separate studies were established during the summer of 2023 on a grower field in Seneca County, NY. The experimental field site was under corn-soybean rotation for >5 yrs with a known history of GR common waterhemp seedbank. An Enlist E3 soybean variety was planted on May 21, 2023. Herbicide programs, including PRE alone and PRE followed by (*fb*) early POST were tested in study 1, whereas programs including early POST alone or early POST *fb* mid POST were tested in study 2. Both studies were conducted in a randomized complete block design with three replications. Results from study # 1 indicated that PRE-alone applications of chlorimuron + flumioxazin + metribuzin, imazethapyr + flumioxazin + metribuzin, acetochlor + fomesafen, and s-metolachlor + metribuzin at field-use rates provided 63 to 87% control of GR common waterhemp 25 days after PRE (DAPRE); however, control did not exceed 32% with any of those treatments at 42 days after mid POST (DAMPOST). In contrast, all PRE programs *fb* an early POST treatment of glufosinate + 2,4-D consistently provided excellent season-long control (82 to 94%) and significantly reduced shoot biomass (up to 96%) of GR common waterhemp. In study # 2, the GR common waterhemp was controlled =93% at 28 DAMPOST with either a single early POST application of 2,4-D + (acetochlor + fomesafen), 2,4-D + glufosinate + (acetochlor + fomesafen) or sequential POST applications of 2,4-D + (acetochlor + fomesafen) *fb* 2,4-D, glufosinate + (acetochlor + fomesafen) *fb* glufosinate, 2,4-D + (acetochlor + fomesafen) *fb* glufosinate, glufosinate + (acetochlor + fomesafen) *fb* 2,4-D or 2,4-D + glufosinate + (acetochlor + fomesafen) *fb* 2,4-D + glufosinate. All sequential POST programs significantly reduced (97 to 100%) biomass of GR waterhemp in study 2. Altogether, results suggest that effective alternative PRE *fb* POST or sequential POST herbicide programs tested in this research can help controlling GR common waterhemp in 2,4-D/glyphosate/glufosinate-resistant soybeans.

Spray Drones: Importance of Nozzle Selection on Coverage and Weed Control. Thomas R. Butts*[1], Jason Davis[2], Tom Barber[1], Jason K. Norsworthy[3], Terry N. Spurlock[1]; [1]University of Arkansas, Lonoke, AR, [2]University of Arkansas, Batesville, AR, [3]University of Arkansas, Fayetteville, AR (415)

Spray drones or remotely piloted aerial application systems (RPAAS) are unique application systems that require a more thorough understanding to optimize their use, particularly regarding nozzle and spray volume selection. The objective of this research was to evaluate nozzle type, spray volume, and application equipment (RPAAS versus ground sprayer) effects on spray coverage and weed control. A non-crop field study was conducted as a randomized complete block design with four replications in spring 2023 at three locations [Newport (35.5759, -91.2523), Lonoke (34.8456, -91.8786), and Rohwer (33.8048, -91.2725), AR]. Treatments comprised three nozzle types (XR11002, TADF11002, and ULD12002), three application setups [RPAAS (DJI T30) at 18.7 and 46.8 L ha^{-1}, and a Bowman MudMaster ground sprayer at 93.5 L ha^{-1}], and a nontreated control. Paraquat (Gramoxone 3SL) was applied to emerged winter annual weed species at each location. Data collection included water sensitive paper for spray coverage, visual weed control ratings, weed biomass 4 weeks after treatment (WAT), and small, unmanned aerial system remote sensing for the Visible Atmospherically Resistant Index (VARI). A greater VARI value indicates more healthy vegetation, thereby reduced efficacy of herbicides. Analysis of variance was conducted with location as a random effect. Coverage was greater from the TADF and ULD nozzles compared to the XR nozzle for the RPAAS applications; however, the XR nozzle provided greater coverage than the other nozzle types for the ground sprayer. Additionally, for the TADF and ULD nozzles, similar coverage was obtained with the RPAAS at 46.8 L ha^{-1} and the ground sprayer at 93.5 L ha^{-1}. Visual weed control ratings were equal at 1 WAT for the RPAAS at 46.8 L ha^{-1} and ground sprayer at 93.5 L ha^{-1} treatments (76 and 77%, respectively), while the RPAAS at 18.7 L ha^{-1} treatment provided 59% control. Additionally, nozzle type decreased visual weed control in the order of XR (76%) > ULD (71%) > TADF (66%). By 4 WAT, similar results were obtained for the application setup effect; however, there was no difference in weed control as affected by nozzle type. Results from the biomass reduction and remote sensing VARI data corroborated the 4 WAT visual control ratings. The RPAAS at 18.7 L ha^{-1} resulted in a greater VARI value (37.1) and less biomass reduction (56%) compared to the other two application setup treatments (31.3 and 59%, respectively). Meanwhile, no effect of nozzle type was observed for either of these response variables. Overall, these data suggest a RPAAS operated at 46.8 L ha^{-1} can provide equivalent coverage and weed control as a ground sprayer operated at 93.5 L ha^{-1}. Nozzle type did not consistently influence weed control across application setups; however, visual observations indicated nozzle selection significantly influenced the effective swath width of the RPAAS application. Further research should evaluate these nozzle impacts to correctly adjust for appropriate overlaps if making multiple spray passes.

Spray Quality Considerations for Targeted Applications: A Syngenta Perspective. R Joseph Wuerffel*[1], Neill Newton[2], Samuel Stephenson[3], Simon Caldwell[4], Cate O'Brien[4], David Belles[2]; [1]Syngenta Crop Protection, LLC, Gerald, MO, [2]Syngenta Crop Protection, LLC, Greensboro, NC, [3]Syngenta Crop Protection, LLC, Basel, Switzerland, [4]Syngenta Crop Protection, LLC, Bracknell, United Kingdom (417)

Recently commercialized targeted application systems have taken different approaches to trigger an application from only the required nozzles needed to transfer the dose to the target, thereby minimizing the area sprayed around the target. Several commercialized green-on-brown systems have proven effective using a single, even nozzle with narrow fan angles (e.g. 40 degrees) in chemical fallow and pre-plant burndown situations in flat terrain. Recent advancements in imaging and algorithm development now allow for broader uses in-crop (green-on-green applications) where product efficacy and spray drift are potentially of greater concern given the timing of these applications during crop development. Commercialized green-on-green targeted application systems used in-crop utilize either single, even nozzle systems with narrow fan angles or traditional broadcast nozzles (e.g. 80 to 110 degrees) with single or multiple nozzle activations over a target. This presentation will outline the interactions of factors that impact the dose transfer in targeted application systems used in-crop, highlighting the need for additional research and industry effort to provide guidance to applicators using these systems.

Evaluating Joint Action of Glufosinate Plus PPO-Inhibiting Herbicides. Ramawatar Yadav*, Andrew R. Kniss; University of Wyoming, Laramie, WY (418)

Previous research has suggested that adding commercially formulated glufosinate to protoporphyrinogen oxidase (PPO) inhibitors improves weed control compared to PPO inhibitors applied alone. Greenhouse experiments were conducted in 2023 to determine whether this observation is due to an interaction between herbicide active ingredients or due to the adjuvant in the commercial formulation. Kochia (*Bassia scoparia* (L.) A. J. Scott) and common lambsquarters (*Chenopodium album* L.) were sprayed with combinations of PPO inhibitors and Liberty 280 SL formulation components, with or without 1% v/v methylated seed oil (MSO). PPO inhibitors included saflufenacil at 1.5 g ai ha^{-1} or flumioxazin at 5.5 g ai ha^{-1}. Liberty formulation components included commercially formulated Liberty 280 SL at 450 g ai ha^{-1}, aqueous glufosinate at the equivalent rate (450 g ai ha^{-1}), or the Liberty adjuvant system without glufosinate also at the equivalent concentration. Individual plant visible injury and aboveground dry biomass data were recorded 3 weeks after treatment. Data were analyzed using a linear mixed-effects model, where PPO inhibiting herbicide and weed species were considered random effects, and glufosinate and adjuvant treatments were considered fixed effects. Glufosinate without PPO-inhibitors caused < 10% injury. In the absence of MSO, aqueous glufosinate did not increase visible injury or decrease dry biomass more than the PPO-inhibiting herbicide applied alone. In the absence of MSO, the PPO herbicide plus Liberty adjuvant system without glufosinate resulted in similar visible injury and dry biomass as the PPO herbicide plus fully formulated Liberty 280 SL with glufosinate. In the presence of MSO (1% v/v), no differences in visible injury or dry biomass were observed among the combinations of PPO inhibitors alone and PPO inhibitors plus Liberty formulation components. These results suggest that the previously observed joint action between glufosinate and PPO inhibitors may be due to potentiation from the adjuvant in commercially formulated Liberty 280 SL, and not necessarily a synergistic effect from glufosinate.

Liberty Ultra (L-glufosinate Ammonium) Improves Crop Tolerance Across Glufosinate Tolerant Crops When Compared to Applications of Racemic Glufosinate-Ammonium. Amber N. Eytcheson*[1], Jayla Allen[2], Seth Baines[3], Scott Baker[4], Dustin Black[5], Ryan Grieger[6], Tyler Schmidt[3], Bablu Sharma[7], Lex Tyson[8], Felipe Zabala[9], Liam J. Vincent[10]; [1]BASF Corporation, Lubbock, TX, [2]BASF Corporation, Carollton, MO, [3]BASF Corporation, Nevada, IA, [4]BASF Corporation, Southaven, MS, [5]BASF Corporation, Pikeville, NC, [6]BASF Corporation, Sabin, MN, [7]BASF Corporation, Fowler, IN, [8]BASF Corporation, Leesburg, GA, [9]BASF Corporation, Seymour, IL, [10]BASF, Rtp, NC (419)

Liberty® ULTRA (L-glufosinate ammonium) improves crop tolerance across glufosinate tolerant crops when compared to applications of racemic glufosinate-ammonium. Amber Eytcheson[1], Jayla Allen[2], Seth Baines[3], Scott Baker[4], Dustin Black[5], Ryan Grieger[6], Tyler Smidt[3], Bablu Sharma[7], Lex Tyson[8], Felipe Zabala[9], and Liam Vincent[10] BASF, Lubbock, TX, USABASF, Carollton, MO, USABASF, Nevada, IA, USABASF, Proctor, AR, USABASF, Pikeville, NC, USABASF, Sabin, MN, USABASF, Fowler, IN, USABASF, Chula, GA, USABASF, Seymour, IL, USABASF, RTP, NC, USA Glufosinate ammonium has been registered in the United States for use as a postemergence herbicide in glufosinate tolerant cropping systems for almost 30 years. To date, all glufosinate herbicides sold in the United States have been a racemic mixture, which contain a 1:1 ratio of D-glufosinate and L-glufosinate enantiomers. Pending registration, BASF intends a targeted launch of Liberty ULTRA herbicide, Powered by Glu-L Technology in 2024. Field trials were conducted in 2022 and 2023 to evaluate the crop tolerance and yield in glufosinate tolerant corn, soybean and cotton between applications of racemic glufosinate and Liberty ULTRA. Applications of Liberty ULTRA improved crop tolerance and had no impact on yield in glufosinate tolerant corn, soybean and cotton, as compared to applications of racemic glufosinate. Liberty ULTRA will have a higher concentration of the herbicidal active L-glufosinate isomer in the formulation as compared to racemic glufosinate formulations, which enables a 25% reduction in application product rate, allowing customers to cover more acres from the same product volume compared to other racemic glufosinate herbicides.

***Amaranthus palmeri* S. Watson: A New Threat to Agriculture in Europe and the Mediterranean Region.** Maor Matzrafi*[1], Laura Scarabel[2], Joel Torra[3], Husrev Mennan[4], Lias Travlos[5]; [1]Department of Plant Pathology and Weed Research, Agricultural Research Organization (ARO), Newe Ya'ar Research Center, Ramat-yishay, Israel, [2]Institute for Sustainable Plant Protection (IPSP), National Research Council (CNR), Legnaro, Italy, [3]Department d'Hortofructicultura, Botànica i Jardineria, Agrotecnio—CERCA Center, Universitat de Lleida, Lleida, Spain, [4]Department of Plant Protection, Ondokuz Mayis University, Samsun, Turkey, [5]Laboratory of Agronomy, Department of Crop Science, Agricultural University of Athens, Athens, Greece (344)

Amaranthus palmeri S. Watson is a dioecious broad-leaved species characterized by rapid growth, high seed production, efficient resource use, and adaptability to diverse environments and cropping systems. *A. palmeri* populations are spreading beyond their native range in South western US, into the Mediterranean region and have been reported in several European and Mediterranean countries. Recent climate models have predicted that the distribution of *A. palmeri* may extend in the near future to France, northern Italy, and south-eastern Europe. First stands of *A. palmeri* were located along roadsides, and later in nearby agricultural fields. Possible routes of introduction include contaminated animal feed and grain shipments for industrial processing. Due to the similarity among member of the *Amaranthus* genus, there were several misidentification cases, especially related to *A. palmeri* and *A. tuberculatus*. Some European *A. palmeri* populations from Israel, Spain and Italy appear to be resistant to acetolactate synthase (ALS) inhibitors, while others from Turkey and Spain were found as resistant to glyphosate. Effective, transboundary networks have to be established between farmers and researchers to raise agricultural community awareness and continuously monitor the invasiveness of *A. palmeri* in Europe. We summarize recent reports on the occurrence of *A. palmeri* in Europe and the Mediterranean region, including cases of herbicide resistance. We proceed to assess future invasion and spread across Europe according to climate and agricultural practices.

Genetic Mapping of Resistance to 2,4-D and Dicamba in Waterhemp (*Amaranthus tuberculatus*). Isabel Werle*[1], Lucas Bobadilla[2], Damilola A. Raiyemo[1], Patrick Tranel[1]; [1]University of Illinois, Urbana, IL, [2]University of Illinois, Champaign, IL (346)

Non-target-site resistance (NTSR) to auxinic herbicides including 2,4-D and dicamba has been reported in waterhemp populations in the Midwestern United States. A number of gene families have been identified in these populations, but more work is needed to elucidate the magnitude of resistance conferred by these individual genes and their role in NTSR evolution. Genetic mapping studies are a helpful resource for locating important loci associated with herbicide-resistant traits in weeds. The objective of this study was 1) to develop a genetic mapping population with resistance to 2,4-D and dicamba, and 2) to determine the association between phenotypic responses to these herbicides in the mapping population. A pseudo-F_2 genetic mapping population was developed from a biparental cross between an herbicide-resistant 'CHR' and a reference-sensitive 'WUS' waterhemp population. A total of 188 F_2 plants were used for this study. Four clones were produced from each original plant. Two clones were screened with either dicamba (406 g ae ha^{-1}) or 2,4-D (550 g ae ha^{-1}) at the 12-leaf stage. Phenotyping consisted of visual injury at 12 days after treatment (DAT) and comprised of five measurements: leaf curling, meristem damage, stem bending, chlorosis, and total injury. There was a small but significant relationship between phenotypic responses to 2,4-D and dicamba (R=0.2, p=0.005), suggesting that resistance to these herbicides is largely but not completely controlled by separate genes. Phenotypic responses of F_2 individuals to either 2,4-D or dicamba showed a continuous distribution indicating a polygenic trait. Quantitative trait loci (QTL) analysis is underway to identify genomic regions associated with resistance to 2,4-D and dicamba in the CHR population. isabels6@illinois.edu

***Parthenium hysterophorus* L. In the Americas: Predicting Suitable Habitats Beyond its Native Range Under Future Climatic Conditions.** Sarah E. Kezar*[1], Asad Shabbir[2], Antonio DiTommaso[3]; [1]Cornell University, Ithaca, NY, [2]The University of Sydney, Camden, Australia, [3]Soil and Crop Sciences Section, School of Integrative Plant Science, Cornell University, Ithaca, NY (348)

Parthenium weed (*Parthenium hysterophorus* L.) is an annual weed of global significance, beyond its native range from the southern region of North America to the northern parts of South America. The consequences of climate extremes have already been widely observed and predicted to alter the distribution of invasive populations in Australia, Asia, Africa, and Europe. However, this threat is yet to be understood for native populations in North American habitats and cropping systems. The development of a CLIMEX distribution model considered global habitat suitability data to predict the distribution of parthenium weed in North America for current and future (+3 °C) climates. Secondly, irrigation was added to the climate change scenario (+3 °C) to predict how extra moisture may affect its distribution. Parthenium weed is currently found in parts of the southern portion of the Cotton Belt, while increases in habitat suitability in a future climate will likely increase its range and stand densities. Similarly, the northern region of the Cotton Belt is projected to become more climatically suitable under climate change. The range of habitat suitability may further extend to more northern latitudes that encompass the southern Great Plains, go as far north as Virginia along the east coast, and across the west coast. When the irrigation scenario was added to the CLIMEX program, more parts of the semi-arid regions from West Texas to southern California became suitable due to irrigation producing extra moisture to support the establishment and growth of parthenium weed. Transient populations of parthenium weed have been reported in more northern latitudes, but the distribution of this species in both current and future climates is likely limited by cold winter temperatures.

Understanding Phenotypic Variation Between Clopyralid Resistant and Susceptible Common Ragweed with Omic and Greenhouse Analysis. Nash D. Hart*[1], Eric L. Patterson[2], Erin E. Burns[2]; [1]Michigan State University, Durand, MI, [2]Michigan State University, East Lansing, MI (350)

Ambrosia artemisiifolia (common ragweed) is a globally distributed, difficult to control weed species that can cause extensive crop yield reductions unless appropriately managed. In 2018, a biotype of *A. artemisiifolia* was discovered in a Michigan Christmas tree farm that is highly resistant to clopyralid, surviving at clopyralid doses 32 times the recommended field use rate. Chemical weed control is a mainstay in most agricultural systems in the United States and herbicide resistance threatens its effectiveness; therefore, it is essential to understand the mechanism of resistance that allows weed species to become resistant to herbicides and how the mechanism influences plant growth. To this end, we analyzed gene expression in this clopyralid resistant and susceptible *A. artemisiifolia* biotype using RNA-seq. The RNA-seq experiment produced 70 genes that were differentially expressed with a long fold change greater than 2. The resistant biotype had 39 genes overexpressed and the susceptible biotype had 31 genes overexpressed. The experiment revealed many genes of interest that are overexpressed in each biotype, such as CYP83B1, a cytochrome P450, in the resistant biotype and RAP2-3, an ethylene response transcription factor, in the susceptible biotype. In addition, we evaluated growth performance of these resistant and susceptible biotypes in a greenhouse study. The study followed a randomized complete block design with four replications and two runs. Factorial combinations consisted of biotype (clopyralid resistant or susceptible), nitrogen level (low-0 kg N ha^{-1}, medium-112 kg N ha^{-1}, or high-224 kg N ha^{-1}), non-lethal herbicide dose presence or absence (0.105 kg a.i. ha^{-1} or 0 kg a.i. ha^{-1}), and soil moisture (ambient-100% field capacity or reduced-50% field capacity). The following measurements were taken every three weeks for the duration of the experiment: photosynthetic output (quantum yield of photosystem II (Phi2), quantum yield of non-photochemical quenching (PhiNPQ), quantum yield of other unregulated losses (PhiNO), and relative chlorophyll (RC)), plant height, and leaf number. Plant maturation rates were assessed by measuring days after emergence to the appearance of buds and production of pollen. Finally, plant biomass was weighed after plant senescence and seeds were collected. Data were analyzed using linear mixed-effects models in R and means were separated using Tukey's HSD. Data were combined across years. The greenhouse experiment found that the number of leaves at 6 weeks, rate of maturity, seed number, and seed weight were impacted by the main effect of biotype ($p<0.001$, $p<0.001$, $p=0.017$, $p=0.049$). The resistant biotype had 32% more leaves than the susceptible biotype when measured at 6 weeks after treatment averaged across nitrogen, herbicide, and soil moisture treatments. The resistant biotype started to produce pollen 20 days faster than the susceptible biotype averaged across nitrogen, herbicide, and soil moisture treatments. The resistant biotype produced 24% more seeds with the resistant biotype producing 2,303 seeds $plant^{-1}$ while the susceptible biotype produced 1,854 seeds $plant^{-1}$ averaged across herbicide, nitrogen, and soil moisture treatments. In conclusion, it is critical to understand how gene and transcript abundance affect overall plant productivity in resistant weed biotypes.

A Transposable Element Insertion in *IAA16* Interrupts Normal Splicing and Causes Resistance to Dicamba in *Bassia scoparia*. Jacob S. Montgomery*[1], Neeta Soni[1], Eric L. Patterson[2], Philip Westra[1], Keith Slotkin[3], Franck E. Dayan[1], Todd A. Gaines[1]; [1]Colorado State University, Fort Collins, CO, [2]Michigan State University, East Lansing, MI, [3]Donald Danforth Plant Science Center, St. Louis, MO (351)

The recent introduction of genetically modified crops resistant to the herbicide dicamba has increased the usage of dicamba in agricultural settings. This increase has caused accelerated evolution of dicamba resistance in weedy species due to increased selection pressure. A dicamba-resistant population of *Bassia scoparia* (M32) was identified in an herbicide resistance survey of Colorado and surrounding states conducted in 2012. Dose response studies confirmed dicamba resistance within M32 (R:S 6) of approximate equal magnitude conveyed by the previously reported G127N allele of *IAA16* (R:S 8). Sanger sequencing of dicamba-resistant M32 plants revealed the absence of the only known dicamba resistance mechanism in *Bassia scoparia* (G127N substitution in the *IAA16* gene). Populations segregating for dicamba resistance were produced via a bi-parental cross between individuals of M32 and a dicamba-sensitive reference population (7710). Approximately 300 plants each from two segregating F3 families were screened with a delimiting rate of dicamba (560 g ae ha^{-1}). Ratios of alive and dead plants suggest dicamba resistance was simply inherited. A newly developed genotype-by-sequencing protocol was used on individuals from these segregating populations to identify one Quantitative Trait Locus (QTL) underlying this trait. The *IAA16* gene is found within this interval, and a transposable element insertion near the degron domain disrupts normal splicing of exons one and two. Transgenic Arabidopsis lines heterologously expressing the *IAA16* allele from M32 gained resistance to dicamba in both root growth and whole plant bioassays but show a notable fitness cost. Understanding the genetic/physiological basis of resistance will inform future herbicide design and allow for rapid diagnosis of dicamba resistance in *Bassia scoparia*.

Novel PPO1 Target Site Mutations Lead to Cross Resistance to PPO-Inhibiting Herbicides in *Bassia scoparia* (Kochia) from North Dakota. Aimone Porri*[1], Ingo Meiners[2], Samuel Willingham[3], Jens Lerchl[4]; [1]BASF Global Research & Development, Limburgerhof, Germany, [2]BASF, Rtp, NC, [3]BASF, Durham, NC, [4]BASF SE, Limburgerhof, Germany (352)

Kochia (*Bassia scoparia)* is a very problematic weed that is common throughout the Northwest part of the United States and Canada, infesting various crops including, soybeans, canola, spring wheat and pulses. Kochia is difficult to control due to its ability to propagate quickly and to survive in challenging conditions such as heat, drought, and high-saline soils. In addition, since 1988 it has evolved resistance to at least four different herbicide modes of action (groups 2, 4, 5 and 9). Here we report the molecular characterization of Kochia resistance to the group 14, PPO-inhibiting herbicides. Kochia biotypes from different North Dakota locations were treated with saflufenacil and carfentrazone, and the resistant survivor plants were subjected to sequencing and quantitative expression analysis of *PPO1* and *PPO2*. The survivor plants showed a slight upregulation of *PPO1* and *PPO2*. Additionally, the *PPO1* gene carries point mutations in all survivor plants that result in F454L, I and V amino acid substitutions. Biochemical analysis and molecular modelling characterization of the F454L, I and V mutant enzymes suggest that these amino acid substitutions confer resistance by disrupting a pi-pi stacking interaction between PPO1 and the heterocyclic ring of the PPO-inhibiting herbicides. This is the first report that shows PPO1 target site mutations conferring resistance in a broadleaf weed to PPO-inhibiting herbicides.

Branched Broomrape Seed Germination Response to QAC Sanitizers. Pershang Hosseini*, Cassandra L. Swett, Brad Hanson; University of California Davis, Davis, CA (353)

Branched broomrape, a parasitic weed with a broad host range, is a quarantine pest that has recently become a serious problem in California processing tomato fields. Broomrape plants can produce thousands of tiny seeds which are easily spread by farm machinery and equipment. To reduce the risk of spreading seed from to non-infested fields, disinfestation of farm machinery should occur before entering uninfested fields. A three-phase study was undertaken in 2022-3 to evaluate quaternary ammonium compounds (QAC) efficacy on branched broomrape seed. Several individual QACs and commercial QAC sanitizers were evaluated at various exposure durations (1, 3 and 5 minutes) and doses (0-2.5% w/v) to develop initial seed mortality curves. A subsequent experiment was conducted with repeated for three commercial sanitizers containing QAC (Mg4, FQ and CQT) as the second phase in the recommended dose (1% v/v) and short exposure duration (1 minute). The final experiment was conducted in two steps using commercial QAC sanitizers and adding plant and soil debris. The experiment was first done with the recommended dose, followed by a dose-response experiment with higher doses up to 8 % (v/v). Dose-response analysis showed that ADAC, DDAB, and DDAC, effectively prevented broomrape germination. The effective dose for 50% reduction in germination ranged from 0.00002 in DDAC at 10 minutes to 0.402 (w/v) ADAC at a 1-minute exposure duration. As the second phase result, the decrease in broomrape seed viability was noticeable at concentrations as low as 0.05% v/v, and no germination was observed for Mg4 and FQ at the recommended concentration of 1%. However, adding soil (10%w/v) and plant (4%w/v) debris rapidly deactivated the QACs, and no reduction in germination was observed when plant and soil debris was present at the recommended dose of sanitizer. The last dose response with higher doses showed that ED_{50} increased 3.3 to 4.4-fold in the presence of plant debris and from 4.6 to 6.5-fold in the presence of soil debris. The result showed that QAC sanitizers can reduce broomrape seed viability but that sanitizer efficacy is greatly affected by plant and soil debris; thus, physical cleaning of farm machinery prior to sanitizer treatment is a crucial part of broomrape risk management.

Effects of Elevated CO_2 on the Growth of Tropical Spiderwort Under Drought Conditions and Low-Dose Herbicide Applications. William Yates*[1], Stephen Prior[2], Aniruddha Maity[1]; [1]Auburn University, Auburn, AL, [2]USDA, Auburn, AL (354)

The continual rise of atmospheric carbon dioxide could exaggerate weeds' response to agronomic management factors under projected climate change scenarios. Critical field weeds in the southeastern United States, especially those tolerant of several herbicide chemistries, may seriously threaten crop production due to aggravated herbicide resistance response under future stresses. To test this, Tropical spiderwort (*Commelina benghalensis L.*), a federally labeled noxious weed since 1983 that has become very problematic for southeastern peanut producers, was subjected to half the field rate of glyphosate, flumioxazin, and MSMA under elevated CO2 (Ambient vs Elevated: Ambient + 200 mmole mole^{-1}) and soil moisture stresses (100%, 50%, 25%) under an open top CO_2 facility at the USDA-Soil Dynamics Lab in Auburn, AL. Following standard protocol, herbicide was sprayed at a 3-4-leaf stage using a backpack sprayer. Visual injury rating was recorded on a 0-100% scale, 0 being no injury and 100 being the dead plant after the first week and fourth week of spraying. The results have shown that herbicide and soil moisture significantly affected plant injury, but CO_2 did not show any influence. Similar patterns were observed for Tropical spiderwort biomass, root length, and plant growth. Results indicate that Tropical spiderwort control can be influenced by herbicide chemistry, especially under variable soil moisture levels. Future research includes combining temperature factors with the existing stressor to present an inclusive and comprehensive picture of Tropical spiderwort control under a projected climate change scenario.

Genome Sequence of Yellow Nutsedge (*Cyperus esculentus*) Provides Insights into Genetic Variations in Herbicide Protein Targets. Jinesh Patel*[1], Leslie Goertzen[1], Claudia A. Rutland[2], Todd A. Gaines[3], Eric L. Patterson[4], Mithila Jugulam[5], Victor Llaca[6], Kevin Fengler[6], Luan Cutti[7], Joseph S. McElroy[1]; [1]Auburn University, Auburn, AL, [2]Auburn University Department of Crop, Soil, and Environmental Sciences, Auburn, AL, [3]Colorado State University, Fort Collins, CO, [4]Michigan State University, East Lansing, MI, [5]Kansas State University, Manhattan, KS, [6]Corteva Agriscience, Johnston, IA, [7]Federal University of Rio Grande do Sul, Porto Alegre, Brazil (355)

Cyperus esculentus, commonly known as yellow nutsedge, is a part of the Cyperaceae family, recognized as the third largest monocot family with diverse ecological preferences and distinctive holocentric chromosomes, this plant emerges as a captivating subject for genome exploration. Although considered one of the most noxious weeds of agriculture, it has the potential for cultivation with several beneficial agronomic products. Despite its appeal, there has been a limited effort to comprehend the genetic makeup of yellow nutsedge. Chromosome numbers were determined based on cytology. DNA from leaf samples was used to perform PacBio HiFi sequencing and Bionano sequencing to develop a telomere-to-telomere and haplotype-resolved genome assembly. Different plant tissues were used to extract RNA, which was used to perform Iso-Seq to generate and analyze full-length transcript isoforms. The resulting cytometry study and genome assembly indicated 53 pairs of chromosomes, with a genome size of approximately 251.37 Mb, featuring remarkably small chromosomes ranging from 2.3 to 8.4 Mb. Additionally, the mitochondrial genome spans about 998 kb, and the chloroplast genome encompasses approximately 186 kb. Extensive de novo TE Annotator (EDTA) analysis suggests that 38% of the genome comprises repetitive sequences, totaling approximately 96.4 Mb. A total of 13,539 structural variations were observed, encompassing 22.58 Mb of genomic disparities between two haplotypes. The occurrence of a recombination event between chromosomes 27 and 28 resulted in imbalances within a specific set of genes in these haplotypes. Notably, certain genes within this set are targeted by herbicides, such as ALS, ACCASE, Alpha tubulin, and phytoene desaturase. In essence, this genomic study not only facilitates the identification of novel herbicide targets crucial for effective yellow nutsedge management but also unveils prospects for devising strategies to augment the oil content in *C. esculentus* tubers. These insights contribute significantly to advancements in agricultural practices and foster opportunities for crop improvement.

Mechanism of Paraquat Resistance in Italian Ryegrass Populations from North Carolina. Jose H. de Sanctis*[1], Charlie W. Cahoon[1], Wesley Everman[1], Travis W. Gannon[1], Katie M. Jennings[1], Zachary R. Taylor[2], Brock A. Dean[1]; [1]North Carolina State University, Raleigh, NC, [2]North Carolina State University, Sanford, NC (356)

talian ryegrass (*Lolium perenne* L. ssp *multiflorum* (Lam.) Husnot) is a winter annual weed species commonly found in row crops and non-crop areas across North Carolina. Populations resistant to herbicide groups 1, 2, and 9 have already been confirmed in the state. Consequently, paraquat has become a common burndown option for Italian ryegrass control. In 2021, paraquat-resistant populations were confirmed in the Southern piedmont region of the state. The objective of this study was to investigate the mechanism of resistance from the recently found paraquat-resistant Italian ryegrass populations from North Carolina through absorption, translocation, and metabolism studies with ^{14}C-paraquat material. Two separate studies were conducted to investigate the mechanism of paraquat resistance. Both studies were conducted as a randomized complete block design with five replications, two runs, two resistant (R1 and R2), and two susceptible (S1 and S2) populations. In the absorption and translocation study, plants were harvested 0, 4, 12, 24, 48, 96, and, 192 hours after exposure to ^{14}C-paraquat and dissected in four samples (above treated leaf, below treated leaf, treated leaf, and roots). Samples were then dried until constant weight, combusted in a biological oxidizer, and radioactivity was determined by liquid scintillation spectrometry. The amount absorbed was converted to a percentage of the total radioactivity applied and translocation as a percentage of absorbed. In the metabolism study, plants were harvested at 0, 24, 48, 96, and, 192 hours after treatment, samples were then processed and analyzed via HPLC-DAD spectrometry. There were no differences in the total paraquat absorbed nor the rate of paraquat absorption between resistant and susceptible populations with total amount of paraquat absorbed ranging from 89-94%. Furthermore, susceptible populations translocated nearly 4 times more ^{14}C-paraquat out of treated leaf when compared to resistant populations. There was no indication of paraquat metabolism, and all populations had similar amounts of parent material. These results indicate that restricted paraquat movement is associated with paraquat resistance and further investigation is needed to determine the exact resistance mechanism.

Evaluation of Phenospex TraitFinder as a Potential Tool for Weed Control Phenotyping.
Chandrima Shyam*, Alejandro Perez-Jones; Bayer Crop Science, Chesterfield, MO (358)

Evaluation of herbicide response is critical to estimate herbicide efficacy and screen for resistance in weeds, along with estimating herbicide safety and integration of herbicide resistant traits in crops. Traditionally, this evaluation is done through visual observation by giving the plants a rating between 0 to 100, where 0 represents absolute lack of plant injury and 100% indicates complete plant death. However, this rating can vary especially in the mid-range of rating depending on the experience level of the researcher along with bias and fatigue. Through visual rating, it is also hard to capture subtle plant cues that could be captured via digital assessment. TraitFinder from Phenospex is a phenotyping platform that is coupled with multispectral sensors and can be used to scan plants to generate 3D point cloud files along with quantitative data of several plant morphological and physiological parameters. Current study investigates the applicability of this phenotyping technology in evaluating herbicide response to different herbicide modes of action in Palmer amaranth and soybean.

How Genomics is Reshaping Our Understanding of Copy Number Variation and Herbicide Resistance Evolution. Eric L. Patterson*; Michigan State University, East Lansing, MI (359)

The classic dogma of resistance evolution stats that random genetic variation in wild weed populations contains initially rare resistance alleles that then increase in time with herbicide selection pressure. A fundamental question then becomes, where does genetic variation come from? One source of variation is random small polymorphisms that occur during DNA replication. Classic target site mechanisms from SNPs most likely start this way; however, thanks the advent of cheap, third generation sequencing and chromosome level genome assemblies, we are discovering that genomic rearrangements are also frequently sources of herbicide resistance traits. This phenomenon is most obvious in the case of glyphosate, where at least 8 species have developed some sort of target site copy number variation. Each species evolves glyphosate resistance independently and utilizes different rearrangement mechanisms, but the end result is the same. Recently, target site copy number variation was also cited as providing glufosinate resistance in Amaranthus palmeri and ACCase resistance in Digitaria sanguinalis. In separate, extraordinary case of genomic rearrangments, a transposable element inserted into an intron and changed splicing of a target site. These discoveries are only the beginning of the insights that weed genomes have to offer.

Using the Right Tools: Overcoming Constraints to High-Throughput Statistical Genetics Analyses in Weeds Caused by Self-Fertilization and Polyploidy. Samuel R. Revolinski*; University of Kentucky, Lexington, KY (360)

High-throughput genetic sequencing has enabled weed scientists to use powerful statistical tools for investigating genetic processes underlying adaptation in weeds. However, many of the tools currently available assume diploid populations in Hardy-Weinburg equilibrium (random mating). Unfortunately, many weed species are not randomly mating and/or are polyploid. Using tools developed for randomly mating or diploid species when the species are non-randomly mating or polyploid can lead to erroneous results, thus leading to erroneous conclusions. Fortunately, there are appropriate tools for weed scientists to use when using high-throughput sequencing for statistical genetic inference in weeds. Often the first step of statistical inference from genetic sequencing data is calling single nucleotide polymorphisms (SNPs) from sequence alignments. Some tools developed for processing high-throughput sequencing reads and calling SNPs use SNP calling software that is not appropriate for polyploids and will make only diploid SNP calls. Tools such as FreeBayes are capable of polyploid SNP calling but requires that the ploidy is known. The tool nQuire can be used to determine the ploidy of samples directly from high throughput sequencing reads, allowing for the proper ploidy to be chosen for subsequent analyses. Once SNPs are called, often scientists will seek to estimate the admixture of ancestral populations in samples using the tools STRUCTURE or ADMIXTURE that assume Hardy-Weinberg equilibrium, making them inappropriate for use in non-randomly mating weeds. To overcome the deviation from Hardy-Weinburg equilibrium in admixture analyses, sparse non-negative matrix factorization can be used instead. In addition, several tools are available for other down-stream statistical genetic analyses such as genetic diversity, analysis of molecular variance and genetic distance between samples in polyploid or non-randomly mating weed species.

Brawling Weeds and the Fight for Crop Survival. Clarence Swanton*[1], Sasan Amirsadeghi[2], Nicole Berardi[3], William B. Kramer[4], Andrew McKenzie-Gopsill[5]; [1]University of Guelph, Department of Plant Agriculture, Guelph, AZ, Canada, [2]University of Guelph, Department of Plant Agriculture, Guelph, ON, Canada, [3]University of Guelph, Guelph, ON, Canada, [4]Colorado State University, Fort Collins, CO, [5]Agriculture and Agri-Food Canada, Charlottetown, PE, Canada (361)

Direct competition for light, water, and nutrient resources is traditionally considered the driving variable of plant competition. Recent research, however, has suggested that resource competition is not the primary mechanism by which weeds induce crop yield loss. Crop-weed competition begins with plant communication, the ability of the crop seedling to detect the presence of neighboring weed seedlings. Once the crop seedling interprets this incoming communication, significant molecular and physiological changes occur. Such changes include a rapid increase in cellular singlet oxygen, a decline in photosynthesis, a loss in the crop plants' ability to defend against insect and disease damage, and a loss in the crop seedlings' ability to assimilate nitrogen. These four novel competition mechanisms alter the growth trajectory of the crop seedling, contributing to a rapid decline in crop yield potential.

Higher Seeding Densities Improve Perennial Flower Strip Establishment Under Weedy Conditions. Sophie Westbrook*[1], Rebecca Stup[1], Scott Morris[1], Todd Ugine[1], Antonio DiTommaso[2]; [1]Cornell University, Ithaca, NY, [2]Soil and Crop Sciences Section, School of Integrative Plant Science, Cornell University, Ithaca, NY (362)

Vegetation along field margins is an important component of agroecosystem biodiversity but also harbors problematic weeds. Establishing flower strips along these margins is a well-established method of increasing biodiversity and promoting ecosystem services. Key knowledge gaps are related to interactions between seeded plants and existing weeds. We conducted a two-site field experiment in 2022 and 2023 in NY State, USA to test how seed mix composition (monocots plus dicots vs. dicots only) and seeding density (four rates) modify flower strip establishment under weedy conditions. Measurements included seedbank density and diversity, aboveground density and diversity, biomass, cover, canopy height, flowering plant density, and abundance of bees, ladybeetles, and spiders. We found that weed seedbanks prior to the experiment strongly influenced aboveground communities in 2022 (species richness, $P < 0.001$). The aboveground density of seeded species was highest when monocots plus dicots were seeded at the highest tested rates. Although seeded plants occurred at lower densities than non-seeded plants, they were larger than non-seeded plants in 2023. Mean seeded plant size (g per individual) in September 2023 was 6– 54 g and mean non-seeded plant size was below 1 g in all treatments. The number of flowering seeded dicots tended to increase with seeding rate in 2023. Seeding treatment affected bee abundance, especially in sweep-net samples from August 2023 ($P = 0.01$). At the Ithaca site, control treatments averaged 0.0– 0.3 bees while all other treatments averaged 1.3– 4.7 bees. Bee abundance was also linked with flowering black-eyed Susan (*Rudbeckia hirta*) abundance ($P < 0.001$) or flowering seeded species richness ($P < 0.001$). Overall, these results highlight the potential for flower strips to succeed even under weedy conditions. They also suggest that farmers seeking to establish flower strips in weedy fields should use high densities of competitive species.

The Influence of Management on Weed Communities and Yield in Hemp (*Cannabis sativa* L.).
Karla L. Gage*[1], Kaitlin E. Creager[2], Eric J. Miller[2], Kevin Bamber[3], Matthew P. Spoth[3], Michael L. Flessner[3], Lynn M. Sosnoskie[4]; [1]Southern Illinois University Carbondale, Carbondale, IL, [2]Southern Illinois University, Carbondale, IL, [3]Virginia Tech, Blacksburg, VA, [4]Cornell University, Geneva, NY (364)

Following passage of the 2018 Farm Bill, growers can cultivate hemp, defined as *Cannabis sativa* L. with less than 0.3% tetrahydrocannabinol (THC) by weight. Some cultivars are referred to as "dual-purpose" and may be grown for both seed and fiber. While hemp can be a competitive crop, early season weed control can prevent crop establishment. A recent survey identified the top five most troublesome weeds in hemp as morningglory spp. (*Ipomoea* spp.), Palmer amaranth (*Amaranthus palmeri*), crabgrass spp. (*Digitaria* spp.), common lambsquarters (*Chenopodium album*), and common ragweed (*Ambrosia artemisiifolia*). However, there is a lack of information on competitive effects of these and other weeds and how to manage them. There are only two recently registered herbicides, ethalfluralin and quizalofop, for growers to use in hemp production, and research is still needed to expand knowledge of how to integrate the few available weed control tactics. Therefore, the objective of this study was to evaluate the effectiveness of cultural and chemical tactics in production of a dual-purpose hemp cultivar. The study design was a 3 x 2 x 3 factorial with four replications, conducted in Illinois and Virginia. Research plots were seeded at rates of 100, 200, or 300 plants m^{-1} on either 19 or 38 cm rows. Herbicide applications were nontreated, ethalfluralin (1050 g ai ha^{-1}) followed by (fb) quizalofop (77 g ai ha^{-1}); and *S*-metolachlor (1423 g ai ha^{-1}) fb clethodim (76 g ai ha^{-1}). Data collected at end of season consisted of weed species counts and above-ground biomass and hemp yield. Data were analyzed using Analysis of Variance (ANOVA) and Permutational Analysis of Variance (PERMANOVA). There was no difference in weed community Shannon's Diversity Index (H') by site, herbicide, row spacing, or seeding rate. Species richness was higher in Illinois compared to Virginia; an interaction of herbicide, row spacing, and seeding rate in Illinois, suggested that the nontreated 19 cm row spacings at 100 plants m^{-1} had the highest richness of all treatments. Only herbicide significantly affected richness in Virginia; *S*-metolachlor fb clethodim had the lowest richness of all the treatments. Evenness (J'), a measure of species dominance, was lower in Illinois than in Virginia, following the same trends as richness. Waterhemp (*Amaranthus tuberculatus*) biomass in Illinois was affected by herbicide program and seeding rate; the *S*-metolachlor fb clethodim and the 300 plants m^{-1} seeding rate treatments had the lowest biomass. Ivyleaf morningglory (*Ipomoea hederacea*) biomass in Illinois was higher than in the nontreated plots but not significantly different than the ethalfluralin fb quizalofop treatments. Broadleaf signalgrass (*Urochloa platyphylla*) biomass in Illinois was lowest in the *S*-metolachlor fb clethodim treatment, followed by ethalfluralin fb quizalofop, followed by the nontreated. Grass species abundance was higher in Illinois than Virginia; both herbicide programs resulted in reduced grass biomass compared to the nontreated in Illinois, but there were no differences in Virginia. Sites were not significantly different for broadleaf biomass; sites were pooled and both herbicide programs resulted in lower biomass than in the nontreated. Weed community composition was different by site and herbicide treatment independently. Yield was higher in Virginia than in Illinois, but herbicide program was the only significant factor affecting this; and only in Illinois, where the use of either program resulted in increased yield. In conclusion, there were no differences in weed biomass by cultural factors, but biomass was significantly reduced by one or both herbicide programs, depending upon site and species. In some geographies with problematically high weed pressure, the use of an herbicide program may result in increased yields.

Unlocking the Power of Sensor-Based Data Collection in Weed Ecology. Eugene P. Law*[1], Uriel D. Menalled[2], Soren K. Skovsen[3], Matthew Kutugata[4]; [1]Ohio State University, Columbus, OH, [2]Cornell University, Ithaca, NY, [3]Aarhus University, Aarhus, Denmark, [4]Texas A&M, College Station, TX (365)

Recent advances in the fields of sensor technology and artificial intelligence have enabled remote and proximal sensing systems that are capable of identifying individual weed species and measuring their density, biomass, and other characteristics in diverse weed communities. While these technologies have received much attention for their potential applications for precision weed management, they also present many opportunities for fundamental weed ecology research. Low-cost sensor systems can reduce the total cost of data collection through automation, allowing data to be collected across broader geographic areas representing more diversity of weed communities and environmental conditions. Additional strengths of these systems include more opportunities for repeated measurements due to non-destructive sampling methods, and reduced potential for bias to be introduced into results through human error or subjectivity. These technologies do have significant limitations, including the need for high-quality data to train machine learning algorithms, tradeoffs between the spatial and temporal scale and resolution of data and the cost of obtaining it, and the need to develop digital infrastructure for transmitting, storing, and processing data. In this talk we will discuss these strengths and weaknesses and highlight potential applications of sensor-based data collection for research in the areas of weed biogeography, functional diversity, and community assembly.

Does the Amount of Sorgoleone Production Correspond with Weed Suppression in Grain Sorghum (*Sorghum bicolor*)? Megan L. Schill*; Texas A&M, College Station, TX (372)

Allelopathy, characterized by the impact of one plant on another through the release of metabolites in the form of root exudates, plays a pivotal role in influencing competition for nutrients and overall survivability. In the context of weed management, allelopathy stands as a strategic avenue for weed control. Previous research has demonstrated that cultivated sorghum (*Sorghum bicolor*) possesses the capability to mitigate nitrification by producing root exudates, particularly sorgoleone. The primary objective of the present study was to quantify the allelopathic potential in a diverse array of known sorgoleone-producing *Sorghum bicolor* lines (3 lines total). These were assessed in relation to the sorghum line exhibiting the highest recorded sorgoleone production potential. The experimental design comprised a randomized complete block with 5 replications, each containing 4 rows. Weed infestation rates were monitored biweekly, along with assessments of canopy closure and identification of dominant weed species. The outcomes revealed that allelopathic effects were genotype-specific ($p < 0.001$). Subsequent investigations will involve controlled greenhouse experiments to further our understanding of allelopathy in the context of weed control strategies.

Plant Sterols: Potential Preemergent Non-synthetic Herbicide. Krishna Kumar*; Griffing Biologics LLC, Hearne, TX (373)

Plant sterols: Potential pre-emergent non-synthetic herbicides Krishna Kumar[1, 2] and Lawrence Griffing[1, 21] Griffing Biologics LLC, USA, [2] Department of Biology, Texas A&M University, USA Contact email: kksharma@tamu.edu krishnakr.agri@gmail.com The unanticipated off-target effects of the application of synthetic herbicides in agriculture and home gardening has created a need for eco-friendly herbicides for crop protection. A new strategy for sustainable weed management is to use of plant-derived natural inhibitors of weed emergence as an effective alternative to synthetic herbicides. To explore this strategy, we have focused on a natural (non-synthetic) way to change the metabolism and balance of plant sterols in the newly-germinating weed seed. Our model is that these sterols are important for weed emergence because mutants of the sterol biosynthetic pathway such as *fackel*, *hydra1*, *smt1*, *smt2* and *cvp1* in model plant systems such as Arabidopsis and tobacco have severe dwarfing phenotype and altered vascular development. The natural inhibitors of sterol metabolism that we have chosen are the sterols themselves. We have found that sterols exert an end-product inhibition of sterol content in plants when applied with an encapsulation agent that solubilizes the sterol and allows it to enter the plant. The encapsulation agent is a cyclodextrin in a formulation that has a specific molar ratio to sterol. Exogenous application of certain plant sterols in cyclodextrin leads to a reduction in endogenous sterols in plants and mimics the phenotype of sterol mutants. Our findings support the model that sterols are important for weed emergence because exogenous sterol application reduces root growth in the newly-emerged radicle in the germinated seed. Greenhouse trials have shown a significant suppression of the emergence of Rag-weed *(Ambrosia species)* and large *crab-grass* (*Digitaria species*). To further evaluate this non-synthetic pre-emergent herbicide with a novel mode of action (MOA), greenhouse tests are continuing, and field tests are being planned. In the lab we are exploring the mechanism of stage-specific, post-germination inhibition of growth, leading to reduced weed emergence.

Discovery and Mode-of-Action Characterization of a New Class of Diaryl-Ether Herbicides.
Hudson K. Takano*, Chris Kalnmals, Moriah Zielinski, Norbert Satchivi, Josh Roth, Jeff Church, Adel Hamza, Dilpreet Riar, Zoltan Benko; Corteva Agriscience, Indianapolis, IN (497)

Herbicides are effective tools to manage weeds and enable food production and sustainable agriculture. Corteva Agriscience R&D has recently discovered new diphenyl-ether compounds displaying excellent postemergent efficacy on important weed species along with corn safety. Here, we describe the chemistry, biology, biochemistry, and computational modeling research that led to the discovery and elucidation of the primary mode of action for these compounds. The target protein was found to be acetolactate synthase (ALS), a key enzyme in the biosynthesis of branched chain amino acids (valine, leucine, and isoleucine). While weed resistance evolution to ALS herbicides is widespread, the molecular interaction of the diphenyl-ether compounds at the active site of the ALS enzyme differs significantly from that of some commercial ALS inhibitors. The unique biochemical profile of these molecules along with their excellent herbicidal activity and corn selectivity make them a noteworthy development in the pursuit of novel, safe, and sustainable weed control solutions.

Mechanisms of Resistance to VLCFA Biosynthesis Inhibitors in *Lolium* spp. and the Role of Commercial Varieties in Resistance Spread. Rebecka Duecker*[1], Eric L. Patterson[1], Roland S. Beffa[2], Jean Wagner[3]; [1]Michigan State University, East Lansing, MI, [2]Senior Scientist Consultant, Frankfurt, Germany, [3]Georg-August Universität Göttingen, Göttingen, Germany (498)

Ryegrasses (*Lolium* spp.) are both crops and weeds and can quickly evolve herbicide resistance. In addition to post-emergence herbicides, pre-emergence herbicides are increasingly affected by the spreading resistance. This is especially true for regions where ryegrasses are propagated for seed production purposes. Therefore, the resistance level to the very-long-chain fatty acid (VLCFA) biosynthesis inhibitor flufenacet in weedy ryegrass and ryegrass varieties and the underlying resistance mechanism were investigated. In a genome-wide analysis of glutathione transferases (GSTs), a tau class GST was identified and validated in vitro. Resistance in ryegrass varieties can play a role in the spread of resistance as mutliple herbicide resistance was found in the weeds studied as well as in different cultivars.

The Nexus Between Reactive Oxygen Species and the Mechanism of Action of Herbicides.
Catherine J. Traxler*[1], Todd A. Gaines[1], Anita Küpper[2], Peter Luemmen[2], Franck E. Dayan[1]; [1]Colorado State University, Fort Collins, CO, [2]Bayer AG, Frankfurt, Germany (499)

Herbicides are small molecules that act by inhibiting specific molecular target sites within primary plant metabolic pathways resulting in catastrophic and lethal consequences. The stress induced by herbicides generates reactive oxygen species (ROS), but little is known about the nexus between each herbicide mode of action (MoA) and their respective ability to induce ROS formation. Indeed, some herbicides cause dramatic surges in ROS levels as part of their primary MoA, whereas other herbicides may generate some ROS as a secondary effect of the stress they imposed on plants. In this review, we discuss the types of ROS and their respective reactivity and describe their involvement for each known MoA based on the new Herbicide Resistance Action Committee classification.

Bouquet Stage of Meiosis May Have Provided a Mechanism for *EPSPS* Gene Amplification in Glyphosate-Resistant Windmill Grass (*Chloris truncata*). Mithila Jugulam*[1], Mazhar Islam[1], Bikram S. Gill[1], Christopher Preston[2], Jenna Malone[2]; [1]Kansas State University, Manhattan, KS, [2]University of Adelaide, Adelaide, Australia (500)

As a result of the extensive use of glyphosate, an allotetraploid grass weed, *Chloris truncata* (2n=4x=40) has evolved resistance to this herbicide in Australia. Previous research suggested amplification of 5-enolpyruvylshikimate-3-P synthase (*EPSPS*) gene (the molecular target of glyphosate) confers resistance in this weed species. Further, an increase in *EPSPS* copies was correlated with increased resistance to glyphosate in *C. truncata*. However, the mechanism of amplification of *EPSPS* gene is unknown. In this research, we investigated the genomic organization of the *EPSPS* genes using fluorescence in situ hybridization (FISH) in one susceptible (S1) and two resistant biotypes of *C. truncata* populations (R1 and R2). Metaphase chromosomes were prepared from root meristems and used for FISH analyses using *EPSPS* gene as a probe. FISH analysis revealed faint signals of *EPSPS* gene on the telomeric regions of a single pair of homologous chromosomes in S1 *C. truncata* plants. However, much brighter hybridization signals of *EPSPS* gene on more than one pair of chromosomes in the telomeric regions were detected in both R1 and R2 plants. The E*PSPS* signals were found on 3 pairs of homologous chromosomes in R1, while on four pairs in R2 plants. Thus, it appears that there was gene amplification on the native *EPSPS* locus as well as spread of *EPSPS* loci to additional chromosomes. All loci were detected in terminal regions which are hotspots of recombination. This local as well as ectopic *EPSPS* amplification to specific regions of chromosomes is a novel mechanism not observed before. We hypothesize that bouquet stage of meiosis may have provided a mechanism to facilitate this pattern of gene recombination. During bouquet stage of meiosis, telomeres come together forming a bouquet and this may provide an opportunity for ectopic recombination. Overall, the *EPSPS* gene amplification occurred in two steps. First there was tandem EPSPS amplification at the native locus possible by unequal recombination. Second, amplified locus underwent ectopic recombination and spread to two additional chromosomes in R1 and three additional chromosomes in R2 plants. Under continuing selection pressure, we speculate *EPSPS* locus has the potential, using bouquet stage, to spread to other chromosomes.

Evaluation and Potential Mode of Action of Novel Antimicrobial Analogues for Control of Yellow Nutsedge (*Cyperus esculentus*). Gregory R. Armel*[1], James Brosnan[2], Nilda Roma-Burgos[3], Peter J. Porpiglia[4], Jose J. Vargas[5]; [1]AMVAC Chemical Corporation, Rocky Mount, NC, [2]Univeristy of Tennessee, Knoxville, TN, [3]University of Arkansas, Fayetteville, AR, [4]AMVAC Chemical Corporation, Newport Beach, CA, [5]University of Tennessee, Knoxville, TN (501)

Pyrazinamide is a first-line drug for the treatment of tuberculosis (*Mycobacterium tuberculosis*). Several analogues of pyrazinamide and its active metabolite pyrazinoic acid were evaluated as potential herbicides at 3 kg ai/ha to control yellow nutsedge (*Cyperus esculentus*), barnyardgrass (*Echinochloa crus-galli*), and redroot pigweed (*Amaranthus retroflexus*) in soybean (*Glycine max*), rice (*Oryza sativa*) (imidazolinone-tolerant), or sweet corn (*Zea mays* convar. *saccharata* var. *rugosa*) (variety 'Incredible'). Six halogen substituted pyrazine analogues with a carboxylic-acid, acid-ester, or carboxamide in the para-position were applied postemergence and controlled yellow nutsedge = bentazon (840 g ai/ha) or imazethapyr (70 g ai/ha). Foliar injury derived from these compounds applied to weeds was best described as a combination of chlorosis and necrosis in meristematic tissue. The most active compound, 5-fluoropyrazine-2-carboxylic acid, controlled yellow nutsedge and barnyardgrass 71 to 95% and provided similar soybean injury in comparison to bentazon. Another similar analogue with a bromine atom in the 5-position (instead of a fluorine atom) was safe to rice, soybean, and corn and controlled yellow nutsedge greater than bentazon. The herbicidal sites of action targeted by these pyrazinamide/pyrazinoic acid analogues are unknown, but it is theorized they may be disrupting 1-aminocyclopropane-1-carboxylic acid oxidase (ACO) in the ethylene biosynthesis pathway and/or quinolinic acid phosphoribosyltransferase (QPRT) in the nicotinamide adenine dinucleotide (NAD) biosynthetic pathway in susceptible plants.

A Multi-Omics Approach to Investigate the Mechanism of Clopyralid Resistance in Common Ragweed. Nash D. Hart[1], Ednaldo A. Borgato*[2], Eric L. Patterson[3], Erin E. Burns[3]; [1]Michigan State University, Durand, MI, [2]Kansas State University, Manhattan, KS, [3]Michigan State University, East Lansing, MI (502)

Common ragweed (*Ambrosia artemisiifolia*) is a globally distributed difficult to control weed that can cause extensive yield reductions if not properly managed. Clopyralid is a synthetic auxinic herbicide used to control broadleaf species in several tolerant crops, including common ragweed. In 2018, a common ragweed population (40-R) from a Michigan Christmas tree farm lacked control with clopyralid. Since previous studies indicated that 32 times the recommended dose of clopyralid was not sufficient to kill this population, we hypothesized that 40-R has a novel mechanism of resistance to auxinic herbicides, different than others previously reported. The objectives of this research were to characterize the level of resistance to clopyralid and investigate the mechanism(s) conferring resistance. We performed a dose-response, inheritance, RNA-seq, and metabolomics experiments comparing 40-R population with a known susceptible population (39-S). Greenhouse experiments indicated that the dose required to reduce growth by 50% in 40-R was greater than 4.48 kg ae ha^{-1}, whereas in 39-S was 0.005 kg ae ha^{-1}, confirming a resistance level greater than 896-fold. In the RNA-seq analysis, we identified 70 genes that were differentially expressed (DEG), with 44 being over and 26 underexpressed. Additionally, we did not find deletion or other mutations in the 40-R IAA degron domain that correlated perfectly with the resistant phenotype. A few DEGs could be the cause of or associated with a non-target-site resistance mechanism, including a cytochrome P450. Further, we tested if 40-R was metabolizing clopyralid via HPLC analysis. Metabolism of ^{14}C-clopyralid was occurring in 40-R and we found that the majority of the parent compound was metabolized within 24 hours of treatment. Interestingly, the inheritance study revealed that the trait is recessive and is inherited as a single locus. In summary, 40-R showed high level of resistance to clopyralid, and whereas metabolism of auxinic herbicides have been reported in other species, this is the first case in which a CYP83-like gene was associated with the resistant phenotype. While metabolism of ^{14}C-clopyralid was observed in 40-R, it is not yet clear if it is metabolized by the DEG CYP83-like gene. Future research will further investigate the involvement of CYP83 with clopyralid resistance in common ragweed, through full-length sequencing examining if there are polymorphisms in 40-R that are not present in 39-S, as well as through heterologous expression. Ultimately, understanding clopyralid resistance in common ragweed and the potential for cross resistance to other auxinic herbicides is of critical importance for continued agricultural productivity in the United States as technologies like Enlist, Xtend, and XtendFlex soybean become more common.

Persistence of Target Site Mutation in Palmer Amaranth (*Amaranthus palmeri*) After 10 Years. Prakriti Dhaka*[1], Matheus Machado Noguera[2], Juan Camilo Velásquez R[2], Gulab Rangani[2], Felipe K. Salto[2], Nilda Roma-Burgos[2]; [1]University of Arkansas, Fayettevile, AR, [2]University of Arkansas, Fayetteville, AR (504)

Persistence of Target site mutations in Palmer amaranth after 10 years Prakriti Dhaka[1,2*], Matheus M. Noguera[1], Juan C. Velasquez[1], Gulab Rangani[1], Felipe K. Salto[1], Paolo Castiglioni[3], and Nilda Roma-Burgos[1] [1]Dept. of Crop, Soil and Environmental Sciences, [2]Cell and Molecular Biology, University of Arkansas, Fayetteville, AR and [3]ENKO Chem USA Palmer amaranth (Amaranthus palmeri) is one of the most common and troublesome weeds in the USA. Protoporphyrinogen oxidase (PPO)-inhibiting herbicides are among the most widely used chemical tools for Palmer amaranth control especially after the rapid evolution and spread of acetolactate synthase (ALS)- and glyphosate-resistant populations. We evaluated a current Palmer amaranth population in Greene County, Arkansas, USA for target-site mutations (TSM) to check the persistence of resistance-conferring mutations to PPO herbicides after 10 years. On-farm trials were conducted in 2023 followed by genotyping of survivors involving flumioxazin and sulfentrazone preemergence and fomesafen and saflufenacil postemergence. This population was confirmed resistant to foliar-applied fomesafen in 2014 (23% mortality) and was cross-resistant to foliar-applied acifluorfen, lactofen, carfentrazone, fluthiacet, and pyraflufen-ethyl. This field population was also resistant to soil-applied fomesafen (83% control) and oxyfluorfen (68% control). Target-site mutation is the major mechanism of resistance to PPO herbicides. The majority of plants in the original population carried ?G210 mutation. Assays conducted on the same seedlot a few years later revealed that 20% of plants in this population also harbored the newly discovered PPO2 mutation G399A. After 10 years, the current population showed 16% control with foliar-applied fomesafen (420 g/ha) and 62% control with saflufenacil (50 g/ha) in the field. Soil-applied flumioxazin controlled the current population <10% and sulfentrazone 25% in the on-farm study. ?G210 remained the predominant mutation which was detected among 63% of fomesafen survivors and in 25% of saflufenacil survivors. The three other known PPO2 mutations G399A, R128G or R128M were not detected most likely because these mutations are rare; thus, it would require a large number of samples to conclude their absence. Some resistant plants did not carry any mutations, indicating the presence of NTSR in this population.

Tetflupyrolimet: Discovery of its Novel Herbicide Site-of-Action Dihydroorotate Dehydrogenase (DHODH) Inhibition. Chad Brabham*[1], Steven Gutteridge[1], Sang-Ic Kim[1], Ryan Emptage[1], Il-Ho Kang[1], Atul Puri[2]; [1]FMC Corporation, Newark, DE, [2]FMC, Newark, DE (505)

Dodhylex™ active is the first new site-of-action (SOA) herbicide in nearly a generation available for commercial use. The progenitor molecule to Dodhylex™ active was discovered using high-throughput screens and initial SOA studies ruled out commercially known SOAs. Through genomics, metabolomics, nutrient reversal, and *in vitro* enzymatic assays, Dodhylex™ active was identified as an inhibitor of pyrimidine biosynthesis by targeting the dihydroorotate dehydrogenase enzyme. Dodhylex™ active will be a new tool for especially rice growers to control problematic and herbicide-resistant grass weed species.

GS2 Amplification in Glufosinate-Resistant *Amaranthus palmeri* (Palmer Amaranth) is eccDNA-Mediated. Matheus Machado Noguera*[1], Patrice Albert[2], Lucas Kopecky Bobadilla[3], Christopher A. Saski[4], Aimone Porri[5], Ingo Meiners[6], James A. Birchler[2], Patrick Tranel[7], Nilda Roma-Burgos[8]; [1]GreenLight Biosciences, Sacramento, CA, [2]University of Missouri, Columbia, MO, [3]Corteva, Indiannapolis, IN, [4]Clemson University, Clemson, SC, [5]BASF Global Research & Development, Limburgerhof, Germany, [6]BASF, Rtp, NC, [7]University of Illinois, Urbana, IL, [8]University of Arkansas, Fayetteville, AR (506)

Resistance to glufosinate-ammonium (GFA) in Palmer amaranth is achieved by an overproduction of the chloroplastic glutamine synthetase (GS2) protein, by means of amplification and overexpression of the coding gene. Previous studies showed that the number of GS2 copies varies over time and across plant tissues, but the physical location of amplified GS2 copies and the mechanism of amplification have not been determined. The objectives of this research were to: 1) investigate inheritance patterns of GS2 copies; 2) determine if the inheritance of GS2 copies is related to its physical location in the Palmer amaranth genome, and; 3) determine whether eccDNAs in GFA-resistant Palmer amaranth contain GS2 copies. Inheritance of GS2 copies did not follow classic Mendelian patterns. Segregation of resistance at the plant level did not correlate well with GS2 amplification. Fluorescence in situ hybridization revealed that not all cells from a high GS2 copy individual contain GS2 amplification, and rare cells from a low GS2 copy number plant may contain cells with several GS2 signals (somatic mosaicism). Whole genome sequencing data from GFA-R individuals showed average coverage of 100 reads per gene across the genome, contrasting with the much higher coverage observed for GS2 and its neighboring genes (400-1000 reads). By analyzing eccDNA-sequence data from GFA-R plants, we observed several eccDNAs containing multiple GS2 copies. GFA-resistance in Palmer amaranth represents the second known example of adaptation to herbicide selection via eccDNA-mediated gene amplification, highlighting the relevance of eccDNAs as resources for evolutionary innovation in plants.

Examining Dicamba Volatility from a Broadcast Tankmix vs See & Spray Split Boom Application of Dicamba and Glufosinate. Larry Steckel*[1], Thomas C. Mueller[2]; [1]University of Tennessee, Jackson, TN, [2]University of Tennessee, Knoxville, TN (449)

Palmer amaranth continues to be a difficult to control broadleaf weed and soybean and cotton production systems in the Midsouth. Dicamba plus glyphosate applications have proven to be ineffective under field conditions, while the combination of dicamba plus glufosinate has shown to control Palmer pigweed. But, the co-application of the two herbicides in a tank mix results in greater dicamba emissions. The purpose of this research is to examine the effect of splitting the application of the two herbicides using See & Spray™ technology. A field study was conducted in Jackson Tennessee in 2023 in a soybean field which was naturally infested with Palmer amaranth. Dicamba and glufosinate were applied at standard label rates, either in a tank mix application or in separate booms for each herbicide. A different sprayer was used for each field plot. The soybeans were at the 4V stage and Palmer amaranth was 10 cm in height. The volatility reducing agent Voliminate was added to both dicamba treatments and spray pH was above 6.0. Applications were made to both field areas at 6:45 AM on July 11, 2023. Winds were 6 km/h, air temp was 21C, relative humidity was 76%, and there was zero cloud cover. After application the first samplers were started approximately 30 minutes later. High-volume air samplers placed inside the treated area captured the dicamba that was coming from the field onto filter media. Samplers had constant flow and measured the air flow. Sampling intervals were approximately 0 to 6, 6 to 12, 12 to 24, and 24 to 36 hours after treatment. Sampling media was collected and put directly into a cooler and then a freezer and was later extracted and analyzed using MSMS. The target application rate the tank mix and the See & Spray was 0.56 kg per hectare. The measured amount was 0.57 for both treatments. Dicamba emissions followed a similar pattern, with apparent volatility the first morning and the first afternoon after application, very low emissions overnight, and higher emissions the second day. The See & Spray treatment had approximate 50% less dicamba emissions, even though the dicamba boom was spraying the entire time due to the extremely high population of Palmer amaranth present in the field. Dicamba volatility would be expected to be lower as the total dicamba application was reduced with the See and Spray technology, under field conditions of less weed infestations. Additionally having the dicamba and glufosinate application being separated also reduced the volatility a substantial amount, 50% in this particular field test.

Pyroxasulfone Impregnated Onto Dry Fertilizer: Efficacy and Residual Concentrations in Equipment. Greg Stapleton*[1], Thomas C. Mueller[2], Larry Steckel[3]; [1]BASF, Dyresburg, TN, [2]University of Tennessee, Knoxville, TN, [3]University of Tennessee, Jackson, TN (450)

Glyphosate resistant (GR) weeds continue to present challenges for weed control in cotton in the United States. The attempt to incorporate alternate modes of action into post-emergent systems has been challenging. This report details the use of the long-standing idea of impregnating herbicide onto dry fertilizer and spreading into emerged fields of cotton.Pyroxasulfone was examined for utility of control of GR Palmer amaranth in cotton in a Tennessee field situation. The study utilized small plot research techniques and a 2 x 3 factorial arrangement of treatments. Factors included pyroxasulfone rate (1X and 2X) and application timing (dry impregnated at two leaf, dry impregnated at six leaf, post-directed spray application at six leaf). Data collected included visual observations of cotton injury and Palmer amaranth control of various time intervals after application.There was no cotton response from any of the dry impregnated herbicide treatments. There was little crop response from the sprayed applications. Palmer amaranth control was essentially complete for many treatments. By 55 days after treatment only the 1X rate of residual applied to six leaf cotton had lower Palmer amaranth control (80%) compared with all other treatments.A separate research study examined fortified fertilizer samples containing a 1X rate of pyroxasulfone. Lab methods involved utilized extracting the fertilizer pellets with methanol followed by analysis with a liquid chromatograph utilizing a diode array detector. Results for ammonium sulfate (AMS), urea, and an AMS plus urea blend showed that recoveries range from 33 to 59% of expected. To simulate cleanout of a fertilizer spreader, untreated fertilizer was added after the fortification procedure was complete. Recoveries in the first cleanout sample were 0% for AMS, and 4% for the urea or the AMS+urea blend. Further cleanout samples contained no measurable pyroxasulfone. The methods reported here could be utilized in other studies to examine different herbicides or different fertilizer blends.

The Relationship Between Palmer Amaranth Control, Expected Dicamba Emissions, and Label Adherence Under Field Conditions in Tennessee. Thomas C. Mueller*[1], Larry Steckel[2]; [1]University of Tennessee, Knoxville, TN, [2]University of Tennessee, Jackson, TN (451)

This report discusses the relationship between how closely a given operator follows the dicamba use label and the outcomes of effective Palmer amaranth control and reduced dicamba emissions under field conditions. The revised dicamba label is extraordinarily difficult for applicators to follow with all the parameters listed in the instructions. One outcome of this restrictive labeling is that liability is transferred from the registrant to the applicator in most situations. The current dicamba label has a plethora of restrictions involving training, various application date cutoffs, various application descriptions on how to apply the product, and substantial record-keeping which must be maintained. Some aspects of the label are being followed by most applicators, including training prior to use and other aspects. However, based on field observations it is probable that many applicators in some geographies are not following the labels to the fullest extent; including border areas, boom height, minimum wind speed, time of day restrictions, adding a volatility reducing agent, adding tank mixture partners not approved on the label, using more than the standard label rates, and following stated cutoff dates. Based on field observations it is apparent that off target movement of dicamba is still occurring, but reports to state agencies are often reduced. Some possible explanations for reduced reports is farmer acceptance of soybean injury from dicamba, and also the lack of direct allocation of blame due to the difficulty of definitively ascribing the source of the off-target dicamba. Field data clearly show that optimum Palmer amaranth control is achieved by applying to smaller weeds and using higher doses of dicamba; both of which are difficult given the label restrictions.

Fomesafen, Oxyfluorfen, and Terbacil Dissipation from Soil Covered with Low-Density Polyethylene Mulch or Left Bare. Annabelle E. McEachin*[1], Timothy L. Grey[2], Kayla M. Eason[3], A Stanley Culpepper[2], Jenna C. Vance[2]; [1]University of Georgia Crop and Soil Sciences, Tifton, GA, [2]University of Georgia, Tifton, GA, [3]United States Department of Agriculture, Tifton, GA (452)

Fomesafen, oxyfluorfen, and terbacil are soil-applied herbicides known to exhibit long-term weed control due to their residual half-lives. However, these herbicides' persistence in soil also raises concerns about carryover effects on sensitive vegetable crops grown rotationally in the same treated beds. Therefore, studies were designed to evaluate the herbicides' dissipation in soil covered by mulch and bare soil over time. Field trials were conducted with raised beds (1.8m x 6.1m) and those requiring mulch being covered with LDPE mulch after herbicide application. One soil core was collected from each plot at a depth of 8 cm at various timings ranging from 0 to 206 days after treatment (DAT) and frozen at -10°C until analysis. Bioassay experiments were conducted by planting four seed of a susceptible plant species into individual cone-tainers filled with the respective soil sample. Plant height (cm) and fresh weight biomass (mg) were measured at the two true-leaf stage. Bioassay results showed similar trends over time between fomesafen, oxyfluorfen, and terbacil. Across herbicides and in both covered and bare-ground plots, samples collected at 206 DAT were still showing a reduction in height and weight when compared to the non-treated control. For additional research, we are analyzing the soil for dissipation data using a LC/MS system.

Auxin Herbicide Formulation Thermal Stability Over Time. Timothy L. Grey*[1], William K. Vencill[2], Kayla M. Eason[3]; [1]University of Georgia, Tifton, GA, [2]University of Georgia, Athens, GA, [3]United States Department of Agriculture, Tifton, GA (453)

Dicamba formulations were specifically formulated for dicamba-tolerant crops in recent years. The stability of these various formulations of auxin herbicides were analytically evaluated for thermal degradation on a gradient table for temperatures at 20, 25, 30, 35, 40, 45, and 50 C for up to 336 hours, in sealed containers. Data was utilized to establish the parameter estimates by modeling with the exponential decay equation [$y = B_o e^{-B_1(x)}$]. Half-life was inversely related to temperatures and formulation for Clarity [dicamba DGA (DGA) diglycolamine salt formulation] and Xtendimax [dicamba VaporGrip (DVG) acetic acid/acetate technology]. DGA half-life was 256, 191, 154, 111, 107, 85, and 99 hours for 20, 25, 30, 35, 40, 45, and 50 C, respectively. In contrast, DVG half-life was 315, 203, 177, 191, 129, 121, and 131 hours, respectively for those same temperatures. DVG half-life was overall greater than DGA when comparing at equal temperatures. To accurately characterize temperature effect on dicamba formulation stability on the thermal gradient table, the Arrhenius equation, expressed as natural logarithm, was calculated. With respect to DGA and DVG, the activation energies were 27.65 and 22.66 kJ mol^{-1}, which are similar. Volatility was not measured in this experiment, only dicamba that was remaining in solution over time and temperature were evaluated.

Quantifying Herbicide Accumulation in the Transplant Hole from Surface Application to Low Density Polyethylene Mulch. Kayla M. Eason*[1], Timothy L. Grey[2], A Stanley Culpepper[2]; [1]United States Department of Agriculture, Tifton, GA, [2]University of Georgia, Tifton, GA (454)

Plasticulture vegetable systems typically combine the use of drip tape, raised beds, and plastic mulch. Herbicides applied over-the-top of plastic mulch prior to transplanting a crop without damage are crucial for maintaining weed control. Experiments using simulated vegetable beds, covered with plastic mulch, were conducted to quantify the concentration of halosulfuron-methyl, glufosinate, glyphosate, *S*-metolachlor, and acetochlor that moved into the crop transplant hole when irrigation (0.63 and 1.27 cm) was applied. All herbicide concentrations were below 1.0 mg ai or ae in the transplant hole regardless of irrigation volume. For halosulfuron-methyl, glyphosate, and glufosinate these concentrations were equal to a 1.3 to 8.9x of the field use rate washing into the transplant hole. Acetochlor and *S*-metolachlor concentrations in the transplant hole were equivalent to 0.1 to 0.7x of field use rates, respectively. The amount of water caught per jar was similar while concentrations varied depending on the herbicide, with the more water-soluble herbicides detected in greater amounts.

Evaluating 'Soil Detoxifiers' to Mitigate Crop Injury from Off-Label Residual Herbicides.
Andrew R. Kniss*; University of Wyoming, Laramie, WY (455)

Two field studies were established near Lingle, Wyoming in 2023 to evaluate whether products marketed as 'soil detoxifiers' reduced herbicide injury in sugarbeet. A log-sprayer was used to apply atrazine, mesotrione, and a pre-mix of atrazine plus mesotrione plus bicyclopyrone at a standard '1X' field use rate, and reduced rates down to 0.016X, plus a nontreated control. Herbicides were applied on March 20, 2023. Soil detoxifiers were applied on April 11; 13 mm of precipitation were received between herbicide application and the soil detoxifier application. Sugarbeet was planted into the treated area on May 17; 131 mm of precipitation was received between soil detoxifier application and planting. Sugarbeet stand was counted in each plot for three consecutive weeks beginning on May 31. Sugarbeet stand was averaged over the three counting dates for analysis. A four-parameter log-logistic model was fit to the data, using sugarbeet density as the dependent variable and herbicide dose as the independent variable. Sugarbeet stand was reduced significantly by the herbicides, regardless of whether the soil detoxifier was applied. The soil detoxifier treatments did not appear to counteract the toxic effect of herbicides on sugarbeet.

An Integrated Approach Towards Weeds Management. Haroon Ur Rashid*; Dubai Community Management L.L.C (Dubai Holding), Dubai, United Arab Emirates (397)

A two-year study was conducted on integrated weed management in maize under different tillage regimes at Agricultural Research Station Swabi Khyber Pakhtunkhwa, Pakistan during Spring 2014 and subsequently repeated in 2015. The experiment was laid out at silt loam soil in Randomized complete block design (RCBD) with a split plot arrangement having three replications. Tillage regimes ((minimum, conventional and deep tillage) were kept in main plots (Factor A) and allelopathic plant residues (sorghum, sunflower and parthenium) as surface mulched in various combinations and their water extracts @ 15L each + atrazine @ ¼th of recommended dose were assigned to the sub-plots (Factor B), for weed management in maize. Data during both years (2014 and 2015) were recorded and analyzed for dry biomass of weeds 30 DAS, kernels ear-1, ear length (cm), kernel yield (kg ha-1) and cost benefit ratio. Foliar application of Sorghum + parthenium water extracts at 15 L integrated with a quarter recommended dose of atrazine (pre emergence) under conventional tillage regimes suppressed total weed dry biomass by 34 and 42% at 30 DAS during 2014 and 2015, respectively which increased maize kernel yield by 52 % over the weedy check and was almost equivalent to the label dose of atrazine (0.50 kg a.i ha-1) and also had the highest CBR (1:20.4). Among the soil mulch treatments, Sorghum + sunflower +parthenium each at 4 Mg ha-1 under deep tillage regimes suppressed weed dry biomass by 69 and 75 % at 30 DAS during 2014 and 2015 respectively, pooled data of both years (2014 and 2015) indicated increase in maize kernel yield by 54 % over control with CBR (1:15:2). However, the mulch treatments and the cost of deep tillage were uneconomical. Hand weeding under deep tillage regimes increased maize kernel yield by 46 % as compared to the weedy check. Based on current studies, it is concluded that foliar application of Sorghum + parthenium aqueous extract integrated with reduced atrazine dose are economical and eco-friendly having the highest CBR. Consequently, reliance on atrazine could be reduced by 75% resulting in environmental safety and sustainability, however further studies are suggested to fine tune our findings. Key words: Allelopathy, Integrated weed management, tillage, sustainable weed management, maize.

Advances in Precision Weed Management, 2024. Vijay Singh*[1], Dhiraj Srivastava[1], Akashdeep Singh Brar[1], Fatemeh Esmaeilbeiki[2], Rutvij S. Wamanse[2], Daniel E. Martin[3], William Reynolds[4]; [1]Virginia Tech, Painter, VA, [2]Virginia Tech, Blacksburg, VA, [3]United States Department of Agriculture, College Station, TX, [4]LeadingEdge Aerial Technology, Smyrna, FL (398)

The unmanned aerial systems (UAS) are currently used for mapping, classification of weeds and spray applications. Advanced machine learning algorithms and faster processing have opened new windows for real-time weed management. The UAS with spray systems are more economical and easier to use compared with manned aircraft systems due to their ability to hover and fly at low speed and altitude. Previously, UAS-based spray applications have indicated excellent weed control in corn, and soybean when applied at postemergence (POST), operating at 3 m altitude, and using 18.7 and 37.4 L ha^{-1} volume. In 2023, additional studies were conducted at Virginia Tech-Eastern Shore Agricultural Research and Extension Center, Painter, VA, to evaluate the efficacy of UAS-based spray applications for preemergence (PRE) herbicide treatments. Two experiments were conducted, 1) evaluating three volumes, and 2) evaluating two nozzle types (air-induction and regular flat fan). Spray application treatments indicated enhanced weed control with 18.7 L ha^{-1} spray volume compared with 37.4 L ha^{-1}, however, both 37.4 L ha^{-1} and 74.8 L ha^{-1} volume provided similar weed control. Experiment 2 emphasized the importance of nozzle selection, indicating that air-induction nozzles are effective in reducing drift and postemergence control but may not be optimal for preemergence applications, which require finer droplet sizes. Separate studies were conducted to explore image analysis techniques and machine learning models for detecting weeds in row-crops. A quality annotated image data was generated, a resource which is currently lacking in weed science. The dataset was subjected to generative modeling to produce previously unexplored versions or weed orientation. Several model architectures using the most recent YOLOv8 series were used to detect weeds. According to the study's findings, the YOLOv8 model has potential for site-specific real-time operations. Subsequent research efforts will focus on creating lightweight machine learning models with high accuracy for weed prediction.

Feasibility Studies on Harvest Weed Seed Control in Cotton. Sarah A.d. Chu*[1], Lauren M. Lazaro[2], Gaylon Morgan[3], Benjamin McKnight[4], Robert Hardin[1], Greg Holt[5], Muthukumar V. Bagavathiannan[1]; [1]Texas A&M University, College Station, TX, [2]Blue River Technology, Sunnyvale, CA, [3]Cotton Incorporated, Cary, NC, [4]Texas A&M AgriLife Extension Service, College Station, TX, [5]United States Department of Agriculture, Agricultural Research Service, Lubbock, TX (399)

Weed seed retention at crop maturity is an important determinant of harvest weed seed control (HWSC) efficacy in a cropping system. HWSC tactics are yet to be deployed in cotton, a system that has high herbicide-resistant weed concerns (especially *Amaranthus* spp.). Cotton harvesters have two major design differences; the cotton pickers remove seed cotton from the plant with spindles, whereas the cotton strippers use rubber bars to remove the seed cotton. The differences in the mechanics of cotton harvesters can contribute to differences in the amount of weed seed shattered to the ground, remained on the plant, and removed from the field with the lint. This study was aimed at determining how the picker and stripper harvesters influence *Amaranthus* spp. seed shattering, retention, and removal during cotton harvest and how these differences could be manipulated to implement a HWSC tactic. Cotton pickers allowed for 64% of *Amaranthus* spp. seed remained on the plant post-harvest. Cotton strippers removed 43% of weed seeds from the field during harvest. HWSC strategies can be developed to effectively target the remnant seed and reduce seedbank inputs. Therefore, the aim of the subsequent experiment was to target the weed seeds remaining on the plant after the picker harvest, and the weed seeds removed with the seed cotton. A flail mower with a cart was utilized to remove weed seeds and plant biomass in the field. To target weed seeds removed with seed cotton, cotton gin trash was collected during the ginning process for further evaluation of weed seed destruction by a stationary impact mill. Results show the opportunities for HWSC in cotton to tackle the proliferation of resistant weeds in this system.

WEEDS: A Multi-Regional Bioeconomic Decision Support Tool for Guiding Integrated Weed Management. Purushottam Gyawali*[1], Karen Lindsey[2], Ankita Ratouri[3], Steven Brian Mirsky[4], Michael Popp[2], Jason K. Norsworthy[5], Muthukumar V. Bagavathiannan[6]; [1]Texas A&M University, Department of Soil and Crop Sciences, College Station, TX, [2]Department of Agricultural Economics and Agribusiness, University of Arkansas, Fayetteville, AR, [3]Agricultural and Biological Engineering, Purdue University, West Lafayette, IN, [4]USDA ARS, Beltsville, MD, [5]University of Arkansas, Fayetteville, AR, [6]Texas A&M University, College Station, TX (400)

The effective management of herbicide-resistant weeds necessitates the adoption of integrated weed management strategies, where knowledge-based tools play a pivotal role in ensuring sustainable weed control and economic profitability. Decision support systems (DSS) serve as an invaluable aid for farmers and practitioners, facilitating the development of robust weed management plans by enabling the assessment of best management practices and an understanding of potential consequences. In this context, a comprehensive simulation model called WEEDS (Weed Ecological and Economic Decision Support) is currently under development to assist decision-making in weed management. The WEEDS model specifically targets prominent broadleaf and grass weed species across major agronomic cropping regions in the United States. It is an extension of the Palmer Amaranth Management (PAM) model, originally designed for guiding Palmer amaranth (*Amaranthus palmeri)* management in the Mid-Southern US. The ongoing improvement to the WEEDS model includes the incorporation of common waterhemp (*Amaranthus tuberculatus*) and barnyardgrass (*Echinochloa crus-galli*), two agronomically important weed species. The current version of the WEEDS tool simulates long-term changes in the population of common waterhemp and assesses economic outcomes in various crop rotations such as corn, soybean, and cotton. While adaptable to diverse weed species and geographical regions throughout the United States, the immediate efforts focus on common waterhemp within the Midwestern and South-Central US. The development of the WEEDS model contributes to the establishment of effective weed management practices by providing a practical decision-support tool to improve the management of herbicide-resistant weeds.

Assessing the Allelopathic Effects of Organic Mulch Extracts on Liverwort Control in Containerized Greenhouse Production. Manjot Kaur Sidhu*[1], Debalina Saha[2]; [1]Michigan State University, Lansing, MI, [2]Department of Horticulture, Michigan State University, East Lansing, MI (401)

Liverwort (*Marchantia polymorpha*) is one of the major weed problems in ornamental crop production. To study the effectiveness of allelopathic properties of organic mulch extracts on liverwort control, six different organic mulch materials- rice hull (RH), cocoa hull (CH), pine bark (PB), maple leaf (ML), shredded cypress (SC) and red hardwood (HW) were used for obtaining mulch extracts. In the lab experiment, the mulch extracts were used to impregnate agar media at an increasing dose of either 1x (2ml), 2x (4ml), 3x (6ml), and 4x (8ml) rates. The liverwort gemmae were transferred to the culture medium in petri dishes that were maintained inside the growth chamber. Data was recorded for number of gemmae germinating and surviving in each petri dish. For greenhouse experiment, the mulch extracts were applied to nursery containers filled with standard nursery substrate. Either RH, HW, CH, ML, SC or PB mulch extracts were applied to each of the container uniformly at either 1X (15ml), 2X (30ml), 3X (45ml), and 4X (60ml) rates, at the beginning of experiment and bi-weekly until 10 weeks. Control set without any mulch extract was included as well. Percent of substrate surface covered by liverwort thalli was visually estimated bi-weekly until 10 weeks after first treatment. Both lab and greenhouse experiments had four replications per treatment, and they were arranged in a randomized complete block design. In lab experiment, ML followed by SC, and HW showed maximum suppression of liverwort germination and growth. In greenhouse experiment, all the mulch extracts were able to provide 100% liverwort control for first two weeks. The PB mulch extract was significantly impactful in reducing liverwort percent coverage at 6, 8, and 10 weeks. In future, more research needs to be done to identify the allelochemicals responsible for the bio-pesticidal activity in these organic mulches.

Cereal Rye Cover Crop Delays Weed Emergence in Cotton. Gustavo Camargo Silva*[1], Muthukumar V. Bagavathiannan[2]; [1]Texas A&M University, Department of Soil and Crop Sciences, College Station, TX, [2]Texas A&M University, College Station, TX (402)

The most popular cover crop species in the United States today is cereal rye, which apart from offering soil and water conservation benefits, has great potential for integrated weed management. There is evidence that cereal rye can delay weed emergence timing in summer cash crops, potentially by decelerating soil warming in the spring and by physically suppressing weed with biomass. This project seeks to determine the effect of cereal rye biomass production on soil temperature and water, as well as how the cover crop may affect weed emergence patterns in a cotton crop. Cereal rye was planted at four seeding rates (0, 20, 40, and 80 kg ha^{-1}) and terminated at three timings (6, 4, and 2 weeks before planting the cash crop) to create a wide range of biomass, totaling 12 treatments. Soil water and temperature were continuously monitored using remote sensors. Cereal rye biomass production was determined at termination, which was carried out using glyphosate (870 g ae ha^{-1}). Cotton was planted into the cereal rye residues with a no-till drill. Weed density and emergence were assessed in the early summer. Preliminary results indicate that high cereal rye biomass levels reduce both maximum and minimum soil temperature at cash crop planting time. Cereal rye residue also reduced the evaporation of soil water. Weed emergence was both reduced and delayed in cereal rye plots compared to fallow ones. Results suggest that a reduction in the amplitude of soil temperature is intrinsically tied to a reduction in soil water evaporation and that this mechanism plays a significant role in total weed suppression by cereal rye cover crop.

Cereal Rye Cover Crop Termination Timings in Corn. Amar S. Godar*[1], Jason K. Norsworthy[1], Tom Barber[2]; [1]University of Arkansas, Fayetteville, AR, [2]University of Arkansas, Lonoke, AR (403)

Cover crops, such as cereal rye, are widely acknowledged for their ability to suppress weeds in diverse cropping systems. However, there is a scarcity of research on their effective implementation in region-specific contexts. This study examines the impact of varying cereal rye termination timings on weed management and corn yield within a two-pass herbicide program, conducted over five site years (2021– 2023) in Arkansas. The herbicide program involved one application at the time of cereal rye termination or corn planting (conventional system), followed by another at the corn V4 stage. Palmer amaranth at V4 corn was more effectively managed in the cereal rye cover crop environment, regardless of termination timing (>75%), compared to the conventional system (<50%). Weed control in both systems was generally excellent 4 weeks later, with slightly better control observed in the environments where cereal rye was terminated later. In contrast, yellow nutsedge control was marginally less effective in the cereal rye system compared to the conventional system. The control of grasses (barnyardgrass and broadleaf signalgrass) generally followed the same pattern as that of Palmer amaranth; however, with clear benefits observed with later termination timings. Corn yield was comparable between the conventional system and the cereal rye system when the cover crop was terminated before corn planting; however, the yield was 16% to 22% lower in systems where the cover crop was terminated at or after corn planting. These findings suggest a nuanced use of cereal rye as a cover crop in corn in the region, with the optimal time for terminating the cover crop being 2 weeks before corn planting. Further research could explore factors that could mitigate the yield loss associated with delaying the termination of the cereal rye cover crop and enhance its utility as a cover crop in corn.

Evaluation of Winter Cover Crop Mixes for Weed Suppression in East Central Texas. Jodie M. McVane*, Muthukumar V. Bagavathiannan; Texas A&M University, College Station, TX (404)

Weed suppression is a challenge throughout the year in Texas. This, coupled with difficulties of soil degradation, climate challenges of excessive heat, droughty conditions, and intense rainfall, can reduce agricultural resiliency. Prevention can be an asset to mitigate these challenges. Winter cover crops can play a role in protecting our soils and improving weed suppression. This three-year study aimed to evaluate five winter mixed species cover crops for biomass production and weed suppression. Two biomass times were collected based on cash crop planting times of corn and cotton. In the February cutting, Mix 1 (all grasses) developed significantly more biomass than the other mixes in 2021 (816 kg ha-1) and 2022 (1749 kg ha-1). In 2023, Mix 5 (no grasses) had the greatest biomass (544 kg ha-1). Weed biomass was similar in all mixes each year of the study ($P<0.05$) during the February cutting. The weedy check had significantly more weeds each year than the average in the mixes with percent increases of 755% in 2021, 5,673% in 2022, and 12,476% in 2023. In the April cutting of cover crop biomass, Mix 1 had the greatest biomass in all three years. From February to April, Mix 1 (all grasses) increased by 391% in 2021, 14% in 2022, and 140% in 2023. There were no significant differences among the mixes in all years in the April cutting of weed biomass. In April, the weedy check had significantly more weeds each year than the average of the weeds in the mixes. The percentage increase was 338% in 2021, 998% in 2022, and 4695% in 2023. Winter cover crop mixes can be part of an integrated weed management (IWM) system to help improve soil protection and health while suppressing weeds throughout the fall, winter, and spring months.

Replacing Fallow with Cover Crops for Weed Suppression in Semiarid Central Great Plains.
Sachin Dhanda*[1], Vipan Kumar[2], Anita Dille[3], Augustine Obour[3], Elizabeth Yeager[3], Johnathan Holman[3]; [1]Kansas State University, Hays, KS, [2]Cornell University, Ithaca, NY, [3]Kansas State University, Manhattan, KS (405)

Winter wheat-grain sorghum-fallow (WSF) is the dominant crop rotation in the semiarid Central Great Plains (CGP). Weed control in the fallow phase of the rotation is critical to conserve soil moisture. The widespread evolution of herbicide resistance in kochia [*Bassia scoparia* (L.) A. J. Scott] and Palmer amaranth (*Amaranthus palmeri* S. Watson) warrants the development of alternative, ecological-based integrated weed management strategies in the region. A field study was conducted at Kansas State University Agricultural Research Center near Hays, KS from 2020 to 2023 to determine the impact of spring-planted cover crops (CC) on weed suppression in no-till dryland WSF rotation. The field site had a natural seedbank of kochia and Palmer amaranth. A CC mixture of oat/spring peas/barley was planted in sorghum stubble during early spring and terminated at oat heading stage with glyphosate and/or glyphosate + (flumioxazin + pyroxasulfone). Chemical-fallow (no CC but glyphosate and PRE application of flumioxazin + pyroxasulfone) and weedy-fallow (no CC and no herbicide) treatments were also included for comparison. Across three years, both CC treatments reduced total weed density by 80 to 91% and weed biomass by 64 to 99% before CC termination as compared to weedy-fallow. CC terminated with glyphosate + (flumioxazin + pyroxasulfone) reduced total weed density by 51 to 64% and 22 to 33% at 90 days after termination as compared to weedy-fallow and chemical-fallow, respectively. This same treatment reduced total weed biomass by 51 to 80% and 14 to 72% compared to weedy-fallow and chemical-fallow, respectively. Winter wheat yields were not significantly different between chemical-fallow and the two CC treatments. These results suggest that spring-planted CC in combination with effective residual herbicides at CC termination can provide significant suppression of kochia and Palmer amaranth in the CGP region.

Evaluation of Cover Crop Options for Industrial Fiber Hemp Production. Jodie M. McVane*, Muthukumar V. Bagavathiannan; Texas A&M University, College Station, TX (406)

Weed suppression research for industrial fiber hemp (Cannabis sativa L.) is lacking (Sandler & Gibson, 2019). Growing fiber hemp in a sustainable way can become the standard. Reducing chemicals used in this crop can add value to the textile and fiber industries. Cover crops can be combined in a fiber hemp rotation; however, it is important to determine the compatibility of different species. The effects of four winter cover crop species, cereal rye, oats, winter peas, and woollypod vetch, on weed emergence and hemp production were evaluated over two summer growing seasons. In 2022, no significant difference ($P< 0.05$) was found in the biomass of the cover crop species. In 2023, oats had the greatest biomass (4460 kg ha^{-1}). In 2022, broadleaf weeds were dominant, and the weedy check treatment had 1357% more weeds than the average weed biomass of the four cover crop species. In 2023, the weedy check had 2343% more weeds than the woollypod vetch. Woollypod vetch was the lowest performer for weed suppression. Oats decomposed the slowest while woollypod vetch the quickest. This resulted in greatest weed suppression with oats and least with woollypod vetch. Winter pea had the tallest hemp in both years. Hemp biomass was significantly greater by 128% in the winter pea treatment in 2022 and 78 % in 2023 than the weed-free control plots with no cover crops. Fiber hemp was incompatible with cereal rye and oat cover crops and had reduced height, bottom diameter, and biomass than all other treatments, including the weedy check and weed-free treatments.

Allelopathic Potential of *Parthenium hysterophorus* Against Selected Weeds of Wheat Crop.
Tauseef Anwar*[1], Noshin Ilyas[2], Huma Qureshi[3]; [1]Department of Botany, The Islamia University of Bahawalpur, Bahawalpur, Pakistan, Bahawalpur, Pakistan, [2]Department of Botany, Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi, Pakistan, [3]Department of Botany, University of Chakwal, Chakwal, Pakistan (407)

In addition to encouraging weeds to develop herbicide resistance, high doses of synthetic weed control agents are also considered hazardous. Potential herbicides that are safer for the environment, more effective, and more cost-effective can be found in natural substances. The allelopathic potential of Parthenium hysterophorus L. was investigated in trials using weeds such as Rumex dentatus, Euphorbia helioscopia, Chenopodium album, Avena fatua, and Phalaris minor of wheat crop. Agar solution containing 0.75 percent (w/v), filter paper, and soil were used as the experimental media. Germination inhibition (percent), combined with a reduction in radicle and plumule length, were researched variables for evaluating allelopathic effects. According to the findings, seeds of R. dentatus, P. minor, and C. album cannot germinate when exposed to allelochemicals from P. hysterophorus. While E. helioscopia, T. aestivum, and A. fatua did not significantly differ from control groups in terms of germination, C. album showed minimal germination. Applying P. hysterophorus leaf extract to agar, filter paper, and soil all resulted in a reduction in the radicle and plumule length (cm) development of all test species. The plumule length was significantly shortened, according to the results, but P. hysterophorus leaf extract had no impact on T. aestivum's radicle length or germination. The fact that P. hysterophorus' growth slows down wheat seedlings suggests that it might not be a good choice for weed control in a field setting.

Modeling the Effect of Density, Emergence Time, Inter- and Intra-Specific Competition of *Echinochloa Crus-Galli* on Growth and Yield of Dry-Seeded Rice: Simulations with INTERCOM. Tahir Hussain Awan*; Rice Research Institute, Kala Shah Kaku, Lahore, Pakistan (408)

Dry-seeded rice (DSR) is an emerging resource-conserving technology in many Asian countries including Pakistan, but weeds remain the major threat to the production of DSR systems. DSR crop yields on-farm rarely approach their production potential, partly as a result of growth reduction due to weed interference. Among the weeds, *Echinochloa crus-galli* mimics rice and is a stronger competitor of rice for resources than other weeds. This weed has developed resistance to herbicides and poses a serious threat to rice production in the world. An adequate knowledge of the biology, ecology and critical period of competition of *E. crus-galli* with DSR is fundamental in designing effective, sustainable and integrated weed management programs for DSR. Cost-effective weed management requires accurate estimates of yield and the potential yield loss resulting from weed infestations. However, crop yield and the effects of weeds are highly variable across weed density and their time of emergence. This may be accomplished through early crop vigor or delaying the weed emergence. An Eco physiological model of rice-barnyard grass competition (INTERCOM) may be useful for predicting the effects of weed density and their time of emergence on crop and weed growth and competitive ability. To evaluate the ability of the model to predict the dry-seeded rice (DSR) growth and yield, the effect of barnyardgrass interference on rice yield loss was evaluated using two season rice data sets collected from the field experiments. Predicted and observed monoculture leaf-area-index, leaf, stem, aboveground, and panicle biomass of both rice and barnyardgrass were in close agreement. For inter-competition between species, height is very important, and the model captured the height very well. The normalized deviation for all values was near zero, which means the model calibration efficiency is good. Model-simulated results were very much similar to our field-observed results. Predicted and observed weed-free rice yields were ranged from 6.42-7.47 t ha^{-1} The simulated results depicted that rice panicle yield was affected by the increasing weed density at early emergence. As weed emergence was delayed, there were no observed effects of different densities as the weed was usually unable to survive and did not cause much reduction in panicle yield. Percentage yield reduction decreased with the decrease in weed density and the delay in their emergence. Barnyardgrass at 70 plants m^{-2}, emerging 2 days after rice emergence (DARE), reduced the grain yield by 65-70%. When the weed emergence was delayed to 45 DARE, the reduction in grain yield was only 2-5%. This reduction in yield was not so much different from the reduction caused by the weed density of 10 plants m^{-2} (0.7-3.2%). having the same emergence time as with rice. The model predicted that barnyard grass emergence with any densities at 45 DARE had negligible effect on rice growth and yield. The model suggests that the use of competitive rice cultivars or delaying the weed emergence may reduce the need for chemical weed control.

Transcriptome Analysis of Junglerice (*Echinochloa colona*) with Elevated Tolerance to Glufosinate. Juan Camilo Velásquez R*, Nilda Roma-Burgos, Gulab Rangani; University of Arkansas, Fayetteville, AR (409)

Transcriptome Analysis of Junglerice (*Echinochloa colona*) with Elevated Tolerance to Glufosinate. Juan Velasquez*, Jeffrey A. Lewis, Gulab Rangani, Nilda Roma-Burgos.*Echinochloa colona* L. (junglerice) is one of the most problematic weeds in rice worldwide. Resistance to herbicides among junglerice populations is increasing. Glufosinate-ammonium (HRAC group 10) is a nonselective herbicide which can be used to control junglerice preplant or in a rotational crop such as glufosinate-tolerant soybean. Junglerice from Arkansas, USA with high resistance to propanil and quinclorac, and low-level resistance to cyhalofop-butyl, also showed elevated tolerance to glufosinate (1.2 fold) and high recovery in the field. An experiment was conducted to generate transcriptome data of this multiple-resistant population 24 h after glufosinate treatment and compare this to that of a susceptible population. This project aims to: 1) identify differentially expressed genes (DEGs) between tolerant and susceptible junglerice before and after glufosinate application; 2) determine whether particular genes and biological processes are significantly upregulated in tolerant versus susceptible genotypes; and 3) identify candidate genes conferring tolerance to glufosinate. The tolerant genotype showed a heightened response to glufosinate application, with twice the number of upregulated and downregulate genes (11081 and 8602, respectively) compared to the susceptible genotype (5866 and 4574, respectively). For both tolerant and susceptible genotypes, genes involved in abscisic acid-activated signaling and the response to oxidative stress were the largest enriched categories among genes upregulated following glufosinate application. Intriguingly, the functionally-related genes were only significantly enriched for either the tolerant or sensitive genotypes but not both. For example, ammonium transmembrane transporters were upregulated only in the susceptible genotype, and more genes involved in photosynthesis were downregulated in the susceptible compared to the tolerant genotype. Nine glutathione S-transferase (GST) transcripts were upregulated in the tolerant genotype compared to the susceptible genotype. Based on the potential connection between glutathione metabolism and glufosinate resistance, these genes were chosen as candidates for further analysis. A UDP-glycosyltransferase and an ABC transporter were significantly more induced in the tolerant genotype and were also considered for further analysis. In conclusion, following glufosinate treatment, the tolerant genotypes showed reduced downregulation of photosynthetic processes and stronger upregulation of genes associated with herbicide metabolism such as GST, UDP-glycosyltransferase, and ABC transporters. Altogether, these results highlight the power of comparative transcriptomics for rapidly identifying candidate genes responsible for herbicide resistance for agriculturally important weeds.

Influence of Soybean Width on Palmer Amaranth (*Amaranthus palmeri* S. Wats.) Emergence in Relay Intercropped Versus Single Cropped Soybean. Jared T. Smith*[1], Jason K. Norsworthy[1], Matthew C. Woolard[1], Tanner A. King[2], Mason C. Castner[1], Tom Barber[3]; [1]University of Arkansas, Fayetteville, AR, [2]University of Arkansas Division of Agriculture, Fayetteville, AR, [3]University of Arkansas, Lonoke, AR (410)

Palmer amaranth remains one of the most troublesome weeds for Arkansas soybean growers. For years, herbicides have been the premier option for controlling this weed, but this has led to the evolution of herbicide resistance and decreased efficacy of herbicide applications. Going forward, an integrated weed management approach will be needed to adequately control Palmer amaranth. This research aims to evaluate the use of winter wheat to suppress the emergence of Palmer amaranth in soybean production systems with different row widths. In the fall of 2022, a field trial was initiated at the Milo J. Shult Agricultural Research and Extension Center in Fayetteville, AR. This experiment consisted of five treatments: drill-seeded soybean as a monocrop, drill-seeded soybean relay cropped with winter wheat, 36-inch row soybean as a monocrop, 36-inch row soybean relay intercropped with winter wheat, and a winter wheat monocrop. Wheat yields between the two soybean spacings did not differ; however, intercropped wheat yielded 55% less on average than the check. Drill-seeded soybean yielded 38% higher than in the 36-inch row treatments, but there was no difference between monocrop and intercrop yields. The drilled monocrop had the most Palmer amaranth emergence throughout the season. Compared to the drilled monocrop, the 36-inch monocrop had 58% less Palmer amaranth emerge, and the intercrops had 94% less Palmer amaranth emerge on average. The greater Palmer amaranth emergence in the drilled monocrop is attributed to increased soil disturbance at planting. These results suggest that relay intercropping winter wheat and soybean could be part of an integrated approach to control Palmer amaranth in the face of increasing herbicide resistance.

Investigating Herbicide Sensitivity in Johnsongrass (*Sorghum halepense*): A Multistate Analysis. Connor L. Purvis*, Erin E. Burns; Michigan State University, East Lansing, MI (411)

Johnsongrass (*Sorghum halepense*) is one of the world's most troublesome perennial weeds, inflicting environmental and economic damage. Johnsongrass has long been problematic in the southern regions of the United States. However, due to climate change, johnsongrass is becoming more problematic in northern regions such as Michigan. Historically, johnsongrass rhizomes were not able to overwinter due to harsh winter conditions however, now johnsongrass rhizomes can overwinter in newly established areas. Further exacerbating control are herbicide resistant populations of johnsongrass. Over 30 cases of herbicide resistance have been reported in johnsongrass to four sites of action. Acetolactate synthase (ALS) inhibitors are one site of action where resistant reports of johnsongrass are extensively noted. Given these factors, the objectives of this study was to determine baseline herbicide sensitivity in populations collected from across the United States and to determine the resistance mechanism. Populations have been collected from 20 states including: Alabama, Arizona, California, Florida, Georgia, Idaho, Illinois, Indiana, Kansas, Kentucky, Maryland, Michigan, Nebraska, Ohio, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, and West Virginia. To determine baseline sensitivity populations were submitted to dose response assays. Seeds from plants were collected and treated with concentrated sulfuric and gibberellic acid. After treatment, seeds were planted in flats filled with potting media in the greenhouse. Once the first two true leaves emerged individuals were transplanted into 12 cm pots and grown until the 3-4 leaf stage. Dose response assays consisted of seven nicosulfuron, glyphosate, clethodim, imazethapyr, and thiencarbazone-methyl rates with four replications. The dose treatments ranged from 0.125 to 64 times the field use rate of 0.09 kg ha^{-1} for nicosulfuron and 0.125 to 8 times the field use rates of 1.61, 0.65, 0.26, and 1.4 kg ha^{-1} for glyphosate, clethodim, imazethapyr, and thiencarbazone-methyl, respectively. Applications were made using a greenhouse track sprayer. Visual injury ratings were conducted weekly. Three weeks after application, aboveground plant biomass was collected, dried, and weighed. Dose response data was analyzed using the drc package in R to estimate the dose that causes 50% injury (ED_{50}). DNA was isolated from resistant populations and followed a CTAB protocol. *Sorghum bicolor* primers were used to amplify the ALS gene. These PCR products were then submitted for nanopore sequencing to analyze the populations for SNPs in the ALS gene. None of the populations are resistant to glyphosate or clethodim, with ED_{50} values ranging from 0.04 to 0.73 and 0.07 to 0.15 kg ha^{-1}, respectively. Twenty seven percent of the populations screened are resistant to nicosulfuron and 63% of the nicosulfuron resistant populations are also resistant to thiencarbazone-methyl and imazethapyr, with ED_{50} values greater than 5.06, 11.2, and 2.08 kg ha^{-1}, respectively. These populations were collected in Michigan (5), Indiana (1), Maryland (1), and South Carolina (1). These resistant populations all contain a SNP at the Trp_{574}, which confers broad spectrum resistance to ALS inhibitors. Future research will investigate the impacts of projected climate change on herbicide sensitivity. This future work will contribute to the current knowledge gap surrounding herbicide efficacy in a changing environment.

HRAC Global - the New Herbicide Mode of Action Classification 2024. Jens Lerchl*[1], Roland S. Beffa[2], Caio Rossi[3], Jens Frackenpohl[4], Jeffrey Epp[5], Gael Le Goupil[6], Hudson K. Takano[7], Hubert Menne[4], James Morris[8], Bernd Laber[4], Matthias Witschel[9]; [1]BASF SE, Limburgerhof, Germany, [2]Senior Scientist Consultant, Frankfurt, Germany, [3]Corteva Agriscience // HRAC Global, Uberlandia, Brazil, [4]Bayer Crop Science, Frankfurt, Germany, [5]Corteva, Indianapolis, IN, [6]Syngenta Crop Protection, LLC, Basel, Switzerland, [7]Corteva Agriscience, Indianapolis, IN, [8]Syngenta Crop Protection, LLC, Jealott`s Hill, Bracknell, United Kingdom, [9]BASF SE, Ludwigshafen, Germany (412)

The new HRAC Herbicide Mode of Action Classification 2024: Herbicides are a key tool for sustainable and efficient agriculture with strong positive impact on soil conservation as well as quality and quantity of harvested crops. HRAC Global strives to promote Integrated Weed Management encompassing chemical, cultural, biological and mechanical measures to avoid herbicide resistance. The use of different mode of action chemistries is an important measure to avoid weed resistance development as much as possible. The new HRAC Herbicide Mode of Action Classification 2024 poster and related website information provide an updated overview on the herbicide chemistries. The HRAC Global Herbicide Mode of Action Working Group reviewed literature information as well as publically available sales data and relevance for resistance management for the latest update of the presented poster. In addition a new poster layout with increased chemistry structures and coloring has been introduced. Changes were aligned within HRAC Global and with WSSA representatives. Information is made available through new attached weblinks on the poster as well as through a communication strategy to a wide stakeholder community in academia, public institutions, companies, students and other interested parties.

HRAC Global Contributions to Improvements in Sustainable Weed Management Based on Good Agriculture Practices. Caio Rossi*[1], Roland S. Beffa[2], Gael Le Goupil[3], Jens Lerchl[4], Bianca Martins[5]; [1]Corteva Agriscience // HRAC Global, Uberlandia, Brazil, [2]Senior Scientist Consultant, Frankfurt, Germany, [3]Syngenta Crop Protection, LLC, Basel, Switzerland, [4]BASF SE, Limburgerhof, Germany, [5]Bayer, Frankfurt, Germany (413)

Adopting available good agriculture practices into a comprehensive plan is a fundamental strategy for achieving sustainable production systems. In combination with agronomic strategies, herbicides are necessary to control weeds in an Integrated Weed Management (IWM) approach to increase crop yields and the quality of harvested products worldwide. Herbicide resistant weeds evolution critical challenge for the global agricultural community. The Herbicide Resistance Action Committee (HRAC) is an industrial body working to develop communication and technical tools, helping to mitigate resistance evolution. The present publication focuses on latest HRAC Global actions around the world. Together with the Weed Science Society of America (WSSA) and CropLife Australia, other herbicides classification holders, an exhaustive herbicide Mode of Action (MoA) classification poster was generated that can be accessed in the Global Resistance Management (GRM) digital application, which was recently launched. Together with CropLife International (CLI), HRAC Global incorporated the MoA information of each active ingredient onto the product label, designating a unique shape for enhanced recognition. For over two decades, the collaborative efforts with the scientific community have been dedicated to continuously improving the International Herbicide-Resistant Weed Database (weedscience.org). This database serves as a unique inventory of herbicide weed resistance cases. Based on that, HRAC, weedscience.org, and WSSA have agreed on criteria defining resistant weed populations, and these criteria undertake regular reviews to ensure their relevance and accuracy. HRAC Global was the first industry body to support the International Weed Genome Consortium (IWGC), aiming to establish the weed genomes offering information to better understanding the evolution of weed resistance and find novel strategies to mitigate it. Another important HRAC activity is to set recommendations on the use of key MoAs through its different working groups (hracglobal.com). HRAC is developing communication strategies and utilizing various tools, such as websites, videos, and factsheets. These initiatives are designed to facilitate a comprehensive understanding of the evolution of weed resistance, enabling all stakeholders to optimize the use of products. HRAC Global relies on regional HRACs (Argentina, Asia, Australia, Brazil, Europe, Japan, South Africa, and USA) and CLI to effectively implement its initiatives and actions. From rural communities to authorities and agriculture experts, HRAC delivers scientific and technical knowledge supported by academic, university and industry collaborations to protect crops while winning the dispute against herbicide resistance in a sustainable manner.

A Community-Based Participatory Research Approach to Herbicide Resistance Management.
Nick Bergmann*[1], Ian Burke[1], Garett Heineck[2], Chloe Wardropper[3]; [1]Washington State University, Pullman, WA, [2]USDA - ARS, Pullman, WA, [3]University of Illinois, Urbana, IL (414)

Herbicide resistance is a "wicked" transboundary resource problem. Consequently, social scientists argue that community-based approaches to herbicide management may offer a way forward in helping to create management solutions. Thus far scholarship has centered on the potential of common pool resource theory and area wide pest management to inform community-based herbicide resistance management. We offer a third possibility: community-based participatory research. Specifically, we posit that creating research partnerships with farmers and other local stakeholders focusing on the co-innovation of new management tools is a viable approach to address herbicide resistance at a community-scale. In particular, we believe the weed science community is well-positioned to lead such an effort because of this framework's primary emphasis on research. To support our claim, we provide case study evidence from an ongoing collaboration in the Pacific Northwest that uses a community-based participatory research approach to improve herbicide resistance management through diversification of crop rotations.

Tour of Texas Agriculture: 2023 Travel Enrichment Experience. Victor Ribeiro*; Oregon State University, Corvallis, OR (441)

The Travel Enrichment Experience (TEE) award provided me the opportunity to tour Texas agriculture with Bayer Crop Science. The tour started in Weslaco, southern Texas, and finished in Lubbock, western Texas. During the tour, I had the chance to visit the Bayer Cottonseed Manufacturing site, the Texas A&M University (TAMU) campus, two TAMU research stations, and private agricultural research companies. Additionally, I had the opportunity to interact with multiple scientists outside my discipline including plant breeders, plant pathologists, and entomologists. The TEE also allowed me to learn about different cropping systems in the United States. For instance, I visited several experiments with different crops such as cotton, citrus, sorghum, and sesame. This experience broadened my thinking about possible career choices and provided me with a greater understanding of relationships that can be beneficial between public and private partnerships. The WSSA TEE award provides weed science students an exceptional opportunity to stimulate their critical thinking and broaden their perspectives as scientists. Therefore, I encourage all graduate students to apply for this scholarship in 2024.

Discovering Various Career Paths in Industry. Eli C. Russell*; Virginia Tech, Blacksburg, VA (442)

A common question that graduate students must answer at the end of the degree program is, "Do I want to pursue a career in academia or industry?" Many students, myself included, have a rough idea about what they want to do in their career, but they have not had the opportunity to experience many of the possible career paths that a weed scientist could take. The WSSA Travel Enrichment Scholarship (TES) allows students the chance to explore some of those potential options. For me, I was curious about opportunities in industry as my understanding of what jobs are available and what those jobs consist of was minimal. My TES took me to Corteva's headquarters in Indianapolis, IN where I was hosted by Dr. David Simpson. Dr. Simpson set up a great itinerary that covered everything that I wanted to know. Unlike most TES, I did not travel around and see what specific research was being conducted but rather met with people in one-on-one meetings where I could learn specifically what their role was in the company. This is exactly what I wanted out of this scholarship as I wanted to know not only about what the company does but what career opportunities were available within the company and what the day-to-day looked like in those positions. Dr. Simpson could not have made a better schedule for me, and it allowed me to meet with over 20 individuals whose roles encompassed regulatory, discovery scientists, field scientists, and global biology leaders, to name a few and provided a good overview of career opportunities within Corteva. It was a truly eye-opening experience and has helped me to narrow down what I want to do and has provided a clear lens for me to make my future career decisions.
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My Travel Enrichment Experience with Blue River Technology. Jeanine Arana*; Purdue University/Horticulture, West Lafayette, IN (443)

Blue River Technology (BRT) is a company that specializes in applying artificial intelligence and computer vision techniques to agricultural practices. Founded in 2011 and acquired by John Deere in 2017, BRT focuses on developing innovative solutions for precision agriculture. The Travel Enrichment Experience (TEE) award allowed me to visit BRT research sites in Arkansas and headquarters in California in August of 2023. I enjoyed meeting and spending time with Lauren Lazaro, William Patzoldt, and Jesaelen Moraes, who kindly hosted me. My visit started at a John Deere LEAD field day in Arkansas with a captivating immersion into the world of autonomous tractors, including the John Deere See & Spray™ Ultimate sprayer, offering firsthand insights into the future of farming automation. Moreover, I had hands-on experience driving the BRT Agronomy Test Machine (ATM), a small-plot research See & Spray Ultimate, which enriched my understanding of these advanced sprayers' intricate functionalities and components. In California, I had the invaluable opportunity to meet with various teams, witnessing the collaborative efforts that drive the development of groundbreaking agricultural technologies. This opportunity displayed the interdisciplinary nature of precision agriculture and underscored the importance of synergy between technological innovation and agricultural expertise. This TEE was unimaginable. I saw a part of agriculture that I cannot see daily. Thanks to the WSSA for supporting graduate students in this way and BRT for being part of it and hosting me.

Travel Enrichment Experience with Corteva Agriscience in Sacramento, California. Isabelle Aicklen*; University of Guelph, Guelph, ON, Canada (444)

In August of 2023, I was hosted by Corteva Agriscience as a recipient of the 2023 WSSA Travel Enrichment Experience. The tour was organized by Dr. Marc Fisher, a field science leader with Corteva, and gave me insight into three key roles in the development and early launch stages of the new product pipeline at locations throughout northern and central California. The tour began at the Woodland Research Facility where I met with Dr. Gabriela Inveninato Carmona, Juan Beltran, and Dr. Renan Guidini, all field scientists who are responsible for executing field trials for the new product pipeline. During this part of the tour, I gained an understanding of the considerations for field trial establishment in the region, learned about permanent crops (e.g., tree crops), and gained insight into Corteva's company structure. Next, I travelled to the Salinas Valley, where I met with Dr. Julian Golec, a virtual field scientist. As part of his role, Julian coordinates with cooperators, university faculty, and large-scale farms to test new products and gain feedback on the efficacy of these products in a broader context. While shadowing Julian, I got to meet with cooperators, learn about present crop production challenges in the region, and got to visit established trial sites. The last part of the tour was spent with Bryce Borges, a market development specialist in the Fresno area. During the visit I was exposed to a wide range of crops including almonds, pistachios, walnuts, grapes, cotton, tomatoes, and olives. In this position, Bryce is responsible for communicating new products to various stakeholders, identifying gaps in the market, and determining product use patterns. Through this experience I became more knowledgeable regarding crop production and the diversity of crops grown in California, the challenges faced by growers in the state, and the contributions of Corteva to solving these issues. Thank you to Corteva Agriscience, Dr. Marc Fisher, and the WSSA for making this experience possible.

Weeds, Insects, Diseases, and New Fashion Trends: A Week with Dr. James Holloway in West Tennessee. Cynthia Sias*[1], James C. Holloway Jr[2]; [1]Virginia Tech, Blacksburg, VA, [2]Syngenta Crop Protection, LLC, Jackson, TN (445)

Syngenta is a leading agtech company present in more than 90 countries worldwide. I had the opportunity to spend a week with one of Syngenta's Senior Field Biology Experts, Dr. James Holloway for my Travel Enrichment Experience provided through the Southern Weed Science Society. Dr. Holloway spent the week showing me what a typical day on the job looks like, and what all his responsibilities entail. Dr. Holloway introduced me and connected me with some of the closest people he works with in both academic and industry positions, and helped me build new relationships during my visit. During my time in West Tennessee, we not only discussed weed science and herbicide trials, but I was also able to learn about current work conducted in pathology and entomology. The most important takeaway for me was to be ready to learn at any moment and to value every personal relationship we build. I strongly encourage other students to apply for the Travel Enrichment Experience and to get to know Dr. Holloway, as he is very active in the weed science societies and always willing to help us younger weed scientists. I would like to thank the Southern Weed Science Society for proving me with the opportunity to learn and make connections with the West Tennessee group through this experience. I would also like to thank Dr. James Holloway for a fantastic Travel Enrichment Experience and for his time and encouragement.

Science Policy Fellowship: an Insight into the Executive Director of Science Policy, ESA, and Federal Grants. Cynthia Sias*[1], Annu Kumari[2], Lee Van Wychen[3]; [1]Virginia Tech, Blacksburg, VA, [2]Crop, Soil & Environmental Sciences Department, Auburn University, Auburn, AL, [3]Weed Science Society of America, Alexandria, VA (446)

The Science Policy Fellowship is a unique opportunity for early career weed science professionals to assist Dr. Lee Van Wychen, Executive Director of Science Policy for the Weed Science Society of America (WSSA), providing valuable experience in diverse weed science policy issues. The WSSA's Science Policy Committee provides expert guidance and delivering science-based information on weed science policies to both National and Regional Weed Science Societies. Annu Kumari, Auburn University, and Cynthia Sias, Virginia Tech, were awarded Science Policy Fellowships for 2023-24. As a Science Policy Fellow (SPF), Annu drafted comments and review on the American burying beetle (*Nicrophorus americanus*), one of 27 species being considered for EPA's Vulnerable Species Pilot (VSP) project. Additionally, she suggested management strategies for invasive weed species such as glossy buckhorn (*Frangula alnus* Mill.) and cogangrass (*Imperata cylindrica*). She also analyzed the first national weed survey data for hemp. Cynthia drafted comments and review for Mead's milkweed (*Asclepias meadii*) for EPA's VSP project. A major task for Cynthia was formatting and analysis of the national weed survey data for the most common and troublesome weeds in grass crops, pasture, and turf in the U.S. and Canada. The SPFs are presenting a poster at each weed science society meetings to advance weed science research, extension, and education while simultaneously promoting USDA National Institute of Food and Agriculture (NIFA) grants and panel reviewer opportunities. Moreover, the SPFs traveled to Washington DC twice for congressional visits and meetings with trade associations and commodity groups, gaining firsthand experience in the significance of advocating for research priorities and regulatory policies at the federal level. They participated in meetings with congressional staff from Alabama, Georgia, and Virginia and discussed their doctoral research. They discussed weed science funding priorities, such as the USDA NIFA IR-4 Project and the Crop Protection and Pest Management program and advocated for changes in the existing Farm Bill policy to create additional research opportunities for weed scientists. The fellowship provided a great opportunity to experience a broad array of weed science policy issues, gaining a deeper understanding of the complexities involved in science policymaking and communications at the federal level. They are grateful to the WSSA and the Science Policy Committee for this unique opportunity and highly recommend this opportunity to peers irrespective of their interest in serving academia, industry, or federal agencies.

Industry Pipelines from Screening and Fieldwork to Regulatory Processes and Product Marketing: Travel Enrichment Experience with FMC. Annu Kumari*; Crop, Soil & Environmental Sciences Department, Auburn University, Auburn, AL (447)

As the recipient of the 2023 SWSS Endowment Enrichment award, I had the opportunity to visit FMC Corporation in August 2023, hosted by Drs. Matthew Wiggins and Aman Chandi. They thoughtfully organized a schedule of meetings considering my area of interest. Top of FormOn the first day, I interacted with the Tech Service Manager and Product Development Manager, who showcased their field trials in Crawfordsville and Keiser, AR, sharing their experiences and roles at FMC. The next day, I flew to Philadelphia and had a group dinner with the FMC team for an informal introduction. I visited the Stine research facility, spending a day with the herbicide, fungicide, and insecticide discovery teams, exploring formulation and application technology. This provided insights into innovative tools and processes for developing new products. I also had the opportunity to meet the biology statistics team, which was particularly fascinating as I minored in Statistics. The following day, I visited FMC Tower Philadelphia to learn about North America's marketing leadership, regulatory processes, and product registration. A meeting with the Chief Technology Officer (CTO) of FMC allowed me to discuss the industry's present and future vision. During my visit, I gained valuable insights from esteemed researchers, deepening my understanding of the product development and commercialization process. Many thanks to the FMC Corporation team, and the SWSS for this valuable experience. I highly encourage all graduate students to consider applying for this great opportunity.

2023 Endowment Enrichment Scholarship: Envisioning the Perspectives of Corporate Leaders Through a Week-Long Educational Experience in Bayer Crop Science. Navdeep Godara*; Virginia Tech, Blacksburg, VA (448)

As a part of the SWSS Endowment Enrichment Scholarship (EES) program, I selected Bayer Crop Science, St. Louis, MO as my host. The week-long educational program at Bayer Crop Science was an enriching experience for me as it allowed me to visualize one of the leading crop science company's functionality and stewardship. Drs. Greg Elmore and Matthew Goddard hosted me during my trip and organized visits to field stations, greenhouses, small molecules discovery labs, application technology labs, climate corporation, and the digital field solutions team. Beyond field and lab visits, my hosts also organized one-on-one meetings with over 20+ business and research leaders at Bayer Crop Science. I learned about how Bayer Crop Science is designing and bringing innovative solutions for farmers and comprehended about skillset required in future generations of leaders in corporate settings. Leadership is an essential component at every step of the corporate ladder. SWSS EES helped me to understand the different types of roles that exist in the industry for weed science professionals and the importance of leadership and teamwork for climbing the corporate ladder. I would like to express my sincere gratitude to the SWSS Endowment Foundation for providing me and my peers with this wonderful opportunity. I also want to thank my hosts because of them my travel was fun beyond learning about research, business, and development of new products. I highly recommend my peers to apply for the SWSS EES program in the future.

Increasing Weed Detection Accuracy on UAV and Ground Imaging Systems by Training Machine Learning Models with Synthetic Data Generated from 3D Models. Nicholas J. Witthoeft[1], Dimitris Zermas[1], Henry Nelson[1], Andrew A. Muehlfeld*[2]; [1]Sentera, Inc., Saint Paul, MN, [2]Sentera, Inc., Apex, NC (462)

The performance of machine learning models, including those for weed detection and classification, is limited by the quantity, diversity, and accuracy of labeled data for training. Furthermore, in precision agriculture, any attempt to adjust image requirements for a given task demands the collection of a plethora of new images of sufficient variety. These constraints are regularly the bottleneck for the development and evaluation of deep learning models. In this work, we introduce Prospero, a synthetic image and label generation pipeline based on 3D models. We display the capabilities of Prospero to augment a limited set of real-world images captured by UAVs (Unmanned Aerial Vehicles) with realistic-looking synthetic images and pixel-perfect mask annotations and to facilitate the training of deep learning models for the detection of weeds as small as ¼ inch. Unlike the synthesis of images with 2D methods, each plant generated by Prospero is unique, and its three-dimensional nature maintains advantages that enhance the photorealistic character of the images, e.g., the simulation of shadows across different lighting conditions. We use Prospero to generate training sets for three components of our green-on-green weed analytics suite: row detection, weed detection, and weed classification. We found that on low complexity tasks, such as in the case of row detection, synthetic data alone can be sufficient and alleviate the burden of real-world data collection and curation. On the other hand, the weed detection model trained on synthetic imagery alone was not sufficient but enabled the bootstrapping of a model used for pre-labeling real-world images. This model reduced labeling time by a factor of 5, shortening a 15-week development effort to 3 weeks with the final model trained on a combination of synthetic and real images achieving 98% weed control and 68% herbicide savings across 6 field trials. The detection model, originally designed for 30" row spacing, was finetuned with rapidly regenerated synthetic training data including 15" row spacing. The performance the resulting model achieved on 15" row spacing fields was equivalent to performance on 30" row spacing fields. The weed classification model - with classes for grass, Amaranthus, and other broadleaves - benefited from the addition of synthetic training data due to the low quantity of real-world training data. A 3D-model-based synthetic training data generation pipeline can shorten model development timelines, improve performance, and enable rapid adaptations to new environmental variables. Future work will study how the addition of diverse synthetic imagery to a limited diversity real-world imagery training set affects performance on diverse test sets gathered in expanded field trials.

Nonchemical Approaches to Managing Italian Ryegrass in Hazelnut Orchards. Marcelo L. Moretti*; Oregon State University, Corvallis, OR (463)

Herbicide-resistant Italian ryegrass (*Lolium multiflorum* Lam.) is a predominant weed infesting hazelnut orchards in Oregon. Confirmed resistant populations in the state include herbicide mode of action groups 1, 2, 9, 10, 15, and 22, hence challenging chemical control of this weed. Four field studies were conducted in 2023 to compare the nonchemical methods and chemicals to control Italian ryegrass during the spring. The tested treatments included mowing (2 km h^{-1}), EWC at 15 MJ ha^{-1} (2 km h^{-1}), and glufosinate (1.68 kg ai ha^{-1}) applied once or twice. Additionally, treatments combining EWC with mowing or glufosinate were assessed, resulting in eleven treatments. EWC was performed using an alternating current and 30 kW (EH-30 Thor, ZassoTM), treating swaths 1.2 m wide. The above-ground shoot, inflorescence biomass, and inflorescence density were determined 56 days after initial treatment (DAIT). Mowing once showed no significant difference compared to nontreated. However, when performed twice, mowing led to a 30% reduction in inflorescence density and an 84% reduction in weight. EWC, applied once or twice, reduced Italian ryegrass inflorescence density (51-58%), weight (55-73%), and shoot weight (45-75%) compared to nontreated, with no differences between single or double applications. Similarly, glufosinate applied once or twice reduced Italian ryegrass inflorescence density (68 to 86%) and weight (73 to 93%). Combinations of EWC with mowing or glufosinate proved highly effective, controlling 89 to 96% of the Italian ryegrass and exhibiting comparable efficacy to two applications of glufosinate (96%). The results indicate that Italian ryegrass control by EWC during the spring period is as effective as glufosinate and more effective than mowing.

The Potential Benefits of Targeted Herbicide Application on Row Middles. Ana Claudia Buzanini*[1], Nathan Boyd[2], Arnold W. Schumann[3], Renato Herrig Furlanetto[1]; [1]University of Florida, Wimauma, FL, [2]University of Florida, Balm, FL, [3]University of Florida, Lake Alfred, FL (464)

Smart spray technology can detect weeds and apply herbicides only where needed in the area between raised, plastic-covered beds (row middle) in plasticulture production. The Gulf Coast Research and Education Center (GCREC) in Wimauma, FL has developed a prototype smart spray that uses convolutional neural networks with the YOLO-V3 algorithm to differentiate between broadleaf, grass, and nutsedge in row middles. Two sets of field experiments have been conducted to determine the effectiveness of smart spray technology using a combination of pre-emergence (PRE) and post-emergence (POST) herbicides. The targeted spray is just as effective as banded spray in reducing weed density. The use of PRE herbicide is an important factor in reducing weed density. Although the absence of PRE herbicides can reduce costs, the use of POST herbicides may need to increase to achieve sufficient weed control. In experiments 1 and 2, two PRE-herbicide applications followed by 2 targeted POST-herbicides with smart spray technology reduced herbicide use by 52% and 13%, respectively, compared to banded applications. In the absence of a PRE application, targeted applications reduced herbicide usage by 40-67% in experiment 1 and 79-84% in experiment 2 compared to banded applications.

Evaluation of Soybean Injury to Low Volume Applications as Influenced by Application Type and Spray Volume. Livia Pereira*, Ryan D. Langemeier, Justin T. McCaghren, Steve Li; Auburn University, Auburn, AL (465)

Spray drones are still a new method of application to deliver pesticides and are being adopted worldwide. One challenge of spray drones is that due to logistical concerns, low volumes must be used for large fields. Additionally, the effect of rotor wash driving spray into the canopy may also affect crop herbicide response. Spray tank mix and volume interactions for drone applications still need to be studied in order to understand their effect on crop response. The objective of this study was to evaluate soybean injury to low-volume application as influenced by spray drones or ground sprayer and spray volumes. The study was conducted at two sites in Macon and Limestone Counties, Alabama during the growing season of 2022, and in Limestone County during 2023 season. The experiment was a randomized complete block design with three replications. Plot sizes at both sites were 5.5 m by 45.7 m for drone applications and 3.6 m by 45.7 m for ground sprayer applications. Treatments consisted of a combination of glyphosate, pyroxasulfone, COC, and AMS either with or without fomesafen applied with a machine-mounted CO_2 pressurized sprayer at different spray volumes. Application occurred when soybean was at the 5-6 trifoliate stage. Data collection included visual injury at 3, 7, 14, and 21 Days After Treatment (DAT). Soybean heights were taken at 7, 14, and 21 DAT. Additionally, NDVI was measured using a UAV sensor at 0, 7, 14, and 21 DAT. All data were analyzed in SAS 9.4. The results showed a site-by-treatment interaction at 3 DAT. At Macon County, treatments with fomesafen applied with ground sprayer at 93.5 L ha^{-1} presented the highest percentage injury, and it was significantly higher compared to drone applications at 18.7 L ha^{-1} for both treatments with and without fomesafen. At Limestone Co., treatments with fomesafen applied with ground sprayer at 46.7, 93.5, and 140 L ha^{-1} and without fomesafen at 140 L ha^{-1} also presented more injury than 17.7 L ha^{-1} both with and without fomesafen. For both sites, treatments applied with ground sprayer at 10 L ha^{-1} with fomesafen had a higher injury when compared to both drone applications at 2 L ha^{-1} at 7, 14, and 21 DAT. Overall, treatments without fomesafen tended to show less crop injury. Soybean heights were not statistically different from the NTC across all ratings. Spray application with ultra-low volume does not always mean more crop injury. The study showed that ultra-low volumes will not necessarily increase crop injury, however, questions on efficacy remain.

My Opinion: Targeted Weed Management is the Future of Weed Management. Nathan Boyd*; University of Florida, Balm, FL (467)

Targeted weed management involves the use of various sensors to detect weeds, followed by their subsequent removal. The accuracy of weed detection, identification, and localization has seen rapid improvement. Notably, the technology required for weed detection within crop canopies has often outpaced the development of end-effectors essential for precisely targeting and removing weeds without causing harm to the surrounding crops. While the adoption of targeted spray or cultivation technologies remains relatively limited, it is expected to become more widespread as the technology continues to improve. On-going pressure to reduce on-farm agrochemical inputs, coupled with labor shortages, is likely to drive the normalization and widespread adoption of this technology. To stay relevant in the future, the Weed Science Society of America (WSSA) should consider the following actions: 1) take a more prominent role in the development and evaluation of these technologies, 2) define acceptable terminology and identify preferred research and statistical methodologies specific to these technologies, 3) facilitate collaborative research between private and public entities, 4) conduct an in-depth evaluation of the impact of wide-scale adoption of these technologies, and 5) promote increased opportunities for funding related to research in this area.

Evaluating See & Spray™ Premium as a Single Tank Option for Weed Management. Robert S. Brown*[1], William L. Patzoldt[2], Chad Yagow[3], Gaylia Ostermeier[4]; [1]Blue River Technology, Wentzville, MO, [2]Blue River Technology, Sunnyvale, CA, [3]John Deere, Champaign, IL, [4]John Deere, Slater, IA (468)

See & SprayTM Premium by John Deere was introduced in 2023 as the most recent offering to growers as a precision upgrade kit for select MY18 and newer 400, 600, and R-series sprayers. See & Spray Premium is a single tank option that sees, targets, and kills in-season weeds using advanced cameras and machine learning algorithms that distinguishes crops from weeds and selectively targets herbicide applications to the weeds. The See & Spray Premium system targets weeds in corn (Zea mays L.), soybean (Glycine max (L.) Merr.), and cotton (Gossypium hirsutum L.) agronomic production systems to reduce herbicide use, reduce tendering, increase weed control, and reduce crop stress with potential yield improvements. Large-plot field studies were conducted in corn, cotton, and soybean in the Midwest, Delta, and TX during the 2022 and 2023 field season to determine the efficacy of See & Spray Premium, and how residual herbicides (e.g. Group 15) could be incorporated into a single tank option for growers along with POST-active chemistries. All trials were evaluated at an operating speed of 8 MPH (2022) or 12 MPH (2023). Treatments occurred at the POST application timing containing combinations of both POST-active and residual chemistries. Four treatments were evaluated that included: 1) Broadcast: post-active plus residual 2) See & Spray: POST-active only 3) See & Spray: POST-active plus residual 4) See & Spray: POST-active, followed by a broadcast application of a residual herbicide as a second and separate pass. After each herbicide application, subplot-level visual weed control, and visual crop injury were evaluated at seven and 14 DAT, respectively. Additionally, spray savings were calculated for each treatment and final yield was recorded. Results from this two-year study showed that weed control was reduced when residual herbicides were not applied or when only sprayed where weeds were present when combining data across years. Crop injury was reduced when residual herbicides were not part of the tank mix, as well as when they were only target-applied, when compared with broadcast applications of these chemistries.

Bridging Computer Vision and Weed Recognition: Developing a Collaborative Open-source Image Repository Using a Bench-robot. Navjot Singh*[1], Matthew Kutugata[1], Søren K. Skovsen[2], Maria Laura Cangiano[3], Chris Reberg Horton[3], Muthukumar V. Bagavathiannan[4], Steven Brian Mirsky[5]; [1]Texas A&M, College Station, TX, [2]Aarhus University, Aarhus, Denmark, [3]NCSU, Raleigh, NC, [4]Texas A&M University, College Station, TX, [5]USDA ARS, Beltsville, MD (469)

An open-source image repository enhances capabilities for weed detection and facilitates various AI-related research initiatives. To establish this image repository, capturing numerous images at various growth stages is necessary. The USDA has engineered a machine known as BenchBot for this purpose. Specifically designed for capturing multiple images of weed plants in pots throughout their growth phases, once initiated, this bench robot operates autonomously, requiring minimal supervision.The bench-robot is operated in three locations: USDA (Maryland), North Carolina State University, and Texas A&M to systematically capture images of weeds up to 30 cm in height. Utilizing a Sony camera and flash mounted on a semi-autonomous mechanical frame, the bench-robot biweekly photographs plants in pots, generating raw images processed through a customized pipeline. In Texas A&M setup, this efficient system photographs 500 plant pots in just four hours. As of December 2023, 27,000 images of potting area of 26 different weed species have been collected. The processed images has yield around 253,000 cutouts of individual weed plants, removing background and marking plants with bounding boxes in original images for the NAIR. This open-access repository serves as a versatile resource for training detection models tailored to diverse applications. Its utility extends to tasks such as detecting weeds in crops and optimizing spraying strategies. The repository facilitates the development of models capable of differentiating between different weeds and weeds from crops, thereby enabling precision in weed management efforts. Future plans involve the addition of more weed, cover crop, and cash crop varieties, ensuring the continuation of this impactful imaging initiative for years to come. This will contribute valuable data to advance weed science and agricultural research.

See & Spray™ Ultimate - Development and Evaluation for Weed Management in Agronomic Crops. William L. Patzoldt*[1], Robert S. Brown[2], Chad Yagow[3], Gaylia Ostermeier[4]; [1]Blue River Technology, Sunnyvale, CA, [2]Blue River Technology, Wentzville, MO, [3]John Deere, Champaign, IL, [4]John Deere, Slater, IA (470)

See & Spray Ultimate is a recently introduced John Deere self-propelled sprayer that uses multiple new technologies for weed management in agronomic crops. These new technologies consist of cameras and computers used to identify weeds in real-time with the ability to target herbicide applications to weeds. In addition, See & Spray Ultimate has a new carbon-fiber boom with increased stability that improves the consistency of targeted applications. The sprayer also has a dual tank delivery system that has multiple benefits to the user, which includes the ability to broadcast herbicide products in the same pass as targeted applications, the ability to reduce antagonism of certain herbicide combinations by separation of products, and the ability to apply product combinations that are restricted as a tank mixture through separation in dual tanks. See & Spray Ultimate has been field tested over several years in soybean (*Glycine max (L.) Merr*.), cotton (*Gossypium hirsutum L*.), and corn (*Zea mays L*.) production systems across various locations in the United States. In these studies, there were significant reductions of herbicide products applied through the See & Spray system as targeted applications when compared with broadcast applications, which also provided equivalent visual weed control and yield protection as broadcast applications. Furthermore, See & Spray Ultimate provides the ability to combat herbicide-resistant weeds more economically and efficiently by using product mixtures with multiple-effective sites-of-action. In summary, See & Spray Ultimate is a collection of technologies that has multiple benefits to users for the management of weeds in agronomic crops.

Optimizing Herbicide Savings in Plasticulture Production: A Simulation Approach Using AI and Different Nozzle Setups. Renato Herrig Furlanetto*[1], Ana Claudia Buzanini[1], Arnold W. Schumann[2], Nathan Boyd[3]; [1]University of Florida, Wimauma, FL, [2]University of Florida, Lake Alfred, FL, [3]University of Florida, Balm, FL (471)

The development of artificial intelligence models has allowed different applications in agriculture. The cutting-edge Yolo object detection model has been successfully applied in different areas such as the identification of different weed species, target applications, mapping, and more. The target application is a technological way to reduce herbicide amounts required to control weeds by triggering spraying only where weeds occur. However, there is a lack of research that focuses on analyzing the Yolo model's accuracy in identifying weeds, nozzle setups, and savings associated with implementing this technology. To address this, we conducted a study to simulate a target application in the row-middle in a strawberry field using the state-of-the-art Yolov8 model. We used two different approaches – bounding boxes and segmentation mask – and evaluated different nozzle setups ranging from one to four and we compared savings to a uniform broadcast application over the entire field area. We collected 10,640 images from broadleaves, grasses, and nutsedges in different experimental trails at the University of Florida Gulf Coast Research and Education Center in Wimauma, Florida. The images were manually annotated using bounding boxes and segmentation masks through the Segment Anything Model (Meta AI). The dataset was augmented and split into training data (80% of the images) and validation data (20% of the images), and a Yolov8 model was trained over 2,500 epochs using the HiPerGator high-performance computing cluster. A custom graphical user interface was created using PyCharm and OpenCV to perform the simulations. To evaluate the effectiveness of the applications, we captured videos from the row middle using a GoPRO Hero 8 mounted at a height of 0.5 meters above the soil, while driving at a speed of 1 mile per hour. We measured the output volume of the nozzle by manually assessing a TeeJet 8001VS tip, allowing us to calculate the savings between the target and the broadcast application. According to the findings, both approaches achieved high accuracy in identifying weeds during the model training stage, with an accuracy (mAP) and F1-score higher than 0.90 (mAP – 0.96 for bounding boxes, 0.92 for segmentation masks, and F1-score – 0.94 for bounding boxes, 0.91 for segmentation masks). The simulation with different nozzle setups revealed that using target spray application can result in significant savings, with savings of 50.91% (one nozzle), 68.25% (two nozzles), 74.62% (three nozzles), and 78.57% (four nozzles) for bounding boxes in relation to broadcast application. For segmentation masks, savings of approximately 32.08% (one nozzle), 48.61% (two nozzles), 56.97% (three nozzles), and 62.15% (four nozzles) were found. However, a few detections were observed for the bounding boxes approach in relation to segmentation masks, which incorrectly increased the savings. After correction, the bounding boxes approach resulted in approximately 23.19% (one nozzle), 30.03% (two nozzles), 33.61% (three nozzles), and 35.20% (four nozzles) in application savings. Both approaches displayed low rates of under-classification, indicating that the model needs more images and variability to improve the detection. Overall, the results suggest that computer simulations provide a practical and accurate tool for estimating savings by using a target application system. The use of Yolov8 with segmentation masks produces better results in terms of object identification and savings. The simulations also demonstrate that using four nozzles reduces product usage by only applying it to weeds and not to the soil.

Specialized Nozzle Tips for Targeted Spray Applications Using John Deere's See & Spray(TM) Technology. Jesaelen Gizotti de Moraes*[1], Trevor Stanhope[2], Scott Brown[3], William L. Patzoldt[4], Chad Yagow[5], Gaylia Ostermeier[6], Nick Fleitz[7]; [1]Blue River Technology, Santa Clara, CA, [2]Blue River Technology, Chicago, IL, [3]Blue River Technology, St. Louis, MO, [4]Blue River Technology, Sunnyvale, CA, [5]John Deere, Champaign, IL, [6]John Deere, Slater, IA, [7]Pentair Hypro, Shepherdsville, KY (472)

Agricultural technology is rapidly advancing with the goal to reduce herbicidal use, increase plant health, and to reduce environmental impact. See & SprayTM technology by John Deere utilizes computer vision and machine learning to identify and spray weeds in agronomic crops. Nozzle tips are one of the most important components of the application process, directly impacting the quality of a spray application. Hydraulic nozzle tips used for standard broadcast applications have also been used for targeted applications. However, as sprayer technology evolves and advances, there is also the need to renew efforts to advance hydraulic nozzles. Work has been conducted to design and develop spray nozzle tips for targeted broadcast systems in order to optimize See & Spray applications by improving savings without detrimental effects on weed control; in addition, meet droplet size spectra requirements for label approvals of specific chemistries.

The Evaluation of Dodhylex in Mississippi Rice Production. Dalton R. Whitt*[1], Hunter D. Bowman[2], Jason A. Bond[3], Taylor D. Burrell II[3], Thomas W. Eubank[4], Gregory A. Mangialardi[5]; [1]Mississippi State University, Leland, MS, [2]Mississippi State University, Starkville, MS, [3]Mississippi State University, Stoneville, MS, [4]Mississippi State University, Greenville, MS, [5]Mississippi State University, Shelby, MS (260)

The Evaluation of Dodhylex™ in Mississippi Rice Production DR Whitt, HD Bowman, JA Bond, TD Burrell, TW Eubank, GA Mangialardi Synthetic herbicides utility as weed killers' is threatened by the widespread evolution of resistance to most herbicide mode of actions (MOA). Barnyardgrass which can significantly reduce rice yield, has limited control options due to its evolved resistance to many herbicides. Additionally, there have been no reports on herbicides with a novel MOA for nearly 30 years. However, FMC Corporation, recently discovered tetflupyrolimet, known as Dodhylex™ active. This new MOA has been classified as WSSA & HRAC Group 28, which inhibits dihydroorotate dehydrogenase. Multiple studies were conducted in 2023 to evaluate tetflupyrolimet for midsouthern United States (U.S.) rice production at the Delta Research and Extension Center in Stoneville. The first study determined barnyardgrass control and rice tolerance with tetflupyrolimet and clomazone in thirteen different stand alone and/or combination treatments. The second study evaluated tolerance of four midsouthern U.S. row crops (Cotton, Soybeans, Grain Sorghum, Corn) to low rates of tetflupyrolimet and clomazone. These low rates, designed to simulate drift, were applied immediately following planting and at the V4 crop stage. Visual weed control and crop injury ratings were taken after applications and yield data was collected at crop maturity. Results indicate increased residual barnyardgrass control with the addition of tetflupyrolimet to clomazone. In the second study common midsouthern U.S. crops have shown no injury related to tetflupyrolimet symptomology, and yields were not decreased. The discovery of tetflupyrolimet is an important one and appears to provide a safe option for residual barnyardgrass control in Mississippi rice production.

Alternative Herbicide Options to Paraquat for Weed Control in Mississippi Row Crops.
Gregory A. Mangialardi*[1], Jason A. Bond[2], Tom W. Allen[3], Trent J. Irby[4], Luis A. Avila[4], Thomas W. Eubank[5], Whitney D. Crow[4], Hunter D. Bowman[4]; [1]Mississippi State University, Shelby, MS, [2]Mississippi State University, Stoneville, MS, [3]Mississippi State University, Cleveland, MS, [4]Mississippi State University, Starkville, MS, [5]Mississippi State University, Greenville, MS (261)

Alternative Herbicide options to Paraquat for Weed Control in Mississippi Row Crops Mangialardi G.A., Bond J.A., Bowman H.D., Eubank T.W. Paraquat is a non-selective group 22 herbicide inhibiting photosynthesis at photosystem I. Paraquat was applied to U.S. crops in totals of 769,292 kg to cotton (*Gossypium hirsutum*), 407,325 kg to corn (*Zea mays*), and 49,441 kg to rice (*Oryza sativa*) in 2020. Palmer amaranth (*Amaranthus palmeri*) causes more economic damage than all glyphosate-resistant weeds in the southern U.S., and paraquat is often utilized at planting for control of a wide variety of problem weeds. Uncertainty of paraquat's future due to high mammalian toxicity and few treatments for accidental poisoning provokes the need to study alternative herbicide options for weed control in Mississippi row crops. Two studies were conducted at Delta Research and Extension Center in Stoneville, MS, in 2022 and 2023 to evaluate control of Palmer amaranth with different herbicides applied at multiple timings. Both studies were designed to simulate herbicide treatments targeting Palmer amaranth applied immediately following planting of Mississippi row crops and were conducted in fallow areas with treatments arranged as two-factor factorials within a randomized complete block design with four replications. In the Herbicide Treatment Study, Factor A was herbicide treatment and included paraquat at 841 g ai ha^{-1} plus metribuzin at 140 g ai ha^{-1}, glyphosate at 1,121 g ae ha^{-1} plus tiafenacil at 25 and 50 g ai ha^{-1}, glyphosate at 1,121 g ha^{-1} plus dicamba at 560 g ae ha^{-1}, glufosinate at 656 g ai ha^{-1}, glyphosate plus 2,4-D choline at 2,164 g ae ha^{-1}, and 2,4-D choline at 1,065 g ae ha^{-1} plus glufosinate at 656 g ha^{-1}. Factor B was application timing with treatments applied when Palmer amaranth was 7 or 25 cm in height. In the Application Timing Study, Factor A was herbicide treatment and included paraquat at 841 g ha^{-1} plus metribuzin at 140 g ha^{-1}, glyphosate at 1,121 g ha^{-1} plus tiafenacil at 25 and 50 g ha^{-1}. Factor B was application timing with treatments applied when Palmer amaranth reached 2, 10, 17, 25, and 33 cm in height. All treatments containing paraquat or dicamaba included nonionic surfactant (NIS) at 0.5% v/v, while treatments containing tiafenacil included methylated seed oil (MSO) at 1% v/v. Data will be subjected to ANOVA using PROC GLIMMIX procedure obtaining the least squared means with an alpha level <0.05. In the Herbicide Treatment Study, only paraquat plus metribuzin, glyphosate plus dicamba, and glufosinate plus 2,4-D controlled 7- and 25-cm Palmer amaranth $\geq$90% across all evaluations. However, glufosinate and glyphosate plus tiafenacil at 50 g ha^{-1} controlled 7-cm Palmer amaranth similar to the three previously stated treatments. These treatments did not provide comparable control of 25-cm Palmer amaranth. In the Application Timing Study, paraquat plus metribuzin controlled 2-, 10-, and 17-cm Palmer amaranth $\geq$92%. Glyphosate plus both rates of tiafenacil controlled 2- and 10-cm Palmer amaranth similar to paraquat plus metribuzin. Control never exceeded 42 and 27% when all treatments were applied to 25- and 33-cm Palmer amaranth. Control of Palmer amaranth with paraquat is still very effective. However, results from this work identified other potential herbicide options for control of Palmer amaranth if used correctly.

Glyphosate-Resistant Italian Ryegrass Control with Mixtures of Residual Herbicides. Jacob B. Dodd*[1], Jason A. Bond[2], Taylor D. Burrell II[2], Thomas W. Eubank[3], Gregory A. Mangialardi[4]; [1]Mississippi State University, Sunflower, MS, [2]Mississippi State University, Stoneville, MS, [3]Mississippi State University, Greenville, MS, [4]Mississippi State University, Shelby, MS (262)

Glyphosate-resistant Italian ryegrass control with mixtures of residual herbicidesBecause glyphosate-resistant (GR) Italian ryegrass is resistant to multiple herbicide mechanisms of action in Mississippi, sequential applications of herbicides are required for control. Treatments of acetochlor with a microencapsulated (ME) formulation might offer an option for a fall-applied residual herbicide targeting GR Italian ryegrass that also possibly exhibits a rotation interval favorable for rice in the spring after application. Two separate field studies were conducted in 2021-22 and 2022-23 in Stoneville, Mississippi, to evaluate fall-applied treatments of group 15 herbicides with and without flumioxazin for control of GR Italian ryegrass (Herbicice Mixture Study) and to determine the effect of adding a residual herbicide to a sequential clethodim treatment following fall-applied residual treatment (Sequential Application Study).The experimental design of the Herbicide Mixture Study was a randomized complete block with a two-factor factorial arrangement of treatments and four replications. Factor A was flumioxazin rates of 0 and 72 g ai ha-1. Factor B was Group 15 herbicide and included no group 15 herbicide, acetochlor at 1,266 g ai ha-1, dimethenamid-P at 841 g ai ha-1, S-metolachlor at 1,424 g ai ha-1, and pyroxasulfone at 240 g ai ha-1. The Sequential Application Study utilized a randomized complete block with a two-factor factorial arrangement of treatments and four replications. Factor A was fall treatment and included no fall treatment, dimethenamid-P at 842 g ha-1, and acetochlor at 1,267 g ha-1. Factor B was sequential herbicide treatment and included no sequential treatment, clethodim at 140 g ai ha-1, clethodim at 140 g ha-1 plus S-metolachlor at 1,424 g ha-1, and clethodim at 140 g ha-1 plus flumioxazin at 72 g ha-1. Data were subjected to ANOVA and estimates of least squared means were utilized for mean separation (p = 0.05).Dimethenamid-P, pyroxasulfone, and S-metolachlor alone provided = 94% control of GR Italian ryegrass 21 d after treatment (DAT) in the Herbicide Mixture Study. The addition of flumioxazin to dimethenamid-P, pyroxasulfone, and S-metolachlor did not improve control 130 DAT. In the Sequential Application Study, GR Italian ryegrass control was = 96% with treatments containing dimethenamid-P at 70 d after fall application. When no fall treatment was utilized, the addition of flumioxazin to clethodim POST increased control = 14% compared with clethodim alone.Fall-applied residual herbicides are a necessary component of programs for control of GR Italian ryegrass in Mississippi. Treatments with fall-applied dimethenamid-P performed better than acetochlor accept when fall-applied acetochlor was followed by a sequential application of clethodim plus S-metolachlor. Poor control with acetochlor might be related to its ME formulation compared with dimethenamid-P being an emulsifiable concentrate (EC).

Evaluation of Oxyfluorfen in a Furrow Irrigated 'ROXY' Rice Production System. Thomas W. Eubank*[1], Jason A. Bond[2], Hunter D. Bowman[3], Taylor D. Burrell II[2], Gregory A. Mangialardi[4], Dalton R. Whitt[5]; [1]Mississippi State University, Greenville, MS, [2]Mississippi State University, Stoneville, MS, [3]Mississippi State University, Starkville, MS, [4]Mississippi State University, Shelby, MS, [5]Mississippi State University, Leland, MS (263)

Evaluation of Oxyfluorfen in a Furrow-irrigated ROXY Rice Production System.Eubank T.W., Bond J.A., Bowman H.D., Burrell T.D., Mangialardi G.A., Whitt D.R. Furrow-irrigated rice (*Oryza sativa* L.) is grown on raised beds with water furrows similar to the traditional irrigation method for row crops in the mid-southern U.S. However, greater weed pressure occurs in furrow-irrigated rice than in traditional flooded rice. Moist soil conditions from repeated furrow irrigation allow weed emergence throughout the growing season. Non-transgenic, herbicide-resistant rice cultivars have been utilized to combat certain weed species such as weedy rice. A new non-transgenic rice has been developed called ROXY, which is resistant to formulations of oxyfluorfen. Utilizing the ROXY rice production system in a furrow-irrigated system could help combat troublesome terrestrial weeds. The ROXY rice production system represents a useful weed control option for rice producers. To evaluate the performance of oxyfluorfen in a furrow-irrigated ROXY rice production system, two concurrent field studies were conducted at the Delta Research and Extension Center in Stoneville, MS, from 2022 to 2023. The first study evaluated residual grass and broadleaf weed control with oxyfluorfen applied delayed-preemergence (DPRE). The experimental design was a randomized complete block with a 3 x 4 factorial arrangement of treatments and four replications. Factor A was oxyfluorfen rates of 0, 700, and 981 g ai ha^{-1}. Factor B was herbicide mixture and included no mixture, clomazone at 560 g ai ha^{-1}, saflufenacil at 50 g ai ha^{-1}, and halosulfuron-methyl plus prosulfuron at 83 g ai ha^{-1}. The second study evaluated residual grass and broadleaf weed control with oxyfluorfen in a full-season herbicide program for furrow-irrigated rice. The experimental design for the second study was a randomized complete block design with a 4 x 4 factorial arrangement of treatments and four replications. Factor A was DPRE treatment and included no DPRE treatment, oxyfluorfen at 1,121 g ha^{-1}, oxyfluorfen 1,121 g ha^{-1} plus clomazone at 560 g ha^{-1}, and clomazone at 560 g ha^{-1} plus saflufenacil at 50 g ha^{-1}. Factor B was postemergence (POST) treatment and included no POST, propanil plus thiobencarb at 6,728 g ha^{-1} applied to rice in the two- to three-leaf stage (EPOST), quinclorac at 421 g ha^{-1} plus halosulfuron-methyl plus prosulfuron at 83 g ha^{-1} plus petroleum oil surfactant at 1% v/v applied to rice in the four-leaf to one-tiller stage (LPOST), and propanil plus thiobencarb EPOST followed by quinclorac plus halosulfuron-methyl plus prosulfuron plus petroleum oil surfactant LPOST. Rice injury and weed control were recorded at 14, 21, 28, and 35 d after first application (DAA). Mean rice height was recorded 28 DAA and at maturity. Data will be subjected to ANOVA using the PROC GLIMMIX procedure in SAS 9.4 with estimates of least square means at a 5% significance level used for mean separation. In the first study, barnyardgrass control was = 64% across all three mixtures 35 DAA with no oxyfluorfen. When oxyfluorfen was mixed with clomazone, saflufenacil, or halosulfuron plus prosulfuron, barnyardgrass control was = 78%. No differences in barnyardgrass or Palmer amaranth control were observed between the two oxyfluorfen rates. In the second study, oxyfluorfen plus clomazone DPRE only improved barnyardgrass control compared to clomazone plus saflufenacil DPRE at 48 DAA when no POST treatment was applied or when POST treatment was propanil plus thiobencarb EPOST. Oxyfluorfen DPRE did not control Palmer amaranth 48 DAA. However, when oxyfluorfen plus clomazone was followed by propanil plus thiobencarb EPOST, Palmer amaranth control increased 32%. Oxyfluorfen has the potential to be a tool utilized in furrow-irrigated rice, but utilizing different herbicide modes of action, and residual chemistries will be necessary in a full-season program.

Optimizing Pyroxasulfone-Coated Granular Ammonium Sulfate for Cotton Production Systems. Brock A. Dean*[1], Charlie W. Cahoon[1], Zachary R. Taylor[2], Jose H. de Sanctis[1], Jacob C. Forehand[3], James H. Lee[1]; [1]North Carolina State University, Raleigh, NC, [2]North Carolina State University, Sanford, NC, [3]North Carolina State Unviersity, Raleigh, NC (264)

Pyroxasulfone is among one of the most effective residual herbicides for controlling multiple herbicide-resistant Palmer amaranth. However, it is only registered to be applied postemergence-directed (POST-directed) or coated on granular fertilizer in cotton. With POST-directed applications widely abandoned in North Carolina, and given the importance of efficiency among producers, studies were conducted to optimize pyroxasulfone-coated granular ammonium sulfate in cotton. Two separate studies were conducted in 2022 and 2023 near Rocky Mount and Clayton, NC, to evaluate the optimal rate of granular ammonium sulfate (AMS) for pyroxasulfone-coated AMS, and the ideal timing for which it should be top-dressed in cotton. In 2022 and 2023, an XtendFlex® cotton variety was planted at both locations. For the rate study, AMS rates included 160, 214, 266, 320, 372, 426, and 480 kg ha^{-1}, equivalent to 34, 45, 56, 67, 79, 90, and 101 kg N ha^{-1}, respectively. All rates were coated with pyroxasulfone at a rate of 118 g ai ha^{-1} and top-dressed on 6- to 7-leaf cotton. For the timing study, pyroxasulfone (118 g ai ha^{-1}) was coated on granular AMS and top-dressed at a rate of 320 kg ha^{-1} (67 kg N ha^{-1}) on 5- to 7-leaf, 9- to 11-leaf, and 1st bloom cotton. For both studies, weed control and cotton tolerance to pyroxasulfone-coated AMS was compared to pyroxasulfone (118 g ai ha^{-1}) applied postemergence over-the-top (POST) and POST-directed. The check in both studies received 320 kg ha^{-1} of nontreated AMS as a grower standard. Prior to applications, all plots, including the check, were maintained weed free using glyphosate and glufosinate; no residuals were used prior to applications. Visual estimates of Palmer amaranth control and cotton injury were collected bi-weekly until 70 days after treatment. Additionally, Palmer amaranth density was recorded, and cotton was machine harvested and weighed to determine yield at the conclusion of the season. For both studies, pyroxasulfone applied POST was the most injurious, while pyroxasulfone-coated AMS resulted in minimal injury regardless of the AMS rate or timing of application. No differences in Palmer amaranth control were observed when pyroxasulfone was applied coated on granular AMS at rates of 160 (79%), 214 (83%), 266 (85%), and 320 (85%) kg ha^{-1}. However, pyroxasulfone coated on 160 kg ha^{-1} of AMS resulted in statistically less control in comparison to pyroxasulfone applied POST (92%) and POST-directed (89%), as well as the 372 (88%), 426 (88%), and 480 (88%) kg ha^{-1} rates of pyroxasulfone-coated AMS. For the timing study, the method of application resulted in no differences in Palmer amaranth control; however, differences in control were observed at each application timing. No differences in cotton lint yield were observed across any treatment in both studies.

Herbicide Performance of Alite 27 in Axant™ Flex Cotton Systems. Jennifer Dudak*[1], Zachary R. Treadway[1], Todd A. Baughman[1], Greg Baldwin[2], Tom Barber[3], Charlie W. Cahoon[4], A Stanley Culpepper[5], Benjamin McKnight[6], Scott A. Nolte[7], Adam C. Hixson[8]; [1]Oklahoma State University, Ardmore, OK, [2]BASF, Research Triangle Park, NC, [3]University of Arkansas, Lonoke, AR, [4]North Carolina State University, Raleigh, NC, [5]University of Georgia, Tifton, GA, [6]Texas A&M AgriLife Extension Service, College Station, TX, [7]Texas A&M AgriLife Extension, College Station, TX, [8]BASF, Lubbock, TX (265)

Herbicide Performance of Alite 27™ in Axant™ Flex Cotton Systems J. Dudak*[1], Z. Treadway[1], T. Baughman[1], G. Baldwin[2], T. Barber[3], C. Cahoon[4], A. Culpepper[5], B. McKnight[6], S. Nolte[6], A. Hixson[7], [1]Oklahoma State University, Ardmore, OK; [2]BASF, Research Triangle Park, NC, [3]University of Arkansas System Division of Agriculture, Lonoke, AR; [4]North Carolina State University, Raleigh, NC; [5]University of Georgia, Tifton, GA; [6]Texas A&M AgriLife Extension, College Station, TX; [7]BASF, Lubbock, TX ABSTRACT Weeds are continually evolving resistance to many of the common herbicide sites of action labeled for use in cotton production. This in combination with observations of weeds resistant to auxin herbicides is of considerable concern to weed management practitioners. One of the methods to reduce pressure on the auxin herbicide technology is through the application of residual herbicides at planting. However, this can add additional challenges since early season cotton injury is often observed with these applications. BASF integrated a tolerance trait to Alite 27 (HPPD inhibitor) in cotton to provide producers another tool for weed management. Studies were conducted to evaluate the use of Alite 27 on weed efficacy, cotton response and lint yield. A three year multi-state research project was conducted at various locations across the cotton belt, including: Tillar, AR; Ty Ty and Ideal GA; Clayton and Rocky Mount NC; Bixby, Altus, and Fort Cobb, OK; and College Station, TX. HPPD-tolerant cotton was planted and managed based on local growing practices. The following herbicide treatments were applied PRE at 6 of 7 locations in 2021, 2022, and 2023: Alite 27 (3 fl oz/A) alone and either Direx/Cotoran (16-32 fl oz/A) or Reflex/Brake (12-24 fl oz/A) alone or in combination with Alite 27. All PRE treatments were followed by a POST application of Engenia (12.8 fl oz/A) + Outlook (12.8 fl oz/A) + Roundup PM II (32 fl oz/A) + Aegos (8 fl oz/A). At Tillar, AR in 2021, PRE treatments included: Cotoran (24 fl oz/A) alone or in combination with Alite 27 (3 fl oz/A), Cotoran + Caparol (16 fl oz/A), and a three-way combination of all three herbicides. Three POST applications of various herbicide combinations were made following all PRE treatments at Tillar. In 2022, Prowl H2O (32 fl oz/A) alone and in combination with Alite 27 (3 fl oz/A) were added to the treatment list. Less than 10% visible cotton injury was observed at any location 2 weeks after planting (WAP) at all site-years, except Ty Ty, GA in 2022 and College Station, TX in 2023. Alite 27 + Direx PRE controlled Palmer amaranth (*Amaranthus palmeri* S. Watson) and annual grass 97% or greater 2 WAP at all site locations except College Station, TX (2021) and Rocky Mount, NC (2023). Alite 27 + Prowl H2O controlled Palmer amaranth and annual grass at least 95% at 2 WAP all site-years except College Station, TX and Rocky Mount, NC (2023). Following the POST application, Alite 27 + Direx and Alite 27 + Prowl H2O controlled both Palmer amaranth and annual grass at least 91 and 95%, respectively, at all site-years except Rocky Mount, NC in 2023. In 2021, control of Palmer amaranth and annual grass was excellent season long and less than 60% in 2022 at Tillar, AR. This was due to the lack of two additional POST applications throughout the growing season. Alite 27 exhibited excellent cotton tolerance while providing control of Palmer amaranth and annual grass when used as part of an overall cotton herbicide management program.

Injury, Growth, and Yield Following the Co-Application of Group 15 and Non-Selective Herbicides on One-Leaf 2,4-D- and Dicamba Tolerant Cotton (*Gossypium hirsutum* L.). Logan N. Vallee*[1], Daniel O. Stephenson, IV[2], Connor Webster[1]; [1]LSU AgCenter, Baton Rouge, LA, [2]LSU Ag Center, Alexandria, LA (266)

Injury, Growth, and Yield Following the Co-Application of Group 15 and Non-Selective Herbicides on One-Leaf 2,4-D- and Dicamba-Tolerant Cotton (*Gossypium hirsutum* L.).LN Vallee, DO Stephenson, IV, and LC Webster. Cotton (*Gossypium hirsutum* L.) is one of the most important textile fibers in the world with the U.S. being the third largest producer. Studies were conducted in 2021 through 2023 at the LSU AgCenter Dean Lee Research and Extension Center near Alexandria, LA to determine the sensitivity of 2,4-D- or dicamba- tolerant cotton to an early season application of a Group 15 and registered non-selective herbicides. Both studies were randomized complete block designs with a two-factor factorial arrangement of treatments with four replications. In the dicamba-tolerant cotton study, Factor A was no non-selective, dicamba at 0.6 kg ae ha^{-1}, glyphosate at 1.3 kg ae ha^{-1}, or dicamba + glyphosate at 0.6 + 1.3 kg ae ha^{-1}. Factor B consisted of either no Group 15 herbicide, acetochlor at 1.3 g ai ha^{-1}, or *S*-metolachlor at 1.1 kg ai ha^{-1}. All treatments containing dicamba were co-applied with 1% v/v drift and volatility reduction agents. In the 2,4-D- tolerant cotton study, Factor A consisted of either no non-selective, 2,4-D alone at 1.0 kg ae ha^{-1}, glyphosate alone at 1.2 kg ae ha^{-1}, glufosinate alone at 0.7 kg ai/ha^{-1}, premix of 2,4-D choline:glyphosate 1.0:1.0 kg ae ha^{-1}, or 2,4-D choline + glufosinate 1.0 + 0.7 kg ai ha^{-1}. Factor B was identical to the dicamba-tolerant study. In both studies all treatments were applied to one-leaf cotton. All studies remained weed-free throughout the season. Visual injury evaluations were recorded 3, 7, 14, 28, and 42 d after application (DAT) using a 0% to 100% scale. Averaged across evaluation date, cotton injury was 6% or less following all combinations of non-selective and Group 15 herbicides in the dicamba tolerant cotton study. Regardless of non-selective herbicide, cotton was injured 12% following *S*-metolachlor application 3 d after treatment, which was greater than all other treatments at 9% or less at all evaluation dates. Dicamba-tolerant cotton yield ranged 1710 to 2050 kg ha^{-1} and did not differ. In the absence of a non-selective herbicide, 2,4-D tolerant cotton injury was 6 to 7% greater following applications containing acetochlor or *S*-metolachlor. Additionally, the co-application of either Group 15 herbicide with a non-selective did not increase cotton injury with injury ranging from 6 to 11% regardless of evaluation date. 2,4-D tolerant cotton yield ranged 1470 to 1740 kg ha^{-1} and did not differ. Data indicates that acetochlor or *S*-metolachlor can be co-applied with non-selective treatments to one-leaf dicamba or 2,4-D tolerant cotton without a yield reduction, but transient injury should be expected.

Peanut Response to Herbicides as Influenced by Injury Caused by Thrips. Ethan Foote*, David L. Jordan; North Carolina State University, Raleigh, NC (267)

Suppressing weeds and tobacco thrips (*Frankliniella fusca* Hinds) and western flower thrips (*Frankliniella occidentalis* Pergande) early in the cropping cycle of peanut (Arachis hypogaea L.) is an important step in optimizing yield. The majority of growers apply systemic insecticide in the seed furrow at planting. Aldicarb, imidalcloprid, oxamyl, and phorate can be used at this timing. However, in many cases, suppression is not complete and growers apply acephate to peanut foliage to further suppress thrips. Paraquat can be applied to peanut within the first 28 days after emergence to control small broadleaf weeds and annual grasses. Bentazon is included to reduce phytotoxicity from paraquat. In many cases, herbicides with residual activity are co-applied with paraquat and bentazon to further protect peanut from early season weed interference. Timing of paraquat application and acephate to suppress thrips often overlap and growers routinely apply paraquat, bentazon, acephate, and *S*-metolachor as a tank mixture for suppression of weeds and thrips. However, the product label for paraquat indicates that paraquat should not be applied to peanut with significant injury caused by thrips feeding. A standard recommendation in North Carolina and Virginia is to apply acephate to suppress thrips and allow peanut to recover before paraquat is applied. The general recommendation is that acephate should be applied at least one week prior to paraquat. However, there are no data in the peer-reviewed literature that supports this recommendation. Therefore, research was conducted to determine if acephate applied one week prior to paraquat suppresses thrips adequately to allow plants to recover from thrips injury to avoid yield loss from the combination of injury from thrips and paraquat. Research was conducted at two locations in North Carolina. In one experiment, treatment factors included: 1) aldicarb applied in the seed furrow at planting (0 or 1.2 kg ai/ha), acephate applied 1 week prior to postemergence herbicides (0 or 0.54 kg ai/ha), and two levels postemergence herbicide (no herbicide or paraquat plus bentazon plus *S*-metolachor plus nonionic surfactant). Additional treatments included acephate applied with the herbicide combination previously mentioned following no aldicarb or aldicarb. A final set of treatments included acephate applied at alone at the timing of the postemergence herbicides (with and without acephate) following not aldicarb or aldicarb. In a second experiment, a similar treatment structure was included but did not include aldicarb treatments. In-furrow insecticide was not applied in this experiment. Paraquat, bentazon, and *S*-metolachor were applied at 0.15, 0.56, and 1.1 kg ai/ha, respectively. Pesticides were applied in 145 L/ha aqueous solution at 205 kPa. Postemergence herbicides were applied 4 weeks after planting. Plot size was 2 rows by 9 m and treatments were replicated 4 times. Data for the combination of thrips and herbicide injury were recorded two and three weeks after herbicides were applied using a scale of 0 to 100 where 0 = no plant stunting and 100 = plant death relative to the aldicarb control without postemergence herbicides. Data were subjected ANOVA and means were separated using Fisher's Protected LSD test at a = 0.05. Aldicarb and acephate reduced injury of peanut caused by tobacco thrips feeding in both experiments. Injury from the combination of herbicides and thrips injury in the absence of insecticide was often greater than injury from herbicides following aldicarb. However, applying acephate one week prior to postemergence herbicides did not result in a decrease in peanut stunting compared with application of herbicides without a prior application of acephate. Plant stunting was also similar when herbicides were applied alone or with acephate. Even though significant stunting was observed with many of the pesticide sequences and combinations, yield was not reduced in either experiment when compared to the no-herbicide, aldicarb control. While yield reductions from both paraquat injury and thrips injury can occur, in other cases injury early in the season caused by both sources does not always observed. Additional research is needed to determine the consistency of the response observed in these experiments. May and early June in North Carolina were

unseasonably cool in 2023, and this may have masked response as peanut grew slowly until mid-June.

Evaluation of Application Timing of a Diflufenican Premixture for Soybean Tolerance and Weed Control. Matthew C. Woolard*[1], Jason K. Norsworthy[1], Mason C. Castner[1], Tanner A. King[2], Leonard B. Piveta[1], Thomas R. Butts[3], Tom Barber[3]; [1]University of Arkansas, Fayetteville, AR, [2]University of Arkansas Division of Agriculture, Fayetteville, AR, [3]University of Arkansas, Lonoke, AR (268)

Bayer CropScience is seeking registration of Convintro™ brand herbicides, with one being a herbicide for use in soybean [*Glycine max* (L.) Merr.]. Convintro will be a premixture containing diflufenican, metribuzin, and flufenacet, adding a new site of action to soybean production. This herbicide will be targeted to control Palmer amaranth (*Amaranthus palmeri*), the most problematic weed in soybean production. Therefore, an experiment in 2022 and 2023 was conducted at the Milo J. Shult Agriculture Research and Extension Center in Fayetteville, Arkansas to evaluate application timing of Convintro for soybean tolerance and weed control. In the experiment, Convintro was applied 14-day preplant (DPP), 7 DPP, preemergence, and 3 days after planting (DAP) at 1X with "X" representing the anticipated 1X rate in soybean. At 21 DAP, soybean injury was the highest the closer the Convintro application occurred to planting in both years. By 42 DAP, injury was <5% for all application timings evaluated. Palmer amaranth control 21 DAP, ranged from 88 to 99% in 2022, and 91 to 99% in 2023, with control increasing as Convintro applications were delayed. By 42 DAP, preemergence and 3 DAP application timings in 2022, and 3 DAP in 2023, were providing =90% control of Palmer amaranth. Grain yield was collected at maturity with yields increasing the later Convintro was applied in both years. Convintro has flexible application timings that will reduce the risk of injury to soybean and maximize weed control. Additionally, Convintro will add a new site of action to help diversify weed control programs across the Midsouth.

Rice Performance Following Exposure to Sub-lethal Concentrations of Paraquat at Multiple Growth Stages. Mary Jane Lytle*[1], Tameka L. Sanders[2], Hunter D. Bowman[3], Jason A. Bond[1]; [1]Mississippi State University, Stoneville, MS, [2]Mississippi State University: Delta Research & Extension Center, Stoneville, MS, [3]Mississippi State University, Starkville, MS (269)

Rice (*Oryza sativa* L.) in the midsouthern U.S. is often planted in the same window when preplant or preemergence herbicide applications are applied to other row crops in adjacent fields. Paraquat is frequently recommended as a tank-mix partner in preplant and preemergence situations to remove existing vegetation, which can potentially lead to off-target movement of the herbicide onto rice fields. Off-target movement may also occur late-season to rice from paraquat utilized as a harvest aid in other crops. Although previous research has documented rice response to early- and late-season off-target movement of paraquat, research identifying rice after multiple exposures to paraquat is not available. Therefore, research was conducted from 2019 to 2021 at the Mississippi State University Delta Research and Extension Center in Stoneville, MS, to evaluate rice growth and yield after exposure to sub-lethal concentrations of paraquat multiple times during the rice life cycle. Treatments were arranged as a two-factor factorial within a randomized complete block design and four replications. Factor A was early-season exposure timing and consisted of no early-season exposure and paraquat applied at 84 g ai ha^{-1} to rice in the spiking to one-leaf (VEPOST) and three- to four-leaf (MPOST) growth stages. Factor B was late-season exposure and consisted of no late-season exposure and paraquat applied at 28 g ha^{-1} to rice when 50% of plants in a plot had visible panicles (HEAD), to rice the day of draining (DRAIN), and a sequential treatment with rice exposure at HEAD followed by (fb) DRAIN. Visible injury to rice was evaluated and yield data were collected at harvest. Data were subjected to analysis of variance (ANOVA), and estimates of least square means were utilized for mean separation (a=0.05). An early-season paraquat exposure (VEPOST OR MPOST) resulted in greater (=13%) injury 7 and 14 days after treatment (DAT) when followed by exposure at HEAD or DRAIN as opposed to plots that were not previously exposed to paraquat (=10%). Injury from paraquat was more from the MPOST (19 to 24% injury) than the VEPOST (13 to 19%) exposure when followed by a HEAD or DRAIN exposure. Grain yield was reduced by 1,990 kg ha^{-1} when rice was exposed to paraquat at HEAD or HEAD followed by DRAIN. Multiple exposures to sub-lethal concentrations of paraquat negatively affected rice performance. Multiple exposures to paraquat had the greatest effect on rice performance when the exposure occurred both early- and late-season. Rice was most sensitive following early-season exposure fb HEAD fb DRAIN. Although rice can recover from multiple exposures to paraquat, severe injury and reduced yields may occur.

Effectiveness of Herbicide-Coated Fertilizers in Cotton. Summer L. Linn*[1], Jason K. Norsworthy[2], Samuel C. Noe[3], Jeong-In Hwang[2], Mason C. Castner[2], Maria Carolina C R Souza[4], Tom Barber[5]; [1]University of Arkansas Department of Crop, Soil, and Environmental Science, Fayetteville, AR, [2]University of Arkansas, Fayetteville, AR, [3]University of Arkansas, Fayetteville, KY, [4]University of Arkanas, Fayetteville, AR, [5]University of Arkansas, Lonoke, AR (270)

Herbicide-coated fertilizers provide a potential practical facet of herbicide application that could provide additional late-season residual control of problematic weeds such as Palmer amaranth (*Amaranthus palmeri* S. Wats.). Two main factors dictate the potential of an herbicide to be utilized for a treated fertilizer application: cotton tolerance and weed control. Therefore, this study was designed to evaluate herbicide injury to cotton and Palmer amaranth control while using herbicide-coated fertilizer applied over the top of cotton at the 6- to 8-leaf growth stage. The study was conducted in 2023 at both the Milo J. Shult Agricultural Research and Extension Center in Fayetteville, Arkansas, and the Lon Mann Cotton Research Station near Marianna, Arkansas. The study was designed as a two-factor factorial randomized complete block with nine treatments with four replications. The first factor was site-year and the second was the herbicide coated onto the fertilizer blend. The nine treatments were as follows: pyroxasulfone at 91 and 128 g ai/ha, *S*-metolachlor at 1388 g ai/ha, florpyrauxifen-benzyl at 29 g ai/ha, fluometuron at 1120 g ai/ha, fluridone at 168 g ai/ha, pyroxasulfone at 128 g ai/ha plus fluridone at 168 g ai/ha, pyroxasulfone at 128 g ai/ha plus fluometuron at 1120 gai /ha, and fluridone at 168 g ai/ha plus fluometuron at 1120 g ai/ha. A non-treated check was included for comparison. The fertilizer blend coated with each herbicide comprised 196 kg/ha urea and 112 kg/ha muriate of potash. At planting, fluometuron was applied to all plots at a rate of 560 g/ha. At the 1-to 2-leaf and 6- to 8-leaf growth stages glyphosate at 1544 g ae/ha plus glufosinate at 655 g ai/ha. Cotton injury and Palmer amaranth control were assessed at 1, 2, 3, and 4 weeks after treatment (WAT). At 1, 2, and 3 WAT, the fluometuron plus fluridone treatment caused the most injury to cotton (13, 10, and 6%, respectively). At 2 WAT, Palmer amaranth control was comparable among all treatments, excluding florpyrauxifen-benzyl at Marianna. By 4 WAT, Palmer amaranth with florpyrauxifen-benzyl had dropped to 78%, which was 16 percentage points less than that of the treatment with the highest residual control, pyroxasulfone plus fluometuron. Considering both cotton tolerance and Palmer amaranth control, all tested herbicide-coated fertilizer treatments, except florpyrauxifen-benzyl, offer adequate residual control without causing substantial cotton injury. These findings underscore the significant potential for integrating herbicide-coated fertilizers into cotton production, based on crop tolerance and residual Palmer amaranth control. Additional research is imperative to ascertain possible yield impacts due to these treatments.

***Amaranthus palmeri* Control and Axant Flex™ Cotton Response Following Isoxaflutole.**
Maxwell E. Smith*[1], Peter A. Dotray[2], Adam C. Hixson[3]; [1]Oklahoma State University, Altus, OK, [2]Texas Tech University/ Texas A&M AgriLife Research and Extension, Lubbock, TX, [3]BASF, Lubbock, TX (271)

Herbicide-resistance complicates the control of troublesome weeds in cotton across the United States. Herbicide-resistance has been confirmed in *Amaranthus palmeri* to many of the currently available herbicide-tolerant traits in cotton, such as glyphosate, glufosinate, and dicamba. Axant™ Flex cotton from BASF, the first quadruple herbicide tolerant cotton germplasm, includes herbicide-tolerance to isoxaflutole, an herbicide that is novel to cotton production. In 2021 and 2022, field studies were conducted at the Texas Tech University New Deal Research Farm. The objective of these studies was to evaluate crop response and *Amaranthus palmeri* control following applications of isoxaflutole in Axant™ Flex cotton. Visual crop response and weed control evaluations were made following preemergence and early-postemergence applications. Visual crop response was =9% and 0% 21 days after preemergence application in 2021 and 2022, respectively. Visual crop response was =13% and =10% 7 days after early-postemergence applications in 2021 and 2022, respectively. *Amaranthus palmeri* control 29 days after preemergence applications that contained isoxaflutole was >92% and >88% in 2021 and 2022, respectively. *Amaranthus palmeri* control 28 days after early-postemergence application was >71% and >78% for all treatments in 2021 and 2022, respectively. In 2021, lint yield ranged from 1,471-1,650 kg ha^{-1}. In 2022, lint yields ranged from 1,594-2,272 kg ha^{-1}. The use of isoxaflutole in Axant™ Flex cotton will aid in the management of troublesome weeds and contribute to a season-long weed control strategy.

Evaluation of Tetflupyrolimet and Clomazone Mixtures on a Crowley Silt Loam Soil. Maranda P. Arcement*, Connor Webster, John A. Williams, Wesley B. Carr, Steven B. Stoker, Logan N. Vallee; LSU AgCenter, Baton Rouge, LA (272)

Evaluation of Tetflupyrolimet and Clomazone Mixtures on a Crowley Silt Loam Soil Arcement M.P., Webster L.C., Williams J.A., Carr W.B., Stoker S.B., Vallee L.N. Tetflupyrolimet, a novel herbicide being developed by FMC®, hinders *de novo* pyrimidine biosynthesis by inhibiting dihydroorotate dehydrogenase. Tetflupyrolimet is selective for grass control in rice (*Oryza sativa* L.) and is the first herbicide in the new Herbicide Resistance Action Committee Group 28. A study was conducted in 2023 at the H. Rouse Caffey Rice Research Station near Crowley, Louisiana, to evaluate different rates of tetflupyrolimet and clomazone applied alone and in mixtures for preemergence grass control in rice. Plot size was 3-m by 9.14-m with 16-19.5 cm drill-seeded rows of 'PVL03' at 78.4 kg ha^{-1}. This study was a randomized complete block design with five sequentially increasing rates of tetflupyrolimet applied alone (a, b, c, d, and e), five rates of clomazone applied alone at 125 g ai ha^{-1}, 188 g ai ha^{-1}, 250 g ai ha^{-1}, 313 g ai ha^{-1}, and 375 g ai ha^{-1}, and five applications of mixtures of tetflupyrolimet and clomazone with corresponding increasing rates. A nontreated check was added for comparison. Because tetflupyrolimet is still being developed, usage rates of tetflupyrolimet are to remain confidential and denoted as rates "a," "b," "c," "d," and "e," where the lowest rate correlates to the first letter in alphabetical order and the highest rate correlates to the last letter. Uniform stand treatments of halosulfuron plus prosulfuron at 105 g ai ha^{-1} and quizalofop at 1086 g ai ha^{-1} were applied at the two- to three-leaf and panicle initiation rice growth stages, respectively. All herbicide applications were applied with a CO_2-pressurized backpack sprayer calibrated to deliver 93.5 L ha^{-1}. Visual evaluations of percent control for this study included barnyardgrass [*Echinochloa crus-galli* (L.) P. Beauv.] and broadleaf signalgrass [*Urochloa platyphylla* (Munro ex C. Wright) R.D. Webster] at 21 and 56 days after treatment (DAT). Visual evaluations of percent control were also recorded for Amazon sprangletop [*Leptochloa panicoides* (J. Presl) Hitchc.] at 63 DAT. Rough rice yields were obtained and adjusted to 12% moisture. At 21 DAT, barnyardgrass was controlled 70 to 77% when tetflupyrolimet and clomazone were applied alone at "a" and 125 g ha^{-1}, respectively; however, when tetflupyrolimet at "a" and clomazone at 125 g ha^{-1} were mixed, 87% control of barnyardgrass was observed. At 56 DAT, 72 to 83% control of barnyardgrass was observed when tetflupyrolimet at "c" and clomazone at 250 g ha^{-1} were applied separately, while 93% control was observed from tetflupyrolimet plus clomazone at the rates of "c" and 250 g ha^{-1} respectively. Comparable results were observed for broadleaf signalgrass at 21 and 56 DAT. Tetflupyrolimet control of Amazon sprangletop at 63 DAT ranged from 68 to 95% across all rates, while clomazone achieved 25 to 62% control across all rates. The mixtures of clomazone and tetflupyrolimet controlled Amazon sprangletop 78 to 95% across all rates. These results suggest that using a preemergence mixture of clomazone plus tetflupyrolimet significantly increases grass control in rice compared to control observed when each herbicide is applied alone.

Evaluating Cover Crops and Herbicides for Weed Control in Soybean. Annu Kumari*[1], Andrew J. Price[2], Steve Li[3]; [1]Crop, Soil & Environmental Sciences Department, Auburn University, Auburn, AL, [2]USDA-ARS-NSDL, Auburn, AL, [3]Auburn University, Auburn, AL (273)

In mid-south, southeastern, and northeast United States soybean production regions, the evolution of herbicide-resistant weeds has become a significant management challenge for growers. The issue of rising herbicide costs for managing herbicide-resistant weeds is also a growing concern, leading to the utilization of cover crops as an integrated weed management strategy for addressing these challenges. Field experiments were conducted at two locations in Alabama in 2022 to evaluate winter cereal cover crops including a mixture, and herbicide system integration in soybean. Treatments included five cover crops: oats, cereal rye, crimson clover, radish, and a cover crop mixture. Cover crops were evaluated for their weed-suppressive characteristics compared to a winter fallow treatment. Additionally, four herbicide treatments were applied: a pre-emergence (PRE) herbicide, a post-emergence (POST) herbicide, PRE plus POST herbicides, and a non-treated (NT) check. The PRE herbicide was *S*-metolachlor, the POST treatment contained a mixture of dicamba and glyphosate. The PRE plus POST system contained the PRE application followed by POST application. Our results show that cereal rye and the cover crop mixture provided weed biomass reduction compared to all cover crop treatments across both locations. Furthermore, we observed higher soybean yield following the cereal rye cover crop than the winter fallow treatment at one location. POST and PRE+POST herbicide treatment resulted in higher weed biomass reduction and improved soybean yield than the PRE herbicide treatment alone and NT check at both locations.

Assessment of Prohexadione Calcium Tank-Mixed with Postemergence Peanut Herbicides.
Samantha J. Bowen*[1], Kayla M. Eason[2], Walter S. Monfort[1], Timothy L. Grey[1]; [1]University of Georgia, Tifton, GA, [2]United States Department of Agriculture, Tifton, GA (274)

When grown in excess, peanut vines have the potential for fostering disease under the canopy and can become damaged during mid-to-late season pesticide applications. The use of a plant growth regulator (PGR), specifically prohexadione calcium, in peanut can reduce vine growth and increase yield, with the potential of increasing overall net return. With input costs significantly increased, the use of tank-mixtures can alleviate the costs and loss of time from sequential applications. However, limited information is available regarding the effects of tank-mixing prohexadione calcium with postemergence herbicides in peanut. Therefore, greenhouse studies were designed to determine the effect on species-specific levels of weed control by tank-mixing prohexadione calcium with commonly used postemergence peanut herbicides. The objectives of this study were to determine if herbicide efficacy would be changed with the addition of a PGR as well as to evaluate the response of various weed species to these tank-mixed applications. Experiments were conducted as a randomized complete block design with three replications per treatment and repeated in time, three times. Treatments include tank-mix combinations of prohexadione calcium (formulated as Kudos®) at 0.6X and 1X field-rates, chlorimuron, clethodim, sethoxydim, and 2,4-DB. Weeds evaluated include sicklepod [*Senna obtusifolia* (L.) Irwin & Barneby], Florida beggarweed [*Desmodium triflorum* (L.) DC.], morningglory spp. (*Ipomoea* spp.), and large crabgrass [*Digitaria sanguinalis* (L.) Scop.]. Weeds were planted 75 and 15 days before treatment to represent the variation in sizing that could occur in a field setting. Data collection included visual estimates of injury (% chlorosis/necrosis and % epinasty) at 3 and 7 days after treatment (DAT) and above ground biomass (g plant^{-1}) at 7 DAT. Trends in visual injury and biomass did not correlate to an increase in weed control for any herbicide or weed species and herbicide efficacy was not influenced by prohexadione calcium rate. Results from these experiments will address weed control with respect to tank-mixture compatibility when prohexadione calcium is applied with herbicides.

Cover Crops and Fall-applied Residual Herbicides for Managing Herbicide-resistant Italian Ryegrass in North Carolina. Jose H. de Sanctis*[1], Charlie W. Cahoon[1], Wesley Everman[1], Travis W. Gannon[1], Katie M. Jennings[1], Zachary R. Taylor[2], Brock A. Dean[1], Jacob C. Forehand[3], James H. Lee[1]; [1]North Carolina State University, Raleigh, NC, [2]North Carolina State University, Sanford, NC, [3]North Carolina State Unviersity, Raleigh, NC (275)

North Carolina growers have long struggled to control Italian ryegrass (*Lolium perenne ssp. multiflorum*), especially in the south-central region, where no-till systems are largely adopted due to soil conservation practices. In these settings Italian ryegrass is traditionally managed with burndown herbicide applications in the spring shortly before planting. Recent studies conducted with populations collected from the same area have confirmed the presence of populations resistant to nicosulfuron, glyphosate, clethodim, and paraquat. To avoid the spread of such biotypes and provide an effective control of Italian ryegrass it is crucial to integrate alternative management approaches. The objectives of this study were to evaluate Italian ryegrass control with cover crops and fall applied residual herbicides and investigate the level of cover crop injury from residual herbicides. This study was conducted in Salisbury and Clayton, NC, during the fall/winter of 2021-2022. Cover crops were seeded on Oct/20/2021 and Oct/18/2021 in Salisbury and Clayton, respectively, and Oct/19/2022 in Clayton. Residual herbicides were applied immediately after planting. The study was designed as a 3x5 strip-plot, where the strips were the three cover crop treatments (no-cover, cereal rye at 80 kg ha^{-1}, and crimson clover at 18 kg ha^{-1}) and the subplots consisted of five residual herbicide treatments (S-metolachlor at 1420 g ai ha^{-1}, flumioxazin at 60.6 g ai ha^{-1}, metribuzin 470 g ai ha^{-1}, pyroxasulfone at 119 g ai ha^{-1}, and no-pre). Data collection consisted of bi-weekly visual estimates of Italian ryegrass control and cover crop injury, cover crop stand, and Italian ryegrass density. Cover crop and Italian ryegrass biomass were collected in the spring of 2022 and 2023, at 24 weeks after planting (WAP). In the 2022 season, metribuzin injured cereal rye and crimson clover 64% and 53%, respectively; however, metribuzin injury was 6% or less for both cover crops in 2023. Flumioxazin resulted in an unacceptable injury level in crimson clover with 45% and 38% in 2022 and 2023, respectively. Furthermore, in 2022, Italian ryegrass control at 24 WAP in plots where no pre was applied was 84% and 37% in cereal rye and crimson clover and it shifted to 61% and 48% in 2023, respectively; moreover, when pyroxasulfone was applied Italian ryegrass control was 83% and 69% in 2022 and 88% and 67% in 2023, in cereal rye and crimson clover plots, respectively. Findings from this study suggest that although cover crops can be an effective weed management tool, differences in weather conditions can alter the effectiveness of this strategy. Therefore, integrating an effective and non-injurious residual herbicide fall application can help sustain an acceptable level of Italian ryegrass control until the next planting season.

The Impact of Overcast Weather on Provisia Rice Injury Before and After Quizalofop Applications. Wesley B. Carr*, Connor Webster, John A. Williams, Maranda P. Arcement, Steven B. Stoker, Logan N. Vallee; LSU AgCenter, Baton Rouge, LA (276)

The Impact of Overcast Weather on Provisia Rice Injury Before and After Quizalofop Applications. W.B. Carr, L.C. Webster, J.A. Williams, M.P. Arcement, S.B. Stoker, L.N Valle Crop injury in non-transgenic herbicide-resistant rice (*Oryza Sativa* L.) can be induced by decreased herbicide metabolism as a result of poor growing conditions. In 2023 and previous growing seasons, crop injury has been observed when quizalofop was applied at the labeled rate in Provisia® rice during periods of low solar radiation and low temperatures. In 2023, at the H. Rouse Caffey Rice Research Station near Crowley, Louisiana, two studies were conducted to evaluate overcast weather conditions before and after quizalofop applications in Provisia® rice. Shade cloths (The Shade Cloth Store, Mundelein, Illinois 60060) were used in these studies to simulate overcast growing conditions. Each study was set up as a two-factor factorial arrangement of treatments with three replications. Factor A consisted of either no shade cloths or shade cloths at 30, 60, or 90 percent shade. Factor B consisted of quizalofop applied at 0, 120, or 239 g ai ha^{-1} at the three- to four-leaf rice growth stage. In the first study, overcast conditions were simulated for 7 days prior to quizalofop applications. In the second study, overcast conditions were simulated for 7 days after quizalofop applications. Herbicide applications were made with a CO_2-pressurized backpack sprayer calibrated to deliver 140 L ha^{-1}. Visual evaluations for crop injury were recorded 14 days after treatment (DAT). In addition to crop injury, rice plant heights and stand counts were recorded at 14 DAT. At 14 DAT, crop injury was 2 to 8% following quizalofop applications when no overcast weather was simulated across both rates. In the first study, crop injury was observed at 5, 9, and 19% when quizalofop was applied at 120 g ha^{-1} following 7 days of 30, 60, and 90% shade, respectively. In the second study, crop injury was observed at 7, 13, and 30% when quizalofop was applied at 120 g ha^{-1} followed by shade at 30, 60, and 90%, respectively, for 7 days. This research indicates that overcast growing conditions are playing a role in crop injury in the Provisia® rice production system.

The Influence of Cotton Seed Quality on PRE Herbicide Tolerance. Jacob C. Forehand*[1], Charlie W. Cahoon[2], Guy Collins[3], Keith L. Edmisten[4], Lori Snyder[1], Zachary R. Taylor[5], Brock A. Dean[2], James H. Lee[2], Jose H. de Sanctis[2], Michael Phillips[1]; [1]North Carolina State Unviersity, Raleigh, NC, [2]North Carolina State University, Raleigh, NC, [3]North Carolina State Unviersity, Bailey, NC, [4]NC State University, Cary Nc, NC, [5]North Carolina State University, Sanford, NC (277)

Today's larger farms must cover more acres in a limited amount of time, resulting in cotton planted under suboptimal conditions, therefore increasing the risk of PRE herbicide injury on young cotton seedlings. The purpose of this study was to investigate the relationship between cool germ percentage and cotton PRE herbicide tolerance. In this study we used three different varieties with differing cool germ percentages (Variety 1 at 56%; high cool germ, Variety 2 at 45%; moderate cool germ, and Variety 3 at 25%; low cool germ). Each variety had a non-treated check and was subjected to different herbicides at one (1X) and two (2X) times the labeled rate. These herbicides included acetochlor (1261 and 2522 g a.i. ha^{-1}), fomesafen (280 and 560 g a.i. ha^{-1}), diuron (841 and 1681 g a.i. ha^{-1}), and fluometuron (1121 and 2242 g a.i. ha^{-1}). Field studies were conducted in 2022 and 2023 at two locations, one at the Peanut Belt Research Station in Lewiston, NC, and another location at the Upper Coastal Plain Research Station in Rocky Mount, NC. Plots were kept weed free with multiple applications of glyphosate and glufosinate. Cotton stand and injury (visual 0-100%) were collected 7, 14, and 21 days after planting (DAP). Crop biomass at 21 DAP and lint yield were also collected. Data was subjected to analysis of variance using JMP Pro 17 software, and means were separated using Fisher's Protected LSD at an alpha value of 0.05. The main effects of year and cool germ were significant for cotton stand. In 2022, high, moderate, and low cool germ seed lots had stands of 10.21, 9.28, and 8.22 plants m of row^{-1}, respectively. In 2023, high, moderate, and low cool germ seed lots had stands of 8.33, 8.1, 6.93 plants m of row^{-1}, respectively. Crop biomass was similar across herbicides with the exception for diuron 2X at Rocky Mount in both 2022 and 2023. Diuron was the most injurious PRE herbicide; cotton response to diuron was influenced by seed quality with the high cool germ, moderate cool germ, and low cool germ seed lots being injured 18, 22, and 31% in 2022 and 24, 27, and 38% in 2023, respectively. Early season injury was transient and did not impact lint yield.

***Zoysia* Spp. Putting Green Tolerance to Post-emergent Herbicides.** Benjamin D. Pritchard*[1], Gregory K. Breeden[2], James Brosnan[3], Weston Floyd[4], Chase Straw[4], Eric H. Reasor[5]; [1]University of Tennessee Knoxville, Knoxville, TN, [2]University of Tennessee, Knoxville, TN, [3]Univeristy of Tennessee, Knoxville, TN, [4]Texas A&M, College Station, TX, [5]PBI Gordon, Dallas, TX (278)

Zoysiagrasses (*Zoysia* spp.) are used on >9500 ha of golf course surfaces throughout the U.S., primarily fairways and tees in transitional climates. Recently, cultivars offering dwarf canopy height and improved quality have been released for putting green use; however, tolerance of these cultivars to postemergence herbicides is unknown. Field research was conducted in 2021 and 2022 evaluating the tolerance of 'Lazer' (*Z. matrella* × *Z. minima*) and 'Prizm' (*Z. matrella*) zoysiagrass to seven herbicides: Aethon™ (pyrimisulfan + penoxsulam), Arkon™ (pyrimisulfan), Katana® (flazasulfuron), Q4® Plus (2,4-D + quinclorac + dicamba + sulfentrazone), SpeedZone® EW (2,4-D + MCPP + dicamba), Surge® (2,4-D + MCPP + dicamba + sulfentrazone), and Vexis® (pyrimisulfan). Responses on Prizm and Lazer were assessed in Knoxville, TN and College Station, TX, respectively. Herbicides were applied at = 2x label recommendations to plots arranged in randomized complete block designs with four replications. Height of cut measured 3.2 and 3.8 mm in Texas and Tennessee, respectively. Turfgrass injury and quality were visually evaluated once weekly for four weeks with data subjected to ANOVA. Turfgrass injury varied among cultivars and years. In Tennessee, no herbicide injury was detected on 'Prizm' by 4 WAT in either year. In Texas, 0 to 18% injury was observed on 'Lazer' 4 WAT in 2021, with no herbicide injury detected on this date in 2022. On 'Prizm', Q-4® Plus and Speedzone® EW applications resulted in the greatest degree of injury (5 to 8%) among herbicides tested, whereas Surge® and Katana® resulted in the greatest injury (31 to 61%) on 'Lazer'. Overall, Prizm was more tolerant to the cohort of herbicides tested than Lazer, as no treatment injured Prizm > 8% in either year of this study. However, future research is warranted exploring tolerance of these cultivars to other pre- and postemergence herbicides labeled for use in turfgrass.

Investigating Herbicide Tolerance on *Cosmos bippannatus*. James H. Lee*[1], Brock A. Dean[1], Charlie W. Cahoon[1], Jacob C. Forehand[2], Zachary R. Taylor[3], Jose H. de Sanctis[1]; [1]North Carolina state university, Raleigh, NC, [2]North Carolina State Unviersity, Raleigh, NC, [3]North Carolina State University, Sanford, NC (279)

Evaluating POST Herbicide Options for *Cosmos bipinnatus* J.H. Lee, C.W. Cahoon, Z.R. Taylor, B.A. Dean, J.C. Forehand J.S. De Sanctis During the summer of 2023, herbicide safety screening was conducted on *Cosmos bipinnatus* currently being planted by the N.C. Department of Transportation (NC DOT) Roadside Environmental Unit for inclusion in the wildflower program. *C. bipinnatus is* a summer annual that is planted extensively across the state. Two locations were planted, one at Central Crops Research Station in Clayton, NC on July 25th, 2023. The second site was provided by Garrett Seed Farm in Four Oaks, NC on September 3, 2023. Both locations had pendimethalin at 1064 g ai/ha and s-metolachlor at 1092 g ai/ha applied at planting. The following herbicides were applied (rates in parenthesis)postemgergence: fluometuron (1212 g ai/ha), fluometuron (2241 g ai/ha), 2,4-DB (175 g ae/ha), 2,4-DB (210 g ae/ha), 2,4-DB (245 g ae/ha), a premix of flufenacet + metribuzin (378 g ai/ha), a premix of flufenacet + metribuzin (474 g ai/ha), tolpyralate (29 g ai/ha), topramezone (12 g ai/ha), flumetsulam (1 g ai/ha), flumetsulam (6 g ai/ha), fluroxypyr (118 g ai/ha), tembotrione (92 g ai/ha), acifluorfen (140 g ai/ha), imazapyr (70 g ai/ha), imazapyr (350 g ai/ha), pyroxasulfone (64 g ai/ha), sulfentrazone (140 g ai/ha), isoxaflutole (53 g ai/ha), simazine (1121 g ai/ha), halauxifen (5 g ai/ha), tiafenacil (25 g ai/ha), fluridone (168 g ai/ha), flumioxazin (420 g ai/ha), a premix of flumioxazin + prodiamine (980g ai/ha). When required by label recommendations, crop oil concentrate, methylated seed oil, and non-ionic surfactant were added at recommended rates. In this trial fluometuron at 1212 g ai/ha acts as a comparison treatment for C. bipinnatus, as this is the current labeled standard practice used by the NCDOT. Clayton was treated on August 10th, 2023, and Four Oaks was treated on September 18, 2023. At treatment, the average height of C. bipinnatus was 15 cm. Treated plots were 3 meters wide by 9 meters long. At each location, running checks were left between plots. Treatments were replicated 4 times throughout each location. Treatments were applied using a CO2 pressurized backpack sprayer equipped with Tee jet flat-fan AIXR 11002 nozzles, calibrated to deliver 140 liters per hectare. Visual ratings of general phytotoxicity were recorded at one, two, and three weeks after treatment. Heights were taken four weeks after treatment. Percent bloom reduction was also visually estimated at peak bloom. It was found that fluometuron (1212 g ai/ha), fluometuron (2241 g ai/ha), pyroxasulfone (64 g ai/ha), a premix of flufenacet + metribuzin (378 g ai/ha), a premix of flufenacet + metribuzin (474 g ai/ha), isoxaflutole (53 g ai/ha), flumioxazin (420 g ai/ha), and a premix of flumioxazin + prodiamine (980g ai/ha) caused little to no reduction in bloom compared to the running check. There appear to be several viable herbicide options that could be used over the top of C. bipinnatus. Another year of testing is needed to determine if these herbicides are safe. After further testing, 24(c) labels can be pursued so that these products may be incorporated into weed management plans by the NCDOT wildflower program

Crabgrass and Texas Panicum Control with Group 15 Herbicides Applied Preemergence.
Livia Pereira*, Steve Li; Auburn University, Auburn, AL (280)

Gramineous weeds continue to be challenging to control in crops, especially in crops where herbicide tolerance traits are not available, such as peanuts. The objective of this study was to compare the efficacy of four Very Long-chain Fatty Acid (VLCFA) Inhibiting herbicides for preemergence control on two grass species with different seed sizes. The study was conducted in Henry County, AL during summer of 2022 and 2023, and in Macon County during summer of 2022. The seeds of *Digitaria sanguinalis* and *Panicum texanum* were spread onto tilled 1.83 x 1.83 m plots and incorporated with a rotary tiller, and then treated with herbicides immediately after. Plots were hand weeded to remove all other weed species as needed. Data collection involved weed counts and visual rating at 14, 28, and 42 days after treatment (DAT). Additionally, a handheld greenseeker and a multispectral imaging camera on an unmanned aerial vehicle were used to assess growth plus biomass collected at 42 DAT. Imagery was analyzed in QGIS 3.22 and statistics were conducted in SAS 9.4. The results showed that treatments were consistent among all sites and years. We observed a control over 94% for all products on *Digitaria*, and overall *Panicum* presented more difficult to control. The treatment that consisted of pyroxasulfone plus carfentrazone had the highest level of control for *Panicum*, while all treatments had same level of control for *Digitaria* when compared to non-treated control (NTC). Both *Panicum* and *Digitaria* presented no significant difference for stand counts across products even at 42 DAT, but pyroxasulfone plus carfentrazone was numerically lower for both species. Similar to stand count, no significant difference for dry biomass for *Digitaria*. In conclusion, the research findings demonstrated that while all VLCFA-inhibiting herbicide products performed well in controlling Digitaria, only pyroxasulfone plus carfentrazone was significantly effective in controlling Panicum compared to the untreated control. The study revealed noticeable species-specific differences in control efficacy for the two grass species, emphasizing the importance of following the correct herbicide recommendations for specific weed species at a given site before the planting season.

North Carolina Survey of Herbicide Resistant Italian Ryegrass Populations. Jackson W. Alsdorf*, Diego J. Contreras, Ronel J. Argueta, Wesley Everman; North Carolina State University, Raleigh, NC (281)

Lolium perenne L. ssp. multiflorum is a troublesome weed commonly found in North Carolina. In June of 2022, 118 samples were collected from around the state by taking mature weed seed heads from wheat fields. The objective of this study is to understand the frequency and distribution of resistance to multiple herbicides. Samples were threshed then stored in a freezer. In the greenhouse, seeds were germinated in flats, then transplanted into individual conetainers with 4 replications treated with one of 6 treatments: untreated check, glyphosate (1349 g ai ha), glufosinate (596 g ai ha), mesosulfuron (15 g ai ha), pinoxaden (61 g ai ha), and paraquat (562 g ai ha). Ratings were taken weekly on a scale of 0-100 for each individual plant, with 0 being no control, and 100 being plant death. Populations with 50% or less control with a specific herbicide are considered to be potentially resistant. 114 populations were found to be resistant to mesosulfuron, 17 to pinoxaden, 2 to glyphosate, 1 to paraquat, and 0 to glufosinate. One five-way resistant population was found, along with 10 three-way resistant populations. These results are helpful tools for growers and county agents as they put together effective weed control programs.

Investigating Triclopyr Drift Under Roadside Conditions. Estefania Gomiero Polli*, Travis W. Gannon, Mathieu C. LeCompte, Ronald R. Rogers, Khalied Ahmed; North Carolina State University, Raleigh, NC (282)

Triclopyr is a synthetic auxin herbicide widely used to manage roadside vegetation due to its effective, selective, and prolonged action on broadleaf species, as well as its low toxicity to humans and animals. However, if triclopyr drifts away from the roadside into agricultural lands, it can result in severe injury and yield loss of sensitive crops. The objective of this study was to quantify vapor and particle drift of triclopyr as influenced by season, formulation, and nozzle type under roadside conditions. Field studies were conducted on a roadside located at Interstate 540 in Wake County, NC from March 2022 to November 2023, utilizing a randomized incomplete block design with three replications. Triclopyr amine and choline were applied at 3363 g ai ha^{-1} using Boominator and Nutating nozzles calibrated to deliver 50 GPA at 40 psi. Triclopyr vapor concentration reaches its peak within the first 24 hours after application, with the concentration of triclopyr amine being 0.06% higher than triclopyr choline during this period. Additionally, a higher concentration of triclopyr vapor was detected in the spring and summer compared to fall and winter. Nonetheless, for particle drift, triclopyr concentration and driftable distance were consistent across formulations and nozzle types. Triclopyr was detected at levels below 2% of the application rate within 12 m from the sprayed zone. This study provides valuable insights into triclopyr vapor, emphasizing temporal, formulation, and seasonal variations, while also addressing consistency in particle drift between triclopyr formulations and nozzle types.

Assessing Injury and Physiological Response of Black-eyed Susan (*Rudbeckia hirta*) Treated with Common Roadside Herbicides. Rachel C. Woody-Pumford*[1], Matthew B. Bertucci[1], Mike D. Richardson[1], Dirk Philipp[1], Hannah E. Wright-Smith[2]; [1]University of Arkansas, Fayetteville, AR, [2]University of Arkansas, Little Rock, AR (283)

Black-eyed Susan (*Rudbeckia hirta*) is native to plains, prairies, and open woodlands throughout the continental U.S. *Rudbeckia hirta* is used in prairie roadside restoration sites due to its drought tolerance, ecological value to pollinators, showy blooms, and relative ease to sow and manage. It is important to manage weeds when establishing new plantings for prairie restoration projects to prevent invasive and weedy species from outcompeting small native grasses and forb seedlings. However, current recommendations are to avoid the use of herbicides for up to three years after planting. A greenhouse (fall 2022 and spring 2023) and field (summer 2023) study were conducted to assess the injury and physiological response of *R. hirta* when treated with the common roadside herbicides clopyralid, florpyrauxifen-benzyl, metsulfuron, and quinclorac. For the greenhouse trial, experimental units were 14 plants grown separately in 3.8 × 21.6 cm containers, and treatments were replicated 5 times. Herbicides were applied to plants using a track sprayer to deliver 187 L ha^{-1} at 1.6 kph to plants when multiple sets of true leaves were present, but anthesis had not begun. Following application, plants were maintained in a greenhouse, and weekly data collections were conducted including plant mortality and visual assessments of plant injury rated on a scale of 0 to 100 measured against the nontreated controls. Although not statistically higher than plants treated with florpyrauxifen-benzyl 1 and 2 WAT, plants treated with clopyralid had the highest levels of injury throughout the greenhouse trial, with a mean injury rating of 91% by 4 WAT. Additionally, by 4 WAT, significantly more plants treated with clopyralid died (38%) than plants in the other treatments (< 18%). Experimental units for the field trial were 4.6 m^2 plots that included a mix of grass and forb species native to Arkansas. Consistent with the greenhouse trial, *R. hirta* plants treated with clopyralid or florpyrauxifen-benzyl had higher levels of injury than those treated with metsulfuron or quinclorac at 1, 2, 4, and 5 WAT. However, there was a limited effect on the number of plants in bloom and the average number of open inflorescences per plant, with no significant differences between any of the herbicide-treated and nontreated plots throughout the majority of the trial (2-4, 6, 12-16 WAT).

Anaerobic Soil Disinfestation: a Promising Method to Manage Weeds and Nematodes in Sweetpotato. Simardeep Singh*[1], Matthew A. Cutulle[2], Churamani Khanal[3]; [1]Clemson University, Central, SC, [2]Clemson University, Charleston, SC, [3]Clemson University, Clemson, SC (284)

Anaerobic soil disinfestation (ASD) is a promising organic pest management strategy that can potentially suppress weeds and soil-borne pathogens in organic agriculture systems. ASD is facilitated by incorporating carbon sources, irrigating to field capacity, and covering the soil with impermeable plastic mulch. Greenhouse studies were conducted at Clemson University, South Carolina, to evaluate the impact of ASD on weed control, nematode reproduction, and sweetpotato biomass. Two-gallon microcosms were filled with Upsate soil and were amended with chicken manure + molasses as the carbon source for ASD and compared with the non-amended control. Each microcosm was inoculated with weed seeds (yellow nutsedge and carpet weed) and 10,000 eggs of the southern root-knot nematode (*Meloidogyne incognita*). Black plastic mulch was then sealed over the microcosms for three weeks, followed by the transplantation of slips from twenty sweetpotato genotypes. Over the eight weeks of the study, weed counts, sweetpotato vigor, and nematode reproduction data were collected. Results suggested that the microcosms receiving the carbon amendment spent the most time under anaerobic conditions (<200 mvh). Experimental units that went anaerobic generally had lower weed cover percentage (78%), individual weed count of yellow nutsedge (79%), and carpet weed (64%) as compared to non-amended control. Second-stage juveniles of southern root-knot nematode varied between the sweetpotato lines, with the lower number observed in sweetpotato line 04-671 (23 J2 per 100 cm^3 of soil); however, a higher number was observed with commercial sweetpotato susceptible cultivar Beauregard (173 J2 per 100 cm^3 of soil). The addition of chicken manure + molasses as a carbon source resulted in higher above-ground biomass (6.5 g) of sweetpotato compared to the non-amended control (3.4 g). The results of these greenhouse studies should be validated under field conditions with future ASD field studies.

Pre-emergent Herbicide Application Timing for Management of Annual Foxtail (*Setaria*) in Bermudagrass Pasture. Charles E. Smith III*[1], Michael C. Bocz[2], Hannah C. Lindell[2], Maria L. Zaccaro-Gruener[1], Nicholas T. Basinger[2]; [1]University of Georgia Crop and Soil Sciences, Athens, GA, [2]University of Georgia, Athens, GA (285)

WSSA/SWSS Joint Meeting (January 22 – 25, 2024).Oral presentation: SWSS 15-minute oralTitle:Pre-emergent Herbicide Application Timing for Management of Annual Foxtail in Bermudagrass Pasture. Author list: Charles E. Smith III*, Michael C. Bocz, Maria L. Zaccaro-Gruener, Hannah C. Lindell, Nicholas T. Basinger (*) presenter Foxtail infestations, including green (*Setaria viridis*), yellow (*S. pumila*), giant (S. *faberi*), and knotroot (*S. parviflora*), negatively affect pasture and hayfield productivity and forage quality, necessitating effective management strategies. A study examining pre-emergence herbicide timing was conducted at the J. Phil Campbell Research and Education Center in Watkinsville, GA. This experiment evaluated the efficacy of pendimethalin (4.47 kg ai/ha), indaziflam (0.073 kg ai/ha), and hexazinone (0.84 kg ai/ha) applied biweekly from February 1st to April 1st over the 2022 and 2023 growing seasons. This resulted in 15 treatments plus a nontreated check. The pasture site was composed of 'Russell' bermudagrass *(Cynodon dactylon*) with a history of yellow foxtail infestation. Foxtail emergence counts were conducted bi-weekly within a 0.25-m^2 quadrat after the final herbicide application in each plot, and foxtail seedlings were pulled after counting. Aboveground biomass was collected from one-0.25-m^2 quadrat in mid-June, mid-July, and early September, and biomass was separated and weighed by species (foxtail, bermudagrass, and other species). Harvest weights were determined at the same time points by harvesting aboveground biomass at a height of 12.7 cm with a rotary mower. Results indicated that all herbicide treatments, except hexazinone in 2023, successfully reduced cumulative emerged foxtail plants in both years. Pendimethalin was effective in reducing and delaying foxtail emergence and was more consistent in both years than indaziflam or hexazinone. Biomass results aligned with emergence patterns, with pendimethalin exhibiting effectiveness in reducing foxtail biomass in 2022, especially when applied on February 1st; however, by the September harvest, no treatment provided lower foxtail biomass than nontreated, regardless of timing. Harvest weights were unaffected by herbicide treatment. However, pendimethalin and indaziflam resulted in higher levels of bermudagrass composition in both years at the July harvest in 2022 and the June and July harvests in 2023. Conclusively, no single herbicide application provided season-long foxtail control regardless of application timing. Pendimethalin was more consistently effective in reducing foxtail emergence, but subsequent applications may be necessary for season-long control. Long-term foxtail control strategies may require a combination of herbicides, sequential applications, and cultural practices.

Effect of Application Timing of the Weed Zapper on Palmer Amaranth (*Amaranthus palmeri*) Control and Sweetpotato Yield and Quality. Colton D. Blankenship*[1], Katherine M. Jennings[1], David W. Monks[1], David L. Jordan[1], Charlie W. Cahoon[1], Nicholas T. Basinger[2], Jerry J. Baron[3]; [1]North Carolina State University, Raleigh, NC, [2]University of Georgia, Athens, GA, [3]IR-4 HQ, NC State University, Raleigh, NC (286)

Weed management is a major challenge in both organic and conventional sweetpotato production systems, with most sweetpotato hectarage requiring expensive hand weeding. The Weed Zapper is a commercially available machine that is used to electrocute weeds that grow over top of crop canopies. Because sweetpotato canopy heights are typically shorter than many troublesome weed species, the Weed Zapper has potential to be used to improve weed control and reduce the frequency of hand weeding. Studies were conducted to determine the optimal frequency of use of the Weed Zapper in conventional and organic sweetpotato production systems for weed control and crop safety. The study design consisted of a 2x5 factorial split-plot design with four replications, wherein the main plot factor was preemergence herbicide application and the subplot factor was Weed Zapper application frequency. The preemergence herbicide treatments consisted of flumioxazin applied at 0.21 kg ha^{-1} preplant or no herbicide; the weed zapper treatments consisted of weedy, hand-weeded, weekly, biweekly (every two weeks), and monthly weed zapper applications. Preemergence herbicide application affected no. 1 and marketable sweetpotato yield, with the flumioxazin treatment resulting in higher yield than the no herbicide treatment. Additionally, weed zapper treatments also had an effect on both no. 1 and marketable sweetpotato yield; the weekly and biweekly treatments were not different from one another nor the hand-weeded treatment. Monthly applications did not result in acceptable yield or Palmer amaranth control. Because the biweekly application schedule resulted in similar yield to the weekly and hand-weeded treatments, it is likely a good compromise between efficiency and weed control for sweetpotato production. However, visual Palmer amaranth control results indicate that Weed Zapper applications alone may not be sufficient for acceptable weed control in all environments.

Effect of Transplant Type on Sweetpotato (*Ipomoea batatas*) Tolerance to Herbicides. Samuel E. Crawford*, Katherine M. Jennings, David W. Monks, David L. Jordan, Jonathan R. Schultheis, Adrienne M. Gorny, Levi D. Moore, Stephen J. Ippolito; North Carolina State University, Raleigh, NC (287)

Sweetpotato is an important crop to North Carolina. Weed competition can reduce sweetpotato yield.Traditionally, non-rooted sweetpotato cuttings are transplanted in production fields. Limited researchhas been conducted on establishment of sweetpotato from plug plants by placing sweetpotato cuttingsin plug trays and growing the cuttings in the greenhouse. Plug plants form a root ball beforetransplanting into the field, allowing for earlier establishment after transplanting. Theoretically plugplants could allow for better competition with weeds as well as potentially decreasing the number ofdays to canopy closure. In addition, forming a root ball before planting could improve sweetpotatotolerance to herbicides. Studies were conducted to determine the effect of herbicides on sweetpotatoproduced using vegetatively propagated sweetpotato plug plants. Treatments were arranged in a 6 x 3factorial design. The whole plot factors were herbicide (nontreated, flumioxazin, clomazone, fluridone,fomesafen, and S-metolachlor) and propagation method (traditional, 2 node and 3 node plug plants).The study was maintained weed-free through cultivation and hand removal as needed. All vegetativecuttings other than the traditional were allowed to grow in the greenhouse for two weeks prior totransplanting on July 6 and 26 at the Horticultural Crops Research Station, Clinton NC. Herbicidetreatments included flumioxazin at 107 g ai ha-1, clomazone at 420 g ai ha-1, fluridone at 336 g ai ha-1,and fomesafen at 280 g ai ha-1 applied PREPLANT. S-metolachlor was applied five days POST transplantat 800 g ai ha-1.Foliar injury from the herbicides was minimal with flumioxazin, clomazone, fomesafen, and S-metolachlor causing < 5% injury. However fluridone caused up to 50% injury at 3 wk after transplanting(WAT). Propagation method did not affect tolerance of sweetpotato to herbicides. Total yield (sum ofcanner, no. 1, cull, and jumbo grades) was similar to the nontreated check for all treatments. Averagedacross treatments marketable yield was reduced with greenhouse propagated plug plants due to anincreased number of cull storage roots. There were more culls for all greenhouse propagatedtransplants. Inversely, there were more no. 1 storage roots for traditionally planted sweetpotato.

Database Development Workflow and Comparison of Different Annotation Methods for Weed Detection in Turfgrass Systems. Mikerly M. Joseph*[1], Chang Zhao[1], Arnold W. Schumann[2], Nathan Boyd[3], Pawel Petelewicz[1]; [1]University of Florida, Gainesville, FL, [2]University of Florida, Lake Alfred, FL, [3]University of Florida, Balm, FL (288)

Targeted spraying using ground-based equipment enables drastic reduction in herbicide inputs and application costs. Such technologies rely on maximized efficacy of computer vision-based deep learning algorithms to detect weeds in real-time. Their performance can be elevated by expanding and diversifying training dataset. However, the choice of annotation method and model development procedure may impact the minimum amount of data required for successful training. This study evaluated 1) the performance of object detection versus semantic segmentation in spotted spurge [*Chamaesyce maculata* (L.) Small] recognition in bermudagrass (*Cynodon* spp.) turf canopy using You Only Look Once (YOLOv8) model trained with highly restricted dataset and 2) single-step training process using manually labeled images only and two-step training in which model was first pre-trained with manually labeled portion of training dataset, and then deployed to automatically predict target weed in remaining images (step 1). Following this both manually and automatically labeled images were pooled together and used to retrain the model (step 2). All models were trained using a limited dataset of 800 training images, 100 validation images and 138 test images, to determine whether the selected approach yields improvements. Semantic segmentation outperformed object detection as denoted by higher *precision* (0.61 vs. 0.40), *recall* (0.62 vs. 0.33), and *F*1 *score* (0.62 vs. 0.36) and resulted in successful (all aforementioned metrics >0.50) spotted spurge detection despite the low amount of training images used. The equivalent size training dataset was insufficient to successfully train the object detection model. Therefore, further limiting dataset for pre-training step resulted in poor automatic labeling and lack of improvements in final model's performance. This indicates that prerequisite for use of such two-step approach is pre-trained model's ability to already adequately detect target plant (i.e., achieve *precision*, *recall* and *F*1*score* of >0.50).

Cover Crop Allelopathy: A Sustainable Weed Management Strategy in Sweet Potato. Alaina M. Richardson*[1], Alyssa L. Miller[1], Worlanyo Segbefia[2], Ncomiwe A. Maphalala[3], Dante Elias[1], Aricia Ritter Correa[1], Josiane C. Argenta[1], Sabrina Sastre[1], Tabata M. Oliveira[4], Te-Ming (Paul) Tseng[5]; [1]Mississippi State University, Starkville, MS, [2]Mississippi State University, Plant and Soil Science Department, Starkville, MS, [3]Mississippi State University-Department of Plant and Soil Sciences, Starkville, MS, [4]MSU, Starkville, MS, [5]Mississippi State University, Mississippi State, MS (289)

The Sweet Potato (*Ipomoea batatas* (L.) Lam.) has flexible uses as food, feed, and industrial product usage. There are over 27,000 acres across one-hundred and fifty farms in Mississippi and the state also ranks second and third in the nation in terms of acreage and production, respectively. Farmers to suppress weed species, enhance biodiversity, improve soil health, and minimize pests and diseases in plants have used cover crops for a long time. In sweet potatoes, there is a significant problem with weeds interfering with yields; reducing crop yield by up to 80%. A chemical approach is usually the most popular utilization, but it can lead to disadvantages with crop quality, intolerance, and in worse-case scenarios environmental toxicity. To overcome limited weed control options and preserve or improve sweet potato quality and yield for Mississippi growers, there is a great need to find a supplemental weed control strategy that can effectively reduce the weed pressure around the crop and, at the same time, protect the yield and quality of the storage roots. One solution is the utilization of cover crop allelopathy, an alternative method that is environmentally friendly, and organically favored. This study aimed to assess the efficacy of five cover crop species (crimson clover, cereal rye, hairy vetch, wheat, and buckwheat) in controlling a troublesome weed species in sweet potato cultivation, namely yellow nutsedge. A comparative analysis with the control group revealed significant differences in weed suppression. Over the course of 42 days, wheat exhibited the highest reduction in yellow nutsedge height (24%), followed by crimson clover (18.4%), while rye had a modest impact (7%). Vetch and buckwheat showed the least reduction. Regarding biomass reduction of yellow nutsedge, cereal rye demonstrated the most substantial suppression, with shoot biomass reduced by 24% and root biomass by 22%. Clover achieved a 7% reduction in shoot biomass. Vetch and wheat caused the same reduction in the shoot biomass (4%). Rye, wheat, and vetch exhibited a 15% reduction in root biomass, while clover showed a 5% reduction. Buckwheat did not reduce the root and shoot biomass of yellow nutsedge. These results highlight that wheat is the most effective cover crop in reducing yellow nutsedge while cereal rye was most effective in suppressing both root and shoot biomass. Overall, wheat, rye, clover, and vetch emerge as highly effective, with buckwheat displaying the least efficacy against this specific weed species. Keywords: weed suppression, sweet potato, organic, common weed species, allelopathy, cover crops

Identification of Non-Target Site Resistance Mechanisms in Annual Bluegrass (*Poa annua* L.).
Ronald R. Rogers*, Travis W. Gannon, Mathieu C. LeCompte, Estefania Gomiero Polli, Khalied Ahmed; North Carolina State University, Raleigh, NC (290)

Herbicide-resistant weeds with non-target site resistance mechanisms (NTSR) are a growing threat, as cross-resistance and multiple resistance to herbicides with differing mechanisms of action (MOA'S) become more prevalent. Annual bluegrass is a problematic weed in turfgrass systems. The growth characteristics of this species coupled with herbicide resistance to multiple MOA's increases agronomic, economic, and social pressure on turfgrass managers. Very little prior research has documented NTSR mechanisms in turfgrass systems therefore, the objective of this study was to determine if select annual bluegrass populations were exhibiting NTSR characteristics. Seventeen unique resistant annual bluegrass populations were identified for NTSR screening to either acetolactate synthase-inhibiting (ALS), photosystem-II (PS-II) or 5-enolpyruvylshikimate-3-phosphatesynthase (EPSPS) herbicides. To evaluate NTSR mechanisms absorption and translocation experiments utilizing ^{14}C-herbicide was conducted. Data were subjected to analysis of variance in SAS 9.4 and subjected to Tukey's Honest Significant Difference (HSD) test at a=0.05. ALS NTSR screening identified a population from Virginia with less ^{14}C-trifloxysulfuron absorption (25.7%) when compared to the susceptible population (38.3%) at 24 HAT. Similarly, at 96 and 192 HAT the Virginia population absorbed 15.5% and 13.6% less ^{14}C-trifloxysulfuron when compared to the susceptible population. Furthermore, reduced translocation was observed in populations collected from Florida, Georgia, and South Carolina when compared to the susceptible population. PS-II NTSR screening identified four populations that exhibited reduced ^{14}C-simazine absorption when compared to the susceptible population beginning at 12 HAT. EPSPS NTSR absorption and translocation studies did not identify any populations exhibiting reduced absorption or translocation, respectively, when compared to the susceptible population. These data suggest that reduced absorption may contribute to resistance in five of the populations screened and reduced translocation may contribute to resistance in three of the populations screened.

Endozoochorous Seed Dispersal Potential of Dominant Southern Weeds. Akashdeep Singh*, Aniruddha Maity, David P. Russell, Brandon Smith; Auburn University, Auburn, AL (291)

Cattle grazing on weed-mixed forage biomass can potentially spread weed seeds, leading to plant invasions across pasture lands. Understanding the possibility and intensity of this spread is crucial for developing effective weed control methods in grazed areas. This research examined the influence of bovine digestive fluid on the survival and germination of six different weed species. We conducted an in vitro experiment to evaluate the germination and survival of weed seeds after incubation in bovine digestive fluid for seven time periods (0, 4, 8, 12, 24, 48, and 72 hours). Furthermore, a full Tilley and Terry procedure was applied to an eighth sample after 48 hours of incubation by stopping fermentation, simulating complete abomasum digestion. The findings revealed differences in seed survival and germination among all weed species, with tall morningglory reaching zero germination after 24 hours of incubation but palmer amaranth and johnsongrass still having upto 10% germination after 96 hours of incubation, suggesting that cattle grazing could affect seed distribution and invasiveness in grazed grasslands and rangelands. The small seed size, hard and impermeable seed coat of Palmer amaranth and Johnsongrass made them highly resistant, whereas morning glory seeds were highly susceptible to rumen fluid, likely due to their seed coat becoming easily permeable and ruptured. This suggests that cattle grazing could be a significant seed dispersal mechanism for some of the weed species. Our research provides important insights into the potential role of grazing as a weed dispersal mechanism or a practical, cost-effective method for weed control decreasing germination and viability in some weed species.

Dual Purpose Cover Crop-Living Mulch System for Weed Suppression in Cotton. Gustavo Camargo Silva*[1], Muthukumar V. Bagavathiannan[2]; [1]Texas A&M University, Department of Soil and Crop Sciences, College Station, TX, [2]Texas A&M University, College Station, TX (292)

Cover crops have become one of the main conservation practices in recent years. Cereal cover crops such as oat and cereal rye provide great benefits for soil and water conservation, and weed suppression. Cereal cover crops are generally planted in the fall and terminated in the spring with herbicides or tillage. Mowing is another termination strategy that allows for cover crop regrowth. Since cotton is a slow-growing crop, cover crop regrowth after mowing could provide an extended period of ground cover and, consequently, weed suppression. This project seeks to determine the potential of oat and cereal rye cover crops for regrowth after mowing and its influence on the emergence of problematic weeds in cotton production. Oats and cereal rye were planted in the fall. Treatments were implemented in the spring, including mowing, mowing + PRE herbicides, mowing + skipping the cotton row, mowing + skipping the cotton row + PRE herbicide, chemical termination, and a fallow control. Cotton was planted into the cover crop residues with a no-till planter. Cover crop and winter weed biomass production were determined at termination. Cover crop regrowth potential, ground coverage, and light interception by the cover crop residue were measured in the early season. Weed density and biomass were assessed throughout the summer. Cotton yield was determined at harvest. Preliminary investigations indicate that oat produces twice as much biomass as rye at termination, but rye shows a higher potential for regrowth after mowing. The mowed cover crops show the potential to reduce weed pressure between the cotton rows compared to fallow ground and can be an effective aid to herbicide resistance management in cotton production.

Row Direction-dependent Light Exposure and Mulching Can Improve Weed Suppression and Yield in Peanut. Ankit Yadav*, David P. Russell, Aniruddha Maity; Auburn University, Auburn, AL (293)

It is an established fact that weeds compete for nutrients, light, and water with the main crop resulting in qualitative and quantitative yield loss. Managing light availability and quality in the microenvironment around crop rows can be useful in promoting crop growth over weeds. Several weed management tactics like intercropping and narrow row spacing are heavily based on managing light competition. We hypothesized that altering row orientation can help in weed management by greater shading of weeds in the inter-row spaces. An experiment was conducted in the summer 2023 in a southern Alabama peanut field in a factorial design with crop row orientation (E-W, N-S, NW-SE, NE-SW), spacing (36" single row and 36" twin row), and mulch (mulch and no mulch) as three factors. First year results indicate that peanut plots with E-W row orientation had significantly lower weed density followed by NE-SW. Mulching significantly reduced weed density, whereas no significant effects of row spacing were observed. Interestingly, we observed no significant difference in seed yield. Results will be confirmed after second year experiment.

Sheep as a Potential Tool for In-Season Cotton Weed Management. Matthew C. Stewart*; Texas A&M University, College Station, TX (294)

Sheep as a potential tool for in-season cotton weed management. Matthew Stewart[1], Reagan Noland[3], Ben McKnight[2], Reid Redden3, [1]Texas A&M University, College Station, TX, [2]Texas A&M AgriLife Extension, College Station, TX, [3]Texas A&M AgriLife Extension, San Angelo, TX. Increased reliance on herbicides in crop production has led to many weed species becoming resistant to multiple herbicide modes of action. Sheep herbivory may be a viable alternative weed control method, as sheep have the potential to preferentially graze weeds and be averse to eating the cotton plant due to the presence and concentration of gossypol. Common weeds such as Palmer amaranth and field bindweed are major competition for cotton plants in this region but are also palatable to sheep. Field research was initiated at the Texas AgriLife extension and research center in San Angelo, Texas during the 2022 and 2023 seasons. Treatments include three different cotton growth stages to initiate grazing (4-leaf, 8-leaf, and mid-bloom) and three different levels of grazing intensity (approximately 70%, 90%, and 100% weed removal with presumably greater cotton damage with increasing intensity). The effects of these treatments are quantified by monitoring sheep grazing activity, assessments of weed biomass removal, cotton damage, and ultimately cotton yield. Current findings indicate that grazing at later growth stages may impose less damage to the cotton as palatability declines with maturity. During the 4-leaf, 8-leaf, and mid-bloom initiation, sheep spent 52%, 66%, and 75% of their time in each plot, respectively, grazing on weeds rather than cotton. Grazing intensity had no influence on final cotton biomass within the 4-leaf and mid-bloom initiation timings, although less intense grazing resulted in greater cotton biomass than the most intense grazing within the 8-leaf initiation timing. The less intense (70%) grazing at the 8-leaf initiation has resulted in the greatest balance with 1,637 kg/ha of cotton biomass (10% less than weed free check) and 192 kg/ha of weed biomass (64% less than weedy check) remaining in the field. The exploration of sheep herbivory as an alternative weed control method presents promising insights on the dynamics of sheep herbivory at different intensities and cotton growth stages. This approach may offer a sustainable solution to the challenges posed by weed resistance to herbicides and can contribute to ongoing efforts to optimize weed control practices in cotton production.

Evaluating the Integrated Harrington Seed Destructor for Use in Virginia Soybean Production. Eli C. Russell*, Kevin Bamber, Matthew P. Spoth, Michael L. Flessner; Virginia Tech, Blacksburg, VA (295)

Harvest Weed Seed Control (HWSC) concentrates, removes, or destroys weed seeds as they pass through the combine. Seed impact mills are but one way to implement HWSC. Seed impact mills, like the integrated Harrington Seed Destructor (iHSD), are aftermarket modifications that are mounted directly onto the back of the combine. This mill processes the chaff fraction as it exits the combine and kills the weed seeds therein. Extensive testing has been conducted in Australia looking at the effectiveness of seed impact mills in wheat production. However, testing in soybean production is minimal to date. Two different experiments were conducted to determine the effectiveness of the iHSD in soybean. The first experiment used a stationary test stand to evaluate seed kill of 10 different species, and horsepower draw and seed kill of four species as affected by increasing chaff flow rate and chaff moisture. The second experiment tested the iHSD in the field on a commercial combine. The goal was to determine seed kill of six species and the percentage of weed seeds that bypassed the mill by exiting the combine in the straw fraction. Data from our stationary mill indicates that all species experienced a >98% kill. Horsepower draw increased as the chaff flow rate increased, but not as chaff moisture increased. Additionally, seed kill decreased for all tested species as the chaff flow rate increased but remained >99% even at 2-fold normal throughput. Chaff moisture had less of an effect on seed kill with only Palmer amaranth (*Amaranthus palmeri*) having a decrease in seed kill but remained >99.5% at 30% moisture. In the field, seed kill was >98% for all species tested, very similar to the stationary mill. The data also indicated that <5% of weed seeds by-passed the mill by exiting the combine in the straw fraction. So, these data indicate that the iHSD effectively kills a variety of weed seeds across a range of soybean harvest conditions. Coupled with the low seed loss in the straw, the iHSD could be used to reduce the soil seed bank returns of these problematic species. ecrussell@vt.edu

Tillage Type and Enlist® Technology: Evaluating Weed Specie Shift in Georgia Field Corn.
Hannah C. Lindell*[1], Charles E. Smith[1], Michael C. Bocz[1], Timothy L. Grey[2], Nicholas T. Basinger[1]; [1]University of Georgia, Athens, GA, [2]University of Georgia, Tifton, GA (296)

Field corn ranks as the third largest commodity grown in Georgia, with an economic value of $509.1 million. Maintaining a weed-free crop while optimizing yields is crucial. Introduction of Enlist® seed technology, in the southeastern US, could additionally affect weed management and population composition. Major weeds facing corn producers in the region include Palmer amaranth (*Amaranthus palmeri*), morningglory (*Ipomoea* spp.), sicklepod (*Senna obtusifolia*), Texas panicum (*Urochloa texana*) and large crabgrass (*Digitaria sanguinalis*). However, production practices, including tillage, vary across different physiographic regions of the Southeast. When coupled with Enlist® herbicide use patterns, weed shifts could manifest. In Watkinsville, Plains, and Midville, Georgia from 2022 – 2023, studies combining tillage methods (conventional, strip-till, and no-till) and POST herbicides, (quizalofop, 2,4-dichlorophenoxyacetic, and/or glyphosate tank mixed with atrazine and pendimethalin, applied on v3 – v5 corn) were combined as a three by five factorial arrangement of treatments in a randomized complete block design. Weed species frequency, density, end-of-season biomass, and corn yield were recorded. In Plains, Palmer amaranth frequency was 74% higher under nontreated conventional tillage methods. Sicklepod density was 60% more with strip-till + quizalofop for Watkinsville 2022, and 22% more after glyphosate alone in 2023. Plains' sicklepod occurred 39% more with 2,4-D + glyphosate compared to nontreated. For Watkinsville 2022, all POST herbicides reduced crabgrass density by 50%. In Plains, Texas panicum occurred 51% more in no-till + 2,4-D, compared to all other treatments. In Watkinsville, glyphosate or 2,4-D + glyphosate reduced weed biomass by 62% (2022) and 92% (2023) compared to nontreated. In Plains 2022, 2,4-D did not reduce weed biomass. With no-till, corn yield decreased 52% and 7% in Watkinsville 2022 and 2023, respectively. Enlist® seed technology in Georgia's corn fields revealed region-specific nuanced weed management outcomes. Tailoring tillage and herbicides based on location is crucial for optimizing yield.

Pre-Harvest Morningglory Desiccation in Corn Using Sprayer Drone Technology. Thiago Bento Caputti*[1], Livia Ianhez Pereira[2], Steve Li[1]; [1]Auburn University, Auburn, AL, [2]University of Nebraska-Lincoln, North Platte, NE (297)

Pitted morningglory (*Ipomoea lacunosa* (L.)) is a pervasive and economically impactful weed, posing challenges to crop harvesting operations due its ability to entwine with corn plants, reducing yields and impeding combines to work efficiently. To address this issue, a study was conducted to evaluate the effectiveness of drone-based sprayer technology in desiccating morningglory, specifically targeting a window of 14 to 21 days before corn harvesting. For this purpose, a DJI Agras T40 drone was utilized for the application of herbicides, with two different spray volumes: 2 and 3 gallons per acre (GPA). The study focused on two distinct fields located in the state of Alabama. To assess the impact of the treatments, a multi-faceted approach was employed, including visual ratings and drone imagery captured using the DJI Mavic 3M drone. These assessments were carried out 14 days after treatment (DAT) and involved the generation of two key vegetation indices: the Normalized Difference Vegetation Index (NDVI) and Visible-Band Difference Vegetation Index (VDVI). The results of this study revealed that, on average, 14 DAT, the morningglory control based on visual ratings exceeded 80%. Furthermore, the NDVI index exhibited an average value of 0.4, and VDVI index displayed an average of 0.05. Significantly, the analysis indicated that there were no substantial differences between the two spray volumes of 2 and 3 GPA. This finding was consistent across visual control assessments, as well as the NDVI and VDVI results. In conclusion, this research demonstrates that the utilization of a sprayer drone is efficient to control late season morningglory on corn pre harvest. Importantly, it provides evidence that farmers can achieve the same level of control with a reduced spray volume, offering both cost savings and effective weed management.

Spray Deposition Pattern and Weed Control Efficacy of Multipass UAV and Ground Applications. Daewon Koo*, Navdeep Godara, Juan Romero, Shawn Askew; Virginia Tech, Blacksburg, VA (298)

Previous methods for assessing spray deposition patterns faced limitations due to restricted sampling areas and low resolution within the field. A technique employing fluorescence dye as a pesticide proxy, combined with aerial image analysis, was developed. Studies assessed spray deposition patterns from a multipass spray drone with flat-fan or air-induction nozzles, a simulated ride-on sprayer, and a spray gun with a flooding nozzle. A fluorescent dye solution (Cartax DP Liquid, Heubach Colorant USA LLC, Charlotte, NC) was applied at 3.7 L ha^{-1}, irrespective of the method. Six ultraviolet lamps illuminated a quarter of each plot, and nighttime aerial images were taken. Each image was overlaid with a 5000-point grid at 0.27-dm^2 resolution where the average hue was calculated using FieldAnalyzer (Green Research Services LLC, Fayetteville, AR). The hue was converted to estimated fluorescence dye dosage based on a logarithmic standard curve from four reference plots treated with known concentrations and confirmed via fluorescence spectrometry. Results showed the multipass spray drone, regardless of nozzle type, overapplied by 24% (>150% targeted rate) compared to the ride-on sprayer. Both drone applications had at least 35% more drift than ground applications. Subsequent field trials at Blacksburg, VA, assessed smooth crabgrass control from quinclorac 841 g ai ha^{-1} and topramezone 36.8 g ai ha^{-1} applied by multipass UAV and ground application. Topramezone via drone controlled smooth crabgrass 10% more than ground application at 28 DAT, but had 24% more spatial variability. Smooth crabgrass control and spatial variability were similar for quinclorac, regardless of application method. Drone application drifted 19% more than ground application, regardless of the herbicide.

Elevated Temperature and CO_2 Effects on Epicuticular Waxes of Glyphosate-Resistant and Susceptible Palmer Amaranth (*Amaranthus palmeri*) Biotypes. Juliana de Souza Rodrigues*[1], Oliva Pisani[2], Daniel Patrick Liebert[2], Timothy L. Grey[3]; [1]University of Georgia/Department of Crop and Soil Science, Tifton, GA, [2]U.S. Department of Agriculture - Southeast Watershed Research Lab, Tifton, GA, [3]University of Georgia, Tifton, GA (299)

The plant epicuticular wax layer is a primary defense mechanism against various environmental and biological stressors, such as protection against excessive water loss, solar radiation from UV to visible light, and significantly influencing surface wettability and particle adhesion. Notably, changes in the composition and quantity of the epicuticular wax may also impact herbicide absorption, which is crucial for weed management programs. Therefore, this research focused on analyzing the composition and quantity (µg/cm^2) of Palmer amaranth epicuticular waxes in the context of current and elevated CO_2/temperature scenarios. The study was conducted in growth chambers with plants subjected to current CO_2 (*c*CO_2) levels of 410 ± 30 ppm and low temperatures (LT) of 33ºC/23ºC (day/night), as well as elevated CO_2 (*e*CO_2) levels of 800 ± 30 ppm and high temperatures (HT) of 36ºC/26ºC (day/night). Epicuticular waxes of the biotypes were collected from leaves using mechanical extraction with collodion and analyzed via GC-MS. In total, 64 compounds from 9 chemical groups were identified in the epicuticular wax layer of Palmer amaranth biotypes. These chemical groups were n-alkanes, fatty acids, ?-hydroxy acids, alcohols, diterpenoids, triterpenoids, tocopherols, sterols, and ketones. The proportion of these compounds (%) varied depending on the biotype and scenario, with *n*-alkanes being more predominant in the *c*CO_2/LT scenario and alcohols being more prevalent in the *e*CO_2/HT scenario. For instance, under *e*CO_2/HT, the total wax content (µg/cm^2) represented an increase of 40% for all biotypes compared to the *c*CO_2/LT scenario. Elevated levels of CO_2 and changes in temperature have led to alterations in both the concentration and composition of epicuticular wax constituents, which may significantly influence the hydrophobicity and permeability of the epicuticular layer, emphasizing the necessity for further in-depth research in this field.

Mapping Predicted Biomass in Rye Using 3-D Imaging. April M. Dobbs*[1], Avi S. Goldsmith[1], Daniel J. Ginn[2], Søren K. Skovsen[3], Muthukumar V. Bagavathiannan[2], Steven Brian Mirsky[4], S. Chris Reberg-Horton[1], Ramon G. Leon[1]; [1]North Carolina State University, Raleigh, NC, [2]Texas A&M University, College Station, TX, [3]Aarhus University, Aarhus, Denmark, [4]USDA ARS, Beltsville, MD (301)

Cover crops can suppress weeds physically through a mulching effect that inhibits weed germination. Estimating cover crop biomass is crucial for predicting weed suppression ability. However, patchiness in cover crops often makes biomass estimation difficult. This study used ground-based Structure-from-Motion (SfM) to estimate biomass in cereal rye (*Secale cereale* L.) and applied kriging to map the distribution of predicted biomass. SfM was used to generate 3-D point clouds of cereal rye from videos collected by a hand-held GoPro camera over five fields in North Carolina in 2023. Biomass and crop height were measured in quadrats throughout each field. A model was generated to predict biomass based on point cloud pixel density and crop height. Measured biomass at termination was linearly related to pixel density multiplied by crop height (r^2= 0.813) through levels of 9,000 kg ha^{-1}. Based on independent data validation, predicted biomass and measured biomass were linearly related (r^2= 0.713). In areas of low biomass, the model underestimated biomass by as much as 2,837 kg ha^{-1}, and in areas of higher biomass, it overpredicted by as much as 3,140 kg ha^{-1}. However, the field maps showed similar distributions of high and low biomass areas. This method provides a robust prediction of rye biomass and can potentially be used by growers to nondestructively estimate biomass production and identify areas in the field that may be at greater risk of late-season weeds.

Updating the Critical Period of Weed Control in Soybean [*Glycine max* (L.) Merr.]. Steven B. Stoker*[1], Daniel O. Stephenson, IV[2], Connor Webster[1]; [1]LSU AgCenter, Baton Rouge, LA, [2]LSU Ag Center, Alexandria, LA (302)

Updating the Critical Period of Weed Control in Soybean [*Glycine max* (L.) Merr.]. S.B. Stoker, D.O. Stephenson IV, L.C. Webster Soybean [*Glycine max* (L.) Merr.], is an important crop worldwide and in the mid-southern region of the United States. Studies were conducted in 2023 at the Dean Lee Research and Extension Center near Alexandria, LA to evaluate the critical period of weed control in soybean production. Plots were 9 m long with 4, 1 m rows on 96.5 cm beds seeded with 'Asgrow 47XFO' at 330,230 seed ha^{-1}. The experimental design of this study is a randomized complete block with four replications. Treatments consisted of weed removal at 2, 3, 4, 6, 8, and 10 weeks after emergence (WAE) and weedy interference intervals commenced at 2, 3, 4, 6, 8, and 10 WAE. Weedy full season and weed-free full season controls were implemented for comparative measures. Removal timings were prompted at each interval relative to crop emergence. Initial weed removal was performed using mechanical measures and following initial weed removal, plots were maintained by implementing post-direct applications of non-selective herbicides. Evaluations consisted of plant heights, node counts, and weed density ratings at each weed removal timing. Weed spectrum consisted of barnyardgrass [*Echinochloa crus-galli* (L.) Beauv.], browntop millet [*Urochloa ramosa* (L.) Nguyen.], goosegrass [*Eleusine indica* (L.) Gaertn.], hophornbeam copperleaf (*Acalypha ostryifolia* Riddell), Palmer amaranth (*Amaranthus palmeri* S. Watson), and prickly sida (*Sida spinosa* L.). Soybean yield was obtained and adjusted to 13% moisture content.

Precision Weed Detection and Management Using Mini-Robots. Aryan Anand*[1], Maliha Kabir[1], Prabha Sundaravadivel[2], Krishna Reddy[3], Reginald Fletcher[3]; [1]Dept. of Electrical and Computer Engineering, The University of Texas at Tyler, Tyler, TX, [2]The University of Texas at Tyler, Tyler, TX, [3]United States Department of Agriculture, Agricultural Research Service, Stoneville, MS (303)

The frequency of weed infestations has been on the rise recently. Since most fields and cultivation areas are extensive, it can be time-consuming for agricultural workers to identify and address weed outbreaks. Moreover, when weed growth occurs in densely vegetated regions, there is a high probability that the weeds will remain hidden among the crops, making it challenging for farmers to pinpoint their precise locations. To aid farmers and agricultural workers in detecting and managing weed outbreaks accurately, we propose using mini robots to move around the agricultural fields and collect data from the weeds. They act as subsystems for drones that are designed for weed monitoring. The mini robots can be outfitted with various sensors, including haptic, temperature, and humidity sensors. When these mini robots send the data wirelessly to the drone, equipped with high-resolution cameras and sophisticated imaging software, it gains the capability to identify weed clusters with remarkable precision.

Effects of Boom Height and Nozzle Combinations in See & Spray™? Applications on Weed Control in Soybean. Wyatt J. Stutzman*[1], Tristen H. Avent[2], Jared Buck[3], Diego J. Contreras[4], Wesley Everman[4], Michael M. Houston[5], Lauren M. Lazaro[6], Jason K. Norsworthy[2], William L. Patzoldt[6], Julie L. Reeves[7], Larry Steckel[3], Michael L. Flessner[1]; [1]Virginia Tech, Blacksburg, VA, [2]University of Arkansas, Fayetteville, AR, [3]University of Tennessee, Jackson, TN, [4]North Carolina State University, Raleigh, NC, [5]Blue River Technology, Greenville, MS, [6]Blue River Technology, Sunnyvale, CA, [7]The University of Tennessee, Jackson, TN (304)

For herbicides to be effective, adequate spray coverage is essential. As a sprayer travels across a field, boom height can vary due to boom flex or uneven terrain, which influences both the spray width covered by a nozzle and the time it takes a spray droplet to reach its target. The John Deere See & Spray™ (S&S) Ultimate, with advanced boom control (BoomTrac™), keeps the nozzle tip of the boom within 25 cm of the target boom height to provide better spray accuracy. For systems like S&S Ultimate that only spray when weeds are detected, this variance in time-to-target, which is also influenced by nozzle, can alter whether the spray droplets hit before, at, or after the target as the equipment travels across the field. To evaluate this, three spray heights (25, 51, 76 cm) and three nozzle types (John Deere PS3DQ0003, TeeJet TP6503R4, TeeJet AIXR11002) were used on a 4-meter research S&S Ultimate to determine the effects on weed control and soybean injury. For each height and nozzle combination, a broadcast application of glufosinate + *S*-metolachlor, and a dual tank application (*S*-metolachlor broadcast applied, glufosinate S&S applied) were made. There were no interactions with nozzle, so data were pooled accordingly for subsequent analyses. Soybean injury was only greater than 20% at 7 days after treatment at the 25 cm boom height. There were no differences across any other rating timings or nozzle heights. Injury was typical of *S*-metolachlor distorting leaves contacted, but new growth was unaffected, leading to recovery. Weed control was consistent across locations and >90% across all treatments with the exceptions of the non-treated and pre-emergent only checks. Therefore, while variation in boom height due to boom flex or uneven terrain may cause a difference in application height above the target, there was no difference in weed control efficacy.

Field Evaluation of Salinity Tolerance and Weed Competitiveness of Lowland Rice Genotypes in Organic Production. Gursewak Singh*[1], Brian Ward[2], Raghupathy Karthikeyan,[1], Michael W. Marshall[3], Sarah White[1], Jai Rohilla[4], Matthew A. Cutulle[2]; [1]Clemson University, Clemson, SC, [2]Clemson University, Charleston, SC, [3]Clemson University, Blackville, SC, [4]USDA-ARS Dale Bumpers National Rice Research Center, Stuttgart, AR (305)

Saltwater intrusion threatens coastal rice production, particularly in South Carolina (SC), where current rice cultivars are salt-sensitive. Additionally, weed infestation has been a major factor contributing to yield losses in organic rice production in partial saltwater agroecosystems. Addressing this challenge necessitates a comprehensive understanding of the effects of salinity on lowland rice cultivars and weed interactions to ensure profitability and effective weed control in organic rice production. This research study assessed the impact of varying ocean water concentrations and native weed pressure in field conditions. A field experiment was designed to evaluate the salinity tolerance of six rice genotypes (Carolina Gold, Santee Gold, Doble Carolina, M202, Jupiter, and JN100) under different seawater concentrations (0%, 1.5%, 3%, 6%, and 12%), both in weed-free and weed-competition scenarios. Saltwater was collected weekly from the adjacent saltwater marsh in a reservoir using a gas pump. The calculated volumes are then pumped into the field plots. Electrical conductivity (EC) probes monitored the salinity level of the reservoir and treated plots. The results indicated that M202 and JN100 showed the highest salt tolerance. Weed competition reduced the rice plant height, number of tillers, panicles, dry root, and shoot weight across the tested salinity level. Weed competition led to an approximately 50% reduction in the aboveground (shoot) and belowground (root) weights of rice plants, compared to weed-free plots, across the tested salinity levels. Weed biomass, weeding time and regrowth of weeds declined significantly above 3 % seawater concentration compared to control.

Measuring Weed-crop Leaf Area Ratios with UAV Imagery to Predict Yield Loss in Corn.
Avi S. Goldsmith*, Robert Austin, Charlie W. Cahoon, Ramon G. Leon; North Carolina State University, Raleigh, NC (306)

The Kropff and Spitters model predicts yield loss based on the relative leaf area index of weeds and crop as well as a weed competition coefficient "q". The model was not widely adopted as at the time of introduction, there was no practical way to quickly estimate leaf area during the growing season in commercial production settings. Remote sensing technologies like UAV's, allow a rapid and simple quantification of leaf area for multiple species making the use of the Kropff and Spitters a viable practical tool. The goal of this study was to measure relative leaf cover of weeds with aerial imagery to predict weed induced yield loss in maize (Zea mays L.). Aerial Images of maize were collected at four locations in North Carolina with variable weed pressure prior to canopy closure. The images were analyzed with supervised-object based classification to obtain the relative leaf cover of weeds and maize. A correction factor (i.e., c) was developed to compensate for differences between leaf area index and leaf cover, which allowed for prediction of maize yield loss with adequate accuracy. The results demonstrated by combining aerial imagery and mathematical optimization of crop-weed competition, may allow for growers to anticipate weed driven yield loss and help inform their management and financial decisions.

Characterizition of Various John Deere See & Spray™ Sprayer Settings. Diego J. Contreras*[1], Jackson W. Alsdorf[1], Ronel J. Argueta[1], Lauren M. Lazaro[2], William L. Patzoldt[2], Wesley Everman[1]; [1]North Carolina State University, Raleigh, NC, [2]Blue River Technology, Sunnyvale, CA (307)

Blue River Technology and John Deere's See & Spray™ technology is a computer vision and machine learning system adapted for sprayers that provides the ability to selectively target weeds within a crop. The See & Spray™ ATM machine is a condensed version of the commercial See & Spray™ Ultimate, which allows for small plot research in weed science. See & Spray™ ATM operators can adjust several settings, one of the options provides the ability to select a sprayer sensitivity setting. Sprayer sensitivity is defined as the confidence level of the sprayer to trigger a spray on a targeted weed. With a lower sensitivity, the sprayer will need a high confidence level to spray a weed, with a higher sensitivity, the sprayer will require a lower confidence level to spray the same weed. While lower sensitivity settings may potentially reduce sprayer output, more weeds may be missed when compared to a higher sensitivity setting. Weed size is generally thought of as an important factor when adjusting sprayer sensitivity settings. This experiment was deisgned with the objective of determining what factors influence See & Spray™ sprayer sensitivity selection in cotton and soybean models and what adjustments should be made to reduce missed weeds. The factors of interest were sprayer travel speed, weed species, weed size and weed location within the crop row. Two experiments were established consisting of two experimental runs in both cotton and soybean crops. Weeds were transplanted into plots, consisting of grass weeds only (Texas panicum and large crabgrass), broadleaf weeds only (Palmer amaranth and sicklepod) and mixed weeds which contained the species previously mentioned. Weeds were smaller than two inches and larger than four inches, and transplanted in the furrow and in the bed besides the crop row. Data logs were collected with the See & Spray™ ATM machine by simulating sprays at travel speeds of 8, 12 and 15 miles per hour and using high, mid and low sprayer sensitivity settings. The data logs processed to determine a percentage of targeted weeds that would have triggered a spray. Data were subjected to an ANOVA using PROC GLIMMIX in SAS 9.4 to determine statistical differences between factors. In both cotton and soybean, sprayer sensitivity setting was the greatest factor impacting targeting weeds. Travel speed was not a significant factor in targeted weeds. Weed size and weed species impact targeted weeds within a sprayer sensitivity setting. Targeted weeds at a low sprayer sensitivity setting could not be increased by adjusting other parameters listed.

Stress Resilience in Weeds Through Physiological Priming- A Case Study Using Palmer Amaranth. Gagandeep Kaur*[1], Rohit Kumar[2], Elizabeth Leonard[1], Nishanth Tharayil[1]; [1]Clemson University, Clemson, SC, [2]Clemson University, Central, SC (308)

Stress-induced priming could confer resilience to weeds against environmental stressors. However, the widespread occurrence of such resilience and the underlying physiology remain unknown. Phytochemicals, by neutralizing the reactive radicals produced under stress, could contribute to resilience. We studied the priming-induced stress resilience in Palmer amaranth (*Amaranthus palmeri*) biotypes resistant to glyphosate due to their potential ability to enhance phytochemical production from EPSPS gene amplification. Four-week-old amaranth plants were primed with a sublethal dose of glyphosate (40 times lower than the GR50) and subsequently subjected to trigger stress doses (1x, 2x, and 3x of the prime concertation) after the initial metabolic perturbations subsided. During the priming phase, the cellular perturbation from glyphosate was evident from the immediate accumulation of shikimate, which subsequently decreased and stabilized by 72 hours. During the trigger phase, the shikimate accumulation positively correlated with glyphosate concentrations in the non-primed plants, whereas the shikimate content in the primed plants did not increase with increasing glyphosate concentration. The changes in pool size of > 4500 mass features captured using the global metabolomics approach also reflected the resilience conferred by the sublethal dose of glyphosate, where the glyphosate trigger perturbed the metabolic pool of the glyphosate-primed plants to a lesser degree.

Evaluating Soybean (*Glycine max*) Seed Inoculation with *Rhizobium japonicum* and Plant Growth-Promoting Rhizobacteria (PGPR): Impacts on Yield, Soil Microbial Properties, and Herbicide Carryover. Ncomiwe A. Maphalala*[1], Alaina M. Richardson[2], Josiane C. Argenta[2], Sabrina Sastre[2], Aricia Ritter Correa[2], Dante Elias[2], Te-Ming (Paul) Tseng[3]; [1]Mississippi State University-Department of Plant and Soil Sciences, Starkville, MS, [2]Mississippi State University, Starkville, MS, [3]Mississippi State University, Mississippi State, MS (309)

Evaluating Soybean (Glycine max) Seed Inoculation with *Rhizobium japonicum* and Plant Growth-Promoting Rhizobacteria (PGPR): Impacts on Yield, Soil Microbial Properties, and Herbicide Carryover. Ncomiwe Maphalala[1], Alaina Dawkins[1], Josiane Argenta[1], Sabrina Quevedo Sastre[1], Aricia Ritter Correa[1], Dante Bergmann Elias[1], Te-Ming Tseng[1] [1]Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762 Abstract Corn (Zea mays L.) and soybean [Glycine max (L.) Merr.] are frequently grown in rotation throughout the mid-western United States and Canada. The success of seeding soybean after corn establishment is influenced by the residual nature of the corn herbicides that were applied. Numerous studies have reported on the impact of residual corn herbicides on soybean yield. For example, there is a concern for carryover from fall-applied dicamba and atrazine in soybean. The aim of this study, therefore, is to determine if inoculating soybean seeds with *Rhizobia* enables the plants to withstand the impact of corn residual herbicides. Thus, the effect, on plant growth, biomass, injury, and nodulation, of five rates of corn residual herbicides (1x, 0.75x, 0.50x, 0.25x, 0x) on soybean inoculated with *Rhizobium* and plant growth-promoting rhizobacteria (PGPR) were investigated under greenhouse conditions. PGPR inoculant *Bacillus subtillis* and *Rhizobium japonicum* were used for this study. Soybean seeds were inoculated with *Rhizobium* singly or in combination with *Bacillus subtillis*. The herbicides under evaluation were atrazine (Aatrex at 2241 g ai ha^{-1}), mesotrione (Callisto at 105g ai ha^{-1}), S-metolachlor+atrazine+mesotrione (Lexar at 1120 g ai ha^{-1}), and rimsulfuron+nicosulfuron (Steadfast at 105 g ai ha^{-1}). A significant variation of plant growth, injury, nodulation, and biomass in response to inoculating or co-inoculating with *B.subtillis* and *B.japonicum*, at all atrazine herbicide rates, was observed. Inoculating with *B. japonicum* at 0, 0.50, and 1X resulted in an increase of 44, 41, and 26 %, respectively, in plant height. Inoculating with *B. japonicum* and co-inoculation with *B. japonicum* and *B.subtillis*, at all herbicide rates except 1X, resulted in a significant increase in plant biomass levels ranging from 31 to 50 %. A principal components analysis reflected a positive correlation between dry biomass and active nodule number. Inoculating soybean seeds with bacterial inoculants could help address corn residual herbicide carryover concerns in soybean. Future experiments will assess soybean yield and soil microbes' response to seed inoculation. Keywords: residual herbicide, injury, plant growth, rhizobium, herbicide carryover, Glycine max (L.) Merr nam392@msstate.edu

Image Classification of Herbicide Symptomology in Cotton Using Deep Learning. Ubaldo Torres*[1], Joe Johnson[2], Bishwa B. Sapkota[1], Scott A. Nolte[3], Muthukumar V. Bagavathiannan[1]; [1]Texas A&M University, College Station, TX, [2]Soil and Crop Sciences, Texas A&M University, College Station, TX, [3]Texas A&M AgriLife Extension, College Station, TX (310)

Cotton injury due to herbicide-induced off-target movement is a significant issue, compounded by factors like crop sensitivity, herbicide chemistry, and dose. The specific herbicide-induced symptomology and the severity of damage are typically determined through visual assessments, which require expert knowledge. With the advances in computer vision and deep learning, there is a potential to automatically classify herbicide-induced symptomology in cotton using digital images. Field experiments were conducted in 2021 and 2022 at the Texas A&M Research Farm near College Station, TX, to classify specific herbicide symptomology in digital images using deep learning. Cotton injury from eight herbicides (nicosulfuron, 2,4-D, dicamba, atrazine, isoxaflutole, glyphosate, glufosinate, and paraquat) at three simulated drift rates were evaluated at three growth stages, along with a non-treated control. Treatments were applied with a CO_2 pressurized backpack sprayer to conventional cotton using a TTI11002 (for auxins) or a TT11002 (all other herbicides) nozzle, at a 140 L ha^{-1} spray volume. Following the herbicide application, digital images were collected weekly using a 24.1 megapixel Cannon® DSLR camera. Five classification models (DenseNet121, InceptionV3, VGG19, ResNet50, and ViT) were tested with a dataset of over 36,000 images spanning nine classes. Results show that most models effectively classified herbicides with different modes of action. The herbicide with the highest classification based on the F1 score was paraquat, followed by isoxaflutole. The highest model test accuracy was observed for DenseNet121 and ViT at 85 and 84%, respectively. The standalone ViT model lacked overall accuracy; however, once its backbone network is replaced by a convolution neural network, the ViT model produced an overall classification accuracy between 74 and 96%. The findings indicate a promising prospect for image-based models in diagnosing herbicide symptomology in crops. Research is ongoing to reduce model overfitting, enhance model accuracy, and explore other convolutional neural networks for this application.

Comparison of Weed Suppression by Bicultures and Monocultures of Sunn Hemp and Sorghum-sudangrass Cover Crops. Jean-Maude Louizias*[1], Johan Desaeger[2], Rosalie L. Koenig[3], Gabriel Maltais-Landry[4], Carlene A. Chase[5]; [1]University of Florida, Gainesville, FL, [2]University of Florida/Gulf Coast Research and Education Center, Wimauma, FL, [3]University of Florida/Agronomy Department, Gainesville, FL, [4]University of Florida/Soil, Water, and Ecosystem Science, Gainesville, FL, [5]University of Florida, Horticultural Sciences Department, Gainesville, FL (311)

Sunn hemp (SH, *Crotalaria juncea* L.) monoculture has various advantages in agroecosystems, including the suppression of weeds. However, because of high SH seed prices, Florida strawberry growers are interested in a biculture of SH with sorghum-sudangrass (SS, *Sorghum bicolor* Moench × *S. sudanense* [Piper] Stapf) to reduce the cost of cover crop (CC) use. Our study objective was to determine whether using bicultures would allow us to preserve the weed management benefits that the SH monoculture (0%SS) provides. In summer 2022, a replacement series field trial was conducted at the Plant Science Research and Education Unit in Citra, FL, and repeated in 2023. We used a 5×3 factorial treatment arrangement with five SH:SS biculture proportions expressed as the percent of SS in the mix (0%SS, 25%SS, 50%SS, 75%SS, and 100%SS) at three seeding rates (20, 40, and 60 lb/acre). A no-CC, weedy control was also included. The treatments were arranged in a randomized complete block design with four replications. Data were collected on CC density and CC biomass and weed density and weed biomass at eight weeks after planting. Shoot biomass from each CC species was utilized separately to calculate relative yield (RY) and relative yield total (RYT). In both years at all seeding rates, all bicultures produced equivalent or higher cover crop biomass than the 0%SS treatment. Averaged over year, no suppression of weed density was observed at the 20 lb/acre seeding rate, whereas all CC treatments effectively suppressed weeds at 60 lb/acre. Only 0%SS and 100%SS had lower weed densities than the control at 40 lb/acre. Weed biomass was effectively suppressed to lower than the control by all CC treatments with all seeding rates in 2023, and with the 60 lb/acre seeding rate in 2022. In 2022, at the lower seeding rates, only the bicultures and 100%SS reduced weed biomass to lower than control. The responses shown by RY and RYT curves in 2022 indicated no interference occurring between the species at 20 lb/acre but showed a synergistic effect of SH on SS at 40 and 60 lb/acre. In 2023, at all seeding rates, both species contributed more biomass than predicted by their proportions in biculture indicating that mutualism had occurred. We conclude that bicultures of SH with up to 75% SS can result in equivalent or more CC biomass and weed suppression than 0%SS and thus have the potential to reduce CC cost for strawberry production.

Effect of Adjuvant on Droplet Characteristics and Deposition of Residual Soybean Herbicides. Sydney C. Baker*[1], Darrin M. Dodds[2], Luis A. Avila[1], Jake A. Patterson[1], Antonio Augusto Tavares[1]; [1]Mississippi State University, Starkville, MS, [2]Mississippi State University, Mississippi State, MS (312)

Cover crops are believed to offer various advantages to soybean producers. However, the residue left behind may impede the effectiveness of soil-applied residual herbicides thus diminishing long-term weed control efficacy. Adjuvants cause a reduction in surface tension that may assist in the penetration of soil-applied herbicides through dense crop residue, thereby improving soil contact. This study aimed to evaluate the influence of two surfactants on droplet characteristics to improve deposition and efficacy of soil-applied herbicides in a cover crop system. Studies were conducted near Starkville, Brooksville, and Verona, MS using *S*-metolachlor (1788 g ai ha^{-1}), flumioxazin (105 g ai ha^{-1}), pyroxasulfone (183 g ai ha^{-1}), and metribuzin (147 g ai ha^{-1}). The adjuvants, Induce™ (NIS) and Kinetic™ (OS), were evaluated at each location in conjunction with each herbicide. Rhodamine-B dye (5% v/v) was added to each treatment solution to quantify deposition using fluorimetry. Generally, herbicide/adjuvant combinations evaluated had no effect on visual barnyardgrass control. Application of *S*-metolachlor without addition of an adjuvant resulted in greater soil deposition. Metribuzin and flumioxazin demonstrated greater soil deposition when applied with NIS. Greater soil deposition of pyroxasulfone was observed when applied with NIS or without addition of an adjuvant. Droplet size was influenced by preemergence herbicide and adjuvant combinations, and a correlation between droplet size and herbicide deposition was observed – smaller droplets resulted in greater herbicide deposition at the soil level. Visual weed control assessments at 7, 14, 21, 28, and 35 days after treatment (DAT) indicated that despite variations in herbicide deposition at the soil level, the amount reaching the soil was sufficient for adequate weed control.

Assessing the Allelopathic Effects of Coumarin and Chlorogenic Acid Alone and in Synergy with Glyphosate on the Management of Palmer Amaranth (*Amaranthus palmeri*). Alyssa L. Miller*[1], Josiane C. Argenta[1], Varsha Varsha[2], Ziming Yue[3], Te-Ming (Paul) Tseng[4]; [1]Mississippi State University, Starkville, MS, [2]Department of Plant and Soil Sciences, Mississippi State University, Starkville, MS, [3]MSU, Mississippi State, MS, [4]Mississippi State University, Mississippi State, MS (313)

Herbicides have long been the primary means of controlling weed species in many agricultural fields. However, herbicide resistance has become a significant issue, particularly in cotton production. Resistance is making it challenging to control weeds, and more sustainable options are necessary. Environmental concerns and pressure from the Environmental Protection Agency have made this even more pressing. One promising alternative is the use of allelochemicals, such as coumarin and chlorogenic acid, which can act as bio-herbicides. These chemicals can be used alone or mixed with glyphosate for a synergistic effect that can be applied broadcast, postemergence. Allelochemicals, such as coumarin and chlorogenic acid, have been proven to have weed-suppressive effects; however, data are lacking on the herbicidal effects of these compounds. Two experimental runs were conducted, each consisting of 10 treatments with five replications per treatment. The treatments included independent applications of coumarin and chlorogenic acid, along with subsequent combinations with glyphosate at both 1X and 2X the recommended rate. Observations on plant height and injury were recorded at 7, 14, 21 and 28 DAT. Additionally, fresh biomass was recorded at 28 days after treatment (DAT). A mixture of glyphosate and coumarin produced the most effective control of Palmer amaranth, outperforming both glyphosate-only and coumarin-only treatments in terms of effectiveness. The symptoms induced by this treatment were evident in the form of epinasty, leaf curling, and node stacking, leading to an average visual injury of around 60% on Palmer amaranth plants at 28 DAT. Coumarin + glyphosate treatment also resulted in twice the height reduction in Palmer amaranth plants at 28 DAT compared to the glyphosate-only treatment, suggesting a notable synergistic effect in suppressing Palmer amaranth growth. The results of this study underscore the potential enhancement in the effectiveness of herbicide mixtures through the addition of allelochemicals, offering insights into the improved suppression of weed species.

Cereal Rye Cover Crop Termination Timing and Methods Influences Weed Management in Peanut. Olumide Samuel Daramola*[1], Greg MacDonald[2], Ramdas Kanissery[3], Barry L. Tillman[4], Hardeep Singh[5], Pratap Devkota[6]; [1]University of Florida/IFAS, Jay, FL, [2]University of Florida, Gainesville, FL, [3]University of Florida - IFAS, Immokalee, FL, [4]University of Florida, North Florida Research and Education Center, Mariana, FL, [5]University of Florida, West Florida Research and Education Center, Jay, FL, [6]University of Florida, Jay, FL (314)

Growers have been experimenting with cover crop termination timings and methods to maximize weed suppression and potentially reduce herbicide inputs in peanut. A field study was conducted in Jay, FL in 2023 to evaluate the effects of cereal rye cover crop termination timings (early or late termination), termination methods (standing or rolled cereal rye) and herbicide programs on weed suppression and peanut parameters. The study was arranged in a randomized complete block split-split-plot design, with cereal rye termination timing as the main plot factor, termination method as the sub-plot factor, and herbicide programs as the sub-sub plot factor. Delaying cereal rye termination until 14 d to peanut planting optimized biomass production and increased Palmer amaranth (Amaranthus palmeri S. Watson) control by 11% compared with termination at 28 d to peanut planting, but sicklepod [Senna obtusifolia (L.) Irwin & Barneby] control was not affected. Standing and rolled cereal rye provided similar weed control and density, but standing rye reduced peanut canopy height and width when termination was delayed until 28 d to peanut planting. The herbicide programs fluridone (PRE) fb paraquat + bentazon + *S*-metolachlor (EPOST) fb imazapic + 2,4-DB + dimethenamid-*p* (MPOST) and imazapic + 2,4-DB + dimethenamid-*p* (EPOST) fb acifluorfen + 2,4-DB + dimethenamid-*p* (MPOST), resulted greater Palmer amaranth and sicklepod control than flumioxazin (PRE) fb acifluorfen + 2,4-DB + dimethenamid-*p* (MPOST) at 12 weeks after planting. Delaying cereal rye termination increased peanut yield with reduced herbicide input (PRE fb MPOST or EPOST fb MPOST) similar to intensive herbicide program (PRE fb EPOST fb MPOST). Similarly, rolled cereal rye increased peanut yield with reduced herbicide programs similar to intensive herbicide program. These data suggest that rolled cereal rye with delayed termination can aid in suppressing weeds and reduce herbicide input to protect peanut yield.

Evaluating the Spray Patterns of Four Boomless Nozzles at Increasing Speeds. Thomas H. Duncan*[1], John D. Byrd, Jr.[2], Kayla L. Broster[2], Chris R. Gregory[1]; [1]Mississippi State University, Starkville, MS, [2]Mississippi State University, Mississippi State, MS (315)

Boomless nozzles are considered a highly convenient means of making herbicide applications in areas such as pastures, forestry, roadsides, and utility rights of way, where obstructions or field conditions could seriously impede or even damage a spray boom. However, very few studies have analyzed the spray patterns of these nozzles to determine how best to use these nozzles in the field or compare actual performance of these nozzles to manufacturer claims. While boomless nozzles have long been documented as less effective than boom sprayers, this does very little to help applicators who are reliant on this application technology. Two studies were conducted at Mississippi State University over two years to evaluate the swath widths of three boomless nozzles at three operating speeds. Two indoor studies were conducted at the Mississippi Horse Park during 2022 and 2023, with subsequent outdoor studies conducted on unimproved turf at the RR Foil Plant Science Research Center. Both studies were a 4 by 3 factorial arrangement of treatments, with nozzle and application speed as factors. Nozzles used were the Boominator 1870 (advertised to cover 11 m), Boominator 1400 ST (no advertised swath available), Hamilton #10 (advertised to cover 15 m), and the Boom Buster 187 (advertised to cover 12 m). Applications for both studies were made with a 3-point hitch tractor sprayer equipped with a Hypro roller pump operated at 1.6, 3.2, and 6.4 KPH. For the indoor study, a solution of water and FD&C Blue #1 food dye (Flavors and Color) was applied over six replicate rows of 21.5 X 28 cm Kromekote paper sheets (CutCardstock), spaced every 0.3 m perpendicular to the swath of each nozzle out to 0.6 m past the advertised swath. Once dried, the sheets were scanned at a resolution of 600 dots per inch (DPI) and analyzed with the USDA Automatic Paper Analysis tool in the DepositScan program for ImageJ (Version 1.38X) to obtain coverage data. These data were then used to develop deposition curves to determine the total and effective swaths of each nozzle at each speed. The field study was conducted on a flat, grassy area with mixed species of grass and clover. This study was conducted in a similar manner to the indoor study, minus the Kromekote paper, but with 10.5% v/v MSMA 6 Plus (monosodium methyl arsenate) added to the water-dye solution. Field applications were made August 8, 2022, and August 18, 2023. Treated swaths were measured immediately following application. Killed swaths were measured 3 days after treatment (DAT) when visual injury was obvious. Data were analyzed with RStudio (Version 2023.12.0) and two-way ANOVA, with means separated by Fisher's Protected LSD (a=0.05). Effective swath data from the indoor study were converted to a percent ratio of the total swath measured to create a relative effective swath to better compare the effect of speed on spray deposition between nozzles. Pattern overlap was then simulated for each nozzle at each speed, with the uniformity measured by Coefficient of Variance. Each nozzle was then analyzed separately across speed as each nozzle responded differently. While spray patterns varied between 2022 and 2023, there were similarities in the patterns produced and similar trends in how increased application speed affected swath widths. The spray pattern of the Boom Buster 187 appeared to be the least affected by speed and performed most similarly to manufacturer claims, while the Boominator 187 and Hamilton nozzles produced more acceptable uniformity coefficients when overlapped based on measured effective swaths.

Glyphosate as a Selective Herbicide? Maureen M. Kahiu*[1], James Brosnan[2]; [1]University of Tennessee, Knoxville, Knoxville, TN, [2]Univeristy of Tennessee, Knoxville, TN (316)

Glyphosate and glufosinate are non-selective herbicides applied to dormant turfgrasses in the southeastern United States. Research was conducted in Knoxville, TN during 2023 in response to extension questions regarding tolerance of actively growing hybrid bermudagrasses (*C. dactylon* x *C. transvaalensis*) to these herbicides. Separate trials were conducted on 'Tifway' (TIF), 'Tahoma 31' (T31), and 'Latitude 36' (L36) hybrid bermudagrass in July and October 2023. Plots established to T31 and L36 were maintained as golf course fairways (1.3 cm height of cut) while TIF plots were maintained as golf course rough (5 cm height of cut). Each of these six trials was arranged as a randomized complete block design with four replications of plots measuring 1.2 x 1.2 m. In each trial, glyphosate was applied at 175, 350, or 525 g ai ha^{-1} whereas glufosinate was applied at 105, 220, and 324 g ai ha^{-1}. Herbicides were applied in water carrier on 31 July 2023 and 16 October 2023 using CO_2-pressurized backpack sprayers at 374 L ha^{-1}. Turfgrass injury was visually assessed relative to non-treated check plots (0 g ai ha^{-1}) in each replication using a 0 (i.e., no injury) to 100% (i.e., complete kill) scale through 49 days after treatment (DAT) in each experiment. Treatment-by-cultivar-by-application timing interactions were detected on all assessment dates. Tolerance of T31 and L36 to both herbicides in this study was similar. Glyphosate (175 g ai ha^{-1}) resulted in = 21% injury 21 DAT in both July and October. Applications at 350 g ai ha^{-1} responded similarly whereas those at 525 g ai ha^{-1} resulted in commercially unacceptable injury on both grasses. Injury with glyphosate was transient as recovery occurred 28 DAT in July. In October, 28 days were required for recovery on L36 whereas 42 days were needed on T31. In both July and October, all rates of glufosinate resulted in commercially unacceptable injury on both T31 and L36. Injury was greater on TIF with all herbicides (at both timings) than T31 or L36. Overall, these results indicate that actively growing hybrid bermudagrass is tolerant of glyphosate applications at = 175 g ai ha^{-1} in July and October. This response suggests that glyphosate (= 175 g ai ha^{-1}) can possibly be used in mixtures with other herbicides to increase mode-of-action diversity for weed control in hybrid bermudagrass.

Ecological Shifts in Weed Communities Influenced by Management Practices and Elevated CO_2 in Forage Bermudagrass (*Cynodon dactylon*). Andrew J. Ahlersmeyer*[1], Stephen Prior[2], Andrew J. Price[3], Aniruddha Maity[1]; [1]Auburn University, Auburn, AL, [2]USDA, Auburn, AL, [3]USDA-ARS-NSDL, Auburn, AL (317)

High quality bermudagrass (*Cynodon dactylon* [L.] Pers.) hay production depends on effective nutrient management and weed control. At the same time, climate change factors including CO_2, temperature, and precipitation patterns have been documented to impact biological and ecological evolution in plants, including both agronomic crops and weeds. Consequently, there have been reports of reduced herbicide efficacy and increased weed competitiveness. Therefore, the objective of this study was to evaluate the impacts of management practices and elevated CO_2 on weed ecology in bermudagrass hay production. In 2017, the bermudagrass cultivar 'Russell' was sprigged into a constructed fine sand soil bed at the USDA National Soil Dynamics Research Laboratory in Auburn, AL. The experimental design was a split plot, with management regime as the primary factor and CO_2 concentration as the secondary factor. Weed ecology research was initiated during the 2023 growing season. Overall, total biomass production was significantly greater in managed plots compared to unmanaged, and elevated CO_2 compared to ambient CO_2. Temporal shifts in weed dominance were also observed throughout the summer, with broadleaf weeds dominant in June and October, but grasses dominant in August. Weed species diversity was significantly higher in unmanaged plots compared to managed plots, however, CO_2 had no significant impact on species diversity. Overall, we suspect that elevated CO_2 had a minimal effect on weed ecology due to bermudagrass efficiently sequestering carbon as a C_4 plant species.

Enhancing Weed Detection Capabilities in Low-cost Drone Systems for Crop Monitoring.
Roberto Gomez Gonzalez*[1], Prabha Sundaravadivel[2], Reginald Fletcher[3], Krishna Reddy[3]; [1]Dept. of Electrical and Computer Engineering, The University of Texas at Tyler, Houston, TX, [2]The University of Texas at Tyler, Tyler, TX, [3]United States Department of Agriculture, Agricultural Research Service, Stoneville, MS (318)

This research project is centered on implementing an adaptive proportional, integral, and derivative (PID) controller system in conjunction with weed detection algorithms specifically tailored for the affordable Tello EDU Drone. PID controllers are widely recognized for their effectiveness in providing stable and precise control across various industries and applications, adapting to dynamic conditions with precision. The Tello drone, a complex low-cost system boasting multiple degrees of freedom (e.g., roll, pitch, yaw, and altitude), is the focus of our study. Within our research, we have integrated neural networks with pre-trained models capable of detecting and tracking weeds in extensive agricultural fields. Our ultimate objective is to incorporate low-cost drones as first-responder subsystems for early weed detection. During training, our model iteratively learns to extract pertinent features from input images, enabling precise predictions. By training a model with labeled image datasets divided into training, validation, and test sets, our aim is to develop an accurate and robust machine-learning model for object recognition. This implementation lays the groundwork for a multitude of applications, ranging from object detection and image classification to more intricate tasks like autonomous navigation and robotics. To demonstrate the PID controller, we employ a neural network model, MobileNetSSD, loaded from a pre-trained Caffe model. This model leverages the same foundational principles as a custom-trained one. In the context of our approach, a pre-trained Caffe model's binary file stores the essential weights, biases, and gradients for each network layer, facilitating the detection of the targeted object.

Length of Residual Herbicides in Xtend Soybean System. Karina Beneton*, Jennifer Dudak, Zachary R. Treadway, Todd A. Baughman; Oklahoma State University, Ardmore, OK (227)

Length of Residual Herbicides in Xtend Soybean System K. BENETON*, J. DUDAK, Z. TREADWAY, T. BAUGHMAN, [1]Oklahoma State University, Stillwater, OK Amid widespread occurrence of herbicide-resistant weeds in the United States, the use of preemergence (PRE) herbicides is an important strategy for weed management in soybean [*Glycine max* (L.) Merr.]. The objective of this study was to determine the length of residual weed control in a Xtend soybean system, applying PRE herbicides from four distinctives herbicide modes of action. The treatments were arranged in a randomized complete block design with cloransulam-methyl (35 g ai ha^{-1}) metribuzin (420 g ai ha^{-1}), pyroxasulfone (89 g ai ha^{-1}), and sulfentrazone (89 g ai ha^{-1}). Each herbicide was applied alone or in various two, three-way combinations. Field experiments were conducted in 2022 and 2023 at Oklahoma State University research stations near Bixby and Fort Cobb, OK. PRE herbicides were followed by a POST application of dicamba (1540 g ai ha-1) + glyphosate (2100 g ai ha-1) + s-metolachlor (1120 g ai ha-1) + potassium carbonate (1400 g ai ha-1). Soybean injury was 10% or less with all treatments except chloransulam + sulfentrazone (Fort Cobb 2023) and metribuzin + sulfentrazon (Bixby 2023) with and without the addition of chloransulam. The major weeds present were palmer amaranth *(Amaranthus palmeri), large crabgrass (Digitaria sanguinalis, and ivyleaf morningglory (Ipomoea hederacea*). The only treatment that controlled Palmer amaranth early season at least 90% at Fort Cobb in 2022 was pyroxasulfone + metribuzin or sulfentrazone, and chloransulam + pyroxasulfone + sulfentrazone. Palmer amaranth control was at least 90$ early season at the other 3 site-years except metribuzin + sulfentrazone (Fort Cobb 2023), and pyroxasulfone, or chloransulam (Bixby 2023). Control was at least 80% (Fort Cobb 2022), 90% (Fort Cobb 2023), 100% (Bixby 2022), 88% (Bixby 2023) with all 3-way combinations. Large crabgrass control was at least 85% season long at Fort Cobb (2022 and 2023) and Bixby (2022) with all treatments applied. Large crabgrass control was lower prior to POST applications at Bixby in 2023 but 99-100% with all treatments late season following the POST application. Ivyleaf morningglory control was over 80% season long (Bixby 2022) and 98-100% season long (Bixby 2023). No yield difference was observed with any of the treatments in 2022. Metribuzin in combination with pyroxasulfone and/or sulfentrazone yielded over 2700 kg ha-1 at Fort Cobb in 2023, while yields were above 1800 kg ha-1 with all treatments except chloransulam + pyroxasulfone + sulfentrazon at Bixby in 2023. The results of these studies indicate that environment can challenge weed management systems. Their combinations of residual herbicides can often assist in overcoming some of these challenges.

Cover Crops: a Weed Management Option in Plasticulture Strawberry Row-Middles. Jeanine Arana*[1], Stephen L. Meyers[2], Wenjing Guan[3]; [1]Purdue University/Horticulture, West Lafayette, IN, [2]Purdue University, West Lafayette, IN, [3]Purdue University, Bloomington, IN (228)

The United States ranks second in strawberry production worldwide. Much of this production has been transitioned from perennial matted row to annual plasticulture production. However, in states like Indiana, growers are exploring a hybrid system: multi-year plasticulture production. In response, we explored cover crops for row-middle weed management in plasticulture strawberry production. In September 2022, we planted 'Chandler' strawberry plugs into white polyethylene-mulched rows at Lafayette and Vincennes, IN, and established five row-middle treatments: nontreated and wheat straw mulch controls and three cover crops (oats, cereal rye, and white clover). The oats were winter-killed, and the cereal rye was roller-crimped in mid-May of 2023. Data collected included percent cover crop and weed canopy (per 0.09 m^2); frost-killed flowers, live flowers, and developed fruit per plant within 2 wk after the last spring frost; and total fruit number and yield per plant. At 7 wk after transplanting (WAP), the oats canopy (82%) was greater than that of cereal rye (61%) and white clover (22%), but less than straw mulch (96%). Weed canopy in the straw mulch and oats was 6%, less than the nontreated control (38%). At 27 and 35 WAP, the cereal rye canopy was 96% and 100%, respectively; while the other treatments had less than 85% and 74% coverage, respectively. At 27 WAP, cereal rye and oats at both sites and straw mulch at Vincennes had less weed canopy (< 7%) than the nontreated control (>63%). At 35 WAP, only cereal rye had no weed canopy. At Lafayette, all treatments had 15 frost-killed flowers $plant^{-1}$. At Vincennes, all treatments had 8 frost-killed flowers $plant^{-1}$, except cereal rye (2 frost-killed flowers $plant^{-1}$). There were no differences among treatments in the live flower count at Lafayette (5 flowers $plant^{-1}$) or Vincennes (1 flower $plant^{-1}$). The number of developed fruit at both sites was significantly greater with cereal rye (8 fruit $plant^{-1}$) compared to all the other treatments (= 5 fruit $plant^{-1}$). Total harvested fruit number and yield at Lafayette was 17 fruit $plant^{-1}$ and 135 g $plant^{-1}$ for all treatments. At Vincennes, cereal rye resulted in significantly greater fruit number (10 fruit $plant^{-1}$) and yield (99 g $plant^{-1}$) compared to all other treatments (= 5 fruit and = 49 g $plant^{-1}$). This study demonstrafrited that cereal rye was the most effective choice for suppressing weeds while maintaining or increasing strawberry yield in the first year of a multi-year plasticulture production system.

Utility of John Deere's See & Spray^{TM} Ultimate in Southern U.S. Row Crops. Tristen H. Avent*[1], Jason K. Norsworthy[1], William L. Patzoldt[2], Lauren M. Lazaro[2]; [1]University of Arkansas, Fayetteville, AR, [2]Blue River Technology, Sunnyvale, CA (229)

Increasing costs of inputs and the need for greater environmental stewardship have driven the development of precision application technologies. Recently, John Deere commercially launched See & Spray™ Ultimate for use in the 2023 growing season. See & Spray can apply targeted broadcast applications while simultaneously broadcasting with split-tank and separate plumbing systems. Currently, this technology is supported in select crops and fallow systems. The University of Arkansas Systems Division of Agriculture (UADA) has conducted more than 15 trials over two years evaluating the utility of this technology in soybean and cotton. Preliminary results indicate the See & Spray Ultimate can provide comparable weed control to a broadcast standard program and reduce herbicide inputs. However, data still needs to be evaluated to determine the likelihood of success with varying weed species and sizes, machine settings, and environments. The UADA is conducting trials to determine 1) the effect of weed size, species, location, and machine settings on weed mortality and accuracy; 2) the performance of See & Spray when using cover crops in cotton; 3) the long-term effect of low and high sensitivity settings in single-tank programs on weed seedbank management compared to a standard broadcast program; 4) the impact of See & Spray programs on crop response, weed control, and yield in cotton and soybean; and 5) the effects of weed area, nozzle angle, and machine settings have on potential herbicide savings. Many of these trials will be conducted in collaboration with other universities and Blue River Technology to collect data across the U.S. and determine the fit of this new technology for producers across the country.

Cereal Cover Crops and Herbicides for Integrated Weed Management in Dry Bean. Prayusha Bhattarai*[1], Albert T. Adjesiwor[2], Olga Walsh[3]; [1]University of Idaho, Twin Falls, ID, [2]University of Idaho, Kimberly, ID, [3]University of Idaho, Parma, ID (230)

Herbicide resistance in weeds is a growing concern, particularly for dry bean (*Phaseolus vulgaris*) as they are very vulnerable to weed interference and there are very few herbicides labeled for weed control in this crop. An integrated approach including various weed control tactics is necessary to mitigate this issue. An experiment was conducted at the University of Idaho Parma Research and Extension Center in 2023 to determine weed suppression ability of fall-planted cover crops in dry beans based on the termination practice (chemical termination vs haying). Additionally, the experiment aimed to assess the impact of cover crop biomass on the efficacy of soil-applied herbicides. The experiment was laid out as a split-plot randomized complete block with four replicates. Treatments comprised of three different fall-planted cereal cover crops (barley, *Hordeum vulgare*; triticale, *Triticosecale rimpaui*; and wheat, *Triticum aestivum*) and no cover crop. The cereal cover crops were either terminated chemically with glyphosate or harvested for forage. There were three preemergence herbicides, one post-emergence, and a no herbicide treatment. Dry beans stand density was reduced by up to 39% in the haying treatments. Weed biomass was significantly reduced by all cover crop treatments compared to the no cover crop treatment. Dry bean seed yield was only influenced by herbicide treatments where the untreated check reduced yield by 23 to 30% compared to the pre- and post-emergence herbicide treatments. This study showed the potential benefits of integrating cover crops and herbicides for effective weed management in dry bean.

Is Glufosinate-Resistant Palmer Amaranth Spreading in Northeast Arkansas? Pamela Carvalho-Moore*[1], Jason K. Norsworthy[1], Maria Carolina C R Souza[2], Fidel Gonzalez Torralva[1], Rodrigo Botelho[3]; [1]University of Arkansas, Fayetteville, AR, [2]University of Arkanas, Fayetteville, AR, [3]University of Arkansas, Fayetteville, Brazil (231)

Effective postemergence herbicides in row crops are scarce, and glufosinate is still a valuable herbicide despite the confirmation of resistance in a few weed species. Glufosinate resistance has been confirmed in three Palmer amaranth (*Amaranthus palmeri* S. Wats.) populations in Northeast Arkansas and reducing the movement of resistant accessions is needed to prolong the sustainability of this herbicide. To develop and implement actions to prevent a rapid spread of resistance, it is necessary to obtain information on the movement patterns of glufosinate resistance across Palmer amaranth populations. To determine the spreading patterns, one specific accession (MSR2) that showed a greater resistance level to glufosinate (R/S 24-fold) was targeted, and its location was referenced as an origin. Palmer amaranth plants under a radius of 15 kilometers from the origin were collected. A total of 5 to 10 female plants were collected per location. Glufosinate screening was performed using the 593 g ai ha^{-1} (labeled rate in soybean and cotton). Preliminary findings suggest that most accessions had mortality = 85% with a labeled application rate. However, accessions with mortality rates under 85% have been detected with no apparent correlation regarding direction. Therefore, these initial results indicate that resistance spreading has been occurring in a random pattern across Northeast Arkansas. Increased chloroplastic glutamine synthetase copy number has been confirmed in the MSR2 accession as the resistance mechanism and will be used to associate survivors with likely spread from the origin. Further efforts will focus on determining if there is gene copy number variation among the survivors from these accessions. Results from this study will contribute to understanding glufosinate resistance spread within Palmer amaranth, leading to projected impacts of the weed in future growing seasons.

Impact of Growing Cover Crops on Weed Suppression, Crop Yields, and Profitability in Semiarid Great Plains. Sachin Dhanda*[1], Vipan Kumar[2], Anita Dille[3], Augustine Obour[3], Elizabeth Yeager[3], Johnathan Holman[3]; [1]Kansas State University, Hays, KS, [2]Cornell University, Ithaca, NY, [3]Kansas State University, Manhattan, KS (232)

The widespread evolution of multiple herbicide-resistant (MHR) kochia [*Bassia scoparia* (L.) A. J. Scott] and Palmer amaranth (*Amaranthus palmeri* S. Watson) warrants the development of alternative, ecological-based integrated weed management strategies in the semiarid Central Great Plains (CGP). A field study was conducted at Kansas State University Agricultural Research Center near Hays, KS from 2020 to 2023 to determine the impact of fall-planted cover crops (CC) on weed suppression in grain sorghum, crop yield, and net returns in no-till dryland winter wheat-grain sorghum-fallow (WSF) cropping system. The field site had a natural seedbank of kochia and Palmer amaranth. A CC mixture (triticale/winter peas/radish/rapeseed) was planted during fall after wheat harvest and terminated at triticale heading stage in spring with glyphosate and/or glyphosate + (acetochlor + atrazine). Chemical-fallow (no CC but glyphosate and PRE application of acetochlor + atrazine) and weedy-fallow (no CC and no herbicide) treatments were also included for comparison. After termination of fall-planted CC, grain sorghum hybrid was planted. Across the three-year study, fall CC terminated with glyphosate + (acetochlor + atrazine) reduced total weed density by 87 to 94% and 1 to 13% compared to weedy-fallow and chemical-fallow, respectively. The same treatment reduced total weed biomass by 83 to 96% and 16 to 68% compared to weedy-fallow and chemical-fallow, respectively. Sorghum yields were not different between chemical-fallow and CC terminated with glyphosate + (acetochlor + atrazine) in 2021 and 2023, however in 2022, grain yield was significantly greater (1319 kg ha^{-1}) in CC terminated with glyphosate + (acetochlor + atrazine) compared to chemical-fallow (912 kg ha^{-1}). Gross returns were greater with CC terminated with glyphosate + (acetochlor + atrazine) in 2021 and 2022 but lower in 2023 because of lower sorghum yield (905 kg ha^{-1}). Net returns were less with CC treatments in all three years compared to chemical-fallow, mainly due to CC seed and planting costs. These results suggest that fall-planted CC mixture could help to manage MHR kochia and Palmer amaranth in the semiarid CGP region, however this was not profitable as growing a CC reduced net returns in all years. Future research should evaluate growing this short-season CC as forage to increase net returns.

A Blue Light Shot in the Dark: Impact on Weed Seeds. Sarah A.d. Chu*[1], Sarah E. Kezar[2], Shuyang Zhen[1], Muthukumar V. Bagavathiannan[1]; [1]Texas A&M University, College Station, TX, [2]Cornell University, Ithaca, NY (233)

Blue light (320-490 nm) has been increasingly used in greenhouse production as it can increase anthocyanins, macronutrients, and micronutrients in plants. Plants can perceive blue light with phytochromes and cryptochromes; however, little is known about a seed's perception of blue light. Previous research suggests that blue light may alter seed dormancy and germination, yet detailed investigations are lacking. The objective of this research was to determine the impact of blue light at five different intensities (435 to 1,887 µmol m^{-2} s^{-1}), and seven different exposure timings (5-60 seconds) on six different weed seed species [barnyardgrass (*Echinochloa crus-galli*), large crabgrass (*Digitaria sanguinalis*), johnsongrass (*Sorghum halepense*), Palmer amaranth (*Amaranthus palmeri*), hemp sesbania (*Sesbania herbacea*), and morningglories (*Ipomoea* spp.)]. A germination experiment, in a completely randomized design with four replications and two temporal runs, was conducted to determine the blue light impact on the weed seeds. The experiment was conducted for 21 days with germinated seeds counted and removed every four days. On the 21st day, seed viability was determined using a tetrazolium test. Any seeds that did not germinate or were negative for the tetrazolium test were considered dead. The blue light intensity had little influence on the seed germination of any species, but high exposure time (60 sec) significantly reduced the germination of barnyardgrass (23% reduction). The decrease in germination with an increase in the exposure time of blue light indicates that the duration of blue light exposure plays a major role in impacting seed germination, and may have implications for future weed management strategies.

Fall Application of Soil Residual Herbicides Reduces Weed Abundance in Spring-Planted Chickpeas. Akamjot Brar*[1], Qasim Khan[2], Fabian Menalled[1], Zach Miller[3], Clint W. Beiermann[4], Lovreet S. Shergill[2], Kent McVay[2]; [1]Montana State University, Bozeman, MT, [2]Montana State University, Huntley, MT, [3]Montana State University, Corvallis, MT, [4]University of Nebraska-Lincoln, Scottsbluff, NE (234)

Pulses, including chickpeas (Cicer arientinum L.), offer expanded market opportunities and weed management options, but their slow germination and early growth make early-stage weed control crucial for successful establishment. Fall application of soil-active residual herbicides can aid in early-season weed suppression and improve the establishment of spring-planted chickpeas. Field experiments were conducted with randomized complete block design with 4 reps and 14 treatments at two sites, Southern Agriculture Research Center, Huntley, and Western Agriculture Research Center, Corvallis, Montana during 2022 and 2023 to evaluate crop safety and broadleaf weed control by fall-applied soil active herbicides followed by a POST application in chickpeas. Pyroxasulfone at 131 g/ha ae+ flumioxazin at 60.6 g/ha ae, dimethamid at 950 g/ha ae + pendimethalin at 1.68 kg/ha ae, and metribuzin at 420 g/ha ae provided 90-99% broadleaf weed control at both sites Kochia (Bassia scoparia L.), Common Lambsqaurters (Chenopodium giganetum L.) and Redroot pigweed (Amaranthus retroflexus L.). A single follow-up POST application of pyridate (700 g/ha ae) helped in ensuring season-long control by eliminating weeds that emerged late or escaped PRE. There was no visual injury of any herbicide and yield reductions in chickpeas, and a 90-100% increase in yield compared to untreated control was observed with the best treatments. These herbicide programs can be integrated with other weed management tactics in pulse crops for effective weed control.

Tetflupyrolimet Targets a Novel Site for Barnyardgrass Management in Rice. Mason C. Castner*[1], Jason K. Norsworthy[1], Richard M. Edmund[2], Tristen H. Avent[1], Samuel C. Noe[3]; [1]University of Arkansas, Fayetteville, AR, [2]FMC, Little Rock, AR, [3]University of Arkansas, Fayetteville, KY (235)

Herbicide-resistant (HR) barnyardgrass [*Echinochloa crus-galli* (L.) P. Beauv] has evolved into an increasingly difficult challenge to manage for rice (*Oryza Sativa* L.) producers in the Midsouth. Currently in development by FMC Corporation, tetflupyrolimet (TVE29) is the first conventional herbicide in three decades with a novel mode of action for preemergence (PRE) control of HR barnyardgrass populations. Prior to commercialization of TVE29, experiments were conducted to ensure a high level of performance on barnyardgrass without compromising crop safety. Barnyardgrass control with TVE29 was evaluated on a clay soil in 2021 and 2022 at the Northeast Research and Extension Center, near Keiser, AR. TVE29 was applied in mixture with clomazone PRE followed by (fb) a TVE29 plus clomazone mixture applied POST in combination with a graminicide product (cyhalofop plus penoxsulam, propanil, or fenoxaprop) on the 3-to 4-lf rice. At 56 DAPOST, barnyardgrass control with a PRE fb POST TVE29 and clomazone mixture plus a POST grass product averaged 100% and 98% in 2021 and 2022, respectively, with the lowest control resulting in 96% in the latter year. Rice tolerance to TVE29 was evaluated with 12 rice cultivars in 2021, 2022, and 2023 at the Pine Tree Research Station, near Colt, AR. TVE29 was applied preemergence and early postemergence at a low and high rate of the herbicide. Visible injury was recorded weekly until 28 days after treatment and grain yield was collected at maturity. Response variables were compared to the nontreated control within each cultivar. For each evaluated cultivar, no visible injury or a reduction in relative grain yield was observed from TVE29 regardless of rate or application timing. The integration of TVE29 as a conventional residual herbicide for Midsouth rice production will provide growers with an effective and safe new mode of action for control of HR barnyardgrass using any rice technology of choice.

Cover Crops for Weed Management: is it Worth Implementing in the Upper Midwest? Eric Y. Yu*[1], William Lazarus[1], Axel Garcia y Garcia[2], Lizabeth Stahl[3], Ryan P. Miller[4], Gregg Johnson[5], Ce Yang[1], Debalin Sarangi[1]; [1]University of Minnesota, St. Paul, MN, [2]University of Minnesota, Lamberton, MN, [3]University of Minnesota Extension, Worthington, MN, [4]University of Minnesota, Rochester, MN, [5]University of Minnesota, Waseca, MN (236)

Fall-planted cover crops can outcompete weeds in the spring and provide effective early-season weed control. However, data on critical cover crop biomass production for weed suppression and its influence on soybean yield in the Upper Midwest is limited. There are several inherent challenges incorporating cover crops in Minnesota and other neighboring states in this region and they can lead to increased production cost with little to no benefits. The goal of this study was to generate information for the farmers in Minnesota to decide whether planting cereal rye (*Secale cereale* L.) cover crop would be economically worth incorporating into a silage corn- soybean rotation. Field studies were conducted from 2021 to 2023 at the University of Minnesota's Southwest Research and Outreach Center (SWROC) in Lamberton, MN. Cereal rye (CR) was seeded in the fall of 2021 and 2022 after silage corn harvest. The study looked at four CR seeding rates: 0, 67, 101, and 135 kg ha^{-1}; and four termination treatments: terminating at 7 days before soybean planting (T1); at soybean planting without PRE (T2) and with PRE (T2+PRE); and at 7 days after soybean planting (T3). Soybean was planted at two different timings: mid-May (early planting) and late May (late planting). Economic analyses were performed to determine which combination of factors was most profitable by looking at gross profit margins (GPM). The GPM was calculated by subtracting the input costs from the revenue generated from silage corn and soybean. Planting CR at 67 kg ha^{-1} terminated 7 days after early soybean planting had similar GPM as no cover crop + PRE treatment. Results from this study suggested that growers could expect similar returns adding CR into a silage corn-soybean rotation system with their current practices, but with the added benefits of cover crops that go beyond the short-term returns focused in this study.

Shining A Light on Weed Control: Investigating Directed Energy as a Non-chemical Weed Control Tactic. Ryan C. Hamberg*[1], Jon Jackson[2], Neil Sater[2], Muthukumar V. Bagavathiannan[1]; [1]Texas A&M University, College Station, TX, [2]Global Neighbor Inc., Xenia, OH (237)

There is a growing need for non-chemical weed control tactics, and one potential option is directed energy, which uses a combination of short (<5 second) exposures of near indigo region (~400 nm) and medium infrared (MIR; 2.4-8.0 microns) light. These wavelengths have been shown to be detrimental to plant growth. However, no published research has investigated the efficacy of both factors used in combination, especially in a targeted manner. Therefore, the objective of this study was to determine the effectiveness of directed energy for weed control. Palmer amaranth (*Amaranthus palmeri*) and johnsongrass (*Sorghum halepense*) plants at three growth stages (3, 6, and 10 cm tall) were subjected to five exposure durations of MIR alone or MIR+indigo light. Four replications of 4 individual plants (1/pot; pot size: 6 x 9 cm) of each species and growth stage were exposed for 1, 5, 10, and 15 seconds, with nontreated controls included for comparison. The treated plants were arranged in a completely randomized design. Visual injury ratings (0 to 100%) were conducted 14 days after the treatment (DAT) for all plants. For both species, plant injury increased with increases in exposure duration, with plants =6 cm tall growth stage showing the greatest (>80%) injury. Conversely, plants at the 10 cm growth stage were least affected by the treatments, with a mean visual injury of only 41% across species, wavelength, and exposure time. Plant injury was significantly higher with the combination of MIR + indigo wavelengths, compared to MIR alone for both species. Log-logistic (3-parameter) regression estimates predict that for 6 cm plants, 90% biomass reduction can be achieved in 2.7 and 3 seconds of combined exposure for Palmer amaranth and johnsongrass, respectively. Directed energy shows promise as a non-chemical weed control option, but more research is necessary to optimize its use, including field testing and validation.

Evaluation of Critical Weed-free Period for Three Sweetpotato (*Ipomoea batatas*) Cultivars.
Emmanuel G. Cooper*[1], Stephen L. Meyers[1], Jeanine Arana[2]; [1]Purdue University, West Lafayette, IN, [2]Purdue University/Horticulture, West Lafayette, IN (238)

Sweetpotato (*Ipomoea batatas* L.) is a staple crop that provides nutritional benefits to humans globally, but it is subjected to yield loss when competing with weeds, especially during the early stage of establishment. Yield loss can vary widely based on the cultivar, production environment, weed species, and management techniques. To address this challenge, we conducted field research at the Samuel G. Meigs Horticulture Research Farm, Lafayette, IN and at the Southwest Purdue Agricultural Center, Vincennes, IN, in 2022 to determine the effect of sweetpotato cultivar on the critical weed-free period. The experiment was a split plot design, with weed-free interval treatments as the main plot factor and cultivar as the subplot factor. The three cultivars used were Covington, Monaco, and Murasaki. Weeds were removed by hand and allowed to establish and compete with the crop beginning at 0, 14, 21, 28, 35, or 42 days after transplanting (DAP). As weed-free interval increased from 0 to 42 DAP, predicted total yield increased from 19 kg ha^{-1} to 20,540 kg ha^{-1} for Covington, 3 kg ha^{-1} to 11,407 kg ha^{-1} for Monaco, and 125 kg ha^{-1} to 13,460 kg ha^{-1} for Murasaki at the Lafayette location. At Vincennes, as weed-free interval increased from 0 to 42 DAP, predicted total yield increased from 14,664 kg ha^{-1} to 33,905 kg ha^{-1} for Covington, 4,817 kg ha^{-1} to 18,059 kg ha^{-1} for Monaco, and 12,735 kg ha^{-1} to 21,105 kg ha^{-1} for Murasaki. A threshold of =10% total yield reduction was achieved by maintaining sweetpotatoes weed-free 24 DAP for Covington, 20 DAP for Murasaki, and 33 DAP for Monaco.

Enhancing Herbicide Resistance by Manipulating a Transcription Factor. Srishti Gupta*, Franck E. Dayan; Colorado State University, Fort Collins, CO (239)

Chemical mutagenesis using sodium azide was performed to develop quizalofop-p ethyl (QPE) resistant rice lines. One of the lines (TSR) had a target-site mutation in acetyl-CoA carboxylase. On the other hand, the NTSR line had a novel mutation imparting non-target- site resistance to group 1 herbicide. Genetic mapping identified a single nucleotide polymorphism in an uncharacterized putative zinc finger transcription factor. Transcription factors (TF) play an important role in many biological processes like cell growth, division, and response to abiotic factors, but no mutation in TFs has been associated with herbicide resistance to date. The objective of this research is to understand the molecular mechanism through which a mutation in a transcription factor imparts herbicide resistance. The degree of resistance of TSR and NTSR was assessed with dose-response curve experiments using QPE, relative to a wild-type rice line. The rate of QPE metabolism was measured to determine the basis of resistance in wild-type (WT) rice, NTSR rice and TSR rice collected 1,2,4 and 8 days after treatment using LC-MS/MS analysis. Putative NTSR genes that may be regulated by the mutated transcription factor and contribute to herbicide resistance were investigated using RNA Seq analysis. Glutathione-*S*-transferase (GSTs) and cytochrome P450 monooxygenases (Cyps) genes were more highly expressed in mutated NTSR and double mutant (TSR+NTSR) than in WT rice. Malathion and NBD, metabolic inhibitors of P450s and GSTs respectively when sprayed on WT, NTSR showed reduced metabolism and more injury symptoms as compared to the ones treated with QPE only. Greenhouse assays, the NSTR and TSR lines were 1.9 and 2.4 more resistant to QPE than the WT. On the other hand, a TSR/NTSR double mutant line was 6.8 times more resistant to QPE than WT. Computational studies performed to delineate the role of mutation produces a stable protein-DNA complex with the DNA strand interacting with positively charged amino acids arginine and lysine in the binding domain.

***Typha latifolia* Invasion and Management in California.** Deniz Inci*[1], Michelle Leinfelder-Miles[2], Kassim Al-Khatib[1]; [1]University of California Davis, Davis, CA, [2]University of California Cooperative Extension, Stockton, CA (240)

Typha latifolia, common cattail, grows up to three meters and naturally occurs at ditches, drainage and irrigation canals, lakes, marshes, ponds, rivers, and streams. Unlikely its natural habitat, *T. latifolia* has recently begun to infest rice fields in California's Sacramento-San Joaquin Delta region. Florpyrauxifen-benzyl is a novel synthetic-auxin-type rice herbicide newly registered in California. This research aimed to study the potential of using florpyrauxifen-benzyl for *T. latifolia* control. Two field research were conducted at McDonald Island of the Delta region during the 2022-2023 growing seasons. Treatments were florpyrauxifen-benzyl at 80 and 40 g ai/ha and florpyrauxifen-benzyl at 40 g ai/ha plus triclopyr at 420 g ae/ha use rates. Florpyrauxifen-benzyl were applied at zero to one m tall and one to two m tall plants. Methylated seed oil at 584 ml/ha was also added to all treatments. The study was a randomized complete block design with four replicates. Herbicides were applied on nine m^2 plots to a range of *T. latifolia* from two to three-leaf growth stages up to two-meters-tall growth stages. Visual injuries were rated at 7, 14, 21, 28, and 42 days after treatments (DAT) using a scale where 0 means no injury and 100 means plant kill. All florpyrauxifen-benzyl treatments achieved 100% control when *T. latifolia* were up to one meter. When *T. latifolia* were one to two meters, the efficacy was 96, 78, and 75% at 42 DAT for the listed treatments, respectively. This study showed a great potential for foliar applications of florpyrauxifen-benzyl to manage *T. latifolia* up to one-meter-tall growth stages.

AI And GNSS Integration for Precision Nutsedge (*Cyperus* Spp.) Mapping. Alex Rodriguez*[1], Renato Herrig Furlanetto[2], Arnold W. Schumann[3], Amr Abd-Elrahman[4], Nathan Boyd[5]; [1]University of Florida / Horticultural Sciences Department, Wimauma, FL, [2]University of Florida, Wimauma, FL, [3]University of Florida, Lake Alfred, FL, [4]University of Florida, Plant City, FL, [5]University of Florida, Balm, FL (241)

In Florida strawberry plasticulture systems, uniform soil fumigation is the primary effective management option for controlling nutsedge, which typically occurs in patches. Precise weed maps can be utilized to adjust fumigant rates for known nutsedge hotspots in the field. Using nutsedge as a case study, we propose a ground-based weed mapping system that obtains accurate weed locations by integrating computer vision with the Global Navigation Satellite System. This system comprises three main components: a detector, Real-Time Kinematic (RTK) surveying, and a mapping algorithm. The detector employed is the algorithm YOLOv8, which was trained on 8,238 images and achieved 99.2% precision and 97.4% recall on a validation dataset. An RTK antenna is mounted on the tractor to survey the field, and low-cost cameras are used to capture frames and detect nutsedge. Post-processing involves transformation, calibration, and interpolation using frames with nutsedge detected. A mapping algorithm was developed to calculate the geographical positions of detected nutsedge in the field by using detector outputs and RTK coordinates as input. Maps were generated for two strawberry fields on August 2nd and November 28th, 2023, representing the fallow period and the start of harvesting operations, respectively. Ground control points were incorporated in one of the fields for calibration of the system and to estimate the accuracy of the nutsedge locations calculated by the algorithm. Based on the offset between the algorithm-calculated position and the actual position of 36 nutsedge in the field, the mapping algorithm has a 6.5 centimeters average position accuracy. These results demonstrate that the proposed system can be used to map nutsedge populations in strawberry fields while performing farm operations with a tractor. The ability to create precise maps of an entire population offers a significant advantage for studying nutsedge patch persistence and facilitates the development of a targeted soil fumigation system.

Optimizing Application Timing of Residual Herbicides in a Planted Green Soybean System.
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The utilization of cereal rye surface mulch for early-season suppression of small-seeded summer annual weeds is a promising integrated weed management (IWM) approach aimed at reducing weed population impacts on crop yields while enhancing environmental sustainability through reduced herbicide use and the mitigation of herbicide resistance evolution risks. However, a knowledge gap exists concerning the strategic positioning of soil-applied residual herbicides within high-residue cover crops, which have the potential to interfere with deposition, wash off, and soil bioavailability of residual herbicides. Alternative strategies to optimize the efficacy of residual herbicides include application during early cereal rye growth stages, minimizing residue interception, or delaying application until after cover crop termination to minimize losses due to plant uptake. To address this, a field experiment was conducted across three states (Rock Springs, PA, Georgetown, DE, and Blacksburg, VA) to assess how residual herbicide application timing among alternative soybean and cereal rye management strategies influences population dynamics of water hemp (*Amaranthus tuberculatus;* PA) and Palmer amaranth (*Amaranthus palmeri;* DE and VA) in no-till soybean (Enlist) production systems. The experiment employed a two-factor randomized complete block design with a split-plot treatment structure. Main plots included three soybean planting dates and cereal rye termination timings: boot stage termination at 14 days pre-plant (DPP); boot stage termination 1 day after planting (DAP); and anthesis termination at 1 DAP. Split-plot treatments included residual herbicide application timings relative to cereal rye and soybean growth stages, including boot, anthesis, mid-postemergence (MPOST) 4-6 weeks after planting (WAP), anthesis + MPOST (4-6 WAP), and an untreated control. Pyroxasulfone (0.15 kg ai/ha) served as the test residual herbicide, followed by all treatments receiving a 2,4-D + glufosinate application at the MPOST timing.

Subtelomeric *EPSPS* Duplications Confer Glyphosate Resistance in *Eleusine indica* (Goosegrass). Nicholas A. Johnson*[1], Nathan D. Hall[2], Chun Zhang[3], Qin Yu[4], Eric L. Patterson[1]; [1]Michigan State University, East Lansing, MI, [2]Michigan State, East Lansing, MI, [3]Guangdong Academy of Agricultural Sciences, Guangzhou, China, [4]University of Western Australia, Perth, Australia (243)

Target-site gene copy number variation (CNV) of *5-enolpyruvylshikimate-3-phosphate synthase* (*EPSPS*) has repeatedly been associated with resistance to glyphosate in many agronomic weeds, including the economically important grass, *Eleusine indica* (goosegrass). However, the origin of these CNVs previously remained elusive in goosegrass due to limited genomic resources. To investigate this CNV in goosegrass, we produced high-quality reference genomes for glyphosate-susceptible and -resistant goosegrass lines and fine-assembled this CNV. We reveal a unique translocation of *EPSPS* and a distant genomic region into the subtelomere region and subsequent duplication of these two regions in the subtelomere resulting in glyphosate resistance in goosegrass. This discovery emphasizes the importance of subtelomeres as genetic variation generators in plants and provides another unique example of herbicide resistance evolution.

Inter-seeding Oat (*Avena sativa* L.) in Soybean for Management of Herbicide-resistant Weeds.
Vipin Kumar*, Amit J. Jhala; University of Nebraska-Lincoln, Lincoln, NE (244)

Multiple herbicide-resistant (HR) weeds are widespread in Nebraska soybean cropping system, which demands alternative weed management tools. Cover crops are becoming important alternate weed management tools but there are some challenges with cover crops like inconsistent weed control, reducing availability of soil moisture for cash crops. Inter-seeding small grain (oat) can be a potential alternate weed management option in soybean. A field experiment was conducted to evaluate the effect of inter-seeding oat and different herbicide programs on weed management and soybean yield. The experiment was setup in a split plot experimental design with four replications. Main plot factor was different inter-seeding timing of oat (no oat (NO), oat planted same day as soybean (SD), and oat planted one month before soybean planting (OMB). The split-plot factor was different herbicide programs (H1: no herbicide, H2: pre-emergence (PRE) only (saflufenacil @ 50 g ai ha^{-1} + metribuzin @ 475 g ai ha^{-1}), H3: post-emergence (POST) only (glufosinate @ 656 g ai ha^{-1} + clethodim @ 140 g ai ha^{-1}), H4: PRE fb POST, and H5: PRE fb POST + residual (Acetochlor @ 1262 g ai ha^{-1}). OMB had 34% and 32%, lower soybean counts per meter row as compared to NO, and SD, respectively at V1 soybean growth stage. Whereas, at V5 soybean growth stage, OMB had 6% and 3%, lower soybean counts per meter row as compared to NO, and SD, respectively. Lower soybean stand count with OMB as compared to NO, and SD can be attributed to low soil moisture with OMB. As compared to NO, OMB oat inter-seeding reduced the broad-leaved weed [*Abutilon theophrasti* Medik. (velvetleaf), and *Ipomoea* spp. (morningglory species)] grass weed (*Setaria* spp. (foxtail species) density reduction density by 90 and 63%, respectively when measured at oat termination (21 days after soybean planting using glyphosate @ 1440 g ai ha^{-1}). However, there was no statistically significant effect of oat inter-seeding on *Amaranthus palmeri* S. Watson (Palmer amaranth) density reduction at 5% level of significance. NO treatment had the highest Palmer amaranth (55 plants m^{-2}, and 13.23 g m^{-2}), broadleaved (3 plants m^{-2}, and 3.21 g m^{-2}), and grass (31 plants m^{-2}, and 4.05 g m^{-2}) weed density, and biomass when measured at POST herbicide application. SD and OMB were statistically significant to each other for Palmer amaranth, broadleaved, and grass weed density and biomass at POST herbicide application. Among herbicide program treatment H1 and H3 had the highest density and biomass for all three groups of weeds. Oat inter-seeding treatment did not have any statistically significant effect on density and biomass of any weed group, which indicates that inter-seeding did not provide long season weed control. Inter-seeding oat did not affect the soybean yield.

Effect of Relative Humidity on Glufosinate Efficacy in Kochia (*Bassia scoparia)* and Common Lambsquarters (*Chenopodium album)* Populations. Het Samir Desai*[1], Fabian Menalled[1], Lovreet S. Shergill[2]; [1]Montana State University, Bozeman, MT, [2]Montana State University, Huntley, MT (245)

Glufosinate, a humidity-dependent herbicide, requires >60% relative humidity for optimum efficacy. In Montana, where relative humidity often ranges from 25% to 35% during summer months, sub-optimal weed management following glufosinate application is a recurrent issue. However, we observed that relative humidity ranged between 60% to 80% during early morning hours. This study aims to address two research questions: (1) How long do *Bassia scoparia* and *Chenopodium album* require =60% relative humidity after glufosinate application? and (2) Is there a merit in applying glufosinate during early morning hours to capitalize on higher humidity? A greenhouse study was conducted in a split-split plot design with three replications and two known glufosinate-susceptible *B. scoparia* and *C. album* populations. Seven relative humidity levels, two nozzles (e.g., TeeJet-XR8002VS and TTJ60-110025), and two populations of each species were assigned to the mainplots, subplots, and subsubplots, respectively. Glufosinate-treated plants (0.6 kg ae ha^{-1}) were exposed to elevated humidity (=60%) for different durations, e.g., 1-hour, 2-h, 4-h, 6-h, 8-h, and 21-days. Glufosinate-treated plants were also kept in ambient humidity (25-35%) for 21-d. While glufosinate-treated *B. scoparia* populations exhibited 15-19% survival when kept in ambient humidity, 0% survival was observed in =1-h of elevated humidity. *Chenopodium album* populations were completely controlled when glufosinate-treated plants were kept in elevated humidity for 21-d, whereas 60-100% survival was observed in all humidity treatments. These data suggest that applying glufosinate during early morning hours could enhance its efficacy against *B. scoparia* but not necessarily against *C. album*, pending further field experimentation.

Quantifying the Impact of Palmer Amaranth (Amaranthus Palmeri) Escapes in Furrow-Irrigated Rice: Yield Loss Vs. Seedbank Management. Tanner A. King*[1], Jason K. Norsworthy[2], Maria Carolina C R Souza[3], Summer L. Pritchett[4], Leonard B. Piveta[2], Tom Barber[5], Thomas R. Butts[5]; [1]University of Arkansas Division of Agriculture, Fayetteville, AR, [2]University of Arkansas, Fayetteville, AR, [3]University of Arkanas, Fayetteville, AR, [4]University of Arkansas Department of Crop, Soil, and Environmental Science, Fayetteville, AR, [5]University of Arkansas, Lonoke, AR (246)

When transitioning to a furrow-irrigated rice (FIR) production system, Arkansas rice producers combat Palmer amaranth (*Amaranthus palmeri* S. Wats.) emergence throughout the entirety of the growing season due to the absence of a continual flood. Season-long survival of Palmer amaranth in FIR can reduce rice yields and cause a greater need for additional in-season herbicide applications. A field experiment was conducted at the Milo J. Shult Agricultural Research and Extension Center in Fayetteville, AR, in 2022 and 2023 to determine the influence of Palmer amaranth on furrow-irrigated rice. Newly emerged Palmer amaranth plants were marked every 7 days, beginning 1 week before rice through 4 weeks after rice emergence. Palmer amaranth seed production and biomass decreased exponentially over time after the initial emergence of the weed. Palmer amaranth negatively affected rice yields by 10% or more up to 60 cm away from the plant. Additionally, Palmer amaranth emergence with or 1 week prior to the crop caused at least 57% yield loss within the 0.1 m^2 surrounding the weed. All Palmer amaranth plants that emerged within 4 weeks of rice emergence negatively affected the rice, suggesting that removal of the weed should continue beyond four weeks. To mitigate substantial yield loss from Palmer amaranth, herbicides should be utilized to delay Palmer amaranth emergence or control the weed soon after it emerges. These results suggest that Palmer amaranth time of emergence relative to the rice crop is a crucial factor influencing rough rice yields and Palmer amaranth seed and biomass production.

Weed Seed Bank Control in Rotational Crops for Proactive Herbicide Resistance Management. Chandra L. Montgomery*[1], Albert T. Adjesiwor[2]; [1]University of Idaho, Moscow, ID, [2]University of Idaho, Kimberly, ID (248)

Herbicide-resistant weed populations are evolving rapidly and threatening the sustainability of crop production. A 4-year crop rotation study was initiated in 2021 at the University of Idaho Kimberly Research and Extension Center to evaluate weed control and seedbank dynamics in wheat-alfalfa vs wheat-annual crop (corn and dry bean) rotations. There were three herbicide treatments: non-treated, postemergence (POST) only, and preemergence (PRE) + POST. After the first year, there was no difference in seedbank density among treatments. After two years, weed seedbank density was reduced from 2,227 viable seeds m-2 in the non-treated to 1,344 seeds m-2 in the PRE + POST treatments, representing nearly 40% reduction in seedbank density. There was also a trend of PRE + POST treatments slightly reducing weed seedbank density compared to POST-only treatment. Weed density within the crops during the growing season was influenced by the type of crop as well as the herbicide treatment. Both POST-only and PRE + POST treatments reduced weed density compared to the non-treated and the PRE + POST treatments reduced weed density in each crop compared to the POST-only treatment. Weed control treatments did not affect alfalfa yield. However, herbicide application (POST only and PRE + POST) improved corn and dry bean yield. The combination of fewer weeds and greater crop yield in the PRE + POST treatments holds promise for reducing weed seedbank density and potentially improving long-term crop productivity and economics.

Investigating the Effects of Preemergence Herbicides on Spring Beauty (*Claytonia virginica* L.) Growth in Flowering Turfgrass Lawns. Nikolay Minaev*[1], James D. McCurdy[2], Edicarlos B. De Castro[2]; [1]Mississippi State University, Mississppi State, MS, [2]Mississippi State University, Starkville, MS (249)

Spring beauty (*Claytonia virginica*) is a spring blooming wildflower native to the Eastern United States. It establishes throughout the winter by seed and underground corms before flowering and seed set (roughly February through April in the Southeastern United States). It provides foraging habitat for a wide range of pollinating insects, including its namesake, the spring beauty mining bee (*Andrena erigeniae*). Besides providing pollinator habitat, the ephemeral pink and white spring beauty flowers make for attractive floral displays in urban lawns. Reduced herbicide input, while key to establishment of polyculture lawns, often results in proliferation of weeds. To prevent spring annual weeds, such as crabgrass (*Digitaria* spp.) and goosegrass (*Eleusine indica*), homeowners and commercial applicators need options that selectively prevent weed establishment while being safe on intentionally included flowering forbs. Ongoing research seeks to determine the effects of common homeowner and commercial preemergence herbicides on spring beauty growth and flowering phenology. Field research consists of two replications in time conducted in 2 × 2 m experimental units at two locations at Mississippi State University. Research is conducted as a randomized complete block design at each location. Treatments include: a nontreated control, Scotts® Bonus® S (1.29% atrazine; 168 kg product ha^{-1}), Bioadvanced® 3-in-1 Weed and Feed for Southern Lawns (0.088% dicamba, 0.041% penoxsulam, 0.027% indaziflam; 122 kg product ha^{-1}), Scotts® Turf Builder® Halts® Crabgrass Preventer with Lawn Food (1.29% pendimethalin; 130 kg product ha^{-1}), Barricade® 4FL (0.48 kg prodiamine L^{-1}; 1.75 L product ha^{-1}), Specticle® FLO (0.075 kg indaziflam L^{-1}; 0.44 L product ha^{-1}), and the treated check Trimec® Classic (0.24 kg 2,4-D L^{-1}, 0.025 kg dicamba L^{-1}, 0.064 kg MCPP L^{-1}; 4.7 L product ha^{-1}). At the first location, products were applied on April 6, 2022 and were reapplied the following year on March 15, 2023. At the second location, products were applied on March 15, 2023 and will be reapplied in spring of 2024. Visual injury and flower density were assessed throughout the blooming period. Data were subjected to analysis of variance (a = 0.05) and means were separated using Student-Newman-Keuls method in SAS (Version 9.4; SAS Institute Inc.) PROC GLM. Provisional results are encouraging, suggesting that certain spring preemergence herbicide treatments offer safety to established spring beauty. The treated check Trimec Classic inflicted substantial injury and decreased flowering by 96%, which was more than that of all other treatments. The only visual injury observed due to first-year treatments with preemergence herbicides was that of Halts Crabgrass Preventer. Injury was minimal (27% on February 21, 2023) and manifest as thinned or stunted growth of spring beauty, but flower count was similar to all other treatments. When reapplied on March 15, 2023, all products decreased flowering by 33 to 96% compared to the untreated check when observed two weeks later. While common within maintained lawns, Trimec control/injury of flowering forbs is an expected outcome. However, results suggest that spring application of prodiamine, atrazine, and indaziflam containing products (as well as perhaps Halts Crabgrass Preventer) may be integrated into a turfgrass weed control program while providing acceptable safety on spring beauty. An analogous project evaluates the effects of many of these treatments when applied to spring beauty in the fall (results forthcoming).

The Management of Italian Ryegrass (*Lolium perenne ssp. multiflorumin*) in Winter Wheat Using a Seed Control Unit at Harvest. Hayden S. Love*[1], Travis Legleiter[2]; [1]The University of Kentucky, Lexington, KY, [2]University of Kentucky, Princeton, KY (250)

The reliance of herbicides for control of Italian ryegrass (*Lolium perenne spp. multiflorum*) has increased the selection of herbicide resistant Italian ryegrass populations in Kentucky. Herbicide resistance has led to producers looking for new control options for Italian ryegrass in winter wheat. Australia has seen similar issues in their grain crops with Rigid ryegrass (*Lolium rigidum*) which has led to use of harvest weed seed control. Harvest weed seed control could be an option for control of Italian ryegrass in winter wheat at harvest in Kenucky. A field study was conducted that included two adjacent locations over two growing seasons in Logan County, Kentucky with known Italian ryegrass population. The two treatments for this study were: seed control unit on and seed control unit off, where each treatment was replicated four times. These field studies were laid out in a randomized complete block design where the blocks measured 24 m by 168 m in size. Prior to harvest, Italian ryegrass fresh weights and seedhead densities were recorded in four one-m^2 quadrats in each block to acquire an accurate measurement of the Italian ryegrass population within each plot. All seedheads were thrashed and counted individually to approximate the likely number of ryegrass seed contained within each plot. At wheat harvest, ryegrass seed shattered at the head of the combine, within the thresher chaff, and in the grain tank was collected to determine seed distribution. During wheat harvest, 4 header loss measurements were taken by placing 29 trays across the front of the combine header that equaled to a 1-m^2 in non-harvested wheat. Chaff samples were collected by laying three trays that totaled to an area of 1-m^2 behind the combine as it harvested to collect thresher chaff. Additionally, chaff samples were caught directly from the straw chopper and seed control unit to determine the effectiveness of the seed control unit and loss of seed in the straw portion of the chaff. Once each block was harvested, a grain sample was collected by using a multichambered grain probe to determine the amount of ryegrass seed contained within the grain tank. In both years there was no difference in ryegrass seed lost at the combine header, within the thresher chaff, and in the grain tank. Although, when combining seed found in the grain tank and chaff, there was a difference in the number of seed entering the combine verses seed shattering at the header. In 2022, there was a reduction in ryegrass seed contained within the thresher chaff when the unit was engaged, but in 2023 there was no difference between unit engagement. When header shatter is considered, there was not a difference in ryegrass seed being contributed to the seed bank in both years. In 2022, there was a reduction in ryegrass seed contained in the composite chaff caught directly from the combine when the unit was engaged. Additionally, there was not a difference of the number of seed that was leaving through the straw chopper or seed control unit indicating that an insignificant amount of ryegrass was being lost through the straw portion of the chaff. The results of this research indicate that the seed control unit does control ryegrass seed contained within the fine chaff; although the significant amount of header shatter observed negated the benefits of the seed control unit. Further research evaluating the reduction of ryegrass seed shatter at the combine header is warranted.

The Influence of Climate Change on the Distribution of Allergy-Inducing Plants in the United States. Venkatanaga Shiva Datta Kumar Sharma Chiruvelli*[1], Debalin Sarangi[2], David Moeller[3], Ryan Briscoe Runquist[4]; [1]Graduate Student - Agronomy Department, University of Minnesota, St Paul, MN, [2]University of Minnesota, St. Paul, MN, [3]Professor, Twin Cities, MN, [4]Research Associate, Twin Cities, MN (251)

The introduction and spread of weed species in a new area pose a significant threat to biodiversity, disrupting delicate ecological relationships and exacerbating environmental changes. Global climate change is influencing ecosystems and ecological communities, causing shifts in the phenology, geographic ranges, or population abundance of numerous species. Consequently, forecasting the effects of climate change on the present and future distribution of invasive species is important research to be addressed. Giant ragweed (*Ambrosia trifida* L.) is a strong competitor of agronomic crops due to its stature as one of the tallest annual weeds, posing challenges to manage in crops like corn, soybean, and dry bean. It is also a significant contributor to hay fever, asthma, and various allergic reactions due to its airborne pollen loads during a particular time of the season. Recognizing the need to understand the future distribution of giant ragweed is crucial not only for mitigating competition with crops but also due to health concerns associated with this species. To investigate the temporal and spatial dynamics of past invasions and predict future occurrences, a diverse set of species distribution models (SDMs) was developed. Species distribution models (SDMs) were constructed using extensive occurrence records across the USA and five environmental predictors. Employing boosted regression trees, we projected future occurrence probabilities for giant ragweed by utilizing bioclimatic variables for 2061-80 under ssp585. The potential geographical distribution centers of giant ragweed exhibit a trend shifting towards western states in the USA from the present to the 2061-80s. In brief, climate change has facilitated the expansion of the geographical distribution of giant ragweed to new locations. Ecomanagement and inter-state management strategies are warranted to mitigate the future effects of the expansion of the giant ragweed. Keywords: Giant ragweed, Species distribution models, occurrence records, bioclimatic variables

Factors Influencing Off-Target Movement of Drone Application. Antonio Augusto Tavares*[1], Jake A. Patterson[1], Sydney C. Baker[1], Luiza Jacobsen[1], Darrin M. Dodds[2], Luis A. Avila[3]; [1]Mississippi State University, Starkville, MS, [2]Mississippi State University, Mississippi State, MS, [3]Universidade Federal de Pelotas, Pelotas, Brazil (252)

Pesticide spray drift is one of the main concerns regarding the use of Remotely Piloted Aerial Application Systems (RPAAS). The objective of the study was to investigate spray drift potential for pesticide applications using an RPAAS platform in different conditions including nozzle model, flight height, and carrier volume. The study was conducted at the Mississippi State University Black Belt Branch Experiment Station in a randomized complete block design with a 3 x 3 x 2 factorial arrangement of treatments with five replications. A Leading Edge PrecisionVision 22 equipped with a 4-nozzle boom spaced in 30" was used. Treatment factors included three flight heights (1, 2, and 3 m from the ground), three nozzle types: XR 110015, AIXR 110015, and TTI 110015, and two carrier volumes (28 and 94 L ha^{-1}). A fluorescent dye at 0.1% was sprayed using an RPAAS flying perpendicular to the wind direction with drift collectors placed parallel to the wind direction at downwind distances from the treated area ranging from -7 m to 40 m with 0 m being the center of the flight line. Environmental conditions (wind speed, wind direction, air temperature, and relative humidity) were collected for each application using a portable weather station. The data were submitted to outlier analysis and to a 4-way ANOVA. The means were submitted to multiple comparisons using the Tukey test when the source of variation was significant. The nozzle type was significant (P value=0.00903) with the TTI11015 nozzle having the lowest (29.10 µL cm^{-2}) and XR110015 the highest overall average across all the distances (51.54 µL cm^{-2}). The highest initial drift (at < 10 m) was obtained at the flight height of 3 m. Nozzles that produce larger droplets (TTI110015) are shown to be the main factor in the drift mitigation in RPAAS applications while the flight height appears to have a direct relationship with drift potential.

Genetic Analysis of Colombian Coca Plants in Response to Glyphosate. Yenny Alejandra Saavedra Rojas*[1], Eric L. Patterson[2], Jhon Eric Rivera Monroy[3]; [1]Michigan State University, Department of Plant, Soil and Microbial Sciences, Fulbright. Visiting student researcher, East Lansing, MI, [2]Michigan State University, East Lansing, MI, [3]University of La Salle, Bogota, Colombia (253)

Colombia reported a record 230,000 hectares under coca cultivation (*Erythroxylum sp.*) in 2022, according to the United Nations. Over the past three decades, glyphosate has been the primary herbicide employed for eradicating illicitly grown plants, raising questions about its potential resistance. Therefore, the objective of this study was to investigate the molecular-level variability in coca responses to glyphosate. A dose-response experiment was conducted by applying glyphosate doses from 0 to 4800 g ha^{-1} to two *E. coca* varieties: *Boliviana Roja* and *Gigante*, under greenhouse conditions. Visual injuries were documented three weeks after treatment. DNA samples were sequenced for Thr102, Ala103, and Pro106 mutation in the 5-enol pyruvyl-shikimate-3-phosphate synthetase (*EPSPS*) gene. Additionally, EPSPS copy number variation was examined in DNA from both mentioned varieties and 14 others. Glyphosate dose-response showed *Gigante*'s ED50 at 734.2 g ha^{-1}, whereas *Boliviana Roja*'s ED50 was 3,180.6 g ha^{-1}, indicating a 4.33-fold resistance factor. The sequencing analysis revealed the absence of target site mutations in these varieties. Furthermore, none of the 16 tested varieties showed differential EPSPS copy number variation, indicating that resistance is not linked to the target site. Future research will include differential gene expression to elucidate distinct coca responses to glyphosate. Additionally, the study aims to explore the genome of coca for a deeper understanding of the mechanisms underlying the suspected glyphosate-resistant biotype, offering insights for formulating strategies to enhance herbicide use in the agronomic management of illegal coca plantations.

Tracking ALS Resistance in Barnyardgrass (*Echinochloa crus-galli*) Using Molecular Markers in Southern Brazil Rice Fields. Eduardo C. Rudell*[1], Luan Cutti[2], Guilherme M. Turra[3], Matheus B. Scherer[4], Gabriel M. Dias[3], Vinicius Tasca[3], Catarine Markus[2], Eric L. Patterson[5], Aldo Merotto[2]; [1]Federal University of Rio Grande do Sul (UFRGS), Porto Alegre, Brazil, [2]Federal University of Rio Grande do Sul, Porto Alegre, Brazil, [3]UFRGS, Porto Alegre, Brazil, [4]BASF, Porto Alegre, Brazil, [5]Michigan State University, East Lansing, MI (254)

Barnyardgrass *[Echinochloa crus-galli* (L.) P. Beauv.] is a tough weed widely dispersed in rice and other agricultural fields. Resistance to acetolactate synthase (ALS) inhibiting herbicides has occurred in barnyardgrass due to large recurrent use. Several approaches have been used to report case studies related to the identification of the resistance mechanism in barnyardgrass. However, the frequency of occurrence of the different mechanisms of resistance at field level is unknown in most regions. This study aimed to develop SNAP molecular markers targeting the *ALS* gene in barnyardgrass to identify the mechanism of herbicide resistance, and to identify the frequency and spatial distribution of imidazolinone- and triazolopyrimidine-resistant alleles in rice fields in Southern Brazil. Initially, the *ALS* gene of 20 and 32 populations was sequenced by Sanger and new generation sequencing (Ilumina) methodologies were used to identify the presence of the known mutations related with *ALS*-inhibitors herbicides. After that, SNAP molecular markers were developed targeting the Ala122Thr, Ala205Asn, Trp574Leu, and Ser653Asn *ALS* gene positions for identification through RT-qPCR. A throughput method was developed based on several resistant and susceptible DNA mixture ratios. The phenotypic evaluation consisted of a greenhouse whole-spraying assay to identify the resistance to Imazethapyr (106 $g.ha^{-1}$ + Dash at 0,5% v/v) and Penoxsulam (60$g.ha^{-1}$ + COC at $1L.ha^{-1}$). Leaf tissue for DNA extraction was sampled before spraying and survival was accessed at 21 days after spraying. A total of 237 populations were collected during 2017-2023 mainly from rice fields in Southern Brazil. Samples consisted of bulk collection of escape plants from imidazolinone herbicides applications. Out of that, 183 (77%) were identified as resistant in the phenotypic evaluation. The molecular makers assay identified 173 (73%) populations resistant due to the mutations Trp574Leu, Ser653Asn, Ala122Thr, and Ala205Asn at the frequency of 47%, 28%, 19%, and 6%, respectively. Approximately 4% of the resistant population didn't amplify any of the SNAP markers indicating the presence of other ALS gene mutations or other mechanism of resistance. The optimization of the Trp574Leu SNAP based on fraction dilution of resistant and susceptible DNA indicate the accuracy of resistance identification with sampling up to 30 plants. Molecular markers are faster and less labor-intensive method for identifying herbicide resistance caused by target site mutations. The new phase of herbicide resistance studies regarding large scale evolution and field epidemiological analysis requires the identification of the most important mechanisms of resistance mainly in the complex hexaploidy species such as barnyardgrass.

Khakiweed (*Alternanthera pungens*) Seed Physiology Response. Annabelle E. McEachin*[1], Timothy L. Grey[2], Nicholas T. Basinger[3]; [1]University of Georgia Crop and Soil Sciences, Tifton, GA, [2]University of Georgia, Tifton, GA, [3]University of Georgia, Athens, GA (255)

Khakiweed, *Alternanthera pungens*, is a perennial broadleaf weed difficult to control because of its multiple means of reproduction, vigorous growth, and deep tap root. It reduces the quality of pasture, pecan, and turf areas by choking out desirable grass species. In a greenhouse study, metsulfuron, indaziflam, and pendimethalin were applied to planted khakiweed seed, and emergence response was measured over time. Metsulfuron (2.1 g ai ha^{-1}) provided >70% control POST, but demonstrated low levels, <30%, for PRE applications. Pendimethalin PRE at 1059 g ha^{-1} or greater controlled khakiweed at least 92%. Indaziflam PRE at 30 g ai ha^{-1} or greater controlled khakiweed at least 85%. To further quantify seed physiological response to external factors, the effect of osmotic potential (0 to -1.6 MPa) and constant temperature (15 to 45C) were evaluated in growth chamber studies. Khakiweed seed germination was at least 90%, at 0 and – 0.2MPa, but germination ceased at – 1.2MPa or greater. Khakiweed germination was most rapid at high temperatures (>25C), but cumulative germination counts at the end of the 7-day incubation period were the same for all temperatures.

Grain Sorghum Response to Fomesafen and Terbacil. Nicholas J. Shay*, Eric P. Prostko; University of Georgia, Tifton, GA (256)

Grain Sorghum Response to Fomesafen and TerbacilNicholas J. Shay and Eric P. Prostko The climate in South Georgia provides excellent growing conditions with ample precipitation and favorable temperatures to grow crops nearly year-round. Growers can benefit from double-cropping crops such as grain sorghum (*Sorghum bicolor*) following watermelon [*Citriullus lanatus* (Thunb.) Mastum. & Nakai] to maximize land use and add economic value to their operation. However, capitalizing on the economic advantages of harvesting two crops within a single season must account for potential herbicide injury to rotational crops. An integrated weed management strategy that includes a preemergence application of fomesafen (Reflex®) or terbacil (Sinbar®) is one of the recommended herbicide programs for ensuring a weed-free start against problematic weeds in watermelon production. However, current plant-back restrictions for grain sorghum require a minimum of 10 and 24 months for fomesafen and terbacil, respectively. Therefore, the objective of this research was to determine the tolerance of grain sorghum to fomesafen and terbacil following soil applications applied 90-100 days before planting (DBP). Small-plot, replicated field trials were conducted at the University of Georgia Ponder Research Farm from 2019-2023. The experimental design was a randomized complete block with 4 replications. Five rates of fomesafen (35, 70, 140, 210, 280 g ai ha^{-1}), four rates of terbacil (3.5, 7.0, 10.5, 14.0 g ai ha^{-1}) and a non-treated control, were evaluated. All data were subjected to ANOVA using PROC GLIMMIX and means were separated using Fisher's protected LSD test (P = 0.10). In 2019, results indicated that fomesafen at 210 and 280 g ai ha^{-1} caused significant sorghum yield reductions of 16% and 21%, respectively (P=0.021). Terbacil had no effect on sorghum yield in 2019. From 2020-2023, sorghum yields were not reduced by any rate of fomesafen or terbacil, with yields ranging between 2874 to 3450 kg ha^{-1} (P=0.39). These results suggest that sorghum has sufficient tolerance to terbacil when applied 90-100 DBP. In 4 of the 5 years of trials, sorghum had acceptable tolerance to fomesafen. But, yield losses observed in 2019 suggest that grain sorghum should only be planted when fomesafen is applied 90-100 DBP at < 210 g ai ha^{-1}.

Axant^{TM} Flex Cotton Response to Topramezone. Megan M. Singletary*[1], Peter A. Dotray[2], Gregory B. Baldwin[3], Scott Asher[4], Adam C. Hixson[4], Bobby A. Rodriguez[5]; [1]Texas Tech University, Lubbock, TX, [2]Texas Tech University/ Texas A&M AgriLife Research and Extension, Lubbock, TX, [3]BASF, Research Triangle Park, NC, [4]BASF, Lubbock, TX, [5]Texas A&M AgriLife Research and Extension Service, Lubbock, TX (257)

The increased development of herbicide resistant weeds such as Palmer amaranth (*Amaranthus palmeri* S. Watson) is an issue across the Cotton Belt. Axant^{TM} Flex cotton, developed by BASF Corporation, will be the first quadruple-stacked herbicide tolerance germplasm to aid in the control of troublesome weeds in cotton. Field studies were conducted in 2022 and 2023 at the Texas Tech University New Deal Research Farm near New Deal to evaluate Axant^{TM} Flex cotton response to topramezone applied alone or in tank-mix combinations when applied postemergence (POST) to 3 or 7-leaf cotton. Treatments consisted of isoxaflutole at 0.105 kg ai ha^{-1} or prometryn at 1.33 kg ai ha^{-1} applied preemergence (PRE) followed-by (fb) topramezone at 0.025 kg ai ha^{-1} applied alone or tank mix combinations with isoxaflutole at 0.105 kg ai ha^{-1}, glufosinate at 0.88 kg ai ha^{-1}, glyphosate at 1.65 kg ai ha^{-1}, and/or dicamba at 0.56 kg ai ha^{-1} applied POST. Crop oil concentrate at 1% v/v, ammonium sulfate at 2.52 kg ai ha^{-1}, and potassium carbonate at 0.407 kg ai ha^{-1} were added to treatments based on adjuvant requirements from each respective herbicide label. No difference in cotton stand was observed between isoxaflutole or prometryn PRE treatments relative to the non-treated control. In 2022, no POST treatment made to 3-leaf cotton caused greater than 6% crop response at 7 and 14 days after application. When POST treatments were made to 7-leaf cotton, crop response did not exceed 18% at 7 and 14 days after application. In 2023, crop response was = 2% at 28 days after POST applications made to either 3 or 7-leaf cotton. No differences in lint yield were observed following any herbicide treatment when compared to the non-treated control in either year. Fiber length and strength were not adversely affected by treatments containing topramezone POST in 2022 and 2023. These results support the potential use of topramezone in Axant^{TM} Flex cotton production to help manage troublesome weeds with no adverse effects on cotton yield and quality.

Weed Control with Fomesafen Tank-Mixes in Oklahoma Cotton. Zachary R. Treadway*, Jennifer Dudak, Karina Beneton, Todd A. Baughman; Oklahoma State University, Ardmore, OK (258)

WEED CONTROL WITH FOMESAFEN TANK-MIXES IN OKLAHOMA COTTON. Z.R. Treadway*, J.L. Dudak, K. Beneton, T.A. Baughman; Oklahoma State University, Ardmore, OK ABSTRACT Cotton producers are faced with the ever growing issue of herbicide resistance. Herbicide resistant weeds, such as Palmer amaranth, can be highly detrimental in terms of growth and yield of cotton. Previous studies have shown that cotton lint yield decreases as Palmer amaranth populations increase. An effective residual herbicide, applied preemergence, allows the crop time to emerge and outgrow predacious weeds. Previous research has shown that combining modes of action when applying residual herbicides increases weed control. The following trials were conducted to better understand the potential for fomesafen based preemergence herbicide programs for weed management in XtendFlex and Enlist cotton. Experiments were conducted at two locations in Oklahoma in 2022 and 2023, the Oklahoma State University Caddo research station near Fort Cobb and the Southwest Research and Extension Center near Altus. XtendFlex cotton was planted at Altus in May of both years, and Enlist cotton was planted at Fort Cobb in May of 2023. Plots were 4 rows wide by 25 feet long, and treatments were arranged in a randomized complete block. Treatments included fomesafen (11.2 fl oz/a) alone, prometryn (25.6 fl oz/a) alone, and tank mixes of fomesafen + prometryn at combinations of 25%, 50%, 75%, or 100% of the labeled application rate, all applied PRE. All treatments were followed by a post application of dicamba (12.8 fl oz/a) or 2,4-d (32 fl oz/a) + glyphosate (32 fl oz/a) + acetochlor (48 fl oz/a), based on herbicide technology present. Both plant injury and weed control were rated visually throughout the growing season. Plant injury never exceeded 5% at any location at any point during the growing season. At 2 WAP, control of both Palmer amaranth and annual grass was at least 99% with all treatments across all site years except fomesafen (8.4 fl oz/a) + prometryn (12.8 fl oz/a) at Fort Cobb in 2023. At 4 WAP, control of Palmer amaranth in 2023 was 99% or greater with all treatments. In 2022, the only treatment to exceed 80% control of Palmer amaranth was fomesafen (11.2 fl oz/a) + prometryn (25.6 fl oz/a). In Altus in 2023, control of annual grass was at least 85% with all treatments except fomesafen (2.8 fl oz/a) + prometryn (19.2 fl oz/a). In Fort Cobb in 2022, all treatments provided 93% control of annual grass except fomesafen (8.4 fl oz/a) + prometryn (12.8 fl oz/a). In Altus in 2022, all tank-mix treatments provided 80% control of annual grass except fomesafen (8.4 fl oz/a) + prometryn (6.4 fl oz/a). Following the POST application at both locations in 2023, control of all weeds was at least 90% with all tank-mix treatments except fomesafen (8.4 fl oz/a) + prometryn (12.8 fl oz/a). In 2022, all tank-mix treatments provided at least 86% control of all weeds following the POST application except fomesafen (8.4 fl oz/a) + prometryn (6.4 fl oz/a). Weed control levels did not consistently increase or decrease with the increase or decrease in application rate. These trials highlighted the importance of effective residual herbicide programs, as treatments that were lacking in weed control following the PRE application continued to lack in weed control following the POST application.

Cover Crop Tolerance to Spring-Applied Wheat Herbicides. Claudia R. Walz*, Christy L. Sprague; Michigan State University, East Lansing, MI (259)

Michigan wheat growers plant cover crops following winter wheat harvest to protect their land from soil erosion, retain nutrients, and suppress weeds. Herbicides applied to winter wheat in the spring may impact cover crop establishment and growth. Currently, there is a lack of herbicide label information on the potential carryover to cover crops. Therefore, the objective of this was to assess fall-planted cover crop tolerance following spring-applied herbicides in winter wheat. Field experiments were conducted at 2 to 3 locations for 3 years, for a total of 8 site -years. Soil properties and weather conditions varied by location and year. Soil textures ranged from sandy clay loam to loam to clay loam with organic matter ranging from 1.8 to 3.1%. In the spring, when winter wheat reached Feekes stages 4 or 5, four replications of 10 herbicide treatments, including an untreated control, were applied in 3 by 27 m strips across the field. The herbicides evaluated included: pyrasulfotole + bromoxynil, bicyclopyrone + bromoxynil, thifensulfuron + tribenuron, halauxifen + florasulam, mesosulfuron, mesosulfuron + thiencarbazone, pyroxsulam, pinoxaden + fenoxaprop, and clopyralid. Two to three weeks after wheat harvest, nine different cover crop species were no-till drilled perpendicular to the herbicide treatments, creating a plot size of 3 x 3 m^2. The cover crops included: crimson clover, red clover, Austrian winter pea, dwarf Essex rapeseed, mustard Caliente, oilseed radish, annual ryegrass, cereal rye, and oat. One month after planting, the cover crops were visually assessed for injury and stand, 2-0.25 m^2 quadrats per plot. Before the first frost, near the end of October, covers were assessed again for injury, and aboveground biomass was collected, dried, and weighed. From the time of herbicide application in the spring to cover crop planting growing degree days (GDD_{50}) ranged from 2901-3158 with 25-79 cm of rainfall in 2021, 1583-1866 GDD with 12-21 cm of rainfall in 2022, and 1567 and 1579 GDD with 27 and 29 cm of rainfall in 2023. At the initial evaluation, pyrasulfotole + bromoxynil caused bleaching of the leaf margins for red clover and crimson clover in 6 of 8 and 2 of 8 site-years, respectively. Bicyclopyrone + bromoxynil also caused leaf margin bleaching in 3 sites in 2021 for red clover. However, both red and crimson clover outgrew these symptoms by the end of the fall and these treatments did not impact clover biomass. Planting pea after pyrasulfotole + bromoxynil and bicyclopyrone + bromoxynil showed initial injury, however, pea outgrew this injury and biomass was not impacted. Overall, crimson clover, red clover, Austrian winter pea, dwarf Essex rapeseed, mustard Caliente, oilseed radish, annual ryegrass, cereal rye, and oat established and were able to produce significant amounts of biomass following spring applications of herbicides commonly used in winter wheat.

Palmer Amaranth and Waterhemp in Idaho: Current Distribution and Glyphosate Resistance Confirmation. Albert T. Adjesiwor*[1], Clarke Alder[2], André Lucas Simões Araujo[3], Joel Felix[4], Todd A. Gaines[3]; [1]University of Idaho, Kimberly, ID, [2]Amalgamated Sugar, Boise, ID, [3]Colorado State University, Fort Collins, CO, [4]Oregon State University, Ontario, OR (89)

Palmer amaranth and waterhemp are the two most troublesome pigweeds in crop production systems in the United States. These pigweeds just started to appear in the Pacific Northwest (PNW). A coordinated extension and outreach effort among land-grant universities (University of Idaho and Oregon State University), Amalgamated Sugar, other commodity commissions, and industry was launched to track Palmer amaranth and waterhemp in the PNW. In 2023, tissue samples were collected from pigweeds suspected to be Palmer amaranth and waterhemp and sent to Colorado State University for KASP genotyping test to confirm if the species were Palmer amaranth and waterhemp. The KASP test confirmed that the suspected pigweeds were Palmer amaranth and waterhemp. Since majority of these pigweeds survived multiple applications of glyphosate, 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) gene duplication analysis were conducted to confirm possible glyphosate resistance in the Palmer amaranth and waterhemp populations. About 70% (17 out of 23) of the Palmer amaranth tissue samples showed gene duplication of up to 184 EPSPS gene copies, indicative of glyphosate resistance. All three populations of waterhemp showed gene duplication of 5.7 to 9.2 EPSPS gene copies indicative of glyphosate resistance. The glyphosate-resistant Palmer amaranth and waterhemp populations came from multiple counties in southern Idaho. None of the samples from Oregon showed EPSPS gene duplication. Seed samples were obtained from a number of Palmer amaranth and waterhemp populations for resistance screening to other herbicide sites of action.

Effect of Delayed Postemergence Herbicide Application on Corn. Nader Soltani*, Peter H. Sikkema; University of Guelph, Ridgetown, ON, Canada (90)

Nine field experiments were conducted from 2017 to 2019 in Ontario to determine the impact of early weed interference on corn yield based on corn growth stage, days after emergence (DAE), accumulated crop heat units (CHU), and weed size. The predicted weed size at herbicide application that resulted in a 1, 2.5, 5, 10, 25, and 50% yield loss in corn was estimated to be 1, 4, 11, 53, non-estimable (N est.*), and N est.* cm under low weed density and 3, 5, 7, 11, 27, and N est.* cm under high weed density, respectively. The predicted DAE at herbicide application time that resulted in a 1, 2.5, 5, 10, 25, and 50% yield loss in corn was predicted to be 14, 20, 27, 44, N est.*, and N est.* DAE under low weed density and 5, 7, 11, 17, 25, and 59 DAE under high weed density, respectively. The predicted CHU from planting at herbicide application time that led to a 1, 2.5, 5, 10, 25, and 50% yield loss in corn was 468, 636, 821, 1271, N est.*, and N est.* CHU from planting under low weed density and 207, 283, 385, 551, 972, and 1748 CHU from planting under high weed density, respectively. The predicted crop stage at herbicide application that led to a 1, 2.5, 5, 10, 25, and 50% yield loss in corn was V5, V6, V7, V11, N est.*, and N est.* under low weed density and V1, V2, V3, V4, V8, and V14 under high weed density, respectively. Results indicate that weeds must be controlled before they reach 11 cm in height, prior to 27 days after crop emergence, prior to 821 accumulated CHU from emergence, or prior to the V7 stage under low weed density to avoid greater than 5% yield loss.

1. Effect of Delayed Postemergence Herbicide Application on Soybean. Nader Soltani*, Peter H. Sikkema; University of Guelph, Ridgetown, ON, Canada (91)

Limited information exists on the critical time of weed removal (CTWR) with the currently used soybean cultivars in Ontario. A study consisting of eight field experiments was conducted from 2017 to 2019 in Ontario, Canada, to determine the impact of delayed postemergence (POST) herbicide application on soybean yield based on average weed height at application, days after crop emergence (DAE), accumulated crop heat units (CHU) from the date of planting, and soybean growth stage. The regression model estimated the weed size at herbicide application that led to 1%, 2.5%, and 5% yield loss in soybean was 9, 14, and 20 cm under low weed density (averaging 73 to 134 plants m-2) and 3, 4, and 6 cm under high weed density (143 to 153 plants m-2) conditions, respectively. The estimated DAE at herbicide application time that led to 2.5%, 5%, 10%, and 25% yield loss in soybean was 24, 30, 37, and 53 DAE under low weed density and 8, 10, 14, and 23 DAE under high weed density, respectively. The predicted crop stage at herbicide application that resulted in 2.5%, 5%, 10%, and 25% yield loss in soybean was V4, V5, R2, and R5 under low weed density and VE, VC, V1, and V4 under high weed density, respectively. This study concludes that soybean yield loss is influenced by the weed density (low vs/high) and the time of the first POST herbicide application. When the first POST herbicide application was delayed until soybean was at the V2 stage the monetary loss was Can$20.46 and Can$221.20 ha-1 in low and high weed-density environments, respectively.

Effectiveness of Salvage Herbicide Programs for Weed Management in Cotton. Taghi Bararpour*; Mississippi State University, Stoneville, MS (92)

A field study was conducted in 2023 at the Delta Research and Extension Center, in Stoneville, Mississippi, to determine: 1) what can be done (herbicide programs) when weed infestation and growth stage is out of the range or control due to adverse environmental condition; 2) what is cost (number of application or herbicide program) to control >10-15" (large) glyphosate-resistant Palmer amaranth (*Amaranthus palmeri*), 3) what cotton yield will be in salvage herbicide treatments as compared to standard treatment or weed-free check. The experiment was designed as a randomized complete block. Different herbicide programs (salvage) were used. Stoneville cotton (ST 4550) was planted on May 16, 2023 and emerged on May 23. Treatment (rate in oz/a) as follows: 1) Roundup (glyphosate) at 32 (B) followed by (fb) Roundup (C); 2) Liberty (glufosinate) at 32 (B) fb Liberty (C); 3) Liberty at 32 (B) fb Roundup + Dual Magnum (*S*-metolachlor) at 16 (C); 4) Liberty at 32 (B) fb Liberty + Dual Magnum (C); 5) Liberty at 32 (B) fb Roundup + Select (clethodim) at 12 + Dual Magnum + Agri-Dex (1% v/v) (C); 6) Liberty at 32 (B) fb Liberty at 32 + Select at 12 + Dual Magnum + Agri-Dex (C); 7) Liberty at 29 (B) fb Liberty at 29 + Select at 12 + Agri-Dex (C) fb Liberty at 29 (D); 8) Brake (fluridone) at 16 + Cotoran (fluometuron) at 16 (A) fb Liberty at 29 + Select at 12 + Agri-Dex (B) fb Liberty at 29 + Dual Magnum (E); 9) Weed-free check [Brake + Cotoran (A) fb Liberty at 29 + Dual Magnum (B) fb Liberty at 29 (D)]; and 10) Weedy check. Herbicide applications were done on May 17 for A (preemergence = PRE), June 21 for B (3- to 4-weeks after emergence), July 6 for C (2-weeks after B), and July 18 for D (2-weeks after C) and E (weed flowering). There was no cotton injury. Glyphosate-resistant Palmer amaranth control was 40% by 12 weeks-after emergence (WAE) from the application of glyphosate at 32 oz/a at B (4-weeks after cotton emergence) application followed by (fb) glyphosate at C application (2-weeks after B) (Trt. 1) which indicates Palmer amaranth population in the test area was glyphosate-resistant. Salvage treatment of Liberty (29 oz/a) at B application fb Liberty + Select Max + Agri-Dex at C application fb Liberty at D application (Trt. 7) provided 100% control of glyphosate-resistant Palmer amaranth which was comparable with Brake + Cotoran at A (PRE) fb Liberty + Select Max + Agri-Dex at B fb Liberty + Dual Magnum at E application (Trt. 8). Cotton was harvested on November 1. As was mentioned previously, the first salvage treatments (application B) were applied 4-weeks after cotton emergence on June 21 where palmer amaranth was 10- to 20-in tall (treatment 2, 3, 4, 5, 6, and 7). The salvage herbicide program (treatment 7) Liberty (B) fb Liberty + Select Max +Agri-Dex (C) fb Liberty (D) stopped glyphosate-resistant Palmer amaranth seed production (0%) as treatment 8 or weed-free check plot did. The plot that received this salvage herbicide program provided 6,396 lb/A seedcotton yield which was comparable to treatment 8 (6,759 lb/A) or the weed-free-check plot (6,233 lb/A). Weed interference (weedy check) reduced seedcotton yield 98.9% as compared to weed-free check. The salvage herbicide program (Trt. 7) worked well with 6,396 lb/A seedcotton yield and provided not only 100% control of glyphosate-resistant Palmer amaranth, but also 100% reduced Palmer amaranth seed production (stopped seed deposition to the soil seedbank). Palmer amaranth seed deposition to the soil seedbank must be stopped/reduced for long-term weed management and delaying/stopping the evolution of herbicide-resistant weed.

Weed Management Programs in Mississippi Corn. Taghi Bararpour*, Jason A. Bond, Corey Bryant; Mississippi State University, Stoneville, MS (93)

A field study was conducted in 2023 at the Delta Research and Extension Center, in Stoneville, Mississippi, to evaluate herbicide application programs for glyphosate-resistant Palmer amaranth (*Amaranthus palmeri*), entireleaf morningglory (*Ipomoea hederacea var. integriuscula*), prickly sida (*Sida spinosa*),), hemp sesbania (*Sesbania herbacea*), and broadleaf signalgrass (*Urochloa platyphylla*) control in Mississippi corn (*Zea mays*). Corn (Pioneer 1870YHR) was planted on beds with 40-inch row spacing at a seeding rate of 2.5 seeds ft^{-1} on May 3, 2023 and emerged on May 9. The study was designed as a randomized complete block with 16 herbicide treatments and four replications. Herbicide treatments were as follows: 1) Halex GT (mesotrione + *S*-metolachlor + glyphosate) at 3.6 pt/a + AAtrex (atrazine) at 1.5 qt/a + COC at 1% v/v at V3-V4; 2) ImpactZ (topramezone + atrazine) at 8 fl oz/a + AAtrex at 2 qt/a + Roundup PowerMax (glyphosate) at 32 fl oz/a + MSO at 0.25% v/v at V3-V4; 3) Impact (topramezone) 1.25 oz/a + AAtrex at 1 qt/a + Dual II Magnum (*S*-metolachlor) at 1.3 pt/a + NIS at 0.25% v/v + AMS at 0.25% v/v at V3-V4; 4) Impact Core (topramezone + acetochlor) 32 oz oz/a + AAtrex at 1.5 qt/a + Roundup PowerMax + NIS + AMS at V3-V4; 5) Sinate (topramezone + glufosinate) at 24 oz/a + AAtrex at 1 qt/a + Dual II Magnum + NIS + AMS at V3-V4; 6) Resicore XL (acetochlor + mesotrione + clopyralidat) 3 qt/a + AAtrex at 1 qt/a Preemergence (PRE); 7) Acuron (*S*-metolachlor + atrazine + mesotrione + bicyclopyrone) at 1.5 qt/a PRE followed by (fb) Resicore XL at 1.5 qt/a + AAtrex at 1 qt/a + Durango DMA (glyphosate) at 32 oz/a + NIS at V3-V4; 8) Acuron at 2.5 qt/a PRE; 9) Acuron at 1.5 qt/a PRE fb Roundup PowerMax3 at 25 oz/a + Acuron at 1.25 qt/a + AMS at V3-V4; 10) Zidua SC (pyroxasulfone) at 4.64 fl oz/a + Callisto (mesotrione) at 5.8 oz/a + Stinger (clopyralid) at 0.31 pt/a + AAtrex at 1.25 pt/a PRE; 11) Acuron at 1.25 qt/a PRE fb Roundup PowerMax3 at 25 oz/a + Acuron at 1.25 qt/a + AMS at V4-V5; 12) Resicore at 1.25 qt/a + AAtrex at 0.624 pt/a PRE fb Resicore + AAtrex at 0.624 pt/a + Roundup PowerMax3 at 25 oz/a + AMS at V3-V4; 13) Surestart II (flumetsulam + clopyralid + acetochlor) at 1.25 pt/a + AAtrex at 0.624 pt/a PRE fb Resicore + AAtrex at 0.624 pt/a + Roundup PowerMax3 at 25 oz/a + AMS at V3-V4; 14) Dual II Magnum PRE fb + Roundup PowerMax at 32 fl oz/a + Tough (pyridate) at 8 oz/a + AMS at V3-V4; 15) Acuron at 1.25 qt/a PRE fb Halex GT + AAtrex at 1.5 qt/a + COC at V4-V5; 16) Acuron at 1.25 qt/a PRE fb Liberty (glufosinate) at 32 oz/a + Dual II Magnum at V4-V5. A weedy (nontreated) check was included in the study. There was no corn injury from any herbicide application programs. All herbicide application programs except treatment 14 (75%) provided 90 to 99% control of glyphosate-resistant Palmer amaranth by 11-weeks after emergence (WAE). Only treatments 3, 6, 9, and 10 provided 91 to 95% control of entireleaf morningglory. All treatments provided 91 to 100% control of hemp sesbania and prickly sida. Broadleaf signalgrass control was 90, 94, 94, 91, 89, 93, 94, 93, 88, 95, 89, 83, 85, 94, 90, and 91 from treatment 1 through 16 by 11 WAE, respectively. Yield was affected by Stalk lodging. Corn yield was 153, 160, 148, 157, 145, 152, 150, 177, and 147 bu/a from treatment 1, 2, 4, 7, 9, 11, 13, 14, and 16, respectively. Weed interference (weedy check) reduced corn yield 51% as compared to the treatment with the highest corn yield. In general, the one-pass treatment of Halex GT at 3.6 pt/a + AAtrex at 1.5 qt/a + COC at 1% v/v at V3-V4 (standard treatment) was as good as any other treatment (either one-pass or two-pass) in terms of weed control and corn yield in this study.

Residual Herbicides for Broad- Spectrum Weed Management Programs in Mississippi Peanut. Taghi Bararpour*; Mississippi State University, Stoneville, MS (94)

A field study was conducted in 2023 at the Delta Research and Extension Center, in Stoneville, Mississippi, to evaluate Brake, Valor, and their tank-mixture combinations with residual herbicides for broad-spectrum weed management programs in Mississippi peanut (*Arachis hypogaea*). Peanut (Georgia-06G) was planted at a seeding rate of eight seeds ft^{-1} on May 25, 2023 and emerged on June 2. Plot size was 13 ft wide by 20 ft long. The plot area contained Palmer amaranth (*Amaranthus palmeri*), entireleaf morningglory (*Ipomoea hederacea var. integriuscula*), prickly sida (*Sida spinosa*), broadleaf signalgrass (*Urochloa platyphylla*), and hemp sesbania (*Sesbania herbacea*). The study was designed as a randomized complete block with 18 treatments and four replications. Herbicide treatments were as follows (rate in oz/a): 1) Brake at 16; 2) Brake at 32; 3) Valor (flumioxazin) at 1.5; 4) Valor at 3; 5) Brake at 16 + Valor at 1.5; 6) Brake at 16 + Valor at 3; 7) Brake at 32 + Valor at 1.5; 8) Brake at 32 + Valor at 3; 9) Valor at 3 + Dual Magnum (*S*-metolachlor) at 32; 10) Strongarm (diclosulam) at 0.45 + Dual Magnum; 11) Brake at 16 + Dual Magnum; 12) Valor at 3 + Brake at 16 + Dual Magnum; 13) Valor at 3 + Dual Magnum + Strongarm; 14) Valor at 3 + Dual Magnum + Strongarm + Brake at 16; 15) Brake at 16 + Strongarm + Dual Magnum; 16) Brake at 16 + Warrant (acetochlor) at 48; 17) Brake at 16 + Warrant + Valor at 1.5: and 18) nontreated check. All treatments were applied preemergence (PRE). Peanut injury was 9 and 1; 12 and 3; 3 and 0; 3 and 4; 8 and 3; 0 and 0; 6 and 0; 6 and 5; 3 and 1; 0 and 0; 8 and 4; 6 and 3; 5 and 5; 5 and 5; 1 and 0; 8 and 0; 3 and 0 from treatment 1 through 17 at 1- and 3-weeks after emergence (WAE), respectively. There was no peanut injury after 4 WAE. Palmer amaranth control was 70, 66, 81, 89, 78, 85, 79, 85, 80, 85, 84, 84, 83, and 82% from treatment 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 15, 16, and 17 at 6 WAE, respectively. Only treatment 8, 13, and 14 provided 90 to 93% control of Palmer amaranth at 6 WAE. Entireleaf morningglory control was 78, 79, 83, 94, 81, 89, 84, 94, 87, 89, 84, 88, 98, 95, 88, 80, and 81% from treatment 1 through 17 at 6 WAE, respectively. All herbicide treatments provided 90 to 100% control of prickly sida. The application of treatment 1 through 17 provided 66, 68, 70, 93, 74, 81, 81, 85, 69, 73, 68, 71, 90, 83, 71, 68, and 65% control of hemp sesbania at 6 WAE, respectively. Broadleaf signalgrass was a difficult weed to control. Treatment 1 through 17 provided 59, 58, 61, 75, 54, 55, 69, 78, 79, 86, 86, 81, 92, 92, 89, 76, and 56% control of broadleaf signalgrass at 6 WAE, respectively. Based on this study, treatments 13 (Valor at 3 + Dual Magnum + Strongarm), 14 (Valor at 3 + Dual Magnum + Strongarm + Brake at 16), and 15 (Brake at 16 + Strongarm + Dual Magnum) were the best applications in terms of longer residual activity and broad-spectrum weed control.

Soybean Response to Simulated Drift of Herbicides Commonly Used to Manage Roadside Vegetation in North Carolina. Estefania Gomiero Polli*, Travis W. Gannon, Ronald R. Rogers, Mathieu C. LeCompte; North Carolina State University, Raleigh, NC (95)

Herbicides are widely employed for cost-effective control of vegetation along roadsides. However, the increasing reports of herbicide off-target movement cases in agricultural settings in recent years have raised concerns among agencies responsible for managing roadside vegetation. The objective of this research was to investigate the response of soybean yield to simulated drift of herbicides commonly used along roadsides. Field studies were conducted at Sandhills Research Station in Jackson Springs, NC in 2022 and 2023. Treatments were arranged in a strip-plot design on a randomized complete design replicated 3 times in 2 experimental runs. The whole plots were a two-level factorial of 5 herbicides (sulfometuron, triclopyr, triclopyr + clopyralid, 2,4-D + dichlorprop, indaziflan) and 4 herbicides rates (1%, 5%, 10% and 100% of field rate), and the strip-plot was application timing (18, 12, 6, or 0 weeks before planting and 4 or 8 weeks after planting). Yield data were recorded and converted into a percentage of yield loss as compared to the untreated control. Sulfometuron-methyl and indaziflam caused the highest yield loss at pre-planting - 23% and 26%, respectively - and triclopyr alone, triclopyr + clopyralid, and 2,4-D + dichlorprop at post-planting - 78%, 45%, and 34%, respectively. Furthermore, except for triclopyr alone, YL was lower than 3% when herbicides were applied at 1% of the field rate. Findings of this study suggest that drift of sulfometuron-methyl and indaziflam is more prone to cause soybean yield loss if it occurs pre-planting while post-planting, drift of triclopyr, triclopyr + clopyralid, and 2,4-D poses a higher risk of reducing crop yield.

Fall Application of Soil Residual Herbicides Reduces Weed Abundance in Spring-Planted Fava Beans. Akamjot Brar*[1], Qasim Khan[2], Fabian Menalled[1], Zach Miller[3], Clint W. Beiermann[4], Kent McVay[2], Lovreet S. Shergill[2]; [1]Montana State University, Bozeman, MT, [2]Montana State University, Huntley, MT, [3]Montana State University, Corvallis, MT, [4]University of Nebraska-Lincoln, Scottsbluff, NE (96)

Introducing favabeans (Vicia faba L.) to the Montana cropping systems can offer several crop production, soil improvement, and weed management advantages, but their slow early growth and germination require careful weed control for establishment. This study, conducted at the Southern Agricultural Research Center in Huntley, MT, during 2022 and 2023 with a randomized complete block design with 4 reps and 14 treatments assessed the effectiveness of fall applied soil-active herbicides for weed control in spring-planted fava beans. Best treatments included the herbicide combinations of pyroxasulfone at 131 g/ha ae + flumioxazin at 60.6 g/ha ae, and dimethamid at 950 g/ha ae + pendimethalin at 1.68 kg/ha and metribuzin at 420 g/ha ae alone provided season long control (80-95%) of broadleaf weeds, whereas other tested herbicides provided around 50-70% weed suppression for Kochia (Bassia scoparia L.) and redroot pigweed (Amaranthus retroflexus L.). The subsequent post-emergence application of pyridate (700 g/ha ae) ensured season-long control by eliminating escaped weeds and any potential weed seed bank additions. No serious crop damage was observed with any of the applied treatments and the best treatments provided an 80-100% increase in yield compared to untreated checks. These herbicides can be successfully integrated into current weed management options, facilitating the successful introduction of favabeans into the current cropping systems.

Corn (*Zea Mays*) Tolerance to PRE and POST Application of Metribuzin. Donnie Miller*, Ashley Barfield; LSU AgCenter, St Joseph, LA (97)

A field study was conducted at the LSU AgCenter Northeast Research Station near St. Joseph La in 2023 with the objective to evaluate corn tolerance to metribuzin applied PRE and POST. A three-replication factorial treatment arrangement was utilized and included metribuzin application timing (Factor A: PRE, 2-lf, or 4-lf) and rate (Factor B: 0.047, 0.141, or 0.234 lb ai/A). A nontreated control was included for visual injury comparison and height/yield reduction calculation. Treatments were applied to each 1.9 x 7.6 m plot at designated application timings: at planting of 'DKC 65-99' corn on March 23, to 2-lf corn on April 20, or to 4-lf corn on May 2. Parameter measurements included visual injury 7, 14, and 28 d after application (DAT), height reduction 14 and 28 DAT, and yield reduction. Plant height data for the PRE application timing was lost therefore only the height reduction data for the POST timings is discussed. Factor interactions were not noted for any parameter. Plant visual injury in the form of slight chlorosis was minimal and no greater than 5% at the earliest evaluation intervals and nonexistent by 28 DAT. At 14 DAT, averaged across metribuzin rate, height was reduced 7% at both POST timings in comparison to nontreated plants. Averaged across application timing, pant height was reduced 5 to 8% and equally by all rates. Results were similar 28 DAT with similar plant height reduction of 9 and 10% among POST timings and metribuzin rates. Averaged across metribuzin rate, corn yield reduction ranged from 1 to 2% and was similar among all application timings. Averaged across application timing, corn yield reduction ranged from 1 to 3% and was similar among all metribuzin rates.

Initial Adoption of Physical Impact Mills in Canada. Breanne D. Tidemann*[1], Charles M. Geddes[2], Shaun Sharpe[3]; [1]Agriculture and Agri-Food Canada, Lacombe, AB, Canada, [2]Agriculture and Agri-Food Canada, Lethbridge, AB, Canada, [3]Agriculture and Agri-Food Canada, Saskatoon, SK, Canada (98)

The evolution and spread of herbicide resistant weeds has increased interest in alternative weed management strategies such as harvest weed seed control. Adoption of physical impact mills has begun in Canada as an additional weed management strategy, primarily in Western Canada. A survey of early adopters of physical impact mill technology in Canada was conducted to better understand the motivations behind producers adopting, initial experiences, and research needs. Ten producers responded to the survey, accounting for 18 out of an estimated 30 impact mills in use in the Canada, primarily on the Canadian Prairies. These producers represented larger farms (> 4,000 ha), outfitted the majority of their combines with mills (75% average), and used the mills in essentially all crops grown. Most of the respondents were from Saskatchewan farms with two mills being used in Alberta. Wild oat and kochia were the dominant weeds motivating impact mill adoption. Additional fuel costs from using impact mills was estimated at CAD \$3.46 ha^{-1}, with approximately CAD \$1,500 required each year for maintenance. Primary sources of information for these early adopters were the mill manufacturers and other early adopting farmers, with extension talks and social media being secondary sources of information. Future research needs identified by producers included confirming efficacy, optimizing combine settings, and interactions with precision agriculture technologies.

Enversa™: A New Tool for In-season Residual Weed Control. Kelly A. Backscheider*[1], David M. Simpson[2], Drew Ellis[3], Mike Lovelace[4], Lowell D. Sandell[5]; [1]Corteva, Franklin, IN, [2]Corteva, Indianapolis, IN, [3]Corteva agriscience - IFS, Arlington, TN, [4]Corteva Agriscience, Newcastle, OK, [5]Corteva Agriscience, Ankeny, IA (99)

Waterhemp (*Amaranthus tuberculatus*) and Palmer amaranth (*Amaranthus palmeri*) continue to be driver weeds in soybean production throughout the Midwest. Due to *Amaranthus* species long germination period, the use of Group 15 herbicides applied in-season is often beneficial for effective control. However, many Group 15 herbicides can cause crop response including necrosis and leaf deformation when applied POST in soybean. Enversa™ is a new herbicide developed by Corteva Agriscience and is a proprietary formulation of acetochlor for preplant and POST application in soybean. Trials were conducted in 2023 to evaluate soybean crop tolerance with POST application of Enversa™ at 1X and 2X rates compared to other commonly used Group 15 herbicides. Group 15 herbicides are often applied in combination with other herbicides including glyphosate, glufosinate and 2,4-D choline. Therefore, two and three-way tank-mix combinations with these common tank-mix partners were evaluated. Initial crop response was highest at 7DAA in the 2x tank mixtures, averaging 9 to 11%. However, crop response dissipated to <10% with Enversa™ at 1X and 2X rates at 14 days after application (DAA), and continued to decline in subsequent evaluations. Additionally, all tank-mix combinations averaged less than 15% crop response when averaged across 12 locations at 7 to 14 DAA. Enversa™ will be the preferred residual tank-mix partner for the Enlist® weed control system, pending US EPA regulatory approval, and will be an important residual tool in managing resistant weeds such as waterhemp and Palmer amaranth.

A Systems Approach for Controlling Dicamba Resistant Palmer Amaranth (*Amaranthus palmeri*). Megan M. Singletary*[1], Peter A. Dotray[2], Larry Steckel[3], Gaylon Morgan[4]; [1]Texas Tech University, Lubbock, TX, [2]Texas Tech University/ Texas A&M AgriLife Research and Extension, Lubbock, TX, [3]University of Tennessee, Jackson, TN, [4]Cotton Incorporated, Cary, NC (100)

Dicamba-resistant Palmer amaranth was first reported from Tennessee cotton and soybean fields in 2020. This resistance poses a particular challenge for growers who already face herbicide-resistance to several HRAC modes of action including groups 2, 9, 10, and/or 14. A study was conducted in 2023 at the Texas Tech University New Deal Research Farm near New Deal to evaluate herbicide systems designed to manage dicamba resistant Palmer amaranth. This location is equipped with sub-surface drip irrigation and contains a dense Palmer amaranth weed seed bank. The trial area received a blanket application of trifluralin at 0.84 ai ha^{-1} applied preplant and incorporated twice with a rolling cultivator. ST5091 cotton was planted on May 18 at 104,050 seeds ha^{-1}. Fluometuron (fluo) at 1.12 kg ai ha^{-1} applied alone or fluo at 0.84 kg ai ha^{-1} combined with fluridone (flur) at 0.56 kg ai ha^{-1} was applied preemergence (PRE) at-planting. *S*-metolachlor (*S*-meto) at 1.07 kg ai ha^{-1}, dimethenamid (dime) at 0.84 kg ai ha^{-1}, *S*-meto + glyphosate (gly) at 1.65 kg ai ha^{-1} + glufosinate (glu) at 0.88 kg ai ha^{-1}, or dime + gly + glu was applied early-postemergence (EPOST) to 4-leaf cotton. Pyroxasulfone (pyro) at 0.117 kg ai ha^{-1} was applied mid-postemergence (MPOST) to 8-leaf cotton, and diuron (diur) at 0.56 kg ai ha^{-1} + MSMA at 2.2 kg ai ha^{-1} was applied late-postemergence (LPOST). The MPOST and LPOST applications were made using a Redball hooded sprayer. Visual Palmer amaranth control was recorded prior to each application timing. At 27 days after planting (DAP), just prior to the EPOST application, fluo + flur controlled Palmer amaranth 85%, which was greater than fluo alone (76%). At 43 DAP, just before the MPOST application, all gly + glu tank mix combinations with dime or *S*-meto EPOST controlled Palmer amaranth 99-100% regardless of the preemergence treatment. Without gly + glu, dime or *S*-meto alone failed to control Palmer amaranth >75%. At 70 DAP, just before the LPOST application, = 97% Palmer amaranth control was observed following treatments containing gly + glu EPOST and pyro MPOST. End of season Palmer amaranth control (125 DAP) was = 99% when diur + MSMA was added in a system following treatments that contained dime or *S*-meto with gly + glu EPOST; however, Palmer amaranth control was 96-100% when treatments contained gly + glu EPOST followed by (fb) pyro MPOST fb no LPOST treatment. Of the harvestable plots, lint yield up to 891 kg ha^{-1} was observed following an EPOST application of gly + glu and up to 1019 kg ha^{-1} from plots treated with gly + glu EPOST fb pyro MPOST. Results from this study suggest that dicamba-resistant Palmer amaranth can be effectively controlled without the use of dicamba if timely applications are made. The EPOST application of gly + glu + dime or *S*-meto appeared to be a critically important input for Palmer amaranth management. Additional soil active herbicides at-plant and MPOST were also critical for effective season-long management.

Response of Newly Established Energycane to Cyhalofop-butyl and Florpyrauxifen-benzyl. D Calvin Odero*[1], Shabnam Sadeghibaniani[2]; [1]University of Florida, Belle Glade, FL, [2]University of Florida, Belle Glade, Fl, FL (101)

Energycane is a perennial bioenergy crop that produces lignocellulosic biomass proposed as a possible feedstock for biofuel production in the United States. The southeast United States including Florida is projected to provide feedstocks for biofuel production from perennial grasses such as energycane. In Florida, energycane is to be cultivated in cropping systems which involve rotation with rice. Energycane tolerance to rice herbicides needs to be evaluated to provide potential growers with options for selective control of escapes if planted hectares in Florida increase in the future. Outdoor studies were conducted in Belle Glade, FL in 2023 to evaluate the efficacy of rice herbicides cyhalofop-butyl and florpyrauxifen-benzyl on energycane. Cyhalofop-butyl was applied at 39 to 313 g ha^{-1} and florpyrauxifen-benzyl was applied at 4 to 59 g ai ha^{-1}. Energycane varieties UFCP84-1047 and UFCP84-0053 were evaluated using the herbicides. The herbicides were applied to energycane at the three- to four-leaf stage of growth. Cyhalofop-butyl provided 70% control at the rice labelled rate (313 g ha^{-1}) compared to 40% control with florpyrauxifen-benzyl at the labelled rate (29 g ha^{-1}). Doubling the rate of both herbicides increased control by 10% and 15% for cyhalofop-butyl and florpyrauxifen-benzyl, respectively. These results showed that rice herbicides will not provide acceptable energycane control when applied under non-flood conditions. Further studies will be evaluated to determine the effect of these herbicides on energycane under flooded conditions in which rice is cultivated.

Impact of Application Time on the Fate of PRE-emergence Herbicides in Wisconsin Early-Planted Soybean. Rodrigo Werle*[1], Guilherme Chudzik[1], Ryan P. DeWerff[2], Shelby Lanz[3], Thomas C. Mueller[3]; [1]University of Wisconsin-Madison, Madison, WI, [2]University of Wisconsin, Madison, WI, [3]University of Tennessee, Knoxville, TN (102)

As farmers in the US Upper Midwest shift towards earlier soybean planting time, the in-season efficacy of preemergence herbicides sprayed at planting time is likely to be reduced. Investigating the optimal time of preemergence herbicide application in early-planted soybean is warranted to identify best weed management practices for this novel agronomic management practice. A field study was conducted to evaluate the impact of soil management strategy and preemergence (PRE) herbicide application time on herbicide fate in soil. The study was conducted following a complete randomized block design with four replications in 2022 and 2023 at two locations (Arlington and Brooklyn; Wisconsin). Treatments consisted of a 2X5 factorial with two soil management practices (tillage and no-till) and four application times (at planting, 14, 28, and 41 days after planting) of fomesafen (266.3 g ai ha^{-1}) / S-metolachlor (1,216.7 g ai ha^{-1}) + imazethapyr (70 g ai ha^{-1}) plus a non-treated check (no PRE herbicide applied). Soil samples (0-7.6 cm) were collected 21 days after the last treatment time to quantify S-metolachlor and imazethapyr concentration in the soil. A major difference in precipitation pattern was observed between 2022 and 2023, with much lower precipitation during 2023 growing season, especially at the Arlington location. Results showed an overall smaller herbicide concentration in soil at the Brooklyn location (lighter soil) when compared to Arlington (heavier soil), suggesting faster herbicide dissipation in the lighter soil. The Arlington location showed slower dissipation, particularly during the drought year of 2023, with higher herbicide concentrations compared to 2022. Farmers should be aware that when planting soybean early and using PREs, lighter soils will have faster residual herbicide degradation. Additionally, the early application of PRE herbicides in lighter soils during wet years may result in reduced residual control of late emerging weeds such as waterhemp (*Amaranthus tuberculatus*) and small seeded annual grasses (e.g., *Setaria* spp.), resulting in increased reliance and selection pressure on postemergence herbicides. Further research will look into how herbicide concentration in the soil translates into actual weed control in the field.

Efficacy of Fluridone in Peanut Production Systems. Ethan Foote*, David L. Jordan; North Carolina State University, Raleigh, NC (103)

Suppression of weeds during the first 6 weeks of the season is important for optimizing yield of peanut (*Arachis hypogaea* L.). Although a number of herbicides can be applied preplant incorporated and/or preemergence, herbicides are limited in peanut production systems. Presence of ALS-resistant and PPO-resistant Palmer amaranth (*Amaranthus palmeri* Watts.) and common ragweed (*Abrosia artemisiifolia* L.) increase pressure on those herbicides that are available for use in peanut. Fluridone recently received registration in North Carolina for use in peanut and offers a unique mode of action not previously available for use in this crop. Research was conducted to compare efficacy of fluridone applied with acetochlor, dimethenamid-*P*, flumioxazin, pendimethalin, or *S*-metolachlor compared with *S*-metolachlor plus flumioxazin. Herbicides were applied immediately after planting and received rainfall of at least 1.5 cm within three days after planting. The experiment was conducted at two locations in North Carolina in 2023. Carpetweed (*Mullugo verticillata* L.), common ragweed, entireleaf morningglory [*Ipomoea purpurea* L.), large crabgrass (*Digitaria sanguinalis* L.), and Texas millet [*Urochloa texana* (Buckley) R. Webster] control by *S*-metolachlor plus flumioxazin was equal to or greater than control by fluridone regardless of the herbicide co-applied with fluridone. Common ragweed and Palmer amaranth were not resistant to PPO-inhibiting herbicides at these locations.

Effects of Weed Competition Duration on Grain and Fiber Hemp (*Cannabis sativa*) Yield.
Kevin Bamber*[1], Michael L. Flessner[1], Karla L. Gage[2], Eric J. Miller[3], Kaitlin E. Creager[3], Matthew P. Spoth[1], Lynn M. Sosnoskie[4]; [1]Virginia Tech, Blacksburg, VA, [2]Southern Illinois University Carbondale, Carbondale, IL, [3]Southern Illinois University, Carbondale, IL, [4]Cornell University, Geneva, NY (104)

Industrial hemp is an emerging field crop in the U.S., and there is limited knowledge about the impact of weed competition duration during the growing season. Field studies were established in Blacksburg, Virginia in 2022 and 2023 to evaluate the impact of weed competition duration on grain and fiber production in industrial hemp. The studies utilized randomized complete block design and included two dual-purpose (grain/fiber) varieties (NWG 2730 both years, Joey in 2022, and Félina 32 in 2023) and one fiber variety (JinMA) each year. Plots were maintained weed-free for 0, 1, 2, 4, 6 weeks after hemp emergence, and season long (12-17 weeks depending on maturity of harvest products), with hemp grain, hemp biomass, and weed biomass collected from a fixed 1 m^2 quadrat at harvest. Data analysis focused on modeling variation in hemp grain and biomass yield with weed competition duration (i.e. weeks weed-free) and weed biomass at harvest. In dual-purpose varieties, weed biomass was a more reliable predictor of hemp grain and biomass yield than weed competition duration, but models never explained more than 47% of variation in the data. Hemp grain yield decreased by roughly 100 kg ha^{-1} for every 1000 kg ha^{-1} increase in weed biomass. Hemp biomass decrease with weed biomass increase was more variety-specific in dual-purpose varieties, ranging 400 – 900 kg ha^{-1} hemp biomass decrease with every 1000 kg ha^{-1} weed biomass increase. For the fiber variety, neither weed competition duration nor weed biomass predicted hemp biomass yield. Weed biomass always decreased as weeks weed-free increased, but weed biomass varied widely in plots that were maintained weed-free for 0, 1, and 2 weeks, ranging 0 – 9000 kg ha^{-1} in dual-purpose varieties and 5 – 1600 kg ha^{-1} in the fiber variety. Conversely, weed biomass rarely exceeded 50 kg ha^{-1} in plots that were maintained weed-free for four or more weeks across all varieties. It is possible that the wide variation of weed pressure (that is, weed biomass at harvest) obscured the relationship between duration of weed competition and grain and fiber yield in industrial hemp. While more research is needed, these data suggest that maintaining industrial hemp weed-free for four weeks after emergence has the potential to prevent grain and fiber yield loss from weed competition.

Weed Suppression in Quinoa Fields: Evaluating Chemical and Mechanical Control Methods.
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The global challenges of decreasing water resources, widespread salinity, and drought stress underscore the importance of identifying plants that can thrive in such harsh conditions. Quinoa, a well-known cereal crop, stands out for its resilience to salt and drought and minimal nutrient and nutritional requirements, making it highly valuable in agriculture. However, quinoa production faces a significant hindrance from weeds, which compete for nutrients, light, water, and space, decreasing yield and grain quality. Existing research on suitable herbicides for quinoa is limited, and findings suggest that most herbicides cause substantial damage to quinoa plants and are ineffective in controlling weed infestations in quinoa fields. To address this gap, this study investigated various mechanical and chemical methods for weed control in quinoa fields. The experiment employed a randomized complete block design with nine treatments, replicated four times at the University of Kurdistan Research Center, Iran, 2020. Treatments included weed-free, weed-infested, hand weeding, once inter-row cultivation, twice inter-row cultivation, inter-row flaming, paraquat 400 g ai ha^{-1}(post-emergence), pendimethalin 455 g ai ha^{-1} (pre-emergence), and paraquat 400 g ai ha^{-1}+ salicylic acid 5% (seed priming). The findings indicated substantial reductions in weed biomass with various treatments: paraquat application, twice inter-row cultivation, hand weeding, inter-row flaming, and once inter-row cultivation resulted in reductions of 86%, 84%, 82%, 80%, and 70%, respectively, compared to weed-infested plots. Additionally, it was observed that weeds had a significant negative impact on quinoa yield, causing a reduction of 65%. Conversely, practices such as hand weeding performed twice, inter-row cultivation, and inter-row flaming exhibited notable increases in quinoa yield by 74%, 53%, and 41%, respectively, compared to weed-infested plots. Notably, twice inter-row cultivation and hand weeding emerged as the most effective weed control, contributing to the highest enhancement in quinoa yield. While the paraquat and pendimethalin treatments demonstrated effective weed control, the high sensitivity of quinoa to these herbicides hindered its recovery, resulting in minimal or zero yields. Therefore, carefully considering herbicide selection and application methods is crucial to ensure optimal weed management without compromising the quinoa crop yield.

Evaluation of a Diflufenican-Containing Premix for Residual Palmer Amaranth Control Compared to Current Commerical Soybean Standards. Matthew C. Woolard*[1], Jason K. Norsworthy[1], Tanner A. King[2], Christian T. Arnold[1], Tristen H. Avent[1], Thomas R. Butts[3], Tom Barber[3]; [1]University of Arkansas, Fayetteville, AR, [2]University of Arkansas Division of Agriculture, Fayetteville, AR, [3]University of Arkansas, Lonoke, AR (106)

Palmer amaranth [*Amaranthus palmeri* (S.) Wats.] is the most problematic weed that soybean [*Glycine max* (L.) Merr.] producers face annually. Palmer amaranth has evolved resistance to nine different sites of action globally, leaving producers searching for new sites of action to control this weed. Bayer CropScience is seeking registration of Convintro™ brand herbicides, with one targeted for use in soybean to control Palmer amaranth. Convintro will contain three active ingredients: diflufenican, metribuzin, and flufenacet, adding a new site of action for soybean producers. Therefore, field experiments were conducted at the Northeast Arkansas Research and Experiment in Keiser, Arkansas, in 2022 and 2023 to evaluate the length of residual control of Palmer amaranth compared to commonly used preemergence herbicides. Treatments evaluated included Convintro, Convintro plus Xtendimax with VaporGrip Technology, Warrant, Tricor, Boundary, and Fierce MTZ. In 2022, injury 14 days after treatment (DAT) ranged from 0 to 31%, with the highest injury caused by treatments containing Convintro. In 2023, <5% injury occurred following all treatments, with no difference observed. Convintro was superior or comparable to all treatments in reducing Palmer amaranth emergence 14 days after treatment in both years. By 42 DAT, Fierce MTZ in both years and Tricor in 2023 were superior to Convintro in inhibiting Palmer amaranth emergence. One possible difference in site years can be attributed to the differences in rainfall amounts. Future research should include application timing of Convintro to reduce soybean injury and maximize weed control. Overall, Convintro provides control levels comparable to or superior to several herbicides currently used in soybean and adds a new site of action to help diversify weed control programs.

Dissipation and Carryover Potential for Tetflupyrolimet on Two Silt Loam Soils in the Midsouth. Mason C. Castner*[1], Jason K. Norsworthy[1], Jeong-In Hwang[1], James Stry[2], Atul Puri[3], Richard M. Edmund[4]; [1]University of Arkansas, Fayetteville, AR, [2]FMC, Landenberg, PA, [3]FMC, Newark, DE, [4]FMC, Little Rock, AR (107)

Tetflupyrolimet (TVE29) is the first herbicide in three decades with a novel mode of action for preemergence (PRE) control of barnyardgrass in rice (*Oryza sativa* L.). With the anticipated launch of TVE29, producers in proximity to rice fields may be concerned with off-target movement of the herbicide or carryover to rotational crops. To address the potential for TVE29 to carryover to corn (*Zea mays*), cotton (*Gossypium hirsutum*), grain sorghum (*sorghum bicolor*), and soybean [*Glycine max* (L.) Merr.], two experiments were initiated in 2021 near Colt and Stuttgart, AR, at the Pine Tree Research Station and the Rice Research and Extension Center, respectively. Bulk rice was planted and treated preemergence (PRE) with tetflupyrolimet at none, low, and a high rate of the herbicide. Soil samples were collected at the initial application and bi-weekly until a permanent flood was established. In 2022, corn, cotton, grain sorghum, and soybean were planted within the treated areas from the prior year and final soil samples were collected approximately 365 days after the initial application. TVE29 was extracted from the soil samples and analyzed for the herbicide with LC MS/MS to generate dissipation curves and estimate half-life. In 2022, visible injury to crops was recorded weekly throughout the growing season and grain or lint yield was collected at maturity. No visible injury or reductions in yield could be detected from TVE29 to the subsequently planted crops from (PRE) applications at a low or high rate of the herbicide in the 2021 growing season. At this time, results from the soil analysis are ongoing; however, the risk of carryover from TVE29 to the crops evaluated appears to be unlikely.

Economic Analysis and Effectiveness of Enlist E3 Soybean Herbicide Programs in Arkansas.
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Enlist E3 soybean (*Glycine max* L. Merr.) is an attractive option to producers competing with herbicide-resistant populations of Palmer amaranth (*Amaranthus palmeri* S. Wats.) by utilizing three modes of action (MOA) to control weeds. However, many questions arise regarding the number of applications required and herbicide combinations needed to optimize both weed control and economic returns. The objective of this research was to assess varying herbicide programs in the Enlist E3 soybean system for weed control, soybean yield, and return on investment (based solely on herbicide and application cost). Field experiments were conducted near Marianna, Newport, and Rohwer, Arkansas in 2023. The experiment was set up in a randomized complete block design consisting of 17 total treatments with four replications. The study was designed to evaluate the necessity of: (1) multiple preemergence (PRE) MOA, (2) multiple application timings (2 vs 3), (3) an overlapping residual herbicide, and (4) order in which glyphosate and glufosinate were applied. All herbicide applications were made using a CO_2-pressurized backpack sprayer with AIXR110015 nozzles. Location was considered a random effect for all analyses. The economic analysis was conducted using 2023 herbicide and application costs from a local retailer, and the 2023 USDA-Risk Management Agency soybean harvest price of \$0.47 kg^{-1} (\$12.84 bushel^{-1}). There was no difference in soybean yield across treatments as all yields were within 290 kg ha^{-1}. As a result, the economic analysis revealed that the greatest return on investment (\$1,434 ha^{-1}) occurred from the simplest herbicide program [*S*-metolachlor PRE followed by (fb) 2,4-D and glyphosate early postemergence (EPOST)]. The lowest return on investment (\$1,187 ha^{-1}) occurred from a herbicide program consisting of a multi-MOA PRE (*S*-metolachlor + metribuzin) fb an EPOST of 2,4-D + glyphosate fb a late postemergence (LPOST) of 2,4-D + glyphosate which was approximately double the cost of the herbicide program with the greatest return. The herbicide program with the second lowest return on investment also relied upon sequential applications of 2,4-D and glyphosate with no overlapping residual. This would indicate that although multiple MOA's and overlapping residuals did not provide the greatest return on investment, they do provide an advantage over comparable programs that do not include overlapping residuals or rotate MOA's. Additionally, greater than 95% visual Palmer amaranth control four weeks after final application (WAFA) was only achieved in the treatments that received three herbicide applications with *S*-metolachlor + metribuzin applied PRE. The lowest Palmer amaranth control four WAFA (81%) was observed in the two simplest herbicide programs (*S*-metolachlor fb 2,4-D plus glyphosate or glufosinate). Although one of these herbicide programs provided the greatest return on investment, the 14 percentage point reduction in visual control from the top herbicide programs would significantly increase the soil seedbank thereby impacting long-term economic returns. Overall, this research highlighted that the greatest economic returns occurred in minimalist herbicide programs; however, overlapping residuals and alternating MOA's in sequential applications also provided economic benefits. Future research should evaluate the long-term economics of reduced herbicide programs that allow for additions to the soil seedbank.

Economic Analysis and Effectiveness of XtendFlex Soybean Herbicide Programs in Arkansas.
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The XtendFlex soybean (*Glycine max* L. Merr.) system is one of the most commonly used herbicide trait packages in the Mid-south. The ability to utilize three modes of action (MOA) is an attractive option for Mid-south soybean producers who are looking to battle herbicide-resistant populations of Palmer amaranth (*Amaranthus palmeri* S. Wats.). However, with today's limited profit margins, understanding the economic returns of various herbicide programs is a necessity. The objective of this research was to assess varying herbicide programs in the XtendFlex soybean system for weed control, soybean yield, and return on investment (based solely on herbicide and application cost). Field experiments were conducted near Marianna, Newport, and Rohwer, Arkansas in 2023. The experiment was set up in a randomized complete block design consisting of nine total treatments with four replications. The study was designed to evaluate the necessity of: (1) multiple preemergence (PRE) MOA, (2) an overlapping residual herbicide, and (3) dicamba applied PRE. All herbicide applications were made using a CO_2-pressurized backpack sprayer with TTI110015 nozzles. Location was considered a random effect for all analyses. The economic analysis was conducted using 2023 herbicide and application costs from a local retailer, and the 2023 USDA-Risk Management Agency soybean harvest price of \$0.47 kg^{-1} (\$12.84 bushel^{-1}). There was no difference in soybean yield across treatments as all yields were within 400 kg ha^{-1}. The economic analysis revealed that the greatest return on investment (\$1,581 ha^{-1}) occurred from a herbicide program that consisted of three applications with a multiple MOA PRE [*S*-metolachlor + metribuzin PRE followed by (fb) dicamba + a volatility reduction agent (VRA) early postemergence (EPOST) fb glyphosate + glufosinate late postemergence (LPOST)]. The lowest return on investment (\$1,275 ha^{-1}) occurred from a herbicide program that did not contain metribuzin nor an overlapping residual [*S*-metolachlor + dicamba + VRA PRE fb dicamba + VRA EPOST fb glyphosate + glufosinate LPOST. The three herbicide programs that provided return on investments greater than \$1,500 ha^{-1} all relied upon multiple PRE MOA's (*S*-metolachlor + metribuzin) or overlapping EPOST residuals (pyroxasulfone). Additionally, greater than 95% visual Palmer amaranth control two weeks after the EPOST application (WAEPOST) was only achieved by treatments that received the multiple MOA PRE (*S*-metolachlor + metribuzin). The lowest Palmer amaranth control two WAEPOST (85-87%) was observed in three herbicide programs that did not contain metribuzin PRE nor did they utilize sequential dicamba applications with an overlapping residual (pyroxasulfone) EPOST. These three herbicide programs with the lowest Palmer amaranth control also resulted in 3 of the 4 lowest economic returns on investment. Overall, this research highlighted that the greatest economic returns occurred in herbicide programs containing multiple MOA PRE's, particularly metribuzin. Additionally, overlapping residuals and including dicamba PRE generally improved weed control and increased economic benefits. Future research should evaluate the long-term economics of reduced herbicide programs that allow for additions to the soil seedbank.

Herbicide Strategies to Control Glyphosate-, Dicamba-. and Glufosinate-resistant Kochia (*Bassia scoparia*) Populations in Triple-Stacked Sugarbeet Cultivar. Het Samir Desai*[1], Fabian Menalled[1], Lovreet S. Shergill[2]; [1]Montana State University, Bozeman, MT, [2]Montana State University, Huntley, MT (110)

The prevalence of two-way resistance, specifically to glyphosate and dicamba, within *Bassia scoparia* populations poses a significant challenge to triple-stacked sugarbeet cropping systems in the Northern Great Plains. Our August 2021 survey identified 40% two-way glyphosate and dicamba resistance in *B. scoparia* populations across Southcentral Montana and Northwest Wyoming. Therefore, a greenhouse study was conducted in a randomized complete block design with three two-way resistance *B. scoparia* populations (K18, K24, and K54) and three replications. Herbicide treatments included POST-emergence tankmix applications of dicamba (0.4 kg ae ha^{-1}) + glyphosate (1.0 kg ae ha^{-1}), dicamba (0.6 kg ae ha^{-1}) + glyphosate (1.3 kg ae ha^{-1}), dicamba (0.4 kg ae ha^{-1}) + glyphosate (1.0 kg ae ha^{-1}) followed by dicamba (0.4 kg ae ha^{-1}) + glyphosate (1.0 kg ae ha^{-1}), and dicamba (0.6 kg ae ha^{-1}) + glyphosate (1.3 kg ae ha^{-1}) followed by dicamba (0.6 kg ae ha^{-1}) + glyphosate (1.3 kg ae ha^{-1}). Sub-optimal efficacy of all POST-emergence tankmix applications was observed as weed control ranged from 10% to 79%. Furthermore, the PRE-emergence applications of dicamba (0.6 kg ae ha^{-1}), ethofumesate (3.4 kg ai ha^{-1}), and dicamba (0.6 kg ae ha^{-1}) + ethofumesate (3.4 kg ai ha^{-1}) were tested on two-way resistance *B. scoparia* populations. This study is ongoing, and results are anticipated by 10th January 2024. This research aims to provide crucial insights into effective herbicide strategies for managing glyphosate- and dicamba-resistant *B. scoparia* in the Northern Great Plains.

Herbicide Senesitivity Variation in *Echinochloa* Species. Do-Soon Kim*; Seoul National University, Seoul, South Korea (112)

Echinochloa species is one of the most troublesome weeds in both upland and paddy fields due to its high competitiveness and increasing herbicide resistance. The inreasing herbicide resistance has led to the development of new herbicides for herbicide resistant *Echinochloa* management. For the new herbicide, it is essential to investigate the herbicide sensitivity variation in *Echinochloa* species, which may provide with indication (baseline sensitivity index) of its potential risk of resistance development to the herbicide. As a model case, we conducted the sensitivity variation study to evaluate the baseline sensitivity of *Echinochloa* species to florpyrauxifen-benzyl to estimate the risk of future resistance development. A total of 70 and 71 accessions of *Echinochloa crus-galli* and *Echinochloa oryzicola* were collected from paddy fields in Korea, respectively. These two *Echinochloa* species were grown in plastic pots up to the 5-leaf stage, and treated with florpyrauxifenbenzyl at a range of doses from 2.2 g to 70.0 g a.i. ha^{-1}. Nonlinear regression analyses revealed that GR_{50} values for *E. oryzicola* ranged from 4.54 g to 29.66 g a.i. ha^{-1}, giving a baseline sensitivity index (BSI) of 6.53, while those for *E. crus-galli* ranged from 6.15 g to 16.06 g a.i. ha^{-1}, giving a BSI of 2.61. Our findings suggest that *E. oryzicola* has a greater variation in sensitivity to florpyrauxifen-benzyl than *E. crus-galli*, indicating greater potential risk for the development of resistance to florpyrauxifen-benzyl.

Multiple Resistance to Glyphosate, Dicamba, Chlorsulfuron, Fluroxypyr and Atrazine in Kochia (Bassia Scoparia) from Southcentral Great Plains. Sachin Dhanda*[1], Vipan Kumar[2], Anita Dille[3], Augustine Obour[3], Elizabeth Yeager[3], Johnathan Holman[3]; [1]Kansas State University, Hays, KS, [2]Cornell University, Ithaca, NY, [3]Kansas State University, Manhattan, KS (113)

Kochia [*Bassia scoparia* (L.) A. J. Scott] is one of the most troublesome summer annual broadleaf weed species in the southcentral Great Plains (SGP). Main objectives of this research were (1) to determine the frequency and distribution of herbicide-resistant (HR) kochia in the SGP region and (2) to quantify the level of resistance in HR kochia populations. For objective 1, about 86 kochia populations collected from Kansas (KS), Oklahoma (OK), and Texas (TX) were separately grown in a greenhouse at Kansas State University Agricultural Research Center (KSU-ARC) near Hays, KS using 50-cell plastic trays containing commercial potting mixture. Each population was separately sprayed with glyphosate (1260 g ha^{-1}), atrazine (1120 g ha^{-1}), dicamba (560 g ha^{-1}), fluroxypyr (235 g ha^{-1}), chlorsulfuron (26 g ha^{-1}), and a premixture of dichlorprop/dicamba/2,4-D (374/186/186 g ha^{-1}). Percent survival frequency based on dead and live counts was calculated at 28 days after treatment (DAT). Based on the initial screening data, two putative multiple HR populations and one susceptible (SUS) population were selected from KS, OK, and TX. Separate dose-response experiments for glyphosate, dicamba, and fluroxypyr were conducted in greenhouse at KSU-ARC with plants grown in 10-cm square plastic pots in a randomized complete block design with 12 replications. Data on percent visible injury and shoot dry weights were collected at 28 DAT. Screening results indicated that all surveyed populations were potentially resistant to glyphosate and chlorsulfuron with > 20% survival frequency. Several populations exhibited multiple resistance to glyphosate, chlorsulfuron, atrazine, and dicamba. Results from the dose-response experiments indicated that KS populations exhibited 4 to 6-, 3 to 7-, and 2 to 3-fold resistance to glyphosate, dicamba, and fluroxypyr, respectively, compared to SUS population. Similarly, the putative OK populations were 5 to 8-, 7 to 13-, and 2 to 3-fold more resistant to glyphosate, dicamba, and fluroxypyr, respectively, as compared to SUS population. The TX populations showed 5- and 3 to 7- fold resistance to glyphosate and dicamba, respectively, as compared to the SUS population. These results indicate that multiple HR kochia populations occur throughout the SGP region and awareness of alternative control practices may be warranted.

Genetic Characterization of the Resistance of Caruru Populations to Als-inhibiting Herbicides in the Main Soybean-producing Regions of Brazil. Acacio Goncalves Netto*[1], Marcelo Nicolai[1], Ramiro Fernando Lopez Ovejero[2], Gilmar José Picoli Junior[2], Vanessa Francieli Vital Silva[2], Paulo Ricardo Moreira da Silva[1]; [1]Agro do Mato Soluções Agronômicas, Santa Bárbara D'oeste, Brazil, [2]Bayer Crop Science, São Paulo, Brazil (114)

Genetic characterization of resistance can help identify common characteristics that are causing the expression of resistance or accelerating the selection process of the resistant biotype. The aim of this study was to evaluate allelic variation in resistance genes of Amaranthus spp. to ALS-inhibiting herbicides. The experiments used 15 ALS-resistant biotypes from 6 different Brazilian states: Goiás (1 biotype), Maranhão (1 biotype), Mato Grosso (6 biotypes), Minas Gerais (1 biotype), Paraná (4 biotypes) and Rio Grande do Sul (2 biotypes). DNA was extracted from the leaves of each of the samples using a standard CTAB protocol. The ALS gene was amplified by PCR using the primers ALS_F: 5'-ATGGCGTCCACTTCAACAAACC-3' and ALS_R 5'- CTAATAAGCCTTCTTCCAT CACCC -3'. Three replicates were carried out for each plant sample. The purified PCR products were sequenced using the following sequencing primers: Seq_FP1: 5'-AGTTGTA TTGCCACTTCTGGTCC-3', Seq_FP2: 5'-GAAA TCCTCGCCAATGGCTGAC-3', Seq_RP1: 5'-G TCAGCCATTGGCGAGGATTTC-3', Seq_RP2 5'-TGGACCAGAAGTGGCAATACAAAC-3'. The amino acid sequences obtained were compared using the Geneious Prime® 2022.1 program with a sequence from Amaranthus retroflexus under the GenBank accession number AF363369.1. After analysis, the biotypes were characterized with mutations at points ASP376GLU (11 biotypes), TRP574LEU (3 biotypes) and TRP574LEU plus SER653ASP (1 biotype). Therefore, resistance selection may be occurring in different ways between the Amaranthus species and the states studied. In addition, the mutation points may influence the resistance factor, as well as causing resistance to chemical groups other than the ALS mechanism of action, thus reflecting on the recommendation of herbicides and consequently on management.

Evaluation of Possible Hybridization Between the Weed Species Amaranthus Palmeri and Amaranthus Hibridus, Both Resistant to ALS and EPSPs Inhibitor Herbicides. Acacio Goncalves Netto*[1], Marcelo Nicolai[1], Ramiro Fernando Lopez Ovejero[2], Gilmar José Picoli Junior[2], Vanessa Francieli Vital Silva[2], Paulo Ricardo Moreira da Silva[1]; [1]Agro do Mato Soluções Agronômicas, Santa Bárbara D'oeste, Brazil, [2]Bayer Crop Science, São Paulo, Brazil (115)

Amaranthus hybridus, a common weed in Brazilian agriculture, has been associated with complications in the management of the main crops. Recently, biotypes of A. hybridus, observed in the states of Paraná and Mato Grosso, were identified with resistance to ALS and EPSPs inhibitor herbicides. With the identification of A. palmeri biotypes in Brazil in 2015 that were already resistant to ALS and EPSPs inhibitor herbicides, the question arose as to whether the species could be crossed. The aim of this study was therefore to evaluate possible hybridization between the caruru species A. hybridus and A. palmeri. To this end, the genetic structure of these species was analyzed using SNPS markers obtained from genome complexity reduction libraries using Genotyping by sequencing (GBS). After analyzing the results, it was observed that there was no parental level between the species, showing that there was no hybridization and that the management carried out in both states selected the biotypes with resistance.

Selection Pressure on Dairy Farmers Continues and Unprecedented Mutation (Asp376glu) for the Species is Found. Marcelo Nicolai*[1], Acacio Goncalves Netto[1], Ramiro Fernando Lopez Ovejero[2], Gilmar José Picoli Junior[2], Vanessa Francieli Vital Silva[2], Paulo Ricardo Moreira da Silva[1]; [1]Agro do Mato Soluções Agronômicas, Santa Bárbara D'oeste, Brazil, [2]Bayer Crop Science, São Paulo, Brazil (116)

Euphorbia heterophylla (milkweed) is an important plant in Brazilian soybean cultivation due to its resistance to various mechanisms of action such as ALS inhibitors, PROTOX and EPSPS. Although ALS-inhibiting herbicides were first reported in Brazil in 1993, it is not known whether the resistance mechanism is the same for all biotypes, or whether there has been some differentiation over the years. The aim of this study was to verify whether the resistance of dairy plants to imazethapyr is due to a known enzyme mutation or whether there is differentiation. The milkweed samples (40) were collected from soybean areas in Brazil with escape in the control. To confirm resistance, dose-response curves were carried out. Of the biotypes found to be resistant, six were considered for analysis, from the states of RS, MT, PR and SC. To investigate possible alterations in the ALS enzyme, DNA was extracted using the CTAB method. Two sets of primers were used (ALS1_F 5' CACCGACGTGTTCGCCTAC and ALS1_R 5' TGACTCCCTGCAAGGCTAATTTAAC/ ALS2_F 5' GGWACTGTTATGCCAATTATGCTG and ALS2_R 5' ATCTCCCATCACCCTCRGT), which cover the main regions of mutations in the ALS gene. The amino acid sequences revealed were compared using the Geneious Prime® 2022.1 program with a sequence from E. heterophylla under accession MT479177.1 (GenBank). Five of the samples carry the Trp574Leu mutation (Resistance Factor - RF: 21.48; 18.42; 16.06; 22.87 and 7.40), and in one of the samples an unprecedented mutation was observed for E. heterophylla, Asp376Glu (RF:10.26). It can be concluded that even though milkweed resistance to ALS is consolidated, selection pressure is still active, complexing resistance, which can alter FR, as well as insensitivity to different chemical groups of herbicides.

Premix of Glufosinate with Baicalin: What Does it Mean for Weed Control? Pamela Carvalho-Moore*[1], Jason K. Norsworthy[1], Arthur Yochim[2], Tristen H. Avent[1], Christian T. Arnold[1]; [1]University of Arkansas, Fayetteville, AR, [2]UPL, Raleigh, NC (117)

Glufosinate efficacy is often negatively impacted by environmental conditions or plant morphology. This herbicide is a foundational chemistry in postemergence weed control programs, and it is crucial to avoid unsuccessful applications to ensure longevity of the technology with consistent weed control. The glutathione *S*-transferases (GST) are enzymes highly correlated with the stress tolerance response and detoxification of xenobiotic compounds in plants, including herbicides. Therefore, the objective of this study was to evaluate how the premix of glufosinate and the plant flavonoid baicalin, identified as a potent GST-inhibitor, will impact weed control compared to glufosinate alone. Experiments were conducted at the Milo J. Shult Research and Experiment Center in Fayetteville, AR and at the Northeast Research and Extension Center in Keiser, AR. The treatments consisted of glufosinate alone or glufosinate/baicalin premix. A nontreated control was maintained for comparison. The weed species evaluated depended upon location, and weed control was evaluated weekly until 21 days after treatment across the different weed species: common lambsquarters (*Chenopodium album* L.), Palmer amaranth, and prickly sida (*Sida spinosa* L.). Biomass was collected for Palmer amaranth and prickly sida. At 21 DAT, control increase was observed in all weed species ($p < 0.1$) when the premix was used. Glufosinate/baicalin premix improved control by 32, 11, and 9 percentage points in common lambsquarters, prickly sida, and Palmer amaranth, respectively. The premix had a strong impact on Palmer amaranth biomass, reducing it by 78% in comparison to glufosinate alone. These results showed that the premix of glufosinate with baicalin increases weed control. Additional research is necessary to determine if this improvement is also observed across other problematic species.

Investigations on the Use of Electrocution for Controlling Weed Escapes in Organic Peanut.
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Electrical weeding has the potential to serve as an effective non-chemical weed control option in organic row crops. Organic peanut (*Arachis hypogaea*) growers are faced with limited options for controlling problematic weeds, especially those that escape control tactics early in the growing season. Therefore, assessments on the efficacy of electrical weeding on weed escapes above the peanut canopy were made in an organic peanut farm in Plains, Texas in summer 2023. Palmer amaranth (*Amaranthus palmeri*), waterhemp (*Amaranthus tuberculatus*), and large crabgrass (*Digitaria sanguinalis)* escapes were subjected to electrocution treatments at the early reproductive stage, using a tractor-driven weed electrocutor traveling at 1.6 kph. The treatments included one pass with the electrocutor on or off. The study was implemented in a randomized complete block design (plot size: 9 x 46 m), with four replications. All three test species were naturally present within each plot. At 7 and 21 days after treatment (DAT), visual injury ratings (from 0 to 100%) were conducted on 10 randomly selected plants of each species within each plot. Aboveground biomass of these 10 plants/plot was collected at 21 DAT and dried at room temperature (25 C) for 7 days. At 21 DAT, visual injury was >90% for Palmer amaranth and waterhemp but 61% for large crabgrass. Overall, electrocution was highly effective on Palmer amaranth and waterhemp, with biomass reductions exceeding 85% at 21 DAT. However, the treatment was not effective on large crabgrass, with no significant reduction in aboveground biomass when compared to a nontreated control. Crop injury was <5% within each plot. Results show that weed electrocution is highly effective on some species such as Palmer amaranth and waterhemp, but variable control can be seen with some other species, especially grasses. However, more research is necessary to further validate these preliminary findings and evaluate the effectiveness on additional weed species under different environments.

Rice Response to Fluoridone Following Top Soil Removal on Precision-Graded Fields.

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Furrow-irrigated rice (*Oryza sativa* L.) production has increased across the Mid-south; however, without the cultural strategy of a flood, weed control becomes more problematic. Additionally, weeds atypical to rice production, such as Palmer amaranth (*Amaranthus palmeri* S. Wats.), become troublesome. Precision-grading is an important aspect in Mid-south rice production to maintain an effective irrigation flow-path; however, removal of topsoil can severely impact crop response from residual herbicides. In 2022, a label was granted for fluridone (Brake®) herbicide use in rice production within the Mid-south. The objective of this study was to evaluate the impact of fluridone on rice response when applied to a precision-graded field. An on-farm field study was conducted in 2023 near Osceola, AR (35.7795, -89.9773) with a Sharkey-Steele clay complex soil type. The hybrid rice cultivar RT7521FP was grown in a furrow-irrigated production system. The study consisted of six treatments arranged in a randomized complete block design with four replications applied at the rice 3-leaf stage. These treatments included clomazone (Command 3ME) at 0.34 kg ai ha^{-1}, quinclorac (Facet L) at 0.42 kg ai ha^{-1}, fluridone at 0.09 (0.5x), 0.17 (1x), and 0.34 (2x) kg ai ha^{-1}, and a nontreated control. At 8 and 10 weeks after treatment (WAT), visual rice injury was greater than 65% and 25% for the fluridone 0.17 (1x) and 0.34 (2x) kg ai ha^{-1} treatments, respectively. All other treatments had less than 10% visual injury. Rice canopy coverage was reduced by 14 and 53 percentage points for the 1x and 2x fluridone treatments, respectively, compared to all other treatments (70% coverage) at 8 WAT. Rice heading was delayed by more than 60 and 30 percentage points at 11 and 12 WAT, respectively, in the 2x fluridone treatment compared to all other treatments (82 and 100% headed, respectively). Rice yield in the 2x fluridone treatment was reduced by 21% compared to all other treatments (11,080 kg ha^{-1}). Overall, fluridone applied at a 1x and 2x label rate to a precision-graded field with clay soil caused substantial rice injury and would not be recommended. Although a 0.09 kg ai ha^{-1} fluridone rate (0.5x) did not severely injure rice, this rate has previously provided poor weed control on a clay soil in cotton (*Gossypium hirsutum* L.); therefore, more research is needed to evaluate whether this rate would provide adequate control of problematic weeds in rice before recommending its use on precision-graded rice fields.

Evaluation of Tetflupyrolimet Mixtures with Various Preemergence Grass and Broadleaf Herbicides. Maranda P. Arcement*, Connor Webster, John A. Williams, Wesley B. Carr, Steven B. Stoker, Logan N. Vallee; LSU AgCenter, Baton Rouge, LA (120)

Evaluation of Tetflupyrolimet Mixtures with Various Preemergence Grass and Broadleaf Herbicides Arcement M.P., Webster L.C., Williams J.A., Carr W.B., Stoker S.B., Vallee L.N. Tetflupyrolimet, under development by FMCÒ, is a novel herbicide of aryl pyrrolidinone anilides. By inhibiting dihydroorotate dehydrogenase, tetflupyrolimet interferes with *de novo* pyrimidine biosynthesis. A study was conducted in 2023 at the H. Rouse Caffey Rice Research Station near Crowley, Louisiana, to evaluate tetflupyrolimet mixtures to broaden the control spectrum. Plot size was 3-m by 9.14-m with 16-19.5 cm drill-seeded rows of 'PVL03' at 78.4 kg ha^{-1}. This study was a randomized complete block with a two-factor factorial arrangement of treatments with three replications. Factor A consisted of either no herbicide, tetflupyrolimet, clomazone at 313 g ai ha^{-1}, or clomazone at 313 g ai ha^{-1} mixed with tetflupyrolimet. Factor B consisted of either no herbicide, quinclorac at 2242 g ai ha^{-1}, a prepackaged mixture of halosulfuron plus prosulfuron at 70 g ai ha^{-1}, or saflufenacil at 70 g ai ha^{-1}. Since tetflupyrolimet is still in development, the usage rate will remain confidential. Uniform standard treatments of halosulfuron plus prosulfuron at 105 g ha^{-1} and quizalofop at 1086 g ai ha^{-1} were applied at two- to three-leaf and panicle initiation rice growth stages, respectively. All herbicide applications were applied with a CO_2-pressurized backpack sprayer calibrated to deliver 93.5 L ha^{-1}. Visual evaluations of percent control for this study included barnyardgrass [*Echinochloa crus-galli* (L.) P. Beauv.] and broadleaf signalgrass [*Urochloa platyphylla* (Munro ex C. Wright) R.D. Webster] control at 21 and 56 days after treatment (DAT). Visual evaluations of percent control were also recorded for spreading dayflower [*Commelina diffusa* Burm. f.] at 21 DAT. Rough rice yields were obtained and adjusted to 12% moisture. At 21 DAT, saflufenacil applied alone controlled spreading dayflower 94%, whereas when tetflupyrolimet was mixed with saflufenacil, control decreased to 58%. Barnyardgrass visual evaluations at 56 DAT show a reduction in control when clomazone is mixed with halosulfuron plus prosulfuron or saflufenacil, compared to when tetflupyrolimet is mixed with the same residual herbicides. This study suggests that applying tetflupyrolimet with various preemergence grass and broadleaf herbicides can allow for prolonged control of barnyardgrass. However, these results do indicate a possible antagonistic interaction between saflufenacil and tetflupyrolimet for the control of spreading dayflower.

Antagonism of ALS-inhibiting Herbicides for Control of Aquatic Weeds in Water-seeded Rice. Steven B. Stoker*, John A. Williams, Connor Webster, Maranda P. Arcement, Logan N. Vallee, Wesley B. Carr; LSU AgCenter, Baton Rouge, LA (121)

Antagonism of ALS- inhibiting Herbicides for Control of Aquatic Weeds in Water-seeded Rice.S.B. Stoker, J.A. Williams, L.C. Webster, M.P. Arcement, L.N. Vallee, W.B. CarrRice (*Oryza sativa* L.) is deemed a prevalent crop in many regions around the world, and is considered a pervasive cereal grain crop in southwest Louisiana. Studies were conducted in 2021 and 2022 at the H. Rouse Caffey Rice Research Station near Crowley, Louisiana. This research evaluated the interaction of halosulfuron, prosulfuron, and a prepackaged mixture of halosulfuron plus prosulfuron when mixed with propanil. This study was a randomized complete block design with a two-factor factorial arrangement of treatments with three replications. Factor A consisted of propanil, sold under the trade name Stam® at 0 or 3,363 g ai ha^{-1}. Factor B consisted of either no mix partner, halosulfuron at 35 or 53 g ai ha^{-1}, prosulfuron at 20 or 30 g ai ha^{-1}, or a pre-mixture of halosulfuron plus prosulfuron, at 55 or 83 g ai ha^{-1}. Applications were made post-flood at the 5-leaf to 1-tiller rice growth stage and plot size was 1.5 by 5.2 m^2. All applications were made with a CO_2-pressurized backpack sprayer calibrated to deliver 140 L ha^{-1}. Visual weed control evaluations were recorded at 14 and 21 days after treatment (DAT), where 0 equals no control and 100 equals plant death. The weed species evaluated were alligatorweed [*Alternanthera philoxeroides* (Mart.) Griseb.] and grassy arrowhead (*Sagitaria lancifolia* L.). The Blouin's Modified Colby's method was used to determine the presence of synergistic, neutral, and/or antagonistic interactions. At 14 and 21 DAT, antagonism was observed for alligatorweed control when each herbicide was mixed with propanil. At 14 DAT, an antagonistic interaction was observed for grassy arrowhead control with an observed control of 26% compared with an expected control of 73% when halosulfuron at 53 g ha^{-1} was mixed with propanil. Similarly, at 21 DAT halosulfuron at 35 and 53 g ha^{-1} was antagonized by propanil for grassy arrowhead control. At 42 DAT, fresh biomass of alligatorweed and grassy arrowhead when treated with halosulfuron mixed with propanil did not differ from nontreated comparisons. Based on these results, acetolactate synthase inhibitors can be antagonized when mixed with propanil for control of aquatic weeds.

Effect of Planting Date and Cover Crops on Palmer Amaranth (Amaranthus Palmeri) Emergence in Furrow-Irrigated Rice. Tanner A. King*[1], Jason K. Norsworthy[2], Matthew C. Woolard[2], Christian T. Arnold[2], Pamela Carvalho-Moore[2], Thomas R. Butts[3], Tom Barber[3]; [1]University of Arkansas Division of Agriculture, Fayetteville, AR, [2]University of Arkansas, Fayetteville, AR, [3]University of Arkansas, Lonoke, AR (122)

As the adoption of furrow-irrigated rice (FIR) production systems increase in Arkansas, the need for additional in-season herbicide applications may also be necessary for control of Palmer amaranth due to the extensive germination period provided by the lack of a sustained flood. In crops such as cotton and soybean, cover crops have been shown to be effective in reducing Palmer amaranth emergence, alleviating some selection for herbicide resistance. In 2022 and 2023, a field trial was conducted at the Milo J. Shult Agricultural Research and Extension Center in Fayetteville, AR, to determine the effect of cover crops and rice planting date on total Palmer amaranth emergence and rough rice yield. The cover crops included in this study consisted of cereal rye, wheat, Austrian winterpea, and hairy vetch, all seeded at recommended rates. In both site years, all cover crops were terminated approximately two weeks before their respective rice planting date. In 2022, rice was planted on April 22 and May 13, and in 2023, rice was planted on April 15 and May 3. Cover crop biomass ranged from 80 to 160 g/m^2 and 108 to 372 g/m^2 for the early and late plantings, respectively. Rice yields were similar among treatments, ranging from 7,477 to 8528 kg/ha. Palmer amaranth emergence in both legume cover crops, hairy vetch, and Austrian winterpea was greater than both cereal cover crops in 2022 but not in 2023. Findings from this research fail to indicate a weed control benefit for the evaluated cover crops in rice. Research should be conducted across additional site years to ensure greater confidence in the results observed here.

Identification of a Transporter Required for the Rhizosecretion of the Allelopathic Benzoquinone Sorgoleone. Jing Xi*[1], Bal K. Maharjan[2], Scott R. Baerson[3], Sakiko Okumoto[2], Veena Veena[4], Charles L. Cantrell[1]; [1]United States Department of Agriculture, Oxford, MS, [2]Texas A&M University, College Station, TX, [3]United States Department of Agriculture, Agricultural Research Service, Oxofrd, MS, [4]Donald Danforth Plant Science Center, Olivette, MO (123)

Plant-incorporated protectants (PIPs), defined as pesticides produced by plants via genetic modification, have been widely adopted by growers for insect management. Currently no plant-incorporated protectant herbicides are available for weed management despite the obvious environmental and economic benefits such technologies could offer. We are currently pursuing the development of the allelochemical sorgoleone, which is exclusively produced in root hair cells of *Sorghum* spp., as a plant-incorporated protectant herbicide. Numerous studies have demonstrated the efficacy of sorgoleone as a broad-spectrum plant growth inhibitor, and additionally, sorgoleone affects multiple cellular targets and thus would be less susceptible to evolved weed resistance. To date, we have identified all of the genes encoding enzymes required for the biosynthesis of sorgoleone, beginning with the ubiquitous precursor palmitoleoyl-CoA. The effective deployment of a PIP herbicidal compound, however, requires both the biosynthesis and correct delivery of the compound to its final site of action. To address this, we have recently conducted a transcriptomics-driven approach involving RNA-seq analysis of genes preferentially expressed in root hairs, as well as genes responsive to perturbations in sorgoleone biosynthesis. The resulting datasets were mined for differentially expressed transporter candidate sequences for further analysis via CRISPR/Cas-mediated gene editing in *S. bicolor*. Additionally, publicly available *S. bicolor* mutant populations were searched, and two independent ems-generated nonsense mutant alleles (provisionally designated *str1-1* and *str1-2*) were identified from genotype BTx623. Both mutants exhibited greatly reduced sorgoleone secretory activity, with HPLC analyses indicating a more than 90% reduction in sorgoleone secretion relative to wild-type (BTx623) controls. Co-segregation analyses also revealed that both mutations co-segregated with the reduced secretion phenotype. Taken together, these results strongly suggest an *in vivo* role for STR1 in the rhizosecretion of the allelochemical sorgoleone.

The Two-year Impact of See & Spray^{TM} Premium in Soybean. Tristen H. Avent*[1], Jason K. Norsworthy[1], Michael R. Dodde[1], William L. Patzoldt[2], Lauren M. Lazaro[2], Michael M. Houston[3]; [1]University of Arkansas, Fayetteville, AR, [2]Blue River Technology, Sunnyvale, CA, [3]Blue River Technology, Greenville, MS (124)

John Deere commercially launched See & Spray^{TM} Premium in March 2023, and producers need additional insight into the future effects this technology may have on production systems. Premium offers a more affordable See & Spray option or the ability to retrofit new generation machines with See & Spray functionality without the dual boom/tank setup. In this situation, producers may apply residual herbicides through targeted applications rather than broadcasting, which poses additional risks from the lack of broadcast-applied residual. This research aimed to determine the long-term impact of utilizing single tank See & Spray Premium programs compared to a broadcast. The experiment was designed as a randomized complete block with 3 treatments and 6 replications. All treatments received a broadcast preemergence application. At early-postemergence (EPOST) and mid-postemergence (MPOST), all plots were treated with the same herbicides and rates but differed by application method: 1) broadcast, 2) See & Spray high sensitivity, or 3) See & Spray low sensitivity. In the first year, See & Spray provided herbicide savings from 20% to 81% depending upon application timing and sensitivity level, but some escapes were observed at the end of the year. Again, in 2023, savings ranged from 42% to 83%, and more weeds were observed at the time of application for treatments that received low sensitivity level applications the previous year. Furthermore, the number of escapes in 2023 was 3.5 times greater than the average escapes between broadcast and high sensitivity treatments. The higher number of weeds in the second year indicates that the low sensitivity level, allowed escapes to produce seed for the second growing season. Based on the results of two years with this study, producers should broadcast residuals with See & Spray or utilized the highest sensitivity if applying targeted applications of residual herbicides.

Pendimethalin Antagonistic Effect on Bensulfuron-methyl in Bulrush (*Bolboschoenus planiculmis*) Control in Rice Fields. Sirwan Babaei*[1], Bijan Yaghoubi[2]; [1]University of Kurdistan, Sanandaj, Iran, [2]Professor of Weed Science, Rice Research Institute, Iran, Rasht, Iran (125)

Effective management of major grassy weeds, including barnyardgrass and bulrush, significantly impacts transplanted rice (Oryza sativa L.) production. Two years of four-time replicated field experiments were conducted in 2018 and 2019 to investigate pendimethalin rate (0, 250, 500, 750, 1000, 2000, and 4000 g ai ha-1) and application time [before transplanting (BT) and after transplanting (AT)] on rice toxicity and weeds control when co-applied with bensulfuron-methyl (35 g ai ha-1). Results indicated that by increasing pendimethalin dose barnyardgrass control increased until 750 g ai ha-1 and no differences in barnyardgrass control in higher doses. In comparison, bulrush control decreased significantly by increasing the pendimethalin dose by more than 1000 g ai ha-1. Pendimethalin was more toxic on rice when applied before transplanting than after transplanting. In general, applying 500 and 750 g ai ha-1 pendimethalin was most effective in controlling both barnyardgrass and bulrush. The highest rice grain yield, 5150 kg ha-1, was recorded in hand-weeded control, similar to the yield recorded at 750 g ai ha-1 pendimethalin, indicating this dose is the most suitable for rice production. Generally, herbicide efficacy was higher when AT was applied than when BT was applied. To achieve the best weed control, minimal rice toxicity, and maximum yield, 750 g ai ha-1 of pendimethalin applied at AT is recommended.

Simulated Imazethapyr Carryover in Louisiana Rice Production. Wesley B. Carr*, Connor Webster, Steven B. Stoker, Maranda P. Arcement, John A. Williams, Logan N. Vallee; LSU AgCenter, Baton Rouge, LA (126)

Simulated Imazethapyr Carryover in Louisiana Rice Production. W.B. Carr, L.C. Webster, J.A. Williams, M.P. Arcement, S.B. Stoker, L.N Valle In rice (*Oryza sativa* L.) production in southern Louisiana, many growers practice a rice and crawfish rotation. Due to the anaerobic conditions associated with crawfish production, imazethapyr that was applied in the previous rice crop can persist longer than when aerobic conditions are present. Over the past couple growing seasons, many growers in southern Louisiana have experienced imazethapyr carryover when rotating from a imazethapyr-resistant (IR) rice and crawfish rotation to a non-IR production system. In 2023, at the H. Rouse Caffey Rice Research Station in Crowley, Louisiana, three studies were conducted to evaluate imazethapyr carryover in non-IR rice varieties. The studies were set up as randomized complete blocks with three replications. Treatments consisted of either no imazethapyr or imazethapyr at 2, 4, 7, 9, 11, 13, 15, and 17 g ai ha^{-1}. Imazethapyr applications were made prior to seeding the research area was flushed twice to incorporate the herbicide into the soil profile. Once the soil dried, rice was drill-seeded at 84 kg ha^{-1}, and plot size was 1.5 by 4.3 m^2. Each study evaluated imazethapyr on a different rice variety, with the first being PVL03®, then Cheniere, and Jupiter. Herbicide applications were made with a CO_2-pressurized backpack sprayer calibrated to deliver 140 L ha^{-1}. Evaluations for crop height were recorded 28 days after emergence (DAE). In addition to crop heights, rice plant stand counts were recorded at 28 DAE, and percent heading data was taken at 91 DAE. Rough rice yields were obtained and adjusted to 12% moisture. At 91 DAE, percent heading data for PVL03 was 82% when no imazethapyr was applied prior to seeding, while PVL03 planted into rates of imazethapyr greater than 11 g ha^{-1} resulted in 70 to 72% heading 91 DAE. In the Cheniere study, percent heading at 91 DAE was 78% in nontreated plots; however, 70 to 73% rice heading was observed when imazethapyr was applied prior to rice seeding at 11, 13, 15, and 17 g ha^{-1}. In the Jupiter study, at 91 DAE, 62% rice heading was observed in the nontreated, while the rest of the imazethapyr treated plots were less than 50%. This research indicates that imazethapyr carryover plays a role in rice heading timing.

Understanding Pollen-Mediated Gene Flow from Grain Sorghum (*Sorghum bicolor*) to Johnsongrass (*S. halepense*). Tamara T. Mundt*, Gabriela Elizarraras, Caroline Valiati, Hazal Camci Arik, George Hodnett, William Rooney, Muthukumar V. Bagavathiannan, Nithya K. Subramanian; Texas A&M University, College Station, TX (127)

Pollen-mediated gene flow (PMGF) from cultivated sorghum (*Sorghum bicolor*) to its weedy relative johnsongrass can cause ecological and environmental problems, especially if novel traits such as tolerance to abiotic and biotic stresses are transferred to johnsongrass. During 2023, crosses (natural pollination under field conditions) were made between johnsongrass (female) and ten different sorghum genotypes to understand hybridization potential and progeny characteristics. Sorghum genotypes with resistance to the acetyl-coenzyme A carboxylase (ACCase)-inhibitor herbicides quizalofop (Assure II®) or fluazifop (Fusilade®) were used in the study, which allowed for the quantification of PMGF between the two species. Seeds harvested from johnsongrass growing in the sorghum fields were planted in trays in a greenhouse to screen for the presence of the resistance trait acquired through PMGF. The seedlings were sprayed with quizalofop or fluazifop (depending on the specific crop trait) at three to four - leaf seedling stage. The survivors were identified at 28 days after the herbicide treatment. Results confirmed the occurrence of gene flow from sorghum and johnsongrass. The ploidy of the survivors is being tested using flow cytometry, and the majority in the preliminary testing were tetraploids. Polymerase chain reaction assays are being carried out to positively confirm the putative hybrids based on the presence of mutations specific to the herbicide-resistant sorghum genotypes. This information will be helpful in developing gene flow mitigation strategies and sustainable management of johnsongrass in agricultural landscapes.

Evaluation of Pyroxasulfone Rate and Timing Applied to Cotton Via Impregnated Fertilizer.
Julie L. Reeves*[1], Larry Steckel[2], Tyler Ward[1]; [1]The University of Tennessee, Jackson, TN, [2]University of Tennessee, Jackson, TN (128)

Palmer amaranth (*Amaranthus palmeri)* and grasses are a major concern in cotton fields in the mid-south. Many farmers in Tennessee do not have the necessary time or equipment to run post-direct applications. One alternative would be to apply pyroxasulfone via impregnated fertilizer to provide residual control for these weeds (Steckel). Pyroxasulfone provides residual control of annual grass and broadleaf weeds. According to the Zidua SC label, pyroxasulfone can be impregnated or coated onto granular fertilizer carriers for residual soil surface applications. The growing concern of controlling palmer amaranth in cotton initiated research in testing pyroxasulfone via impregnated fertilizer in partnership with BASF. A 2023 field study was conducted on cotton at the West Tennessee Research and Education Center in Jackson, Tennessee and at a BASF location in Dyersburg, Tennessee. The 7-treatment experiment was arranged in a randomized complete block design with 3 replications. Glyphosate and glufosinate were applied across the entire trial to keep plots weed free prior to treatment applications. Zidua SC at a rate of 3.25 fl oz/acre (1x) and 6.5 fl oz/acre (2x) with each rate impregnated on 250 lbs/a of AMS was used in this trial. These rates will be referred to as 1x and 2x plus fertilizer along with a 1x and 2x rate applied post-directed. Treatments were as follows: nontreated check, 1x rate Zidua SC plus fertilizer, 2x rate Zidua SC plus fertilizer, 1x rate Zidua SC plus fertilizer, 2x rate Zidua SC plus fertilizer, 1x rate Zidua SC, 2x rate Zidua Sc. Treatments 2 and 3 were hand spread on 1-2 leaf cotton. Treatments 4 and 5 were hand spread on 5-7 leaf cotton. Treatments 6 and 7 were sprayed post-directed on 5-7 leaf cotton. Visual cotton injury ratings were evaluated on a scale of 0 to 100 % where 0 equals no injury and 100 equals plant death. Visual palmer amaranth control ratings were evaluated on a scale of 0 to 100 % where 0 equals no control and 100 equals complete control. Visual rating of crop injury and palmer amaranth control were assessed 14, 21, 28, 42, and 56 days after application (DAA) at the Jackson location. Visual rating of crop injury and palmer amaranth control were assessed 28, 42, 56, and 77 DAA at the Dyersburg location. Yield was collected at both locations. The 56 DAA was used for data analysis and the locations were combined. SAS 9.4 was used to analyze the combined data. Minimal crop injury (<5%) consisting of leaf burn from the fertilizer was observed across all treatments including the check. Acceptable palmer amaranth control was still achieved 56 DAA. The 1x rate plus fertilizer, applied at 5 to 7 leaf cotton, provided less control of palmer amaranth and was different compared to the other treatments that provided 90% or greater control. There was a difference in yield amongst treatments: 2x rate Zidua SC plus fertilizer (1-2 leaf), 1x rate Zidua SC plus fertilizer (5-7 leaf), 2x rate Zidua SC plus fertilizer (5-7 leaf). These 3 treatments yielded an average of 4,100 lbs/a of seed cotton, and the remainder treatment yields ranged from 3,700 lbs/a to 3,900 lbs/a with the post-directed application at 5-7 leaf cotton being the lowest yield. This research suggests that applying Zidua SC via impregnated fertilizer provides excellent residual control of palmer amaranth and minimal injury to cotton. This application method at the 1-2 leaf or 5-7 leaf cotton stage is a great option moving forward, to adequately control weed species while also meeting the plant nutritional requirements of cotton. Steckel, Larry. "Zidua Impregnated on Fertilizer Applications in Cotton." *UT Crops News*, 21 June 2021, news.utcrops.com/2021/06/zidua-impregnated-on-fertilizer-applications-in-cotton/.

Effect of Application Timing of Florpyrauxifen-benzyl-Coated Fertilizer on Cotton Tolerance and Residual Palmer Amaranth Control. Summer L. Linn*[1], Jason K. Norsworthy[2], Pamela Carvalho-Moore[2], Tanner A. King[3], Amar S. Godar[2], Tom Barber[4]; [1]University of Arkansas Department of Crop, Soil, and Environmental Science, Fayetteville, AR, [2]University of Arkansas, Fayetteville, AR, [3]University of Arkansas Division of Agriculture, Fayetteville, AR, [4]University of Arkansas, Lonoke, AR (129)

Cotton producers rely on residual and postemergence herbicides for season-long control of Palmer amaranth [*Amaranthus palmeri* (S.) Wats.]. It is vital to maximize Palmer amaranth control while minimizing cotton injury. This study was designed to determine which growth stage is optimal for the application of florpyrauxifen-benzyl coated on fertilizer and applied over-the-top of cotton. This study was planted on May 10, 2022, on a silt loam soil at the Lon Mann Cotton Research Station in Marianna, Arkansas. The study was designed as a two-factor factorial in a randomized complete block with four replications. The first factor was the application timing (growth stage). There were four application timings: the 1- to 2-leaf, 3- to 4-leaf, 5- to 6-leaf, and 10- to 12-node growth stages. The second factor was the presence or absence of florpyrauxifen-benzyl at 29 g/ha coated on fertilizer. The fertilizer blend utilized as the florpyrauxifen-benzyl carrier consisted of urea at 196 kg/ha and muriate of potash at 112 kg/ha. A preemergence application of fluometuron at 840 g/ha and paraquat at 700 g/ha was applied to all plots. Prior to each treatment application (and at the 1-to 2-leaf growth stage in treatments with applications at later growth stages) glyphosate at 1120 g/ha and glufosinate at 667 g/ha were applied to control emerged weeds. Cotton injury and Palmer amaranth control were assessed at 14 and 21 days after treatment (DAT). At 14 DAT, higher Palmer amaranth control was observed when florpyrauxifen-benzyl-coated fertilizer was applied at the 1- to 2 and 3- to 4-leaf growth stages. Glyphosate and glufosinate with florpyrauxifen-benzyl on fertilizer applied to 1- to 2-leaf cotton provided 95% Palmer amaranth control, whereas control was only 69% in the absence of herbicide coated on fertilizer. Applying florpyrauxifen-benzyl on fertilizer at the 3- to 4-leaf stage resulted in a total of 27-percentage point increase in Palmer amaranth control compared to the treatment without the herbicide. Palmer amaranth control was not improved in the other treatments. The 6- to 8-leaf treatments displayed the most crop injury. Cotton was injured 20% in the treatment containing florpyrauxifen-benzyl, and there was 13% injury to cotton without florpyrauxifen-benzyl for same application timing. Cotton was injured less than 15% by all other treatments. These findings demonstrate that there is potential in using florpyrauxifen-benzyl-coated fertilizers applied at selected growth stages due to improved Palmer amaranth control and minimal cotton injury. Additional site years are needed to support or refute these findings, and supplemental research is needed to determine yield loss due to florpyrauxifen-benzyl injury.

Ile2041Asn Substitution Confers ACCase Inhibitor Resistance in Foxtail Barley (*Hordeum jubatum*). Charles M. Geddes*; Agriculture and Agri-Food Canada, Lethbridge, AB, Canada (130)

Foxtail barley (*Hordeum jubatum* L.) is a perennial grass weed that is native to western North America and found throughout Canada. As a facultative halophyte, foxtail barley is commonly present in saline areas of western Canada, where it grows best on wet, fertile and non-alkaline soils. Few herbicides registered for foxtail barley control can cause overreliance on these products and greater selection pressure for herbicide resistance. To-date, however, herbicide-resistant foxtail barley is not known to occur globally. In 2022, lack of control of foxtail barley was observed following quizalofop treatment in three creeping red fescue (*Festuca rubra* L.) fields in the Peace Lowland ecoregion of northern Alberta, Canada. Single-dose screening with quizalofop applied at 70 g ai ha^{-1} resulted in 79%, 90%, and 4% survival of the foxtail barley seedlings derived from mature seeds collected from each of the three fields. In whole-plant dose-response bioassays, foxtail barley from two of the three fields were resistant to quizalofop while the third was susceptible. For example, one accession exhibited 17.3- to 29.0-fold resistance, the second accession exhibited 14.7- to 24.8-fold resistance, and the third remained susceptible (R/S = 1.7) to quizalofop based on biomass dry weight 21 days after treatment compared with two susceptible control accessions. All three populations were susceptible to clethodim (R/S = 1.5) based on biomass dry weight. Therefore, foxtail barley from two of the three fields represent the first known cases of acetyl-CoA carboxylase (ACCase) inhibitor-resistant foxtail barley globally. Sequencing of the *ACCase* gene revealed that the two resistant accessions were heterozygous for a target site mutation resulting in an amino acid substitution at position Ile2041Asn, while the third susceptible accession did not exhibit this substitution. Therefore, the Ile2041Asn substitution confers target site resistance to quizalofop but not clethodim in foxtail barley.

Kochia (*Bassia scoparia*)-Canola Interaction Studies Identified Genes and Processes Likely Involved in Altering Growth and Development in Both Species. David P. Horvath[1], Barbara Dobrin[1], Farhan Tanvir[2], Mukhlesur Rahman[2], James V. Anderson*[3]; [1]United States Department of Agriculture, Agricultural Research Service, Fargo, ND, [2]North Dakota State University, Fargo, ND, [3]USDA, Fargo, ND (132)

Kochia (*Bassia scoparia*) is a problematic weed of canola (*Brassica napus*) production in the northern Great Plains of the USA. To better understand this crop-weed interaction under field conditions, canola (NDOLA-02) was planted at four densities (15.2 cm within-row spacing and 20.3, 40.6, 61, and 81.3 cm between row spacing) with or without broadcast kochia in an RCB design with 4 replicates each at two field sites in Fargo ND. Best practices for fertilizing and insect control were used and plots were maintained free of other weeds by pre-emergence herbicide followed by hand weeding. For controlled greenhouse studies, kochia or canola alone (a single plant) were grown in 8 L pots with potting soil or with either 2, 4, or 6 plants of the opposite species in an RCB design with six replicates per treatment. At the end of the growing season, a strong negative correlation (-0.61 to -0.73) was observed between canola density and weed dry weight - a density of 5-6 plants/ft^2 (0.093 m^2) provided optimal kochia control and canola yields. Under greenhouse conditions, all canola densities significantly reduced kochia biomass, while kochia had a minimal impact on canola biomass. To understand potential plant-plant interactions occurring between kochia and canola under greenhouse conditions, changes in gene expression of canola root tissue in competition with kochia was examined. RNA extracted from root tissues were used to construct Illumina libraries that were sequenced to depths >20M 150 paired end reads. Analysis of RNAseq data identified significant changes in expression ($q<0.1$) of 155 genes in response of canola to kochia. Of the 100 up-regulated genes, most were associated with osmotic and oxidative stress as well as red-light and circadian responses, while the down-regulated genes were primarily associated with auxin and circadian responses. These results indicate that optimal canola densities can significantly reduce kochia biomass, while preliminary sequence data indicates that kochia impacts light and auxin signaling and stress responses in canola root tissues.

Cover Crop Residue Management Strategies Affect Deposition and Wash Off of Soil-applied Residual Herbicides. Cody Smith*[1], John M. Wallace[2], Kyle Elkin[3], Mark VanGessel[4], Michael L. Flessner[5]; [1]Penn State University, University Park, PA, [2]Pennsylvania State University, State College, PA, [3]USDA-ARS, University Park, PA, [4]University of Delaware, Georgetown, DE, [5]Virginia Tech, Blacksburg, VA (133)

Use of cereal rye surface mulch remains a promising integrated weed management (IWM) tactic for early-season suppression of small-seeded summer annual weeds. However, previous research has demonstrated that use of surface mulch can result in reduced soil bioavailability of residual herbicides. Further research is necessary to optimize the benefits of cultural and chemical weed control tactics while minimizing drawbacks. Cover crop management decisions that likely influence soil bioavailability of residual herbicides include (1) the growth stage of cover crops at the time of application, which influences total residue mass; (2) taxonomic traits of cover crops and use of mixtures, which may influence cover crop quality; (3) use of residue management tools such as the roller-crimper prior to application, which influences residue architecture; (4) and the timing of residual herbicide application relative to cover crop termination, which influences the absorption and adsorption rates of herbicides. A field experiment was replicated at Rocks Springs, PA, Georgetown, DE, and Blacksburg, VA in 2022 and 2023 to investigate cover cropping management effects on the soil bioavailability of residual herbicides using a two-factor randomized complete block design with a split plot treatment structure. The main plot included alternative cover crop management tactics, including cereal terminated and left standing at the (1) flagleaf stage; (2) heading stage; (3) and anthesis stage, and (4) cereal rye; (5) crimson clover + cereal rye; and (6) hairy vetch + cereal rye that was roll-crimped at cereal rye anthesis. Split plot treatments including application of a test residual herbicide (pyroxasulfone; 0.09 lb ai/ac) applied (1) at the time of cover crop termination (glyphosate 1.12 lb ae/ac; 0 DAT); or (2) as an EPOST treatment (21 DAT). Field assays were employed to measure deposition and washoff processes relative to a no cover crop control by placing 50 g of sieved field soil in a petri dish positioned at the soil surface and beneath cover crop residues. Soil samples were collected 2 to 4 hr after residual herbicide application (deposition assay) and replaced with another set of petri dishes that were collected immediately after an incorporating rainfall (washoff assay). Pyroxasulfone (ppb) was extracted from soil samples using acetone as the solvent and analyzed using HPLC methodology. 2022 Pennsylvania results are reported: A significant interaction ($F = 3.3$; $p = 0.01$) was observed between cover crop strategy and residual application timing. When applied 0 DAT (green), pyroxasulfone recovery (deposition + washoff) was lower for treatments applied at the anthesis stage (< 33%) compared to early stages (55-78%), but no differences among cover crop treatments were observed at the 21 DAT treatment (43 to 63%). The washoff process contributed a greater proportion of total herbicide recovered in roll-crimped treatments (45 to 80%) compared to standing treatments 0 DAT, with hairy vetch + cereal rye resulting in the lowest deposition (4% of control) and greatest washoff (80% of total recovery). Preliminary results suggest that delaying cover crop termination to the anthesis stage and use of a roll-crimper reduces the bioavailability of pyroxasulfone at the time of an incorporating rainfall. Delaying application (21 DAT) of residuals may increase soil bioavailability relative to 0 DAT. These experiments were replicated in 2023, resulting in six site-years to further identify the trends of interaction between cover crops and residual herbicides on bioavailability of residual herbicides.

Effect of Low Rate of 2,4-D on Tomato at Different Growth Stages. Taghi Bararpour*[1], Te-Ming (Paul) Tseng[2]; [1]Mississippi State University, Stoneville, MS, [2]Mississippi State University, Mississippi State, MS (134)

Tomatoes (*Lycopersicon esculentum*) are an important vegetable crop that is grown commercially and in local gardens in Mississippi. Tomatoes are very sensitive to many herbicides, and with new technologies (Xtend) and/or Enlist (2,4-D) available in soybean (*Glycine max*), cotton (*Gossypium hirsutum*)) and other crops, off-target movement of herbicides, such as 2,4-D and dicamba, may become a concern. A greenhouse study was conducted in 2022-2023 at the Delta Research and Extension Center, in Stoneville, Mississippi, to determine the effect of low rate (simulated drift rate) of 2,4-D on tomato at different growth stages and possible contamination of the fruit. Tomato (cherry tomato) seeds were planted in the small pots (2.5" x 2.5" x 3") containing potting-mix on November 10, 2022. Tomatoes emerged on November 31. Tomato seedlings were transplanted in a bigger pot (6" in diameter by 7" in height) on December 7. The experiment was designed as three (growth stage) by five (treatments) factorial arrangement in a randomized complete block and replicated four times. Treatments were as follows: 1) untreated control; 2) 2,4-D at 1/16X rate + Non-ionic surfactant (NIS) at 0.25% (v/v); 3) 2,4-D at 1/32X rate + NIS; 4) 2,4-D at 1/64X rate + NIS; and 5) 2,4-D at 1/128X rate + NIS. The 1X rate of 2,4-D was 32 fl oz/A. The three growth stages of tomato (application timing) were: A) vegetative stage (before flowering); B) at flowering; and C) at fruiting. Three weeks post-application (WAA), tomato injury from 2,4-D varied significantly by growth stage (averaged across rates). Vegetative-stage tomatoes showed the highest sensitivity, followed by flowering and fruiting stages. Seedlings at the vegetative stage (applied on January 4, 2023) showed no fruit at 1/16 X 2,4-D, while those at flowering (applied on January 20) and fruiting (applied on February 16) stages still produced fruits at 1/16 X. Tomato fruits from different 2,4-D rates and untreated checks were planted on March 16, emerging on March 22, and transplanted on March 27. The F1 progeny, evaluated five times, exhibited no visible 2,4-D symptoms. HPLC analysis revealed no detectable 2,4-D residues (in the fruit) at the lowest rates (1/128 X and 1/64 X). At slightly higher rates (1/32 X and 1/16 X), detectable levels were found. Concentrations increased with higher application rates, notably at the flowering and fruiting stages compared to the vegetative stage. These findings suggest potential implications for 2,4-D on tomato crops, warranting further investigation into its effects on yield and food safety.

IR-4 Project: Success and Benefits to Specialty Crop Growers. Roger B. Batts*[1], Alice Axtell[1], Jaimin Patel[1], Jerry J. Baron[2], Debbie Carpenter[2], Hannah Ross[2]; [1]IR-4 Project HQ, NC State University, Raleigh, NC, [2]IR-4 HQ, NC State University, Raleigh, NC (135)

IR-4 Project: Success and Benefits to Specialty Crop Growers. Roger B. Batts, Jaimin Patel, Alice Axtell, Jerry Baron, Debbie Carpenter, and Hannah Ross. IR-4 Project, NC State University, Raleigh, NC Last year, 2023, marked the 60-year milestone of the IR-4 Project helping growers/farmers of specialty crops (fruits, vegetables, nuts, herbs, spices, ornamentals and other horticultural crops) gain access to registrations of safe and effective chemical and bio-based herbicides, fungicides and insecticides. The IR-4 Project remains relevant because the crop protection industry focuses their research and development efforts on products that provide large sales that yield adequate return on investment. They shy away from specialty crops because of the cost of development of the data required for registration. The IR-4 Project fills this gap of developing data utilizing a network of public sector researchers (University and USDA-ARS) with expertise in pest management and analytical chemistry. Since its inception, IR-4 has secured over 23,000 registrations of crop protection products in food crops and over 56,000 uses in ornamental crops under its Environmental Horticulture program. IR-4 contributes nearly $9 billion to the annual US gross domestic product, according to a 2022 report by the Michigan State University Center for Economic Analysis. IR-4 activities include, but are not limited to: Food Crop Program: Facilitates regulatory approval of pest management solutions for specialty food crops through three research platforms: - Residue Studies - determining the amount of chemical pesticide remaining in the crop at harvest;- Product Performance - developing data to show that a potential use of a pesticide is safe and effective; and- Integrated Solutions - utilizing multiple tactics including chemical pesticides, biopesticides, emerging technologies and other tools in combination to manage critical pests. Environmental Horticulture Program: Supports regulatory approval of pest management solutions for environmental horticultural crops including landscape/nursery plants, cut flowers and more. Biopesticide Regulatory Support: Aids in development and registration of bio-based pesticides for use on specialty crops. International Activities: Facilitates the international harmonization of Maximum Residue Levels (MRLs), supporting U.S. specialty crop growers in accessing export markets. IR-4 also helps build capacity of global minor use programs and collaborates with international partner organizations. For more information, please visit our website: https://www.ir4project.org/

AAFC's Pest Management Centre: 20 Years of Success in Weed Management. Heather E. Peill*; Agriculture & Agri-Food Canada/Pest Management Centre, Kentville, NS, Canada (136)

Overview of the Pest Management Centre's successes over the past 20 years in weed management. Since 2003, the Minor Use Pesticides (MUP) and Pesticide Risk Reduction (PRR) Programs of Agriculture and Agri-Food Canada's Pest Management Centre (PMC) have been working together to improve access to new pesticide uses and reduced risk pest management alternatives for Canadian growers. Every year, targeted pest issues and grower needs are identified and prioritized through stakeholder consultations. With its staff across Canada, the MUP team works with grower organizations and provinces to identify solutions to crop/pest issues and partners with Health Canada's Pest Management Regulatory Agency (PMRA), the US Department of Agriculture IR-4 Project, registrant companies and researchers to develop data necessary to meet regulatory requirements for registration of new minor uses of pesticides. Collaboration with the US IR-4 Project in particular, helps to support simultaneous access to new pesticide uses for growers and reduce trade barriers between the two countries. Since 2003, the MUP team has conducted 463 weed science projects, has submitted over 300 weed regulatory packages to PMRA, and has enabled registration of about 271 new herbicide uses in Canada. The PRR team delivers non-conventional pest management solutions and decision support tools to enable integrated approaches to pest management. To date, the PRR program has led to the development of multiple alternative weed management practices and has delivered effective herbicide resistance risk management tools to growers. Recently, the PMC celebrated its 20th anniversary marking many successes in helping Canadian growers with pest management solutions while supporting sustainable food production and sector competitiveness in global trade.

Weed Management in Sweetpotato (*Ipomoea batatas*) with Bicyclopyrone. Donnie Miller*, Ashley Barfield; LSU AgCenter, St Joseph, LA (137)

A field study was conducted at the LSU AgCenter Northeast Research Station near St. Joseph La in 2023 with the objective to evaluate bicyclopyrone (Optogen®) herbicide for weed management in sweetpotato. A four-replication factorial treatment arrangement was utilized and included pre-transplant herbicide (Factor A: bicyclopyrone at 0.034 or 0.046 lb ai/A, fomesafen at 0.375 lb ai/A, flumioxazin at 0.064 lb ai/A, or linuron at 0.75 lb ai/A) and post-transplant herbicide (Factor B: clomazone at 0.56 or 0.94 lb ai/A, s-metolachlor at 1.27 lb ai/A, or none). Treatments were applied to each 6.3' x 25' plot prior to or immediately following planting of 'Bayou Belle" sweet potato on June 22. Parameter measurements included visual weed control 14 and 28 d after application (DAT) and yield (U.S. #1, canner, jumbo, and total). Factor interactions were not noted for any parameter measured. At 14 DAT, averaged across post-transplant treatments, bicyclopyrone at 2.6 oz/A resulted in 100, 100, 100, 75, 100, 99, 99, and 100% control of goosegrass, broadleaf signalgrass, browntop millet, yellow nutsedge, common purslane, horse purslane, slender amaranth, and barnyardgrass, respectively, which was similar to all other pre-transplant treatments. Averaged across pre-transplant treatments, only with respect to yellow nutsedge control with s-metolachlor was a post-transplant treatment advantageous compared to pre-transplant treatment alone (89% 73%). At 28 DAT, averaged across post-transplant treatments, bicyclopyrone at 2.6 oz/A resulted in 99, 100, 93, 98, 95 and 83% control of goosegrass, broadleaf signalgrass, browntop millet, common purslane, horse purslane, and barnyardgrass, respectively, which was similar to all other pre-transplant treatments. Bicyclopyrone at both rates provided no greater than 73 (equivalent to flumioxazin and linuron but less than the 90% for fomesafen) and 88% (equivalent to fomesafen but less than the 99% for flumioxazin and linuron) control of yellow nutsedge and slender amaranth, respectively. Averaged across pre-transplant treatment, control of all weeds benefited from post-transplant herbicide application (all post-transplant herbicides equivalent and greater than where one was not applied). Averaged across post-transplant treatments, U.S.#1, canner, jumbo, and total yield with the lower rate of bicyclopyrone was 428, 95, 122, and 645 bu/A, respectively, and equivalent to all other pre-transplant treatments. Averaged across pre-transplant treatments, U.S. #1 and canner yield were at least 370 and 109 bu/A, respectively, and equivalent among all herbicides and greater than where no herbicide was applied (331 and 87 bu/A). Jumbo yield was greatest with application of s-metolachlor (199 bu/A), while clomazone at both rates resulted in equivalent yield of 120 and 122 bu/A, and greater than the 64 bu/A where no herbicide was applied. S-metolachlor resulted in a 758 bu/A total yield, which was greater than that of clomazone at 2.5 pt/A (627 bu/A) and where no herbicide was applied (482 bu/A), and equivalent to that of clomazone at 1.5 pt/A (679 bu/A).

Weed Management in Sweetpotato (*Ipomoea batatas*) with Pendimethalin. Donnie Miller*, Ashley Barfield; LSU AgCenter, St Joseph, LA (138)

A field study was conducted at the LSU AgCenter Northeast Research Station near St. Joseph La in 2023 with the objective to evaluate pendimethalin herbicide for weed management in sweetpotato. A four-replication factorial treatment arrangement was utilized and included post-transplant herbicide (Factor A: clomazone at 0.75 lb ai/A, pendimethalin at 0.95 lb ai/A, or no herbicide), layby herbicide (Factor B: pendimethalin at 0.95 lb ai/A, s-metolachlor at 1.27 lb ai/A, or no herbicide), and layby tillage (Factor C: tillage or no tillage). Treatments were applied to each 6.3' x 25' plot immediately following planting of 'Bayou Belle" sweet potato on June 22 or at layby on July 21. Fomesafen herbicide at 0.25 lb ai/A was applied pre-transplant to all plots. Parameter measurements included visual weed control 28 d after layby application (DAT) and yield (U.S. #1, canner, jumbo, and total). Control of carpetweed, common purslane, and horse purslane ranged from 83 to 100% with no factor interactions or treatment differences noted. Averaged across layby herbicide and tillage, clomazone applied post-transplant provided 98% control of barnyardgrass, which was significantly greater than the 80 and 20% control with pendimethalin and where no herbicide was applied, respectively. Averaged across post-transplant herbicide and layby tillage, pendimethalin and s-metolachlor provided equivalent control of 71 and 69% which was greater than the 58% with no herbicide application. Significant multiple 2 factor interactions (AxB, AxC, and BxC) were noted for all other weeds evaluated. Broadleaf signalgrass and browntop millet control across all factor interactions ranged from 90 to 100% and 89 to 100%, respectively, where herbicide and/or layby tillage was applied. Layby tillage did not improve herbicide efficacy post-transplant or at layby. With the exception of layby tillage with no post-transplant herbicide (80%) or layby herbicide (85%), and no post-transplant herbicide followed by pendimethalin applied at layby (81%), goosegrass control across all factor interactions ranged from 89 to 100% where herbicide and/or layby tillage was applied. Layby tillage did not improve herbicide efficacy post-transplant or at layby. With the exception of no post-transplant herbicide followed by pendimethalin at layby (81%), slender amaranth control across all interactions ranged from 91 to 100% where herbicide and/or layby tillage was applied. Layby tillage did not improve herbicide efficacy post-transplant or at layby. Yellow nutsedge control was at least 85% with pendimethalin post-transplant and no layby tillage (90%), layby tillage with no herbicide (86%), pendimethalin at layby with tillage (89%), s-metolachlor at layby with (85%) or without (86%) tillage, pendimethalin at layby without herbicide (87%), s-metolachlor at layby with pendimethalin post-transplant (94%) and no herbicide (88%), and pendimethalin post-transplant without tillage (87%). Layby tillage improved control only for pendimethalin at layby (89 vs. 67%). Averaged across layby herbicide and tillage, equivalent U.S. #1 yields of 393 and 441 bu/A were observed for pendimethalin and clomazone post-transplant, respectively, both greater than no herbicide (211 bu/A). Averaged across layby herbicide and tillage, equivalent jumbo yield of 60 and 81 bu/A was observed for pendimethalin and clomazone applied post-transplant, respectively, and greater than when no herbicide was applied (16 bu/A). Averaged across layby herbicide and tillage, total yields of 577 and 626 bu/A were recorded for pendimethalin and clomazone post-transplant, respectively, and were higher than with no herbicide (321 bu/A). A significant post-transplant by layby herbicide interaction was noted for canner yield. With pendimethalin post-transplant, s-metolachlor at layby produced 149 bu/A, equaling no layby herbicide (131 bu/A) and exceeding pendimethalin at layby (91 bu/A). Canner yields from clomazone (80 to 120 bu/A) or no herbicide (79 to 118 bu/A) post-transplant were equivalent, regardless of layby treatment. Pendimethalin at layby (86 to 113 bu/A) was consistent across post-transplant treatments. Yield with s-metolachlor at layby was greatest following pendimethalin (149 bu/A) or no herbicide (118 bu/A) post-transplant. Canner yield without layby herbicide was 131

bu/A after pendimethalin post-transplant, matching clomazone (120 bu/A) and higher than no post-transplant herbicide (79 bu/A).

Nutsedge vs Vegetable Farmer: the Battle Never Ends. A Stanley Culpepper*, Jenna C. Vance, Taylor Randell-Singleton; University of Georgia, Tifton, GA (140)

Yellow and purple nutsedge continue to be among the most troublesome weeds infesting agricultural crops throughout the world. In southeastern U.S. vegetable production, nutsedge species are often even more problematic as there are few effective herbicides available, the weed has the ability to penetrate through plastic mulch, and methyl bromide has been removed from the marketplace. One of the few herbicides available for vegetable growers to potentially suppress nutsedge across a multitude of crops is glyphosate applied preplant, in row middles, or after crop harvest. With previous research suggesting glyphosate can reduce nutsedge tuber production, three different experiments were conducted in Georgia during 2022 and 2023 evaluating yellow nutsedge response to glyphosate and glyphosate-based systems. Two of the experiments, each conducted at 2 locations with 4 replications, evaluated nutsedge response to glyphosate. When averaged over locations, glyphosate at 1.13, 2.25, 3.38 and 4.5 lb ae/A controlled yellow nutsedge a maximum of 50, 69, 79, and 87%, respectively. When applying glyphosate sequentially or following glyphosate by paraquat on a 7-day interval, yellow nutsedge control at 2 wks reached a maximum of 84 and 94%, respectively; however, by 4 wks control was 79 and 66%, respectively. Due to single or sequential glyphosate applications failing to achieve adequate or sustainable yellow nutsedge control for vegetable farmers, a more in-depth experiment was conducted. Conducted in large plots (18 by 35 feet) and replicated 4 times, the final experiment included removing all emerged nutsedge through disking the entire study area on 8/6/22, and following with one of four treatments: 1) EPTC applied PRE followed by irrigation on 8/6/22, glyphosate + halosulfuron on 9/7/22, a disking event on 9/21/22, and a final application of glyphosate on 10/27/22; 2) glyphosate on 9/7/22, a disking event on 9/21/22, and a final application of glyphosate on 10/27/22; 3) glyphosate + halosulfuron on 9/7/22, a disking event on 9/21/22, and a final application of glyphosate on 10/27/22; and 4) a non-treated control. Yellow nutsedge emerged within one week of trial initiation, with the first killing freeze occurring on 11/7/2022. Treatment rates of herbicides included the following: glyphosate at 2.25 lb/A, halosulfuron at 0.035 lb ai/A, and EPTC at 0.38 lb ai/A. On 5/27/23 the number of nutsedge plants emerged within each plot was counted in its entirety. At that time, the non-treated control accounted for 18,415 plants per acre. The EPTC program reduced emerged nutsedge plants 98%, with the glyphosate + halosulfuron program being 96% effective and the glyphosate only system being 94% effective in reducing nutsedge emergence. In conclusion, glyphosate alone or applied sequentially at labeled rates ($\leq$2.25 lb/A) does not provide a nutsedge management solution for vegetable farmers, since the option to use the tool is for preplant, row-middles, or after harvest only. Removing the infested field from production for a few months and implementing a holistic diversified management program with herbicides and tillage can offer an effective solution to rapidly reduce the nutsedge population.

Evaluating the Vegetative and Reproductive Response of Hemp (*Cannabis sativa* L.) to Simulated Drift Rates of Growth Regulator Herbicides 2,4-D and Dicamba. Alyssa I. Essman*[1], Mark Loux[2], Alexander J. Lindsey[1], Michael Kelly[1], Siyu Yao[1]; [1]The Ohio State University, Columbus, OH, [2]Ohio State University, Columbus, OH (141)

The introduction of soybean [*Glycine max* (L.) Merr] systems with resistance to 2,4-D and dicamba allowed for postemergence applications of these herbicides. These herbicides pose a high risk for off-target movement, and the potential impact on novel crops such as hemp (*Cannabis sativa* L.) is unknown. Two studies were conducted from 2020 through 2022 in controlled environments to evaluate sublethal rates of 2,4-D and dicamba on hemp growth parameters. The objectives were to: 1) determine the effects of herbicide (2,4-D and dicamba) and rate (1x to 1/100,000x labeled rate) on visible injury, height, branching, and plant weight, and 2) determine the effect of 2,4-D rate (1x to 1/100,000x labeled rate) on flower weight and metabolites. Herbicides were applied in the early vegetative stage and evaluations took place 14 and 28 days after treatment (DAT) and at termination. Both herbicides at the 1x rate and dicamba at the 1/10x rate caused visible injury at the 28 DAT evaluation. At the time of trial termination, plants treated with 1x rates of either herbicide or the 1/10x rate of dicamba were shorter than the untreated control. Sublethal rates of 2,4-D and dicamba did not affect branching or plant weight at trial termination. Flower weight and metabolite levels were unaffected by sublethal rates of 2,4-D. This study suggested that hemp may be more sensitive to dicamba than 2,4-D, and that plants exposed to sublethal rates of either herbicide in early vegetative stages may not have distinguishable effects from the herbicide exposure at harvest.

Sweetpotato Variety Tolerance to Herbicides. Prakriti Dhaka*[1], Felipe K. Salto[2], Juan Camilo Velásquez R[2], Mark Shankle[3], Te-Ming (Paul) Tseng[4], Nilda Roma-Burgos[2]; [1]University of Arkansas, Fayettevile, AR, [2]University of Arkansas, Fayetteville, AR, [3]Mississippi State University, Starkville, MS, [4]Mississippi State University, Mississippi State, MS (142)

Sweetpotato Variety Tolerance to Herbicides Prakriti Dhaka[1]*, Felipe K. Salto[1], Juan C. Velasquez. [1], Samuel B. Fernandez[1], Mark Shankle[2], Te-Ming (Paul) Tseng[2], and Nilda Roma-Burgos[1] [1]Dept. of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville, AR [2]Dept. of Plant and Soil Sciences, Mississippi State University, Starkville, MS A greenhouse study was conducted at the University of Arkansas Division of Agriculture, Fayetteville in 2023 to evaluate sweetpotato tolerance to herbicides. Herbicide treatments (g ai ha^{-1}) included carfentrazone (17.5 & 35), saflufenacil (37 &74), acifluorfen (280 & 560), sulfentrazone (126 & 252), metribuzin (42 & 84), imazethapyr (35 & 70), diclosulam (13.4 & 27), topramezone (9.2 & 18.4 g ai ha^{-1}), fluridone (168 &336 g ai ha^{-1}), glyphosate (560 & 1120 g ai ha^{-1}) and glufosinate (409 & 818 g ai ha^{-1}). These were 0.5X and 1X of recommended rates, respectively. Sweetpotato varieties tested were Diane, Orleans, Beauregard 14 (B14), Covington, 529, Morado, Beauregard, Bayou Belle, Hatteras, Evangeline, Centennial and Heartogold. The herbicides were applied at 187 L ha^{-1} with recommended adjuvants to sweetpotatoes with 5cm vine length. Crop injury was evaluated at 7,14 and 28 days after treatment (DAT). Vinelength and biomass of shoot and root were measured at 28 DAT. At 7 DAT, the least injurious herbicides were imazethapyr, fluridone, glyphosate, metribuzin, and topramezone with 6.5 to 11% injury averaged across varieties and herbicide rates. Glufosinate and the PPO-inhibitor herbicides caused severe injury ranging from 71-99%. In general, the 0.5X and 1X rates caused similar injury except for acifluorfen where the 0.5X rate caused 50% injury vs. 92% injury at 1X. Of these injurious herbicides, acifluorfen was tolerable at 0.5X in some varieties including Evangeline, Heartogold, Morado, 529, and Bayou Belle with injuries ranging from 19 to 28%. At 14 DAT, imazethapyr, fluridone and topramezone caused the least injury while injury from glyphosate and metribuzin increased by 13-15%. Averaged across herbicides and rates, Diane was the most sensitive variety while Beauregard, Centennial and Heartogold were the most herbicide-tolerant. Among all herbicides, glufosinate and saflufenacil caused the highest injury at all evaluation periods irrespective of rate and variety. Injury at 7 DAT was positively correlated with injury at 28DAT (r=0.753). Comparing varieties averaged across herbicides and rates, 529 and B14 had the shortest vine, while Heartogold and Bayou Belle had the longest. Treatment with metribuzin increased the vinelength of sweetpotato by 18% averaged across varieties while glufosinate, saflufenacil and glyphosate stunted the sweetpotatoes, showing 30 and 39% reduction in shoot biomass at 0.5x and 1x rate, respectively. Among varieties, the highest shoot biomass was recorded with Diane treated with glyphosate. Morado and Centennial treated with saflufenacil produced the lowest shoot biomass. Root biomass of sweetpotato varieties were similar between rates. Treatment with fluridone and topramezone resulted in higher root biomass across varieties. Hatteras had the highest root biomass at 53.97g/plant followed by Covington, Heartogold, 529 and Diane with the mean 44.32, 43.59, 43.34 and 43.14, respectively. Beauregard and Bayou Belle produced the lowest root biomass (24.45g and 27.26g, respectively). Root biomass was positively correlated with shoot biomass (r=0.415).

Response of Five Herbicide-resistant Annual Bluegrass Biotypes to Methiozolin. Daewon Koo*, Navdeep Godara, Juan Romero, Shawn Askew; Virginia Tech, Blacksburg, VA (144)

Methiozolin, the first fatty acid thioesterase inhibitor (Group 30), has recently been introduced as a pre- and post-emergent herbicide for controlling annual bluegrass (*Poa annua* var. *annua*) on golf turf, spanning cool- and warm-season turfgrass, including putting greens. Given the escalating cases of herbicide resistance in annual bluegrass, the significance of methiozolin for resistance management has grown, particularly due to its novel mode of action in golf turf. Prior studies indicated that the methiozolin rate to control 50% of annual bluegrass populations with target-site resistance to ALS inhibitors, EPSP inhibitors, and PSII inhibitors resembled that of susceptible populations. However, a population with target-site resistance to both ALS and PSII inhibitors required a higher methiozolin dose (2x). This increased dosage was suspected to be associated with an upregulation of non-target-site resistance mechanisms. A greenhouse study explored the response of eight methiozolin rates (0, 125, 250, 500, 1000, 2000, 4000 and 8000 g ai ha^{-1}) across five known annual bluegrass resistance biotypes, encompassing target-site (ALS, EPSP1, and EPSP2) and non-target-site mechanisms (NTR1 and NTR2), in comparison to two susceptible annual bluegrass biotypes (S1 and S2). The study was conducted as a randomized complete block design with six replications. Dry weight was measured at 35 d. The methiozolin rate needed to reduce 50% of annual bluegrass biomass (GR_{50}) was calculated using non-linear subjected to ANOVA in R 4.3.1., and means were separated by Fisher's Protected LSD. Among the biotypes examined, NTR1 was the only one requiring significantly higher methiozolin levels (19 to 25x) compared to susceptible populations to control 50% of annual bluegrass. While non-target-site resistance mechanisms were not fully elucidated for both populations, the disparity in methiozolin GR_{50} between the two non-target-site resistance populations suggested the involvement of specific mechanisms influencing the lower sensitivity of methiozolin to certain annual bluegrass populations. In summary, methiozolin remains a viable option for controlling herbicide-resistant annual bluegrass, although its effectiveness may vary for certain populations exhibiting non-target-site resistance.

Effect of Metcamifen on Trifloxysulfuron Absorption, Translocation and Metabolism in Yellow Nutsedge (*Cyperus esculentus* L.). Ronald R. Rogers*, Travis W. Gannon, Khalied Amhed, Estefania Gomiero Polli; North Carolina State University, Raleigh, NC (145)

Herbicide safeners are a diverse group of chemicals that can prevent herbicidal injury to plants by enhancing a plant's metabolism. Safeners are typically paired for use in specific crops and used in combination with post-emergent herbicides through co-application. Metcamifen is a sulphonamide safener shown to safen clodinafop-propargyl applications in rice (*Oryza sativa* L.) and maize (*Zea mays* L.). Trifloxysulfuron is a post-emergent herbicide used to control broadleaf weeds, grassy weeds, and sedges in select turfgrass systems. Yellow nutsedge is an herbaceous perennial weed that is particularly problematic in various turfgrass and agronomic systems due to its tuber production as well as the longevity of the tubers. Studies were conducted to evaluate the effect of the safener, metcamifen, on the absorption, translocation, and metabolism of ^{14}C-trifloxysulfuron in yellow nutsedge. Including metcamifen in a trifloxysulfuron treatment did not significantly effect ^{14}C-trifloxysulfuron absorption and metabolism in yellow nutsedge. However, yellow nutsedge translocation studies showed greater ^{14}C-trifloxysulfuron in the treated leaf (70.9%> 57.9%) and lower ^{14}C-trifloxysulfuron in the shoots (26.6%< 38.0%) when metcamifen was included in a trifloxysulfuron treatment. Including metcamifen in a trifloxysulfuron application did not influence ^{14}C-trifloxysulfuron metabolism in yellow nutsedge. These data suggest that the inclusion of metcamifen to a trifloxysulfuron treatment may safen herbicide application in an otherwise susceptible species while remaining efficacious on undesirable weed species.

Sequential Applications of Minimized Topramezone Rates for the Control of Mature Goosegrass Populations. Mikerly M. Joseph*[1], Katarzyna A. Gawron[2], Pawel Petelewicz[2]; [1]Auburn University, Auburn, AL, [2]University of Florida, Gainesville, FL (146)

Goosegrass [*Eleusine indica* (L.) Gaertn.] is one of the most troublesome warm-season weeds in the southern United States, commonly infesting various turfgrasses. Currently, the postemergence options for controlling goosegrass are highly limited and its eradication becomes more difficult when the plant starts tillering and develops seedheads. Among the currently registered options, topramezone has the ability to control mature goosegrass. However, research conducted in Florida suggests that despite seemingly effective control, goosegrass may recover due to surviving roots. Therefore, this study assessed strategies aimed to ensure the persistent removal of mature goosegrass populations. Two greenhouse studies were conducted to evaluate the response of goosegrass at 1-3 tillers and 4-10 tillers to topramezone 1) applied once at rates increasing from 0.002 L ha^{-1} to 0.036 L ha^{-1} and 2) at a total rate of 0.018 L ha^{-1} applied once or equally divided into 2, 4, or 8 biweekly applications. Visual control was assessed on a scale of 0 to 100%. None of the single-applied topramezone rates effectively controlled control goosegrass (<60% control) as shown with the rate response study. All sequential topramezone applications tested in the second study resulted in >90% goosegrass control compared to =70% control achieved with single application at 16 weeks after initial treatment. Moreover, programs in which the total rate of 0.018 L ha^{-1} was split into >2 (i.e., 4 and 8) applications provided near-complete (>95%) goosegrass control regardless of tillering stage. Results from this research suggest that extended application programs utilizing minimized topramezone rate may provide persistent control of mature goosegrass populations.

Imazapic Tank-mixes with Non-selective Herbicides for Tropical Signalgrass Control.
Katarzyna A. Gawron[1], Mikerly M. Joseph[2], Pawel Petelewicz*[1]; [1]University of Florida, Gainesville, FL, [2]Auburn University, Auburn, AL (147)

Tropical signalgrass [*Urochloa distachya* (L.) T.Q. Nguyen] has become one of the most troublesome weeds in Florida turfgrasses – particularly in bermudagrass (*Cynodon* spp.) athletic fields and golf course fairways. It is a warm-season season grassy perennial characterized by aggressive growth habit. It can regenerate from stolons and seeds after periods of unfavorable conditions or remain green year-round in the absence of frost. Selective postemergence options for its control are highly limited. Currently, pinoxaden is an industry standard providing reliable and consistent results in Florida; however, turfgrass managers face challenges once its annual application limits are reached, especially in the case of severe infestations. Therefore, identification of alternatives is crucial. This study was conducted to evaluate summer and fall applications of imazapic at 70.05 g ai ha^{-1}, glufosinate at 553.25 g ai ha^{-1} or 840.11 g ai ha^{-1} and their combinations for persistent control of severe (>50% initial cover) tropical singalgrass infestation in bermudagrass 'Tifway 419' maintained as an athletic field in Orange City, FL. Turfgrass recovery rate was also investigated. Herbicides were applied twice biweekly starting from May 18, 2023 (summer sequence) and Oct. 11, 2023 (fall sequence). With the exception of fall-applied standalone glufosinate at 553.25 g ai ha^{-1}, all glufosinate-containing treatments resulted in exceptional (>90%) tropical signalgrass control. Although summer applications resulted in more rapid control, gradual target weed recovery to unacceptable levels (<80%) was observed following peak control at 3 weeks after initial treatment (WAIT). Fall applications provided more gradual control (peak at >90% at 6 WAIT) but persisting at same levels until the final rating event at 12 WAIT. All glufosinate-containing treatments resulted in comparable, rapid, and severe damage to turf; however, gradual turf recovery was observed starting from 3 and 4 WAIT in summer and fall, respectively. Although canopy percent green cover was restored to the levels comparable with nontreated plots from 8 WAIT, complete visual recovery was achieved only with summer applications.

Evaluation of Non-Systemic Alternatives to Glyphosate. Joe Omielan*; University of Kentucky, Lexington, KY (149)

Public perception of the safety of glyphosate has many homeowners requesting the use of alternative products for vegetation management. For this study we included a variety of commercially available fast acting non-systemic products. The trial was established at two locations on the Spindletop Farm in Lexington KY on August 2, 2023. One location was predominantly broadleaves, such as violets and clover (BL) while the other was predominantly tall fescue (TF). The trial had 10 treatments with 3 replications of each arranged in a randomized complete block design with 1.1 m x 3 m plots. The spray volume ranged from 234 L ha^{-1} to 925 L ha^{-1} depending on the product label. NIS at 0.25% v/v was included with the products that were not RTU (ready to use). The canopy height was 13 cm at BL and 18 cm at TF. Treatments included Roundup ProMax @ 2.3 L ha^{-1} (glyphosate), Finale @ 7 L ha^{-1} (glufosinate), Reward @ 2.3 L ha^{-1} (diquat), Scythe @ 7% v/v (pelargonic acid), Final San @ 16.7% v/v (ammoniated soap of fatty acids), Deadweed Brew @ 9% v/v (caprylic acid and capric acid), Avenger @ 25% v/v (citrus oil), Eco Living RTU (NaCl and vinegar), and Natural Armor RTU (NaCl and clove oil). Visual assessments of percent control were done 2 (8/4/2023), 5 (8/7/2023), 9 (8/11/2023), 13 (8/15/2023), 23 (8/25/2023), 37 (9/8/2023), and 62 (10/3/2023) days after treatment (DAT). Data were analyzed using ARM software and treatment means were compared using Fisher's LSD at $p = 0.05$. Most of the contact product treatments, except for Finale, had the greatest control ratings 2 DAT at both locations. Their % control ratings decreased over time as surviving plants regrew. At BL the ratings ranged from 4 to 88% with the top group of treatments; Reward, Scythe, and Deadweed Brew at 82 to 83% control 2 DAT. At TF the ratings ranged from 5 to 96% with the same top group of treatments plus Final San at 92 to 96% control. By 9 DAT, at BL the ratings ranged from 13 to 80% with the top group of treatments: Reward and Deadweed Brew at 70 to 80% control. At TF the ratings ranged from 33 to 72% with the top group of treatments; Roundup ProMax, Finale, Reward, Scythe, Final San, and Deadweed Brew at 57 to 72% control. By 23 DAT, at BL the ratings ranged from 0 to 52% with the top group of treatments; Roundup ProMax and Finale at 40 to 52% control. At TF the ratings ranged from 0 to 78% with the top treatment, Roundup ProMax at 78% control. Alternatives are available but need to be incorporated into a management system which may include repeated applications to achieve the desired objectives.

Utilizing Native Grasses' for Ecological Weed Suppression in Rangeland and Natural Areas: A Review. Liberty B. Galvin*[1], Zhenglin Zhang[2]; [1]Oklahoma State University, Stillwater, OK, [2]University of California Davis, Davis, CA (150)

The invasion of weedy species poses significant challenges in rangelands and natural areas, leading to the degradation of livestock feed quality, reduction in biodiversity, and overall ecological imbalance. Employing native grasses for weed suppression represents an ecologically sound approach that offers a low-input and sustainable management strategy over extended timeframes. This study conducted a systematic literature review to investigate the dynamics between native grasses and weeds, uncovering the potential of native grasses to diminish weed presence through interactions with other biological communities. The research suggests the integration of agronomic and breeding techniques with restoration initiatives, including the use of specialized seeding methods to establish native grasses successfully. A comprehensive planning framework for land managers is proposed, highlighting the importance of considering functional traits for competitive advantages against weeds and prioritizing germplasm availability during species selection. Additionally, management strategies favoring native grasses, such as land clearance and strategic disturbances, are discussed. The mechanisms of weed suppression involve direct competition, indirect interactions through trophic levels of arthropods and grazers, and human-induced disturbances. The findings of this study support the belief that, if employed judiciously, native grasses have the potential to play a crucial role in effective weed suppression.

Influence of Rainfall Timing on the Efficacy of Hexazinone and Quinclorac for the Control of Knotroot Foxtail (*Setaria parviflora*). Tunde Lanre Akanbi*, David P. Russell, Forrest Davis; Auburn University, Auburn, AL (151)

Knotroot foxtail is a perennial grass found in pastures across the Southeastern US. For grazing livestock, young plants maintain desirable forage and grazing potential, however, prolific seed production and poor forage quality at maturity underscores this species' weedy nature. Herbicide active ingredients such as hexazinone and quinclorac have shown efficacy in controlling this weed, but their performance is influenced by soil moisture and rainfall activation. Knowledge of proper application before rainfall is essential for maximizing control and to manage for desirable forage species such as bermudagrass, bahiagrass, and tall fescue. Therefore, research was conducted in a controlled greenhouse at Auburn University to evaluate the response of knotroot foxtail to these herbicides under varied rainfall timings. Knotroot foxtail rhizomes were transplanted into pots and allowed to grow until foliage reached an average height of 28cm before being treated with 0.42 kg ai ha^{-1} quinclorac (1qt/A Facet L) and 0.84 kg ai ha^{-1} hexazinone (3 pt/A Tide Hexazinone). Overhead irrigation was calibrated to simulate 0.63 cm (0.25 in) of rainfall 0, 3, 6, 9, 12, and 15 days after herbicide treatment. Injury was visually estimated at 7, 14 and 51 after each rainfall timing events, and dry weight biomass of rhizomes were recorded at 51 DAT. Statistical analysis was performed using the R software (version 2023.03.0). The data collected were analyzed using ANOVA and the means were separated using Tukey HSD Test. This preliminary study revealed that herbicide selection was a significant factor affecting rhizome biomass of knotroot foxtail ($p < 0.001$). Plants treated with hexazinone had less rhizome dry weight (1.88g) compared to quinclorac with mean dry weight of 3.24g at 51 DAT. There was no significant difference between hexazinone and quinclorac herbicides with respect to knotroot foxtail injury at 51 DAT ($p = 0.07$). Impact of irrigation timing on knotroot foxtail varied with respect to injury and no significant differences were observed at 51 DAT for hexazinone ($p = 0.18$) and quinclorac ($p = 0.38$) treatment. These data suggest potential drought or transplant stress on plants which may have influenced their response to treatments. Further studies will be conducted to ascertain the optimal time required for rainfall to activate these herbicides for better control of knotroot foxtail. Additional efforts will also be undertaken to control these environmental factors by modifying plant establishment period and sub-irrigation methods.

Evaluating Efficacy of Method on McCartney Rose (*Rosa bracteata*). Chris R. Gregory*[1], John D. Byrd, Jr.[2], Thomas H. Duncan[1], Kayla L. Broster[2]; [1]Mississippi State University, Starkville, MS, [2]Mississippi State University, Mississippi State, MS (152)

Macartney rose (*Rosa bracteata* J.C. Wendl.), is a warm-season perennial invasive shrub in Mississippi (Invasive Plant Atlas of United States) and other southeastern states from Maryland and Kentucky westward to Texas. Originally introduced in the United States from China (Weakley 2022) as an ornamental flowering plant, Macartney rose invades pastureland and open noncultivated areas. Plants grow in clumps that can reach ten feet height and greater widths, significantly reducing area available for grazing in livestock production systems. A field study was conducted in Noxubee Co., Mississippi at two cattle grazed field locations. Both locations contained established mature populations of Macartney rose; however, populations in one location had received herbicide application followed by mowing the previous season, while the second location was untreated the previous season. Eight treatments: Method (aminocyclopyrachlor) at 140, 210, and 280 g ai ha^{-1}, Method at 264 g ai ha^{-1} plus Escort XP (metsulfuron-methyl) at 84 g ai ha^{-1}, Method at 280 g ai ha^{-1} plus 2,4-D amine at 560 g ai ha^{-1}, Invora (triethylamine salt of aminocyclopyrachlor) at 109 g ai ha^{-1}, Surmount (picloram+fluroxypr) at 999.5g ai ha^{-1} picloram 806.3g ai ha^{-1} fluroxypr and no herbicide were organized in a randomized complete block design with four replications per treatment. Methylated seed oil (MSO) at 0.5% volume per volume (%V/V) was added to each herbicide treatment which were applied May 31, 2023 with a CO_2 backpack sprayer calibrated to deliver 280 L ha^{-1}. Plant injury was observed and recorded incrementally at 2, 4, 8 and 12 weeks after treatment (WAT). MacCartney rose responses to treatments were analyzed using ARM (revision 2023.6 November 29, 2023 (B=23424)) to compare efficacy. In both pasture locations, the treatment showing the most control was Method at 280 g ai ha^{-1} mixed with 2,4-D amine at 560 g ai ha^{-1} at 2 WAT, with the least control from Method at 140 g ai ha^{-1}. However, at 4 WAT each treatment showed no significant difference in control with the lowest being 80% control and maintained control at both 8 WAT and 12 WAT ratings. Further evaluation will be conducted in spring of 2024 to observe reemergence from treated areas.

Brazilian Vervain (*Verbena brasiliensis*) Control in Bermudagrass Pasture. Michael W. Marshall*; Clemson University, Blackville, SC (153)

Brazilian vervain is an upright, herbaceous perennial weed common throughout the southeast United States. It spreads via woody crowns and seeds. Grazing animals tend to avoid this weed due to its low palatability. As a result, the amount of desirable forage decreases from weed competition and preferential grazing. Very little information exists on effective herbicides for Brazilian vervain control in bermudagrass pastures. Therefore, studies were initiated to evaluate selected broadleaf herbicides for Brazilian vervain control and bermudagrass response. Field studies were conducted at the Edisto Research and Education Center located near Blackville, SC. Experimental design was a randomized complete block with four replications. The site was naturally infested with Brazilian vervain. Herbicide treatments included DuraCor (128 g ha^{-1}), DuraCor+Pasturegard (77+350 g ha^{-1}), Pasturegard (840 g ha^{-1}), Remedy (280 g ha^{-1}), Cimarron Plus (27 g ha^{-1}), and Graslan (2667 g ha^{-1}). An untreated check was included for comparison. Visual crop response and weed control ratings were evaluated at 14 and 30 days after application (DAA). Data were analyzed using ANOVA and means separated using LSD at the 5% level. Bermudagrass injury ranged 6 to 15% at 30 DAA likely attributed to high temperature at the time of application. At 14 DAA, Brazilian vervain control ranged from 33 to 99% control across the two study locations. Graslan provided the greatest level of Brazilian vervain control (93 and 99%) at 14 DAA. At 30 DAA, Brazilian vervain control ranged from 91 to 100% with Pasturegard, Remedy, and Graslan indicating that herbicides containing triclopyr and picloram provided the best control across locations. Cimarron Plus was weak on Brazilian vervain at 30 DAA. Similarly, DuraCor plus Pasturegard control was similarly low at 14 DAA. Brazilian vervain control improved with the higher rate of DuraCor at 30 DAA. In summary, Brazilian vervain control at 30 DAA was good to excellent across all herbicide treatments except Cimarron Plus. Future research will include evaluation of control 9 and 12 months after application.

Controlling Highly Invasive Chinese Tallow (Triadica Sebifera) with Precision Applied Herbicides. Sam H. Ingram*; Corteva agriscience, Savannah, GA (154)

Chinese Tallow (*Triadica sebifera*), also known as Popcorn Tree, is an invasive, leguminous tree first introduced into the southern United States in the 1700's from southern Asia. This rapidly growing, prolific seed producer can quickly displace native plants and reduce overall habitat diversity. Cultural and Mechanical control methods for this invasive species are very labor intensive, and often have little impact on controlling the plant. In 2023, we set out to determine if a lower rate of undiluted aminopyralid (Milestone) applied via hack-and-squirt in comparison to the current labeled rate of diluted Milestone could control Chinese Tallow while also reducing total product applied and number of hacks per tree. A replicated field trial, utilizing trees averaging 4-inch diameter at breast height (DBH), examined efficacy of the following treatments, 1) Milestone at 10% V/V of 1.0 mL, 2) Milestone at 50% V/V of 1.0 mL, 3) Milestone at 100% V/V of 0.5 mL, 4) Aminocyclopyrachlor at 100% V/V of 0.5 mL, and 5) Untreated hack. All cuts on trees were made at a 45°angle, at 3-4 feet above soil surface, using a machete. Treatment 1 followed label instructions to make overlapping hacks on the tree, with applications of diluted solution being applied in every hack. Treatments 2,3, and 4 were applied to 1 hack per 4 inch DBH. Herbicide was applied immediately following the cut using a continuous injector syringe. The number of hacks averaged 8.5, 2.5, 3.2, 2.8, and 2.5 for treatments 1,2,3,4 and 5, respectively. The average amount of solution applied averaged 8.5, 2.5, 1.6, and 1.4 for treatments 1,2,3, and 4, respectively. A visual rating of percentage leaf brownout (Leaf B/O) for each tree within a treatment was taken 30 days after application to give an early indication of herbicide efficacy. The Leaf B/O averaged 90, 87, 90, 96, and 0 for 1,2,3,4 and 5, respectively. These data indicate there is potential to control Chinese Tallow while reducing total solution applied and total hacks made in comparison to the current label recommendations. Pursuance of Special Local Needs (SLN) labels may be an option for states with invasive Chinese Tallow.

Spurious Pixels in the USDA Cropland Data Layer: Implications on Pesticide ESA Consultations. Taylor Randell-Singleton*, A Stanley Culpepper; University of Georgia, Tifton, GA (155)

The Cropland Data Layer (CDL) is a robust GIS dataset created by the United States Department of Agriculture (USDA) as a way to document crop-specific land classifications throughout the country. Updated annually, the CDL identifies and records the locations of over 100 different categories of crops based on satellite imagery, creating a raster-based dataset utilized by federal agencies for various reporting and regulatory objectives. Specifically considering the utilization of the CDL for pesticide regulatory decisions, the CDL provides information on crop acreages and locations of fields where possible pesticide use may occur, representing chemical actions areas. Through efforts to generate county-level refined maps of the intersection of corn, cotton, and soybean fields with threatened and endangered species (listed species) habitat in Georgia, it has become clear that small, erroneous pixels (known as spurious pixels) are present in the cropland data layer. These pixels less than two acres in size appear in areas that are visibly not a crop field on satellite imagery, and therefore represent areas that may potentially interact with listed species habitat, which are not actually a pesticide use site. The objectives of this study were to gain an understanding of what percentage of spurious pixels less than two acres in size are truly erroneous from within sampled areas throughout Georgia. This would support removal of these pixels from the CDL for purposes of determining pesticide use overlap with listed species habitat. Through a random process, three Georgia counties were selected (Berrien, Irwin, and Miller) for evaluation, and five points were randomly placed throughout each county using ArcGIS software. Utilizing corn, cotton, and soybean CDL combined over 2017 through 2021, spurious pixels less than two acres in size were visually assessed using different sources of aerial imagery within a 0.5-mile buffer area surrounding each point, to determine if the pixel was located in a crop field or non-crop field area. Results from sampled areas indicate that 96% of spurious pixels less than two acres in size within sampled areas are truly erroneous and may misrepresent pesticide use in an inaccurate location. The ability to remove pixels less than two acres in size from the CDL would improve the ability to utilize pesticides in areas where listed species are not a concern due to unsuitable habitat. Furthermore, this study supports the need to understand and evaluate average field sizes across the U.S. through surveying, to facilitate accurate pesticide use evaluations for regulatory decision making.

Endangered Species Act and FIFRA, and What They Mean for You. Bill Chism*[1], Sarah A.d. Chu[2], Daewon Koo[3]; [1]Retired from U.S. Environmental Protection Agency, Point Of Rocks, MD, [2]Louisiana State University, Baton Rouge, LA, [3]Virginia Tech, Blacksburg, VA (156)

The Endangered Species Act (ESA), passed in 1973, was designed to protect threatened and endangered species and their critical habitat. The ESA requires government agencies to protect and not take action against any species that has been listed as federally endangered or threatened. Due to recent lawsuits brought against the Environmental Protection Agency (EPA), herbicide labels will now have to comply with the ESA; therefore, the EPA will consider ESA impact for future registration and re-registration herbicide decisions. The proposed framework will require many changes to herbicide labels including limitations on locations of use such as a Pesticide Use Limitation Area (PULA), expanded buffer zones in certain regions, mitigations that producers will need to implement to reduce drift or run-off, and a requirement to check an EPA website that lists current ESA restrictions. To date, no herbicides have been fully removed from the market and the goal of this enforcement is to get herbicide labels in compliance with the ESA. This poster will describe the ESA and how it differs from the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), and how growers, pesticide applicators, and crop consultants, can be impacted by the potential new label requirements to reduce spray drift and runoff/erosion. It also provides a step-by-step guide to EPA's Bulletins Live! Two system for end-users to follow the proposed ESA restrictions and an example of a herbicide label amendment complying with the ESA. The goal of the EPA is to ensure herbicides will be able to be used for years to come in a sustainable manner to preserve ecosystem services for producers and the planet.

What If Glyphosate is Gone: A Demo of Non-glyphosate Herbicide Programs for Corn and Soybean. Dwight Lingenfelter*; Penn State University, University Park, PA (157)

During the COVID-19 pandemic many herbicides including glyphosate were very difficult to obtain and/or not affordable for various reasons. Therefore, many ag practitioners were devising programs that de-emphasized the use of glyphosate. This occasion forced many to be creative about developing alternative herbicide programs for burndown and in-crop applications. Furthermore, since more than 40 countries have banned glyphosate (or have imposed use restrictions and/or issued intent to ban), it is prudent to contemplate and evaluate herbicide programs if the use of glyphosate is ever significantly limited or eliminated. Thus, in 2022, field demonstrations were conducted in weedy fallow fields to compare various corn and soybean burndown and POST herbicide programs that de-emphasize glyphosate in central Pennsylvania. In the burndown programs, emphasis was placed on using various combinations that included paraquat, 2.4-D, metribuzin, and saflufenacil. However, programs that included rimsulfuron, thifensulfuron, mesotrione, and others were also tested. In the POST programs for corn, nicosulfuron, rimsulfuron, dicamba, atrazine, mesotrione, topramezone, and glufosinate combinations were emphasized; while imazethapyr, clethodim, chlorimuron, cloransulam, lactofen, 2,4-D, and glufosinate combinations were showcased as soybean options. Glyphosate was included in certain treatments as a comparison. Herbicides were applied with a small-plot, CO2-backpack sprayer system that delivered 15 GPA (140 L ha^{-1}) thru TeeJet AIXR110015 nozzles on April 30 (burndown study) and June 13 (POST study). MSO or COC plus AMS was included were necessary. Predominate weeds in the burndown area included horseweed (*Conyza canadensis*), mouseear chickweed (*Cerastium fontanum*), dandelion (*Taraxacum officinale*), annual bluegrass (*Poa annua*), and broadleaf plantain (*Plantago major*). Common weeds in the POST demonstration were giant foxtail (*Setaria faberi*), large crabgrass (*Digitaria sanguinalis*), common ragweed (*Ambrosia artemisiifolia*), lambsquarters (*Chenopodium album*), yellow nutsedge (*Cyperus esculentus*), and other scattered species. Weed control was visually evaluated routinely after application.Preliminary results and comments from the burndown trial are summarized below. (For simplicity, herbicide tradenames and imperial rate units are included in the discussion.)Programs with most effective burndown control:· Gramoxone 2 pt/acre+ 2,4-D 1 pt + Atrazine 1 qt (or Metribuzin 6 oz) – Fairly consistent control overall on many weeds.· Sharpen 1 fl oz + 2,4-D 1 pt + Roundup PowerMax 11 fl oz – Overall good control on many weeds; Low rate of glyphosate improves annual bluegrass control and other species; Weaker on larger weeds.· Basis Blend 1.5 oz + 2,4-D 1 pt + Atrazine 1 qt – Adequate overall control; Good control of horseweed; Can be an adequate non-glyphosate option for grass burndown; Higher rates of Basis Blend (2.5 oz) might cause corn injury under cool, wet conditions; Include Sharpen for more consistent horseweed control.· Acuron 2.5 qt + Atrazine 1 qt – Rather consistent control of most species including horseweed, dandelion; Fair to adequate on small annual bluegrass.Programs that were less effective but could have utility in certain areas:· Gramoxone 2 pt + Sharpen 1 fl oz + Metribuzin 6 oz – Not as consistent without 2,4-D in the mix; Weaker on dandelion and plantain; some horseweed escapes; This treatment had more weed regrowth after each week.· Sharpen 1 fl oz + 2,4-D 1 pt + Metribuzin 6 oz – Good control of horseweed; Weaker on chickweed, annual bluegrass, few other weeds.· Trivence 6 oz + 2,4-D 1 pt – Fair burndown on most broadleaf weeds; Possible weakness on larger horseweed, chickweed, dandelion; Some initial suppression of annual bluegrass· Valor EZ 2.5 fl oz + Metribuzin 6 oz – Weak on horseweed, dandelion, plantain, Fair to good on other weeds; The addition of 2,4-D and Classic improves control; Best to apply to actively growing weeds <1" tall near planting.· Zidua Pro 6 fl oz + 2,4-D 1 pt + Metribuzin 6 oz – Overall adequate burndown; Weak on plantain and annual bluegrass· Reviton 1 fl oz + Elevore 1 fl oz – Good control of horseweed; Weak on many other weeds overall Preliminary results and comments from the POST demonstration:· Roundup PowerMax 32 fl oz –

Good overall control of many weeds including pokeweed; weak on horseweed; Most effective treatment on annual ryegrass; Typical escapes later in season due to no residual.· Steadfast Q 1.5 oz + Status 5 oz – Overall, good control of many annuals; Weak on annual ryegrass; Considerable crabgrass and nutsedge populations by late season.· Steadfast Q 1.5 oz + Callisto 3 fl oz + Atrazine 1 pt – Overall, good control of many annuals, especially broadleaves; Fair on pokeweed; Weak on annual ryegrass and larger grasses and bindweed; For additional grass control use Impact or other similar Group 27 instead of Callisto.· Steadfast Q 1.5 oz + Liberty 32 fl oz – Overall, good control of many annuals; Suppression of annual ryegrass; Sizable populations of crabgrass, nutsedge, and Canada thistle by late season.· Realm Q 4 oz + Atrazine 1 pt – Fair control of many annual grasses, better on annual broadleaves; Weak on annual ryegrass; Some activity on pokeweed but not enough to kill; Considerable grasses and nutsedge escapes by late season; Include dicamba for improved broadleaf control.· Impact 1 fl oz + Status 5 oz + Atrazine 1 pt – Very effective season-long control of many annuals, especially broadleaves; Few grasses and nutsedge by late season.· Impact 1 fl oz (or Capreno 3 fl oz) + Liberty 32 fl oz – Overall, good control of many annuals; Some grasses and nutsedge by late season; Add atrazine to broaden the control spectrum.· Pursuit 4 fl oz + Select Max 12 fl oz – Good control of grasses during season; initial control of broadleaves; some nutsedge suppression; High populations of ragweed, lambsquarters and velvetleaf by late season.· Pursuit 4 fl oz + Reflex 1 pt (or Cobra 10 fl oz) – Overall, good control of many broadleaves, especially on ragweed and pigweed; antagonism on grasses and suppression of nutsedge; Weak on annual ryegrass and horseweed; A lot of grasses by late season; Liberty 32 fl oz could be used instead of the Group 14).· Synchrony XP 0.38 oz + Assure II 10 fl oz – Fair to poor control of many annuals; Adequate on foxtails and crabgrass; Weak on annual ryegrass, horseweed, and ALS-resistant pigweed; significant weed populations by late season due to low Synchrony rate – higher rate would have provided better control of broadleaves.· Select Max 16 fl oz + Cobra 10 fl oz – Good control of many weeds including pigweed and ragweed; Adequate on foxtails and crabgrass and only suppression of annual ryegrass; Weak on lambsquarters, horseweed, and pokeweed.· Select Max 16 fl oz + FirstRate 0.5 oz + Classic 0.5 oz – Overall, good control of grasses; great on ragweed, velvetleaf, cocklebur; Suppression of nutsedge, annual ryegrass, and pokeweed; Poor on horseweed, lambsquarters, and ALS-resistant pigweed.· Liberty 32 fl oz + Enlist One 2 pt – Overall, initial control of many annuals; Good control horseweed, pigweed, lambsquarters, and giant foxtail; Fair on larger foxtails and crabgrass; Some activity on annual ryegrass and pokeweed; Considerable yellow foxtail, crabgrass and nutsedge by late season.POST summary: Corn programs for annual weeds can be effective without glyphosate. Soybean programs can benefit from glyphosate since certain broadleaf herbicides antagonize POST-grass herbicide control. Also, broadleaf weed control in soybean can be inconsistent depending on species. Perennial weed control is limited without glyphosate in the program. Since these were conducted in fallow settings (no crop planted), crop competition could improve weed control in some situations.

Advancing Weed Science Research, Extension, and Education: NIFA Grants and Panel Reviewer Opportunities. Annu Kumari*[1], Cynthia Sias[2], James Kells[3], Vijay Nandula[4], Lee Van Wychen[5]; [1]Crop, Soil & Environmental Sciences Department, Auburn University, Auburn, AL, [2]Virginia Tech, Blacksburg, VA, [3]Michigan State University, East Lansing, MI, [4]USDA, Stoneville, MS, [5]Weed Science Society of America, Alexandria, VA (158)

The United States Department of Agriculture-National Institute of Food and Agriculture (USDA-NIFA) administers competitive research, extension, and education programs in support of US agriculture. Several of these programs fund research and extension projects related to weed science along with other pest disciplines. Traditionally, a large number of successful weed science-focused project awards came from the Crop Protection and Pest Management (https://www.nifa.usda.gov/grants/funding-opportunities/crop-protection-pest-management) and the Agricultural and Food Research Initiative Foundational and Applied Science's (AFRI FAS, https://www.nifa.usda.gov/grants/programs/agriculture-food-research-initiative-afri/afri-foundational-applied-science-program) Pests and Beneficial Species of Agricultural Production Systems programs. However, there are several other programs that could be relevant to weed scientists. Some of these include, AFRI FAS – Critical Agricultural Research and Extension (CARE), IR-4 (https://www.nifa.usda.gov/grants/funding-opportunities/minor-crop-pest-management-program-interregional-research-project-4-ir), Methyl Bromide Transition (MBT, https://www.nifa.usda.gov/grants/funding-opportunities/methyl-bromide-transition-program), organic programs - Organic Agriculture Research and Extension Initiative (OREI, https://www.nifa.usda.gov/grants/funding-opportunities/organic-agriculture-research-extension-initiative) and Organic Transitions (ORG, https://www.nifa.usda.gov/grants/funding-opportunities/integrated-research-education-extension-competitive-grants-program-0), and Specialty Crop Research Initiative (SCRI, https://www.nifa.usda.gov/grants/funding-opportunities/specialty-crop-research-initiative). Additionally, several AFRI FAS program area priorities are available for projects involving interdisciplinary research and extension. Weed scientists are strongly encouraged to consider submitting proposals to these USDA-NIFA competitive grant programs. Weed scientists, especially early- and mid-career academic scientists, are also encouraged to volunteer to serve on a USDA-NIFA proposal review panel. Weed science representation on review panels is important and serving on a review panel is a great way to improve proposal-writing skills and build professional networks. Click on this link https://prs.nifa.usda.gov/prs/volunteerPrep.do to volunteer. Volunteering simply places your name on a list of candidate reviewers. There is no commitment until you are contacted by a USDA-NIFA Panel Manager/Program Director and agree to serve on a specific panel. (Copy and paste the respective URL links in a new tab or window of your web browser).

Results from the 2023 WSSA Membership Survey. Hilary A. Sandler*[1], Gregory K. Dahl[2], Carroll Moseley[3], A Stanley Culpepper[4]; [1]UMass Cranberry Station, East Wareham, MA, [2]Winfield United - Retired, Eagan, MN, [3]Syngenta, Brown Summit, NC, [4]University of Georgia, Tifton, GA (159)

A 10-question survey was circulated to the WSSA membership in June 2023 requesting input on society activities. The survey was sent electronically to approximately 1200 members; the survey was opened by approximately 1170 people and 193 responses were tabulated for each question. Six questions had a closed set of responses, two questions allowed for comments in addition to the suggested responses and two were open-ended questions. Sixty percent of respondents favored joint meetings with the regional weed science societies. Six months prior to our annual meeting, 50% of survey participates were already planning to attend the 2024 San Antonio meeting. Half of the respondents (49%) strongly preferred to go to Hawai'i as a meeting destination; 20% had no opinion. Forty-seven (47%) percent said they highly and slightly preferred to have printed copies of the program; 24% strongly and slightly preferred not to have printed copies. Just over half (56%) wished to make a one-time purchase of the next edition of the Herbicide Handbook versus 18% for a subscription; 25% were unsure or had no preference. Respondents were split on whether to continue the Innovative Grants Program with 44% saying either Yes or that they had no preference; 11% said No. Sixty percent (60%) of respondents wished to go on weed-science related tours with one-third preferring to visit the Alamo. The zoo, Mission and botanical gardens were also cited as possible tour options. Respondents were given 9 choices (plus "Other) and asked to indicate their top five priorities for WSSA engagement over the next few years. The choices included: student training and education, funds for weed research, Endangered Species Act and its impact on herbicide applications, support for publishing Open Access, developing Weed Science curricula, recruit new members, regulatory aspects of Weed Science, site selection of the annual meeting, and be a source of reliable Weed Science information for the public. Training and educating students ranked Number 1 (80%); Regulatory and Research funds came in second with 65% and 67%, respectively. "Other" comments included fostering collaborations internationally and with other organizations and promoting professional development opportunities. When queried about how to improve the meeting experience (open-ended question), having a better meeting app, free WIFI and providing a free printed program were among the top suggestions. Offering a tour during the meeting was also suggested. Multiple members wanted to continue to have WSSA-sponsored socials, reduce the number of concurrent sessions and have more networking opportunities. Others cited that having a longer lunch break and more lunch (and plant-based) options would improve their experience. When asked for other programs or functions WSSA could support (open-ended question), respondents frequently cited Extension and Education as desirable options (highest number of comments). Subsidizing student attendance for meetings (as well as enrichment and development events) and lowering overall meeting costs were listed multiple times. Hiring a Communications Director and informing the public about weed science were also noted by respondents.

2023 Survey Results for the Most Common and Troublesome Weeds in Grass Crops, Pasture, and Turf. Cynthia Sias[1], Lee Van Wychen*[2], Annu Kumari[3]; [1]Virginia Tech, Blacksburg, VA, [2]Weed Science Society of America, Alexandria, VA, [3]Crop, Soil & Environmental Sciences Department, Auburn University, Auburn, AL (160)

The 2023 Weed Survey for the U.S. and Canada surveyed the most common and troublesome weeds in the following grass crops: 1) corn (*Zea mays*); 2) rice (*Oryza sativa*); 3) sorghum (*Sorghum bicolor*); 4) spring cereal grains; 5) winter cereal grains; 6) pastures, rangeland, or other hay; and 7) turf. Common weeds refer to the weeds you most frequently see while troublesome weeds are the most difficult to control but might not be widespread. There were 258 survey responses from the U.S. and Canada. In corn, the top five most common weeds were 1) common lambsquarters (*Chenopodium album*); 2) waterhemp (*Amaranthus tuberculatus*); 3) morningglory species (Ipomoea spp.); 4) Palmer amaranth (*Amaranthus palmeri*); 5) giant foxtail *(Setaria faberi).* The most troublesome weeds in corn were 1) waterhemp; 2) morningglory spp.; 3) Palmer amaranth; 4) johnsongrass (*Sorghum halepense*); and 5) kochia (*Bassia scoparia*). In rice, the top three most common weeds were 1) Cyperus spp.; and 2) a tie between barnyardgrass (*Echinochloa crus-galli)* and Amazon sprangletop (*Diplachne panicoides)*. The three most troublesome weeds in rice were 1) Echinochloa spp.; 2) sprangletop spp.; and 3) a tie between Oryza spp. and Cyperus spp. In sorghum, the top three most common weeds were 1) Palmer amaranth 2) johnsongrass; and 3) a tie among kochia; morningglory spp.; and pigweed spp. The top three most troublesome weeds were: 1) johnsongrass; 2) Palmer amaranth; and 3) kochia. In spring cereal grains, the top three most common weeds were: 1) a tie between common lambsquarters and wild oat (*Avena fatua*); and 3) kochia. The top three most troublesome weeds in spring cereal grains were 1) wild oat; 2) kochia; and 3) green foxtail (*Setaria viridis)*. In winter cereal grains, the top five most common weeds were 1) henbit (*Lamium amplexicaule*); 2) common chickweed (*Stellaria media*); 3) downy brome (*Bromus tectorum*); 4) Italian ryegrass (*Lolium perenne ssp. Multiflorum*); and 5) annual bluegrass (*Poa annua*). The most troublesome weeds were: 1) downy brome; 2) a tie between horseweed (*Conyza canadensis*) and Italian ryegrass; 4) annual bluegrass; and 5) kochia. In pastures, rangeland, and other hay, the top five most common weeds were 1) Canada thistle (*Cirsium arvense*); 2) horsenettle (*Solanum carolinense*); 3) dandelion (*Taraxacum officinale*); and 4) a tie between downy brome and musk thistle (*Carduus nutans*). The most troublesome weeds were 1) Canada thistle; 2) leafy spurge (*Euphorbia esula*); 3) horsenettle; 4) downy brome; and 5) johnsongrass. In turf, the top five most common weeds were 1) dandelion; 2) annual bluegrass; 3) white clover (*Trifolium repense*); 4) smooth crabgrass (*Digitaria ischaemum*); and 5) goosegrass (*Eleusine indica*). The most troublesome weeds were: 1) a tie between annual bluegrass and bermudagrass (*Cynodon dactylon*); 3) goosegrass; 4) yellow nutsedge (*Cyperus esculentus*); and 5) dallisgrass (*Paspalum dilatatum*). Overall, the top five most common weeds among all grass crops were 1) common lambsquarters; 2) kochia; 3) dandelion; 4) Canada thistle; and 5) Palmer amaranth. The most troublesome weeds were: 1) kochia; 2) Canada thistle; 3) johnsongrass; 4) Palmer amaranth; and 5) annual bluegrass.

Impact of Spray Nozzle Types and Spray Volumes on Herbicide Efficacy for Weed Control in Enlist Soybean. Vipan Kumar*, Akhilesh Sharma, Freida Ruth Safran Kahan, Dilan Minutello; Cornell University, Ithaca, NY (161)

Selection of appropriate nozzle type and spray volume is crucial for making labelled POST herbicide applications in dicamba/glufosinate/glyphosate-resistant (XtendFlex) or 2,4-D/glufosinate/glyphosate-resistant (Enlist E3) soybeans. The main objective of this research was to determine the impact of nozzle types and spray volumes on the performance of glufosinate or tank-mixture of glufosinate + 2,4-D for weed control in Enlist soybeans. A field experiment was conducted in 2023 growing season at Cornell University Musgrave Research Farm near Aurora, NY. An Enlist soybean variety was planted on May 21, 2023, at 75 cm row spacing. The study site was under corn-soybean rotation for >5 yr and heavily infested with common ragweed, common lambsquarters, and giant foxtails. A tank-mixture of glufosinate + 2,4-D was tested with TeeJet XR, AIXR, and TTI nozzles calibrated at spray volume of 94, 140, and 187 L ha^{-1}, whereas glufosinate was tested with a TeeJet XR nozzle using spray volume of 94, 140, and 187 L ha^{-1}. Three nozzle sizes, 110010, 110015, and 110020, were used to target spray volume of 94, 140, and 187 L ha^{-1}, respectively. All treatments were applied at V5 to V6 soybean growth stage (when weeds were 16 to 20 cm tall) and arranged in a randomized complete block design with 4 replications. Results indicated no significant differences among all tested treatments (combination of herbicides, spray nozzles, and spray volumes) for percent visual control of common lambsquarters (82 to 92%) and giant foxtails (80 to 93%) at 28 days after treatment (DAT). For common ragweed, a significant decrease in control (50 to 68%) was observed 28 DAT when glufosinate was applied with TeeJet XR nozzle across all spray volumes tested. In contrast, a tank-mixture of glufosinate + 2,4-D applied with all tested nozzles and spray volumes provided an excellent control (85 to 92%) of common ragweed 28 DAT. These results demonstrate that using TeeJet XR nozzle could reduce the efficacy of glufosinate (contact herbicide) on common ragweed irrespective of spray volume tested, further suggesting that nozzle selection can play key role in maximizing efficacy of POST glufosinate applied in 2,4-D/glufosinate/glyphosate-resistant soybean.

The Importance of Communicating Agricultural Science and Technology, the Role of CAST, and You! Jill Schroeder*[1], Gregory K. Dahl[2], Anthony L. Witcher[3], Thomas J. Peters[4], Gray Turnage[5]; [1]New Mexico State University, Las Cruces, NM, [2]Winfiled United - Retired, Eagan, MN, [3]Tennessee State University, Mcminnville, TN, [4]North Dakota State University, Fargo, ND, [5]Mississippi State University, Starkville, MS (162)

The Council for Agricultural Science and Technology (CAST) was established in 1972 as a nonprofit group and is composed of many scientific/professional societies, universities, nonprofit organizations, companies, and individuals. CAST convenes and coordinates networks of experts to assemble, interpret, and communicate credible, unbiased, science-based information to policymakers, the media, the private sector, and the public. The wide distribution of CAST publications to non-scientists enhances the education and understanding of topical agricultural issues to the public. At a time when the internet has made it more difficult to separate accurate and inaccurate information, it has never been more critical for reputable sources to deliver trusted, non-partisan information from authorities in their respective fields. Our primary work is the publication of task force reports, commentaries, special publications, and issue papers written by volunteer experts from many disciplines covering topics related to Food Sciences, Agricultural Technology, Animal Sciences, and Plant and Soil Sciences. Weed science is well represented on the CAST Board of Representatives Plant Agriculture and Environmental Issues Work Group with members from WSSA, NEWSS, NCWSS, WSWS, SWSS, and APMS. Board representatives welcome input from the members of our organizations on how CAST can enhance communication of science to more audiences and on topics of concern that need to be addressed through CAST publications. Becoming a CAST individual member is easy, free for students, and one of the best ways to stay informed on the science and technology of food and modern agriculture.

Influence of Flight Height and Spray Qualities on the Swath Width of a Dji T40 Drone.
Michael Althman*[1], Luis A. Avila[1], Ulisses R. Antuniassi[2], Fernando K. Carvalho[3], Gleica G. Silva[4]; [1]Mississippi State University, Starkville, MS, [2]São Paulo State University, Botucatu, Brazil, [3]Researcher and consultant at AgroEfetiva, Botucatu, Brazil, [4]Application technology specialist - AgroEfetiva, Botucatu, Brazil (163)

The objective of this work was to evaluate the effect of flight height spray qualities on swath width of ta DJI T40 drone. The research was carried out in the city of Piraju-SP, in March 2023. 09 configurations were carried out, varying spray qualities (fine, medium and coarse), flight height (4 , 5 and 6 m), at an application rate of 10L ha^{-1}. The methodology was based on the ASAE S386.2, 2018 standard, using a nylon string as a droplet collector, on which only water and dye were applied. After application, each string was collected and the four replicates were analyzed on a spectrophotometer equipped with a software, which calculated the Coefficient of Variation (CV%). The process ended with the indication of the best swatch width according to the uniformity indicated by the CV for the back-to-back (back-to-back) and race-track patterns. The obtained swath widths ranged from 7 to 10 m, with a coefficient of variation within the acceptable range of up to 20%. It was possible to identify that the droplet spectrum and flight height were determining factors in defining swatch width, once greater heights and finer droplets increase the swath widths.

Characterization of Variables That Contribute to the Generation of the Deposition Range of Agricultural Aircraft. Michael Althman*[1], Ulisses R. Antuniassi[2], Luis A. Avila[1], Fernando K. Carvalho[3], Vitor C. R Araújo[4]; [1]Mississippi State University, Starkville, MS, [2]São Paulo State University, Botucatu, Brazil, [3]Researcher and consultant at AgroEfetiva, Botucatu, Brazil, [4]Stewardship Analyst Latam at Sumitomo Chemical, São Paulo, Brazil (164)

Agricultural aircrafts can be dimensioned and equalized according to the technical characteristics of the applications. Thus, the objective of this work was to determine the existing interrelationships between the deposition range and the different models of agricultural aircraft and other operational parameters of aerial applications. The studied variables were deposition range (FD), pressure, application rate, aircraft wingspan, boom span, speed and flight height. The aircraft contemplated in this work were: AT-402, AT-502, Emb-202, Emb-203 and AG-188. Data were subjected to principal component analysis (PCA) to establish interrelationships between the variables under study. The AT-402 and AT-502 aircraft are associated with a greater range of deposition, greater flight speed and wingspan. While the EMB-202, EMB-203 and AG-188 planes are associated with the largest application volume and boom span. Larger deposition ranges are related to larger wingspans and smaller spray volumes. When working with smaller application volumes, it was observed that the FD values are higher, and vice versa.

Development of Molecular Markers to Distinguish Populations of *Rottboellia cochinchinensis* in Louisiana Sugarcane Production. Alice A. Wright*[1], Gerald A. McCollam[2], Elizabeth M. Orgeron[3], Matthew R. Foster[4], Albert J. Orgeron[5]; [1]United States Department of Agriculture, Agricultural Research Service, Houma, LA, [2]USD-ARS, Houma, LA, [3]Louisiana School for Math, Science, and the Arts, Natchitoches, LA, [4]Louisiana State University AgCenter, St. Gabriel, LA, [5]LSU AgCenter, Baton Rouge, LA (166)

Itchgrass (*Rottboellia cochinchinensis*) is the most problematic weed in sugarcane production in Louisiana. Severe infestations can cause significant yield reductions. There are a limited number of herbicides registered for use in sugarcane and of these few are effective against itchgrass. As a prolific seed producer itchgrass can readily establish itself in a field if not controlled early. To better understand this weed, an assessment of populations throughout the sugarcane growing region was started. Seed and leaf tissue samples were collected from 72 locations. Differences in morphology and timing of seed production were observed in some locations. As there is very limited sequence information available for itchgrass, primers spanning introns of the genes encoding herbicide targets EPSPS and ACCase were designed based on conserved regions across several grass species. These were sequenced for a subset of the samples collected and SNPs were identified. Sequencing across all 72 samples is ongoing to determine distribution of SNPs to distinguish different populations. Work has also begun to sequence the itchgrass genome with one of the goals being to develop improved molecular markers based on microsatellites. It is anticipated that this research will lead to a better understanding of the itchgrass populations in Louisiana. By distinguishing different itchgrass populations, improved assessments of their ability to compete with sugarcane and more specific control recommendations can be developed. Mapping these populations over time may also provide insight into how itchgrass is spreading throughout the state and if certain populations are becoming more dominant. Alice.wright@usda.gov

Seasonal Fluctuations of Nonstructural Carbohydrates in the Crowns and Rhizomes of Japanese (*Fallopia japonica*) and Bohemian Knotweed (*F.* x *bohemica*). Roger L. Becker*[1], Ryan S. Mentz[2], Alan G. Smith[1], Neil O. Anderson[1], George A. Annor[1], Matthew D. Clark[1]; [1]University of Minnesota, St Paul, MN, [2]Syngenta Seeds, Clinton, IL (167)

Herbaceous perennials must annually rebuild the above ground photosynthetic architecture, and do so by storing carbohydrates in crowns, rhizomes, and roots between growing seasons. Knowledge of carbohydrate utilization and storage can inform management decisions and improve control outcomes for invasive perennials. We monitored the non-structural carbohydrates in a population of the hybrid *Fallopia* x*bohemica* [Chrtek and Chrtkova´] (Bohemian knotweed) in 2020 an 2021, and in *F. japonica* [Houttuyn] Ronse Decraene) (Japanese knotweed) in 2021. Carbohydrate storage in knotweed crowns followed seasonal patterns typical of perennial herbaceous dicots. Seasonal nonstructural carbohydrates differed between taxa and among sites/years. Starch was consistently the highest nonstructural carbohydrate present. Sucrose levels did not show a consistent inverse relationship with starch levels, which would reflect starch metabolism to sucrose for transport to metabolic sinks as the season progresses. Lateral distribution of starch in rhizomes, and more broadly non-structural carbohydrates sampled prior to dormancy break showed a trend for increasing levels in rhizomes with increasing distance from the crown. Crowns may have lower levels of carbohydrates, with higher levels of starch in peripheral structures as seen in the roots vs. crowns of purple loosestrife and in lateral branches and ascending verticals vs. crowns of hemp dogbane in our previous work. Though not visually apparent, this gradient may reflect metabolic processes already begun in crowns in preparation for shoot emergence and elongation. Numerical average monthly lows for starch in crowns occurred in June and July (5.2 to 10.9 %), and fall numerical average monthly highs occurred in September through November (18.2 to 23.3%). Total nonstructural carbohydrate levels in the crowns also reached seasonal lows in June and July (13.9 to 18.9 %), corresponding to nonstructural carbohydrate depletion to support the observed development of photosynthetic structures above ground with maximum shoot elongation and vegetative development completed by the end of June, just prior to entering the reproductive phase in August. Monthly average minimum to maximum starch levels ranged from 5.2 to 23.3%, somewhat lower by comparison to the 7 to 38% starch range in hemp dogbane, and the 4 to 32% in purple loosestrife from our previous work. Maximum starch accumulation followed complete senescence of above ground tissues by mid- to late-October. We theorize that removal of above ground shoot biomass in early August at or just prior to flowering with a follow up removal of vegetation in the fall prior to senescence would be most effective use of time and labor in depleting carbohydrate reserves. Additionally, herbicide translocation to perennating below ground tissue should be maximized with late-summer and fall applications beginning in mid- to late-August through fall senescence. The caveat is that senescence may occur relatively early compared to many herbaceous perennial dicots in the upper Midwest, narrowing the window of opportunity to spray invasive knotweeds late season. However, in 2023 Bohemian knotweed in Minnesota could have been treated through the last week of October due to unseasonably mild temperatures which delayed assimilate translocation to underground storage organs.

Seedbank Viability in Subsequent Season Following Pre-emergence Herbicides. Ahmadreza Mobli*[1], Rodrigo Werle[2]; [1]University of Wisconsin, Madison, WI, [2]University of Wisconsin-Madison, Madison, WI (168)

Weed seedbanks are the primary sources of annual weed infestation in cropping systems. Farmers benefit from management practices that reduce weed fecundity, increase weed seed losses, and reduce the probability that weed seeds establish. We hypothesized that pre-emergence (PRE) herbicides can reduce the viability of dormant weed seed in the soil seedbank in subsequent growing seasons. A field study was conducted at Arlington and Brooklyn, WI, in 2022 and 2023 (four site-years) to evaluate the impact of PRE herbicides on the viability of dormant weed seeds in the soil seedbank. The field experiment included the application of two PRE herbicide treatments plus a non-treated control (3 treatments) and was conducted in a randomized complete block design with four replications. PRE herbicide treatments consisted of S-metolachlor + sulfentrazone (1378.1 +153.1 g a.i. ha-1; BroadAxe XC) and flumioxazin + pyroxasulfone (70.4 g a.i. ha-1 + 89.3 g a.i. ha-1; Fierce EZ). Treatments were sprayed within 3 days of soybean planting. Two soil samples were collected per plot from all plots 60 days after the PRE herbicide application. One sample per plot was processed for weed seed retrieval the day after collection. The second sample per plot was placed in a freezer at -20°C to simulate winter conditions for 60 days. Following the 60-day freeze period, weed seeds were retrieved from the frozen soil samples. Weed seeds were retrieved through the wet-sieving method. Common lambsquarters seeds were present in all site-years thus the species was selected for the germination test. The germination test was conducted in a factorial arrangement (herbicide treatment × site-year × seed storage condition) in a completely randomized design with four replications and repeated in time (2 experimental runs). Fifty common lambsquarters seeds were placed in Petri dishes (diameter 9 cm) containing sterilized filter paper (Whatman No. 1) moistened with distilled water, placed in day/night temperatures of 25 C/15 C and a 16-h photoperiod. Total germination (%) was recorded 21 days after germination test establishment. ANOVA was conducted using R statistical software version 4.0.2. The treatment × site-year × seed storage condition interactions and the main effects were not significant (P>0.05). The hypothesis of study was rejected as the PRE herbicides did not reduce weed seed germination, indicating its ineffectiveness on dormant common lambsquarters seeds. Additional research is necessary to evaluate the impact of different pre-emergence (PRE) herbicides on dormant seeds of common lambsquarters and other weed species with different seed coat properties.

Potential for Shifts in Palmer Amaranth (*Amaranthus palmeri*) Flowering Timing as a Response to Harvest Weed Seed Control. Eli C. Russell*, David C. Haak, Michael L. Flessner; Virginia Tech, Blacksburg, VA (169)

Palmer amaranth (*Amaranthus palmeri*) is a problematic weed in many different cropping systems across the southeast US due to its competitiveness and propensity to develop herbicide resistance. Palmer amaranth has very high seed retention at harvest, making it a good candidate for harvest weed seed control (HWSC). HWSC is a method that targets weed seeds retained on the plant at harvest for concentration, removal, or destruction as they pass through the combine during harvest. Palmer amaranth may be able to adapt to HWSC with a shift to earlier flowering. If a plant flowers earlier in the season, the seeds could mature and shatter from the plant before the combine has passed through the field. So, the goal of this study is to try and force Palmer amaranth to shift its flowering timing earlier through selective breeding. Initial populations were selected based on latitudinal separation, with one population originating in Delaware (DE) and one in Florida (FL). Seeds were planted and 30 plants from each population were transplanted into individual pots. The time to first inflorescence was measured for each plant. The two earliest flowering males and three earliest flowering females were selected and bred within their population. These F_1 progeny were subjected to the same protocol with the earliest flowering individuals selected again. This process was again repeated with the F_2 progeny. The data indicates that there is a significant reduction in days to flowering between the three generations for both FL and DE. From the initial population to the F_2 progeny, the average number of days to flower decreased from 97 to 61 days for FL and 96 to 58 days for DE. While the reason behind this reduction has yet to be determined, it reveals that there is potential for Palmer amaranth to shift its flowering timing and potentially adapt to HWSC.
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Weed Ecology Implications from Over 100 Years of Applied Soil Amendments in a Corn-Cotton-Wheat-Soybean Rotation. Andrew J. Ahlersmeyer*[1], Audrey Gamble[1], Andrew J. Price[2], Aniruddha Maity[1]; [1]Auburn University, Auburn, AL, [2]USDA-ARS-NSDL, Auburn, AL (170)

Nutrient management influences not only agronomic crops, but also any other weeds present which may compete with crops for nutrient uptake. While some research has been conducted to quantify assimilation of nutrients by weeds, there is little understanding of how long-term soil fertility strategies influence weed ecology specifically. Therefore, the overall objective of this study was to measure the long-term effects of several soil amendments on weed emergence patterns in a corn-cotton-wheat-soybean rotation. This study was conducted at the Cullars Rotation, a long-term soil fertility study on Auburn's campus. Established in 1911, the rotation consists of three tiers (corn, cotton, and double-cropped wheat-soybean), each with 14 treatments of varying levels of N, P, K, lime, micronutrients, and winter legumes. Plots were intensively managed throughout the year to control weeds, insects, and diseases. Nonetheless, we observed several different weed species persisting in plots with varying soil nutrients. In 2023, individual weed densities were highest in the corn tier, but weed biomass at the end of the season was highest in the cotton tier. Although numerous weed species were observed prior to planting the soybean tier, several herbicide applications resulted in little to no weed pressure by harvest. Plots that did not receive K, S, or lime were generally more susceptible to weed infestations, even after multiple herbicide passes. Furthermore, we observed Florida pusley (*Richardia scabra* L.), carpetweed (*Mollugo verticillata* L.), and southern sandbur (*Cenchrus echinatus* L.) to thrive in harsh soil conditions, including the plots receiving no lime (soil pH<4.5). On the other hand, plots that received adequate N, P, and K (with or with micronutrients or winter legumes) generally had little to no weed pressure observed during the growing season. Upcoming work will aim to evaluate how these long-term soil amendments influence the weed seed bank in the soil.

Weed and Soil Microbiome Diversities Effects on Wheat Yield. Eva Hernandez Plaza[1], Fernando Bastida[2], Valle Egea-Cobrero[3], Jordi Izquierdo[4], Sara Navarro[3], Jose L. Gonzalez-Andujar*[5]; [1]INIA-CSIC, Madrid, Spain, [2]University of Huelva, Huelva, Spain, [3]Instituto de Agricultura Sostenible (IAS-CSIC), Cordoba, Spain, [4]Polytechnic University of Catalonia, Barcelona, Spain, [5]Instituto de Agricultura Sostenible (CSIC), Cordoba, Spain (171)

We explore the relationship between crop yield, crop management, weed abundance and diversity, and the diversity of soil microbiome in wheat fields of Mediterranean Spain. On first field season, we selected six wheat pairs of fields, one organic and one conventional. In each field, we placed 14 (1m2) quadrats, four of which were kept weed-free. In every weedy quadrat we obtained the diversity of weed and bacteria communities by recording the cover of weeds per species and by taking soil samples to obtain the abundance of distinct Amplicon Sequence Variants for bacteria. We also registered crop yield in all quadrats and computed a measure of relative crop yield (ratio of yield in weedy and weed-free quadrats). We analysed the effects of weed cover and diversity, bacterial diversity and crop management on crop yields by means of Generalized Linear Mixed Effects Models. There was not an effect of bacteria diversity or weed cover on crop relative yield, whereas there was an interaction between crop management and weed diversity (Estimate=0.02; Chi-square=3.9, df=1, p=0.045). Higher weed diversity was associated with higher values of relative crop yield in fields with an organic management, but not in conventional ones. Our results show that the effect of weeds on crop differ between management schemes and that maintaining weed diversity may not compromise crop yields. We also found that the diversity of the whole bacterial microbiome is not a good indicator of plant-soil interactions and we need to differentiate between the diversity of bacterial functional groups.

Modeling Russian Thistle Emergence, Hydrothermal Time or Thermal Time Model?
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Accurate predictions of Russian thistle (RT) emergence timing are crucial for successful weed management. The objective of this work was to develop and compare two predictive models of RT seedling emergence, a thermal and a hydrothermal time model. The relationship between cumulative seedling emergence and cumulative hydrothermal and thermal time under field conditions were modeled using the Weibull function. Data collected from a field experiment in spring wheat were used to fit the models and validation was conducted with three other field experiments (two in fallow and other with spring wheat). According to Akaike's information criterion (AIC), and both models are deemed suitable for modeling the emergence of this species in the dryland of the Pacific Northwest. However, the thermal time model does not require the consideration of water potential, it is simpler, and may be more suitable for validation in grower fields. The accuracy of the models was assessed by comparing the predicted and observed emergence through linear regression, obtaining R^2 values above 0.77. According to the thermal model, RT seedling emergence begins at 5 TT units, with 50% and 90% emergence being reached at 56 and 197 TT units, respectively. As mentioned, both models could be used as a predictive tool for RT seedling emergence. However, the thermal model might have a more direct applicability to develop decision support systems that help farmers to elaborate RT management strategies because of its simplicity.

Investigating the Potential of Blue Light for Weed Seed Management. Sarah A.d. Chu*[1], Sarah E. Kezar[2], Shuyang Zhen[1], Muthukumar V. Bagavathiannan[1]; [1]Texas A&M University, College Station, TX, [2]Oklahoma State University, Stillwater, OK (173)

Blue light (320-490 nm) use in greenhouses has increased in recent years, driven by its ability to boost anthocyanins, macronutrients, and micronutrients in plants. While plants primarily perceive light through phytochromes and cryptochromes, the seeds' response to blue light remains less investigated. Existing research reports that continuous blue light exposure maintains dormancy in barley (*Hordeum vulgare*) and rigid ryegrass (*Lolium rigidum*) seeds; however, the effects on other species, shorter exposures, and intensities of blue light are far from clear. This study seeks to elucidate how blue light at different intensities and exposure times influences the germination rate of six common weed species: barnyardgrass (*Echinochloa crus-galli*), large crabgrass (*Digitaria sanguinalis*), johnsongrass (*Sorghum halepense*), Palmer amaranth (*Amaranthus palmeri*), hemp sesbania (*Sesbania herbacea*), and morningglory (*Ipomoea* spp.). Employing a completely randomized design experiment in a controlled environment with four replications and two temporal runs, seeds were subjected to five blue light intensities (435 to1,887 µmol m^{-2} s^{-1}) for seven different durations (5-60 seconds). Seeds were grown for 21 days with germination counts conducted every four days, followed by a tetrazolium seed viability test at 21 days after treatment. Seeds that failed to germinate or exhibit viability were classified as dead. Blue light intensity exerted a minimal impact on seed germination; longer exposure times (60 seconds) significantly hindered barnyard grass germination (23% reduction). Therefore, the duration of blue light exposure plays a critical role in influencing seed fate rather than intensity. The findings suggest opportunities for the development of a novel weed management strategy.

Influence of Simulated Rainfall Timing on Preemergence Herbicides Activation. Karina Beneton*, Jennifer Dudak, Zachary R. Treadway, Todd A. Baughman; Oklahoma State University, Ardmore, OK (174)

Influence of Simulated Rainfall Timing on Preemergence Herbicides Activation K. BENETON*[1], J. DUDAK, Z. TREADWAY, T. BAUGHMAN, [1]Oklahoma State University, Stillwater, OK The lack of new modes of action herbicides in the market and, the increase of resistance weeds places a premium on preemergence (PRE) residual herbicide performance. One of the keys to PRE herbicide performance is rainfall activation. Trials were established at Oklahoma State University research stations near Bixby and Lane, OK to assess herbicide performance under different rainfall activation timings. Rainfall (0.5") was simulated on bare ground plots at 3, 7, and 14 days after PRE herbicide application. The herbicide treatments consisted of flumioxazin (90 g ai ha^{-1}) and pyroxasulfone (45 g ai ha^{-1}) alone and in combination with a three-way combination of flumioxazin, pyroxasulfone, and metribuzin (420 g ai ha^{-1}). Visual evaluation of weed control was evaluated and separated using Tukey's test (P = 0.05). Palmer amaranth (*Amaranthus palmeri*) control at Bixby was at least 98% (40 DAT) with all treatments except the single and two-way combination of flumioxazin and pyroxasulfone activated 3 DAT. In fact, control with pyroxasulfone (83%) was less than all other treatments. Large crabgrass (Digitaria sanguinalis) control was 86% with flumioxazin and pyroxasulfone alone and 94% with flumioxaxin + pyroxasulfone with and without metribuzin when activated 3 DAT. Control was 97-100% with all treatments when activated 7 and 14 DAT. Tall waterhemp (*Amaranthus tuberculatus*) control (70 DAT) at Lane was 100% with all treatments regardless of activation timing. The only treatments that controlled ivyleaf morningglory (*Ipomoea hederacea*) over 80% were flumioxazin activated 7 DAT and the 2- and 3-way combinations activated 3 or 7. Large crabgrass (*Digitaria sanguinalis*) was controlled over 90% with the two-way combination activated 7 or 14 DAT and the three-way combination regardless of activation timing. Yellow nutsedge (*Cyperus esculentus*) control was 70% or less regardless of treatment. Preliminary results indicated that activation timing can affect herbicide performance but appeared to possibly result in less residual control than lower control due to delayed activation. Two- and three-way combinations appeared to help with this lower residual control.

Assessing Effects of Propagule Burial Depth on the Development of *Setaria parviflora* and Other Foxtail Species. Maria Leticia Zaccaro-Gruener[1], Logan M. Dyer[1], Gerald M. Henry[1], Patrick McCullough[2], Jason L. Belcher[3], Nicholas T. Basinger*[1]; [1]University of Georgia, Athens, GA, [2]University of Georgia, Griffin, GA, [3]Envu, Auburn, AL (175)

One emerging weed issue that livestock producers encounter in the southeastern United States is knotroot foxtail (*Setaria parviflora*). Weed management of this perennial species is challenging since reproduction occurs via seeds and aggressive rhizomes. Mature plants lack forage value, and when left uncontrolled, they compete with desirable forages, often leading to mouth ulcers and kidney failure when consumed by animals. Substantial knowledge gaps occur concerning the biology and management of this species; hence, research was conducted to determine the feasibility of cultural control through the burial of propagules and compare morphology with other *Setaria* species. The first experiment examined the effect of burial depth (1, 2, 4, 8, and 16 cm) on the emergence and growth of knotroot foxtail rhizomes and seeds. The propagule types examined consisted of small rhizomes (0.375 to 0.725 g), large rhizomes (1.6 to 1.8 g), or seeds. Plant emergence decreased when the burial depth was 8 cm or greater; however, only the 16 cm depth caused a complete elimination of plant emergence from large rhizomes and seeds. A second experiment evaluated knotroot foxtail, yellow foxtail (*S. pumila*), green foxtail (*S. viridis*), and giant foxtail (*S. faberi*) plant morphology. Data collection included monthly evaluations of plant height, phenology, and destructive harvests through the conclusion of the study. Yellow foxtail produced greater total biomass than all other species at 3 and 4 months after emergence (MAE). Knotroot foxtail produced belowground biomass that gradually increased and numerically exceeded other foxtail species by 5 MAE, further confirming differences in root formation and life cycle (perennial vs. annual). Furthermore, management recommendations for knotroot foxtail could include tillage to a depth of =16 cm in order to bury propagules; however, this should be supplemented with herbicide treatments to promote the control of foxtail plants emerging from seeds.

Comparing Vegetative Cover Estimates in a Mixed-species Pasture Using Line-intercept, Line-point, and Visual Observations. Joe C. Neal*[1], Graeme W. Bourd?t[2], Shona L. Lamoureaux[2]; [1]North Carolina State University, Raleigh, NC, [2]AgResearch Ltd, Lincoln, New Zealand (177)

Accurate and precise estimates of vegetative cover of weeds are necessary for ecological research and for weed management decision-making. Such information is particularly important to determine if control programs for inedible pasture weeds, such as *Ranunculus acris* L., are economically worthwhile. Cover estimates for *R. acris* in a dairy pasture from three sampling methods, line-intercept, line-point, and visual observation, were compared. The test area was a dairy pasture in Takaka, NZ (-40.855897, 172.803292) infested with *R. acris*. A 50 m by 50 m area was selected for study. Sixteen sampling transects were established by placing measuring tapes in a 'W' pattern starting from each of the area's four corners. *R. acris* was sampled along the length of the measuring tapes. For the line-intercept method, percent cover was estimated as the length of tape (to the nearest 1 cm) contacted by the foliage *R. acris*. For the line-point method, presence or absence of *R. acris* touching one edge of the measuring tape was recorded every 0.5m using the Grassland Cover Estimator App. Visual estimates of cover were made by 2 trained observers in five, 1 by 9-m sections, longitudinally centered on the sixteen sampling transects. The four segments of each 'W' pattern were treated as replicates for comparison of starting positions (i.e.: from which compass coordinate might one start observations). The coefficients of variability for cover estimates were similar (CVs of 20, 21 and 22% for the visual, line-intercept and line-point methods respectively) suggesting similar precision. However, the average percent cover estimates were 7.5, 8.8 and 11.8%, respectively. raising doubt about which method provides a more accurate estimate of actual cover. These data agree with published literature on this subject, that point-sampling can be as precise as other more laborious methodologies, but additional research is needed to determine the relative accuracy of these and other vegetation sampling methods.

Advancements in Purple Nutsedge (*Cyperus rotundus*) Genome. Jinesh Patel*[1], Leslie Goertzen[1], Claudia A. Rutland[2], Todd A. Gaines[3], Eric L. Patterson[4], Victor Llaca[5], Kevin Fengler[5], Luan Cutti[6], Mithila Jugulam[7], Joseph S. McElroy[1]; [1]Auburn University, Auburn, AL, [2]Auburn University Department of Crop, Soil, and Environmental Sciences, Auburn, AL, [3]Colorado State University, Fort Collins, CO, [4]Michigan State University, East Lansing, MI, [5]Corteva Agriscience, Johnston, IA, [6]Federal University of Rio Grande do Sul, Porto Alegre, Brazil, [7]Kansas State University, Manhattan, KS (179)

Purple nutsedge (*Cyperus rotundus L.*) poses a significant challenge to agricultural ecosystems worldwide due to its resilient nature, making control measures difficult. The development of a high-quality haplotype-resolved reference genome for this weed is crucial for unraveling its evolutionary mysteries and devising effective control strategies. Despite its agricultural impact, prior to this study, no comprehensive efforts were made to sequence the genome of purple nutsedge. In this research, a biotype of purple nutsedge was collected from a field in Alabama and propagated in a greenhouse. DNA extraction from leaf tissue was carried out for PacBio HiFi sequencing and Bionano sequencing. RNA was extracted from various plant parts, including leaves, shoots, flowers, roots, tubers, and rhizomes, facilitating the generation and analysis of full-length transcript isoforms. The karyotype and genome assembly findings unveiled purple nutsedge as a triploid species possessing 165 chromosomes. The three haploid assemblies demonstrated estimated sizes of 268.89 Mb, 276.93 Mb, and 268.89 Mb. The chromosome size ranges from 2.67 to 11.3 Mb. Extensive de novo TE Annotator (EDTA) analysis suggests TE element covers approximately 41.75% of the reference genome, totaling approximately 112.18 Mb. Haplotype-specific gene annotations revealed that Haplotype 1 has 19,068 functionally annotated protein-coding genes, while Haplotype 2 possesses 18,861 genes and Haplotype 3 possesses 18,979 genes. A search for crucial genes targeted by herbicides revealed the presence of two copies of Acetolactate Synthase (ALS) and 4-hydroxyphenylpyruvate dioxygenase (HPPD). An in-depth exploration of the genetic variation and protein structures associated with these genes holds promise for identifying potential vulnerabilities that could be leveraged to develop novel herbicides. This haplotype-resolved reference genome stands as a valuable genetic resource with multifaceted applications. It contributes to unraveling the evolutionary history of purple nutsedge and serves as a foundation for biological studies and the design of new strategies to control it.

Weed Emergence and Growth Monitored Under Mini-greenhouses Located in Canada.
Marie-Josee Simard*[1], Etienne Lord[1], Robert Nurse[2], Martin Laforest[1], Tyler Smith[3]; [1]Agriculture and Agri-Food Canada, Saint-jean-sur-richelieu, QC, Canada, [2]Agriculture and Agri-Food Canada, Harrow, ON, Canada, [3]Agriculture and Agri-Food Canada, Ottawa, ON, Canada (180)

Knowing precisely when a given weed population will emerge in a field could increase the cost effectiveness of weeding operations. Instead of relying on multiple models based on species specific attributes, crop microclimate and local weather, weed emergence could be monitored and validated *in situ* through the accelerated development and monitoring of local populations. Mini-greenhouses ("weed sentinels") were placed in fields located in Eastern Canada to determine if these would allow a gain of more than three days compared to weed emergence under open control conditions. The experiment included quadrats (50 X50 cm) under plastic tents and open control conditions. Emergence counts, growth stage and leaf area (using imagery) were recorded every week. Weed development was accelerated under the mini-greenhouses.

Yield Loss Prediction Based on UAV Altitude, RGB & Multispectral Images, and Weed Interference. Avi S. Goldsmith*, Charlie W. Cahoon, Robert Austin, Ramon G. Leon; North Carolina State University, Raleigh, NC (181)

The Kropff and Spitters model uses the relation between weed and crop leaf area to predict yield loss. This method has proved to be more accurate than weed counts. However, it is not practical if leaf area cannot be estimated quickly. Aerial images of the crop and weeds can be easily collected, and the data could be used to predict yield loss with this model. However, the ideal level of spectral resolution that is required for the model has not been determined. The goal of this study was to use the Kropff and spitters model to predict weed induced yield loss in maize (Zea mays L.) using aerial imagery of various spectral and optical resolutions to measure leaf cover. Aerial images were collected at four locations in North Carolina at 15 and 30 meters using both RGB and four band multispectral (Red, Green, Red-edge, NIR) cameras. Leaf cover of maize and weeds were extracted from the images using supervised-object based classification. After model optimization, the model accurately predicted yield with R2 between 0.86 and 0.91. At 15 m spectral resolution did not affect the accuracy of the prediction, but at 30 m multispectral analysis slightly improved accuracy over RGB especially at higher yields. The results of the present study indicated that the Kropff and Spitters model can provide accurate predictions of yield loss due to weed interference with different levels of spectral and optical resolution.

Elucidation of Sex from Mature Palmer Amaranth (*Amaranthus palmeri*) Leaves Using a Portable Raman Spectrometer. Aidan P. Holman, Nicolas K. Goff, Isaac Juarez, Samantha Higgins, Axell Rodriguez, Muthukumar V. Bagavathiannan, Dmitry Kurouski, Nithya K. Subramanian*; Texas A&M University, College Station, TX (182)

Palmer amaranth (*Amaranthus palmeri*), a dioeceous species, is currently one of the most troublesome weeds across several states in the United States. The dioeceous nature of this species allows for the maintenance of genetic diversity and thereby favors adaptive potential. Identifying the sex of Palmer amaranth plants is crucial for developing tailored control measures due to the distinct characteristics and reproductive strategies exhibited by male and female plants. Traditional methods for sex determination are expensive and time-consuming, but recent advancements in spectroscopic techniques offer new possibilities. In this research, the potential of Raman spectroscopy for determining the sex of mature Palmer amaranth plants was explored. The plants were grown in controlled greenhouse conditions with two experimental runs during 2022. Raman analysis of the plant leaves revealed spectral differences associated with nitrate salts, lipids, carotenoids, and terpenoids, allowing for high accuracy and reliable identification of the plant's sex. These results were further confirmed by HPLC analysis of leaf tissues, and the male plants had higher concentrations of these compounds compared to females. Raman spectra were analyzed using a machine learning tool, partial least squares discriminant analysis (PLS-DA), to generate accuracies of no less than 83.7% when elucidating sex from acquired spectra. These findings provide insights into the sex-specific characteristics of Palmer amaranth and suggest that Raman analysis, combined with PLS-DA, can be a promising, non-destructive, and efficient method for sex determination in field settings. This approach has implications for developing sex-specific management strategies to monitor and control this invasive weed in real-world environments, benefiting farmers, agronomists, researchers, and master gardeners.

Can Endophytes Influence Herbicide Resistance Development in Italian Ryegrass (Lolium Perenne L. Ssp. Multiflorum (Lam.) Husnot)? A Case Study in Alabama. Ankit Yadav*[1], Tony O. Adesemoye[2], David P. Russell[1], Aniruddha Maity[1]; [1]Auburn University, Auburn, AL, [2]United States Department of Agriculture, Agricultural Research Service, Auburn, AL (184)

Italian ryegrass can cause severe yield loss in row crops such as corn (65%), cotton (85%), wheat (92%), and soybean (37%) (Anonymous 2023). Owing to significant diversity in its emergence pattern, seed dormancy, and ecological and morphological characters, it shows exceptional adaptability and thriving capacity in diverse ecological niches. Because of its aggressive adaptive traits and high fecundity, it is considered as a robust invader and a herbicide-resistance prone weed under managed ecosystems. It has been observed that a symbiotic endophyte *Neotyphodium* spp. provides Italian ryegrass with increased tolerance to many abiotic as well as biotic stresses, including pathogens, drought, herbivores, competitiveness, and herbicides such as ACCase-inhibitors. A statewide Italian ryegrass survey was conducted in Alabama to assess the abundance and contribution of *Neotyphodium* spp. in herbicide resistance expression in the state. Preliminary results confirm the presence of *Neotyphodium* spp. across the populations that are under resistance screening against Acetyl-coA carboxylase (ACCase), Acetolactate synthase (ALS), and 5-enolpyruvylshikimate-3-phosphate (EPSP) synthase inhibition modes of action. Our findings will contribute to a better understanding of weed management strategies and the role of fungal endophytes in herbicide resistance.

Exploring the Allelopathic Effects of Cotton Chromosome Substitution Lines (CS Lines) on Weeds Under Field Conditions. Worlanyo Segbefia*[1], Varsha Varsha[2], Ncomiwe A. Maphalala[3], Ziming Yue[4], Tabata Raissa De Oliveira[5], Te-Ming (Paul) Tseng[6]; [1]Mississippi State University, Plant and Soil Science Department, Starkville, MS, [2]Department of Plant and Soil Sciences, Mississippi State University, Starkville, MS, [3]Mississippi State University-Department of Plant and Soil Sciences, Starkville, MS, [4]MSU, Mississippi State, MS, [5]Mississippi State University, Starkville, Ms, MS, [6]Mississippi State University, Mississippi State, MS (187)

Weed interference consistently poses a significant agronomic challenge in cotton production, leading to unfavorable direct and indirect consequences. Allelopathy is a biological phenomenon where some crops can produce substances (called allelochemicals) that ward off weed competition. Allelochemicals are subject to environmental conditions and can be released in various ways. Field trials are necessary to evaluate the effectiveness of weed-suppressing herbicides because greenhouse and lab tests are limited in their capacity to mimic natural ecological settings and interactions. For this research, a 20-foot by a 2-row patch with four replications under randomixed complete block design (RCBD) at Pontotoc, Mississippi, was planted in 2021 and 2022 with eight cotton chromosomal substitution (CS) lines (BNTN 16-15, B10, B26Lo, T26 Lo, B22Lo, T11sh, UA48, and TM1). After three weeks of planting (WAP), seeds of three weed species - redroot pigweed (*Amaranthus retroflexus*), morning glory (*Ipomoea spp.*), and common lambsquarters (*Chenopodium album*) were sown between the cotton rows. The heights of cotton plants were measured every week for six weeks, and the density of each weed species in the field, including native weeds, was recorded. BNTN 16-15 demonstrated the most substantial reduction in weed density at 60%, closely followed by T26lo with 52%. In contrast, T11sh exhibited the least reduction at 32%, and the UA48 cultivar followed with a 35% decrease. T26Lo achieved a 52% reduction, surpassing many of the CS lines. The parent plant, TM1, showed a 44% reduction in weed density, compared to the commercial cultivar UA48, which had a 34% reduction. There was a 20% difference between the least and most effective CS lines (T11sh and BNTN16-15, respectively). In a world where herbicide resistance in weeds is growing, allelopathy may be an effective and sustainable alternative to weed management. These cotton CS lines can be used in breeding programs to develop varieties with better weed-suppressive ability. Such varieties are well-suited for organic farming practices and reduce farmers' reliance on synthetic herbicides under conventional cultivation systems. Keywords: allelopathy, weed density reduction, Gossypium hirsutum, chromosome substitution

Revisiting the Origins of Glyphosate Resistant Giant Ragweed (*Ambrosia trifida* L.) in Canada. Eric Page*[1], Sara Martin[2], Sydney Meloche[1], Alyssa Thibodeau[1], Robert Nurse[1], Peter H. Sikkema[3], Francois Tardif[4], Mike Cowbrough[5], Martin Laforest[6]; [1]Agriculture and Agri-Food Canada, Harrow, ON, Canada, [2]Agriculture and Agri-Food Canada, Ottawa, ON, Canada, [3]University of Guelph, Ridgetown, ON, Canada, [4]University of Guelph, Guelph, ON, Canada, [5]Ontario Ministry of Agriculture Food and Rural Affairs, Guelph, ON, Canada, [6]Agriculture and Agri-Food Canada, Saint Jean Sur Richelieu, QC, Canada (188)

Glyphosate resistant giant ragweed (*Ambrosia trifida* L.) was first identified in Canada in 2008. Although early studies attributed resistance in this species to non-target site mechanisms, the presence of a proline to serine mutation at position 106 of EPSPS2 in common and giant ragweed has recently been reported. The objective of this research was to was to: i) determine if a P106S mutation is present in historical samples of giant ragweed collected from the site of the first report of glyphosate resistance, and ii) determine the frequency and distribution of P106S resistant and susceptible biotypes collected as a part of historical surveys throughout southwestern Ontario. Fifteen historic and current giant ragweed biotypes were genotyped for the presence of a P106S mutation in EPSPS2. This target site mutation was observed in five resistant biotypes in either a homozygous or heterozygous state but was not observed in any of the included susceptible biotypes. Results clearly demonstrates that both target and non-target site resistance mechanisms were present in biotypes collected from southwestern Ontario shortly after the initial report of glyphosate resistance in giant ragweed. This suggest that P106S likely acts additively or synergistically with other non-target site mechanisms to confer glyphosate resistance in both the rapid response and non-rapid response phenotypes associated with glyphosate resistance in giant ragweed.

The Ancestral Karyotype of the Heliantheae Alliance, Herbicide Resistance and Human Allergens: Insights from the Genomes of Common and Giant Ragweed. Sara Martin[1], Martin Laforest[2], Eric Page*[3]; [1]Agriculture and Agri-Food Canada, Ottawa, ON, Canada, [2]Agriculture and Agri-Food Canada, Saint Jean Sur Richelieu, QC, Canada, [3]Agriculture and Agri-Food Canada, Harrow, ON, Canada (189)

Ambrosia artemisiifolia and *Ambrosia trifida* (Asteraceae) are important pest species and the two greatest sources of aeroallergens globally. Here we took advantage of a hybrid to simplify genome assembly and present chromosome level assemblies for both species. These assemblies show high levels completeness with BUSCOs of 94.5% for *A. artemisiifolia* and 96.1% for *A. trifida* and LTR Assembly Index values of 26.6 and 23.6, respectively. The genomes were annotated using RNA data identifying 41,642 genes in *A. artemisiifolia* and 50,203 in *A. trifida*. More than half the genome is comprised of repetitive elements, with 62% in *A. artemisiifolia* and 69% in *A. trifida*. Single copies of herbicide resistance associated genes *PPX2L*, *HPPD*, and *ALS* where found, while 2 copies of the *EPSPS* gene were identified; this latter observation may reveal a possible mechanism of resistance to the herbicide glyphosate. Ten of the 12 main allergenicity genes were also localised, some forming clusters with several copies, especially in *A. artemisiifolia*. The evolution of genome structure has differed among these two species. The genome of *A. trifida* has undergone greater rearrangement, possibly the result of chromoplexy. In contrast, the genome of *A. artemisiifolia* retains a structure that makes the allotetraploidization of the most recent common ancestor of the Heliantheae Alliance the clearest feature of its genome. When compared to other Heliantheae Alliance species, this allowed us to reconstruct the common ancestor's karyotype – a key step for furthering of our understanding of the evolution and diversification of this economically and allergenically important group.

Overexpression of *TaHPPD* Gene in Wheat (*Triticum aestivum*) Reduces Sensitivity to Mesotrione. Susee Sudhakar, Yaiphabi Kumam, Hyeonju Lee, Veerendra Sharma, Harold Trick, Mithila Jugulam*; Kansas State University, Manhattan, KS (190)

Overexpression of *TaHPPD* Gene in Wheat (*Triticum aestivum*) Reduces Sensitivity to Mesotrione Chemical weed control is important to reduce yield losses due to weed competition in crops like wheat (*Triticum aestivum*). Repeated use of herbicides has resulted in the evolution of weed species resistant to commonly used herbicides in wheat fields. Therefore, broadening the herbicide options in wheat is needed. Currently, available herbicide-resistant wheat technologies are limited. Mesotrione, a hydroxyphenylpyruvate dioxygenase (HPPD)-inhibiting herbicide, is registered for use in corn but not in wheat due to crop injury. Metabolic resistance to HPPD-inhibitors, possibly mediated by P450 enzymes has been widely reported in HPPD-inhibitor-resistant plants. Nonetheless, mutations in the *HPPD* gene or overexpression of the *HPPD* gene conferring resistance to HPPD-inhibitors were also reported in wild oat (*Avena sativa* L.). Recently, HPPD-inhibitor-resistant transgenic soybean expressing modified *HPPD* genes from *Pseudomonas fluorescens* and *Avena sativa* were also developed. We hypothesized that overexpressing the target gene (*TaHPPD*) in a known, HPPD-inhibitor-sensitive, spring wheat cultivar, 'Bobwhite' may reduce its sensitivity to mesotrione. The objective of this study was to develop transgenic lines expressing the *TaHPPD* gene and assess their response to mesotrione. Transgenic lines expressing the gene of interest (GOI), the *TaHPPD* gene, were generated via particle bombardment. The regenerated T_0 plants were screened for the presence of GOI. The T_0 plants that tested positive for the GOI were then subjected to molecular and phenotypic analysis in the T_1 generation. We identified a T_1 transgenic line with a relatively higher *TaHPPD* mRNA transcript level compared to the other lines. Further, in response to mesotrione treatment at 6X dose (1X=105 g ai ha^{-1}), this T_1 line also displayed reduced sensitivity. These results suggest that overexpression of the *TaHPPD* gene reduces wheat sensitivity to mesotrione.

Molecular Assays for Rapid Group 2 and Group 9 Resistance Diagnostics in North American Broadleaves. Juliano Sulzback[1], Ednaldo A. Borgato*[2], Luan Cutti[3], Erin E. Burns[1], Eric L. Patterson[1]; [1]MICHIGAN STATE UNIVERSITY, East Lansing, MI, [2]Kansas State University, Manhattan, KS, [3]Federal University of Rio Grande do Sul, Porto Alegre, Brazil (191)

Herbicide-resistant weeds pose a threat to food production in modern agriculture, causing US$31 billion dollars in crop production losses worldwide. In Michigan, highly troublesome weeds that are widely spread across the state include: waterhemp, Palmer amaranth, common ragweed, and horseweed, with populations that are predominantly resistant to glyphosate (Group 9) and ALS-inhibitors (Group 2), major herbicides utilized in soybean and corn cropping systems. Developing molecular assays for rapid resistance diagnostics to confirm in-field status of herbicide resistance can assist with more effective, timely, and proactive management. In this research, we developed and tested PCR-based assays to identify target-site resistance mechanisms to both herbicide groups through Sanger sequencing and *EPSPS* copy number variation. Nine different SNPs were identified in five *ALS* positions known to confer herbicide resistance among all species surveyed. The Pro197Ser was more frequent in horseweed and common ragweed accessions, whereas Trp574Leu was the predominant mutation in Palmer amaranth and waterhemp. Four horseweed accessions contained the Pro106Ser mutation in the *EPSPS* gene, which confers resistance to glyphosate. Additionally, waterhemp and Palmer amaranth displayed *EPSPS* copies ranging from 2-7 and 20-160, respectively. The assays were validated by genotyping several accessions collected in field surveys comparing with known resistant and susceptible accessions. The efficacy of genotyping assays was greater than 98%, and generated results in approximately two days, confirming that this is a robust tool for rapid resistance diagnostics. This research can provide growers with an effective tool to confirm unknown herbicide resistance status in weed populations, allowing them to adopt management practices more efficiently and within the same growing season.

Evaluation of Enhanced Herbicide Metabolism as ALS Inhibitor Resistance Mechanism in Annual Bluegrass (*Poa annua* L.). Fernanda Reolon de Souza*[1], Ericmar Santos[2], Swati Shrestha[3], James D. McCurdy[4], Te-Ming Paul Tseng[1]; [1]Mississippi State University - Plant and Soil Sciences Department, Starkville, MS, [2]Federal University of Pelotas, Pelotas, Brazil, [3]University of Florida, Gainesville, FL, [4]Mississippi State University, Starkville, MS (193)

Annual bluegrass is among the most problematic weeds in turfgrass system with the ability to thrive in wide range of environmental conditions. ALS inhibiting herbicides are most commonly used for controlling annual bluegrass, but over-reliance on this herbicide has selected for herbicide resistant biotypes. Resistant (R) and Susceptible (S) biotype of annual bluegrass were treated with foramsulfuron (F), foramsulfuron+NBD-Cl (F+NBD-Cl), foramsulfuron+malathion (F+M), NBD-Cl, malathion (M), and water, to evaluate if enhanced metabolism was responsible for herbicide resistance in R biotype. R biotype showed slight increase in injury, 10 and 2 % when treated with (F+M) and (F+NBD-Cl), as compared to foramsulfuron alone. On an average, total drymass of susceptible biotype (0.68 g) was higher than that of the resistant biotype (0.31 g) suggesting fitness penalty associated with resistance. ALS enzyme assay carried out to confirm resistance in R biotype showed 1893 times higher resistance in R biotype than susceptible standard. ALS resistance in R biotype was not strongly associated with enhanced metabolism thus suggesting both target site mutation and metabolism as primary mechanism of resistance in annual bluegrass. Keywords: ALS herbicides, enhanced metabolism, fitness penalty, herbicide resistance, turfgrass

Resistance to Acetyl Coenzyme A Carboxylase (ACCase) Inhibitors Among *Lolium multiflorum* Populations: Effect of Multiple Mutations Within the Carboxyl Transferase Domain of ACCase Enzyme. Gulab Rangani*[1], Ana Claudia Langaro[2], Shilpi Agrawal[1], Nilda Roma-Burgos[1]; [1]University of Arkansas, Fayetteville, AR, [2]Corteva Agriscience, Nova Mutum, Brazil (195)

Italian ryegrass [Lolium perenne ssp. multiflorum (Lam) Husnot] is a major weed in wheat, cotton, and soybean production. The use of ACCase inhibitors is an important component of weed management programs for controlling ryegrass infestation. However, the evolution of high resistance to diclofop, and cross-resistance to pinoxaden in ryegrass populations has become prevalent. In this study, we surveyed the frequency of resistance to diclofop among 31 ryegrass populations from Georgia, Arkansas, Mississippi, Alabama and North Carolina. A total of 22, 6 and 2 populations showed 60-100%, 20-50%, and 0-7% survivors, respectively. The physiological basis of resistance to ACCase herbicides is the evolution of resistant ACCase alleles. Many single mutations in the plastidic *ACCase* gene, resulting in amino acid substitutions, endowing resistance to ACCase herbicides have been identified from resistant weed populations. The presence of known resistance-conferring mutations was surveyed using dCAPS assays among survivors. Approximately 26 plants representing five populations were selected for sequencing the region of the ACCase gene that codes for the carboxyl-transferase domain (CT), which is critical for sensitivity to herbicides. Overall, we detected the known mutations I1781L, W2027C, I2041N, D2078G, and C2088R. However, gene sequence data also showed the presence of multiple mutations including L1701M, E1874A, N1878H, G1946E, G1946Q, V1992D, and E2039D. The same data also revealed the zygosity of each mutation. Using this information, a few combinations of mutations were selected for homology modeling via AutoDock Vina to gain insights into the structural interactions between the mutant ACCase protein and diclofop herbicide. Each mutation and its combination showed lesser binding with diclofop compared to wild-type ACCase. Also, the binding energy for G1946E (-4.7 kcal/mol) and its combination was significantly higher than that of the wild type (-6.2 kcal/mol) indicating that G1946E mutation exhibit the lowest affinity with diclofop. Keywords: ryegrass, ACCase, target-site resistance, cross-resistance, computational modeling

Relative Field Emissions of 2,4-D (Enlist) and Dicamba (Engenia) in Soybeans. Joe Beeler*[1], Thomas C. Mueller[1], Larry Steckel[2]; [1]University of Tennessee, Knoxville, TN, [2]University of Tennessee, Jackson, TN (196)

There is little doubt that the widespread adoption of auxin-resistant soybean and cotton seeds have tremendously altered the landscape of weed control in the United States, both from an improved efficacy perspective and from a greater concern for off-target movement (OTM). The labeling of these new products has focused on EPA's changing role given the enhanced scrutiny of non-target effects, including the Endangered Species Act. This report details a direct comparison of the currently used post-emergent weed control programs for 2,4-D and dicamba in soybean. A recent literature search revealed no direct comparisons under field conditions of these two platforms. Studies were conducted in 2022 and 2023 in Knoxville Tennessee to examine 2,4-D and dicamba emissions under field conditions. The test system has been previously fully described (Mueller). Field applications are made by tractors with TTI nozzles and using other parameters according to the current labels. High-volume air samplers are then placed inside the treated area and samples collected from approximately 0 to 6, 6 to 12, 12 to 24, and 24 to 36 hours after treatment. Samplers are processed with methanol extraction followed by liquid chromatography using an external standard technique. The two treatments compared were 1.) Dicamba (Engenia) + glyphosate (Roundup PowerMax3) + volatility reducing agent (Sentris) (all at rates commonly used), and 2.) 2,4-D plus glyphosate (Enlist Duo). The dicamba treatment had higher emissions than the 2,4-D treatment in 2022, with the difference being approximately 50%. In 2023, there was a higher measured 2,4-D concentration than dicamba (about 55%). However, in both years the total amounts of measured herbicide were relatively low, which was attributed to environmental conditions not being conducive to maximum herbicide volatility (lower temperature primarily). Many studies indicate that 2,4-D is less injurious to most nontarget plants compared with the same doses of dicamba. This research indicated that the emissions of 2,4-D and dicamba are basically the same under field conditions, although variability due to extreme weather conditions could drastically change our results.

Relative Dicamba Emissions of Status and Engenia When Applied to Corn. Will Phillips*[1], Thomas C. Mueller[1], Larry Steckel[2]; [1]University of Tennessee, Knoxville, TN, [2]University of Tennessee, Jackson, TN (197)

In recent years there has been tremendous interest in the off-target movement (OTM) of dicamba products when applied postemergence to soybean or cotton crops. While the full impacts of these OTM events can be debated, what cannot be argued is that dicamba OTM is a new phenomenon. Dicamba products have been used for postemergence corn weed control for literally decades. In fact, when the dimethylamine salt of dicamba was introduced it was referred to as a low volatile formulation of dicamba (Banvel). The objective of this research was to provide a preliminary assessment of the relative volatility of a dicamba formulation primarily used on corn weed control (Status) compared with one that is primarily used on broadleaf crops (Engenia). The first study was a humidome study conducted in the greenhouse and the second was a field trial. In both studies the treated surface was field corn that provided essentially 100% aerial coverage of the sprayed area. Sample collection and analysis were similar between the two studies, and based on previous research projects using the two test systems. The humidome project had four treatments each with three replications. The four treatments including the dicamba dosage in g/ha for each were 1.) Status at 280, 2.) Status @ 280plus glyphosate, 3.) Engenia (BAPMA salt) @560 + glyphosate + potassium carbonate volatility reducing agent (VRA), and 4.) Engenia @ 280 + glyphosate plus VRA. Corn size was approximately 15 cm in height at the time of application and samples were collected until 36 hours after treatment. The above referenced treatments 1, 3 and 4 had essentially the same amount of dicamba emissions, but treatment 2 (Status plus glyphosate) had approximately five times the amount of dicamba emissions. Conditions in the study were conducive to maximum herbicide emissions. The field study had 2 treatments, each applied to two plots with 2 samplers inside each treated area. The treatments included 1.) Status at 200 g/ha + glyphosate and 2.) Engenia @560 g/ha+ glyphosate plus VRA. Field corn was 60 cm in height at the time of application. Although the Status dosage was substantially lower than the Engenia, the apparent dicamba total emissions 36 hours after treatment was 60% higher for the Status treatments. One aspect in the design of this experiment that was problematic was what rate of dicamba to use. To be conservative in the protection of non-target effects, one would expect to use the highest labeled rate; which is what was done in the humidome study. However, under field conditions the most commonly used rate is much lower, being approximately one third of the maximum labeled rate. Thus, a more typical use rate was used in the field study. One benefit of the use of Status herbicide is that it contains an auxin synergist which allows for a lower use rate of dicamba and thus a lower environmental load of this potential OTM molecule. Also, the normal application timing of Status is earlier in the growing season and thus would probably avoid higher temperatures which have been associated with greater dicamba OTM. Further research is necessary to elucidate relative OTM potential of these products.

Relative Volatility of S-metolachlor and Pyroxasulfone Under Lab Conditions. Shelby Lanz*, Thomas C. Mueller; University of Tennessee, Knoxville, TN (198)

Herbicide dissipation is a complex process where each individual scenario is governed by unique set of conditions that will determine the most important loss mechanism for that individual situation. Volatilization can be a critical pathway for herbicide loss from agricultural fields with results being possible reduced herbicide efficacy and possible non-target effects in the environment. Prueger et al reported on a 13 year field study that 5 to 63% of applied metolachlor was lost via volatilization and that volatilization remained an important loss process more than five days after application when the soil surface was moist. Ghosh et al. reported 19% metolachlor volatilization during the first eight hours when applied to small corn. Ghosh and Crist have recently developed a one-dimensional mechanistic model based on soil physics to predict time-dependent volatilization of soil applied pesticides, indicating the interest in this research topic. The authors were unable to find any published literature on pyroxasulfone volatility. A laboratory study was conducted to examine the relative volatility of s-metolachlor compared to pyroxasulfone when applied to dry soil. Doses of s-metolachlor were 0.12 and 1.06 kg per hectare and the dose for pyroxasulfone was 0.12 kilogram per hectare. The study was conducted using previously published humidome methods (Mueller previous reports). Apparent s-metolachlor emissions were substantially higher than pyroxasulfone in this test system. When compared at the same rate, s-metolachlor was 6.7 times greater in total nanograms collected at 36 hours after treatment. Most volatilization occurred in the first 12 hours, which is consistent with previous results. Future research is needed to examine the effect of other parameters on s-metolachlor and pyroxasulfone volatility.

Amicarbazone and Other Group 5 Herbicide Behavior in Soil Under Field and Laboratory Conditions. Thomas C. Mueller*[1], Ryan S. Henry[2]; [1]University of Tennessee, Knoxville, TN, [2]UPL NA Inc., Fort Wayne, IN (199)

Amicarbazone is a herbicide under development by UPL for broad-spectrum weed control in corn. This report has two aspects: behavior of amicarbazone, atrazine, and metribuzin under field conditions, and the relative dissipation of these three HRAC Group 5 herbicides in soils with and without previous atrazine use history. Prior research has demonstrated enhanced degradation of atrazine due to previous use. Field studies were conducted in Knoxville, Tennessee, in 2022 and 2023, and standard small plot procedures were used to establish the experiment each year. In each year there were two locations, each having four replications of soil samples collected at approximately weekly intervals from 0 to 8 weeks, and then a sample after harvest. Samples were collected using previously established protocols to obtain a representative sample from each plot and replication was maintained throughout the analysis. Herbicide concentrations in soil were determined by methanol extraction followed by analysis with HPLC – MSMS. Herbicide concentrations were regressed against days after treatment to develop a first-order half-life, $T_{1/2,}$ which is the parameter reported here. Half-lives were mostly less than 10 days with the order from most to least persistent being atrazine> amicarbazone> metribuzin. Half-life values were consistent with previous literature from this location. The second research objective focused on the question of whether amicarbazone would be affected by a soil microbial population that had developed an enhancement for atrazine degradation. To that end, two soils were collected from a farm location in Illinois where the previous atrazine exposure had been established, and enhanced atrazine degradation had been verified. A laboratory study was conducted to examine the relative degradation of the same three herbicides. The test system was developed to have optimum conditions for herbicide degradation, including adequate moisture and temperature. In this experiment, the atrazine enhancement factor (the ratio of the half-lives in the no history soil compared to the soil with atrazine use history) was 24.5 and 19.5 in the two runs of the study. The comparable values for amicarbazone were 1.6 and 1.1, and for metribuzin was 0.9 and 1.1. This indicates that amicarbazone and metribuzin were not subject to the enhancement of degradation in these particular studies based on the atrazine use history.

Does Poultry Litter Increase Weed Emergence? A Multi-location Corn Study in Alabama.
Akashdeep Singh*, Aniruddha Maity, David P. Russell, Rishi Prasad; Auburn University, Auburn, AL (201)

Poultry litter (PL), a byproduct of Alabama's largescale broiler production, is known to boost crop yield and soil health. However, its impact on weed growth is less clear. This research aimed to explore any potential stimulatory effects of PL on weed emergence in Alabama corn fields, considering both north AL clay soil and south AL loamy soil. PL aged less than 6-month, 12-24-month, and 36-48-month-old was applied to corn fields at a rate of 2 tons/acre, with varying nitrogen doses compared to untreated plots. Weed density and biomass data were collected monthly from three 0.25 m2 quadrats per plot, and soil samples were taken post-harvest at three depths across the plots. The findings suggest that PL application progressively increased weed density with the increasing age of PL, showing greatest weed density under 36– 48-month-old PL and least under unfertilized and full fertilized plots. An initial greenhouse investigation indicated that the PL used in this study did not contain viable weed seeds, suggesting that PL might have stimulated weed seed emergence during the crop growing season due to additional nutrient availability from PL. More research is required to fully comprehend these relationships and their implications for farming practices in Alabama. Future studies will include greenhouse experiments and the examination of different doses and sources of poultry litter.

Enhancing Tomato Tolerance to Pre-emergence Herbicides Through the Utilization of Biochar Herbicide Protection Pods. Dante Bergmann Elias*[1], Aricia Ritter Correa[1], Te-Ming (Paul) Tseng[2], Bailey Bullard[1]; [1]Mississippi State University, Starkville, MS, [2]Mississippi State University, Mississippi State, MS

Weed control is a major limiting factor in tomato production, causing significant yield losses and reduced fruit quality when the control is not satisfactory. The primary weeds in tomato include nutsedges, annual grasses, and Palmer amaranth. In the face of constrained weed control alternatives, there is a great need to find an integrated weed control strategy that can effectively reduce the weed pressure around the crop and, at the same time, protect the yield and quality of the fruits. A promising integrated weed control option is to use biochar herbicide protection pods (HPPs). In this research, a greenhouse trial was conducted aiming to evaluate the effectiveness of HPPs in improving the tolerance of tomato to S-metolachlor and metribuzin herbicides. Using activated carbon to protect crop plants from soil-active herbicides, to which they are marginally tolerant, could enhance the efficacy of weed management. Tomato seeds were incorporated into HPPs containing biochar. Each pot was individually seeded with seeds encapsulated in four distinct HPPs: Douglas fir biochar with corn starch binder (DFBC+Cornstarch), Douglas fir biochar with 10% Selvol binder (DFBC+Selvol), Rice husk biochar with corn starch binder (RHBC+Cornstarch), and Douglas fir biochar with 10% Selvol binder (RHBC+Selvol). Tomato seeds without biochar were planted as control. Treatments were applied to 2-3 leaf stage tomato seedlings with either S-metolachlor (1681.28 g/ha) or metribuzin (1120.85 g/ha), and visual injury was evaluated at 7, 14, and 21 days after application (DAA). Dry mass measurements were taken at 21 DAA. An untreated control was also included. In the presence of metribuzin, three of the four biochar treatments (DFBC+Cornstarch, RHBC+Cornstarch, and RHBC+Selvol), exhibited injury of 70, 69, and 70%, respectively. In contrast, the treatment without biochar recorded a higher injury of 79%. No significant difference was observed for dry mass in the presence of metribuzin. In the presence of S-metolachlor, no injury differences were observed among the treatments. However, three biochar treatments demonstrated a substantial enhancement in dry biomass. Specifically, the treatment without biochar exhibited a dry mass of 0.4464 g, whereas DFBC+Cornstarch, DFBC+Selvol+DE and RHBC+Cornstarch exhibited a notable increase to 0.5727, 0.5951, and 0.6026g, respectively, marking a 28, 33, and 35% increase in dry biomass. These initial findings highlighted the potential use of biochar HPPs for improving crop health and yield and also being an important tool for weed management in tomato farming.

Weed Suppression and HPLC Analysis of Chlorogenic Acid in Cotton and Cover Crops Via Phytotron Experiments. Alyssa L. Miller*[1], Josiane C. Argenta[1], Varsha Varsha[2], Ziming Yue[3], Te-Ming (Paul) Tseng[4]; [1]Mississippi State University, Starkville, MS, [2]Department of Plant and Soil Sciences, Mississippi State University, Starkville, MS, [3]MSU, Mississippi State, MS, [4]Mississippi State University, Mississippi State, MS (202)

In row crop production, cover crops have demonstrated effective suppression against weedy plant species through biomass and allelopathy. However, the determination of which cover crop is superior in suppressing specific weed species in the field is complicated by the abundance of weed seeds germinating from the soil's natural seed bank. Identifying cover crop species that exhibit superior weed suppression compared to others is a critical task, warranting thorough investigation. Exploring the potential role of chlorogenic acid (CA) content in explaining observed differences may prove insightful. This approach can provide growers and agricultural workers with a more sustainable and profitable method for weed management. A research project conducted in the MSU Weed Physiology Lab employed a growth chamber to study six cotton accessions (B01, B04, B16, MNTN 4-15, TM-1, and UA48) along with four cover crop species (wheat, rye, crimson clover, and hairy vetch) in two separate runs. Each of the mentioned plant species was germinated and placed in 50 mL vials containing distilled water. water samples from the vials were collected and analyzed for chlorogenic acid content exuded from the roots of the respective plant species using high-performance liquid chromatography (HPLC). A bridging study was also conducted in a greenhouse using cover crop residue from four different cover crop species, including wheat, cereal rye, crimson clover, and hairy vetch. Palmer Amaranth, morningglory species, common lambsquarters, and redroot pigweed/tall waterhemp seeds were planted at the rate of 100 seeds per 0.14 m^2 tray. Each treatment was subsequently assessed for weed densities. HPLC results indicated that at 14 days after transplanting (DAT), B16 and MNTN 4-15 cotton accessions, along with hairy vetch and wheat cover crop species, produced the greatest amount of chlorogenic acid. At 14 DAT, these cotton accessions and cover crops exuded about 0.6 mAU (milli absorption unit), contrasting with clover and rye cover crops, as well as the TM1 cotton line, which produced only around 0.3 mAU. The findings of the greenhouse tray study revealed that, in both runs, the wheat cover crop exhibited a 50% greater suppression of morning glory and approximately 40% better suppression of pigweed compared to rye. The findings from this research suggest that certain cover crop species and cotton lines produce and exude allelopathic chemicals that can suppress harmful weed species and increase crop yield.

Causes for the Spread of Bur Chervil (*Anthriscus caucalis*) as an Arable Weed. Rebecka Duecker*[1], Jean Wagner[2]; [1]Michigan State University, East Lansing, MI, [2]Georg-August Unviersität Göttingen, Göttingen, Germany (203)

Bur chervil (*Anthriscus caucalis*) has evolved from a partly endangered ruderal plant to a serious weed in Europe and also occurs as an invasive neophyte in the USA. In order to investigate the reasons for the spread, resistance studies were carried out in a Germany-wide screening. In addition, the germination behaviour at different temperatures, the influence of the soil temperature on the plant mass, the germination capacity after three weeks in a biogas fermenter and the fate of the diaspores after harvesting were investigated. Target-site resistance due to an amino acid substitution at position 197 of the acetolactate synthase was identified. In addition, it was shown that bur chervil germinates at low temperatures around 1°C, and thus germinates and continues to grow during winter due to the climate change-induced extension of the vegetation period. In this way, bur chervil is able to maintain a competitive advantage over the crop. Distribution by the combine harvester, seed contamination and zoochory may also play a role in the spread of the species, while biogas substrate likely is of minor importance.

Assessing Alternative Crop Rotation Sequence Effects on Waterhemp (*Amaranthus tuberculatus*) Population Dynamics. Megan R. Czekaj*, John M. Wallace; Pennsylvania State University, State College, PA (204)

Diverse crop rotations can disrupt the life-cycle of small-seeded summer annual weed species and represent an important component of integrated weed management (IWM) systems. Varying planting and harvest schedules within diverse crop rotations disrupt weed life cycles by introducing mechanical disturbance and enhanced crop competition. Currently, there exists a knowledge gap in which alternative crop sequences optimize suppression of waterhemp (*Amaranthus tuberculatus*) in Northeast production systems. Spring- or fall-sown small gains such as oats, wheat, and rye exhibit competitive advantages against weed species due to their rapid emergence, germination in cooler temperatures, and aboveground biomass production. Perennial forage crops like alfalfa mixtures disrupt weed life cycles via resource competition and multiple forage harvests per season. Field experiments were conducted at the Russell E. Larson Agricultural Research Center (RELARC) near Rock Springs, PA in 2021-22 and replicated in 2022-23 to investigate how small grains and perennial forages influence waterhemp (*Amaranthus tuberculatus)* life cycles. The experiment was structured as a single-factor randomized complete block design with four replications and six treatment levels. Treatments included (1) spring-seeded alfalfa-orchardgrass, (2) spring-sown alfalfa with oat nurse crop, and (3) fall-seeded cereal rye harvested for silage followed by sorghum sudangrass harvested for silage, with small grain sequences, including (4) spring-sown oats harvested for grain followed by a cover crop mixture, (5) fall-seeded winter wheat harvested for grain and frost-seeded with a medium red clover cover crop, and (6) fall-sown winter wheat harvested for grain followed by a cover crop mixture. These alternative crop sequence treatments vary in the number of disturbance events generated by harvest schedules, crop competition, and timing of herbicide inputs and application.

Utilizing Reduced Tillage and a Living Mulch for Weed Management in Specialty Crops.
Dwayne D. Joseph*; University of Maryland, Chestertown, MD (205)

Adopting a holistic approach in vegetable agroecosystems may involve the utilization of living mulches, which are cover crops interplanted with the cash crop that lives throughout the entire duration of the cash crop cycle. This practice provides many agronomic and ecological benefits, including the enhancement of soil organic matter and the reduction of pest pressure from insects and weeds. Additionally, the persistent presence of living mulches contributes to effective weed management by minimizing niche spaces that weeds typically occupy when the soil surface is left exposed. This study evaluated the effects of cantaloupe interplanted with a red clover (*Trifolium pratense*) living mulch (RC) used in tandem with a standard farmer spray program, denoted as high (H) herbicide inputs or low (L) herbicide inputs, against a traditional plasticulture system (PC) with comparable high or low herbicide inputs. The specific aims were to determine how these different management practices impact weed density and biomass as well as cantaloupe yield. Results show that weed counts were greatest in the low-input plasticulture (PC-L) and lowest in the high-input red clover (RC-H) treatment. High- and low-input PC plots contained 70 times more weeds in the between-row area compared to high- and low- input RC plots. Cantaloupe fruit yield in RC-H and RC-L was roughly a third of the yield obtained from PC-H and PC-L treatment plots. The results suggest that red clover can be used for weed management; however, competition with cantaloupe plants may result in yield reduction.

Model Selection for Mapping Biomass Predictions in Cereal Rye (*Secale cereale* L.). April M. Dobbs*[1], Avi S. Goldsmith[1], Daniel J. Ginn[2], Søren K. Skovsen[3], Muthukumar V. Bagavathiannan[2], Steven Brian Mirsky[4], S. Chris Reberg-Horton[1], Ramon G. Leon[1]; [1]North Carolina State University, Raleigh, NC, [2]Texas A&M University, College Station, TX, [3]Aarhus University, Aarhus, Denmark, [4]USDA ARS, Beltsville, MD (206)

Cover crops can suppress weeds through a physical mulching effect that inhibits weed germination and emergence. Estimating biomass production in cover crops is crucial for predicting weed suppression ability. This study used Structure-from-Motion (SfM) to estimate biomass in cereal rye (*Secale cereale* L.), and used kriging to map the distribution of predicted biomass. Videos were recorded using a hand-held GoPro camera over 4 cover crop fields in North Carolina during the 2023 season, just before termination. Biomass and crop height were measured in quadrats (n=80) in each field. SfM was used to generate 3-D point clouds from the videos corresponding to each sampling quadrat. A predictive model was used to estimate biomass in each quadrat based on point cloud pixel density and crop height. Predicted and measured biomass were linearly related (r^2=0.713) through biomass levels of 9,000 kg ha^{-1}. Field maps of predicted and measured biomass generated by kriging and spatial autocorrelation showed similar distributions of high and low biomass areas. Fields with the least patchiness had moderate spatial dependence, and fields with greater patchiness had higher levels of spatial dependence. Measured biomass data were spatially correlated within 5.4 to 42.2 m, and predicted biomass data were spatially correlated between 3.4 to 12.0 m, depending on the field. This method can potentially be used by growers to nondestructively map biomass production and identify areas with low biomass that may be more likely to experience late-season weed escapes.

A Survey of Resistance in Cheatgrass (*Bromus tectorum*) in Washington Reveals Multiple-resistant Biotypes. Marija Savic*, Samuel R. Revolinski, Jessica E. R. Kalin, Ian Burke; Washington State University, Pullman, WA (207)

Cheatgrass (*Bromus tectorum* L.) is one of the most damaging weeds in the western United States with the distribution of over 20 million hectares damaging arid ecosystems as well as dryland crop production. Cheatgrass is a nearly obligate self-fertilizing species with high genetic variation that allows the species to maintain genetic variation through generations without cross-pollination. Since dryland growers switched to no-till practices, cheatgrass has become a common and troublesome weed in dryland wheat across the inland Pacific Northwest and has developed widespread resistance to ALS/AHAS-inhibiting herbicides. In this study, we evaluated cheatgrass resistance to herbicides typically used for its management in winter wheat cropping systems across Washington. Statewide collection and screening occurred in 2022 and 2023 and included 2400 different cheatgrass accessions collected from farm (F) and natural (N) areas from 80 different sites. Herbicides used in the study were imazamox at 0.053 kg ai ha^{-1}, sulfosulfuron at 0.035 kg ai ha^{-1}, pyroxulam at 0.105 kg ai ha^{-1}, quizalofop at 0.092 kg ai ha^{-1}, metribuzin at 0.21 kg ai ha^{-1}, and glyphosate at 2.5 kg ae ha^{-1}. The experimental design was a complete randomized design with one replication. Plants were harvested 21 days after the treatment (DAA) and fresh biomass was recorded. Overall, the site of the collection was significant (P values < 0.05) across all genotypes. Analysis of variance revealed a widespread resistance to all ALS/AHAS herbicides tested in the study as well as an increased number of glyphosate resistant genotypes. Interestingly, two genotypes from a single site were found resistant to quizalofop, most likely collected from quizalofop tolerant winter wheat (CoAXium wheat) fields, suggesting that wide adoption of this system can lead to further selection of resistant biotypes in grasses, especially in cheatgrass. Cheatgrass genotypes with multiple resistance were discovered at a single site, near Bickleton, WA. These cheatgrass genotypes were found to have a certain level of resistance to each of the herbicide groups used in this study. Further molecular research is necessary to reveal genes underlining metabolic pathways and processes that confer herbicide resistance in cheatgrass.

Weed Seed Capture with a Corn Header for Harvest Weed Seed Control. Wyatt J. Stutzman*[1], Michael L. Flessner[1], Michael Walsh[2]; [1]Virginia Tech, Blacksburg, VA, [2]University of Sydney, Narrabri, Australia (208)

Harvest weed seed control (HWSC) focuses on targeting weed seeds (WS) for removal, concentration, or destruction as they pass through the combine during harvest. While WS has been studied with a platform/grain header, little is known about WS capture with a corn header. To better understand the potential for HWSC in corn and improve WS capture, this experiment evaluated a standard corn header and the same header modified with 360 Yield Saver header brushes on four weeds common to Virginia: moringglory spp. (*Ipomoea spp.*), johnsongrass (*Sorghum halepense*), jimsonweed (*Datura stramonium*), and redroot pigweed (*Amaranthus retroflexus*). During harvest, all plant material was captured from three sources, the ground (i.e. WS passing through the header and not entering the combine), the harvest residue (i.e. WS exiting at the rear of the combine), and the grain. WS from each source were quantified to evaluate seed fate. Data indicated that when the header was unmodified, 41% of jimsonweed, 74% of johnsongrass, 29% of morningglory spp., and 70% of redroot pigweed were found on the ground and therefore not subjected to HWSC. The 360 Yield Saver modification did not increase WS capture at the header for johnsongrass, morningglory spp., or redroot pigweed. However, jimsonweed WS capture increased by 58%. These data indicate that larger seeds have less loss at the header and in some cases WS capture can be increased with header modifications. However, new modifications will probably be needed to capture smaller WS. Overall, there is potential and a need to increase WS capture at the corn header and improve the outlook for HWSC adoption in corn, but more research and innovation is needed.

Evaluation of Residual Herbicide-Coated Fertilizer in Cotton. Brock A. Dean*[1], Charlie W. Cahoon[1], Zachary R. Taylor[2], Jose H. de Sanctis[1], Jacob C. Forehand[3], James H. Lee[1]; [1]North Carolina State University, Raleigh, NC, [2]North Carolina State University, Sanford, NC, [3]North Carolina State Unviersity, Raleigh, NC (209)

Cotton weed management has been further complicated by the development of multiple herbicide-resistant Palmer amaranth (*Amaranthus palmeri* S. Watson). In response to these developments, cotton producers must utilize all available tools for effective management. One such tool is the use of residual herbicide-coated fertilizer. A study was conducted in 2022 and 2023 near Rocky Mount and Clayton, NC, to evaluate residual herbicide-coated fertilizer for cotton tolerance and residual broadleaf and grass control. An XtendFlex® cotton variety was planted in both locations and years. The herbicides evaluated and their respective application rate (g ai ha-1) include pyroxasulfone (118); pyroxasulfone (118) + carfentrazone (9); *S*-metolachlor (1,067); dimethenamid-*P* (630); acetochlor (1,260); pendimethalin (1,064); fomesafen (280); flumioxazin (53); sulfentrazone (210); fluridone (221); diuron (840); fluometuron (1,120); linuron (840); atrazine (1,120); and metribuzin (420). All treatments were coated on granular ammonium sulfate (AMS) and applied at a rate of 320 kg ha^{-1} (67 kg N ha^{-1}) to 6- to 7-leaf cotton on June 17, 2022, and June 21, 2023. The check in the study received the equivalent rate of non-treated AMS as a grower standard for comparison. Herbicide coating was achieved using a concrete mixer, and all treatments were uniformly top-dressed within three cotton row middles using a broadcast shaker with equally spaced and sized holes in the lid. Prior to top-dress, all plots, including the check, were maintained weed-free using glyphosate and glufosinate; no residual herbicides were used prior to applications. Visual estimates of Palmer amaranth control and cotton injury were collected bi-weekly until 70 days after treatment (DAT). Additionally, Palmer amaranth density was recorded, and cotton was machine harvested and weighed to determine yield at the conclusion of the season. In general, all treatments demonstrated Palmer amaranth control consistent with expectations for a standard spray application. Pendimethalin and fluometuron controlled Palmer amaranth 61 to 68 and 67 to 70%, respectively. Over the past two growing seasons, all treatments resulted in minor cotton injury with the exception of metribuzin coated-AMS. At 28 DAT, metribuzin accounted for 32% cotton injury, while all other treatments resulted in injury less than 5%. However, the severity of metribuzin injury varied by location and was likely influenced by the timing and rate of rainfall following top-dress. Minimal differences were observed for cotton lint yield; however, metribuzin significantly impacted cotton lint yield.

Integration of Cover Crops and Herbicides for Weed Management in Cotton. Andrew J. Price*[1], Annu Kumari[2]; [1]USDA-ARS-NSDL, Auburn, AL, [2]Crop, Soil & Environmental Sciences Department, Auburn University, Auburn, AL (211)

A field study conducted in Alabama at three locations from autumn 2021 through the crop harvest in 2022 aimed to evaluate the combined effect of cover crop residue and herbicides for weed control and improve lint yield of cotton. The experiment was conducted in split plot design with main plots were six cover crop treatments: cereal rye, crimson clover, oats, radish, mixture, and winter fallow. The subplots were four herbicide treatments: 1) PRE herbicide included pendimethalin + fomesafen, 2) POST) herbicide included dicamba + *S*-metolachlor + glyphosate, 3) PRE followed by POST, and 4) a non-treated (NT) check. Our results demonstrated that cereal rye outperformed all other cover crop treatments, showing higher relative weed biomass reduction.Top of Form Cover crops, excluding radish, exhibited higher relative weed biomass reduction than winter fallow with corresponding herbicide treatments of either PRE+POST, POST, and PRE. Considering PRE+POST herbicide treatment, we found that cereal rye, crimson clover, mixture, and oats had provided adequate weed control, resulting in a greater than 95% relative weed biomass reduction than radish and winter fallow treatment across all three locations. Moreover, all herbicide treatments had higher relative yield increase than NT check. The overall effect of cover crop, including cereal rye, oats, and cover crop mixture showed a greater relative yield increase than radish, clover, and winter fallow at one location. However, no significant effect of cover crops on yield was observed at other locations. In conclusion, integrating herbicides along with the incorporation of high residue cover crops such as cereal rye, is an effective weed management strategy to control troublesome weeds and sustain cotton lint yield.

Potential Living Mulch Species for Weed Suppression in Texas Cotton. Gustavo Camargo Silva*[1], Muthukumar V. Bagavathiannan[2]; [1]Texas A&M University, Department of Soil and Crop Sciences, College Station, TX, [2]Texas A&M University, College Station, TX (212)

Living mulching is a sustainable agronomic practice in which live cover plants are grown in between the rows of the cash crop until canopy closure. These species generally grow in the early summer and naturally lose competitiveness as the cash crop grows and temperatures increase. Living mulches have several potential benefits, including erosion control, improving soil structure, reducing fertilizer inputs, enhancing biodiversity, and weed suppression. Living mulches reduce weeds mainly by shading the soil surface and competing for space and other resources. Non-competitive mechanisms such as alteration of light quality and allelopathy are also important. This project seeks to evaluate the suitability of different living mulch species for Southeastern Texas cotton production. Cotton development and yield, as well as weed suppression, were observed for each living mulch species. Nine species of living mulch (Japanese millet, oats, wheat, cowpeas, soybeans, white clover, alfalfa, sunn hemp, and buckwheat) were planted in between the rows of cotton at 2 and 4 weeks after the crop planting. There were also weedy and weed-free controls. Living mulch biomass was quantified mid-season. Weed suppression was assessed for each living mulch species. Finally, cotton yield was quantified at harvest. Preliminary results show that cool-season living mulch species have poor germination rates in excessively hot and dry years. Warm-season legume cover crops have the highest potential for establishment, biomass production, and weed suppression. All living mulch species improved cotton yield compared to the weedy control, but reduced yield compared to the weed-free control. Faster-growing species suppressed weeds the best. The study will be repeated for one more year.

HRAC Herbicide Mode of Action Classification 2024. Jens Lerchl*[1], Roland S. Beffa[2], Caio Rossi[3]; [1]BASF SE, Limburgerhof, Germany, [2]Senior Scientist Consultant, Frankfurt, Germany, [3]Corteva Agriscience // HRAC Global, Uberlandia, Brazil (213)

The new HRAC Herbicide Mode of Action Classification 2024: Herbicides are a key tool for sustainable and efficient agriculture with strong positive impact on soil conservation as well as quality and quantity of harvested crops. HRAC Global strives to promote Integrated Weed Management encompassing chemical, cultural, biological and mechanical measures to avoid herbicide resistance. The use of different mode of action chemistries is an important measure to avoid weed resistance development as much as possible. The new HRAC Herbicide Mode of Action Classification 2024 poster and related website information provide an updated overview on the herbicide chemistries. The HRAC Global Herbicide Mode of Action Working Group reviewed literature information as well as publically available sales data and relevance for resistance management for the latest update of the presented poster. In addition a new poster layout with increased chemistry structures and coloring has been introduced. Changes were aligned within HRAC Global and with WSSA representatives. Information is made available through new attached weblinks on the poster as well as through a communication strategy to a wide stakeholder community in academia, public institutions, companies, students and other interested parties.

Statewide Screen of Italian Ryegrass (*Lolium multiflorum*) Populations with Residual Herbicides in North Carolina. Diego J. Contreras*, Jackson W. Alsdorf, Ronel J. Argueta, Edgar A. Posadas, Wesley Everman; North Carolina State University, Raleigh, NC (214)

Italian ryegrass (Lolium multiflorum) is one of the most troublesome weeds for wheat production throughout Southern US (Webster 2008). The inability to control this weed can result in reduced yields, reduced quality, or both (Grey 2012). Additionally, herbicide resistance is a persistent problem throughout the United States, with over 36 reported cases. (Heap 2023). In North Carolina, effective post-emergence control options for L. multiflorum have become very limited. ACCase and ALS inhibitor herbicides, commonly used post-emergence in wheat, have lost efficacy due to an increase in herbicide resistance. Weed control programs for L. multiflorum rely on pre-emergence herbicides due to the limited post-emergence options. Two of the most commonly used are flumioxazin and pyroxasulfone. However, there have been reported L. multiflorum escapes with these pre-emergence options. It is imperative to understand the distribution of surviving populations around the state.To understand the current distriubution of control failures, an experiment was conducted to screen a statewide collection of L. multiflorum populalations with two commonly used residual herbicides in wheat, flumioxazin and pyroxasulfone. 118 populations across the state of North Carolina were collected from wheat fields in 2022. A dose response assay was conducted with three known herbicide susceptible populations collected in 2012 to determine a discriminating dose at the LD90 level for each flumioxazin and pyroxasulfone. The 118 populations were screened by treating the populations with the discriminating dose for each herbicide. At the discriminating dose (21 grams a.i. ha-1) Flumioxazin failed to control (<50%) 6 populations, and 45 other populations exhibited poor control (51 – 69%). Pyroxasulfone failed to control (<50%) 4 populations, and 49 other populations exhibited poor control (51 – 69%). Populations with control failures were spread across the state. The large number of L. multiflorum populations from the 2022 collection that exhibit poor control or lower could be a premature indication of increasing herbicide resistance cases around North Carolina.

North Carolina Survey of Herbicide Resistant Palmer Amaranth Populations. Jackson W. Alsdorf*, Diego J. Contreras, Ronel J. Argueta, Wesley Everman; North Carolina State University, Raleigh, NC (215)

Amaranthus palmeri is a troublesome weed commonly found in multiple row crops in North Carolina. Many cases of herbicide resistance have been documented across the state, and a handful of statewide screens have been done to determine the distribution of these resistance cases. In the fall of 2022, North Carolina was grid sampled in an effort to collect Palmer amaranth seed heads out of fields with observed populations. The objective of this study is to understand the frequency and distribution of resistance to multiple herbicides. 137 populations were collected and seed heads were threshed then stored in a freezer until the screen. Seeds were planted in flats in a greenhouse, and each population consisted of five treatments: untreated check, fomesafen (281 g ai ha), glufosinate (596 g ai ha), dicamba (562 g ae ha), and 2,4-D (798 g ae ha). Ratings were taken weekly on a scale of 0-100 for each individual plant, with 0 being no control, and 100 being plant death. The 28 DAT rating was used to average the total control for all plants across each population within each treatment. If control was 50% or less overall, then that population was determined to be resistant to that specific herbicide. While no populations were found to be considered resistant to glufosinate, dicamba, or 2,4-D, seven populations were found to have potential resistance to fomesafen. These results are helpful tools for growers and county agents as they put together effective weed control programs.

Cytochrome P450 (_CYP72A14_) Overexpression Contributes to Junglerice (_Echinochlo colona_) Cross-resistant to Quinclorac and Florpyrauxifen-benzyl. Juan Camilo Velásquez R*[1], Nilda Roma-Burgos[1], Gulab Rangani[1], Prakriti Dhaka[2], Felipe Keller-Salto[3], Matheus Machado Noguera[1]; [1]University of Arkansas, Fayetteville, AR, [2]University of Arkansas, Fayettevile, AR, [3]Intern student, Fayetteville, AR (216)

Cytochrome P450 (*CYP72A14*) Overexpression Contributes to Junglerice (*Echinochlo colona*) Cross-Resistance to Quinclorac and Florpyrauxifen-benzyl. Juan Velasquez*, Gulab Rangani, Matheus Noguera, Felipe Keller-Salto, Prakriti Dhaka, Nilda Roma-Burgos.*Echinochloa colona* (junglerice) is a major weed in rice production. Florpyrauxifen-benzyl (FPB) is a relatively new auxinic rice herbicide commercialized in 2018. A 2010 junglerice accession has been characterized as multiple resistant to propanil, imazethapyr, quinclorac, and FPB. Metabolic assays suggest that cytochrome P450 (CYP450) activity plays an important role in the mechanism of resistance in this accession. This study aims to 1) identify candidate CYP450 genes contributing to resistance and 2) validate the candidate genes by RT-qPCR. Resistant and susceptible plants were sprayed with FPB, leaf tissues were collected at 0 and 24 h after treatment, and mRNA was extracted and sequenced. Transcriptome data in response to FPB treatment of resistant and susceptible plants were analyzed. From 162 CYP450 genes identified in the RNA-seq analysis, 44 were differentially upregulated in the resistant population (RR) after FPB treatment; 24 of which were more induced than in the susceptible population. Among these genes, *CYP94C1* and *CYP72A14* showed the highest upregulation after FPB treatment (6.4 and 4.4 logFC, respectively). Validation by qPCR experiment confirmed that *CYP72A14* was upregulated in the resistant population 24h after FPB treatment but was unresponsive in the susceptible population. Validation of *CYP94C1* will be done in follow-up studies. Cross-resistance to FPB in a quinclorac-resistant population that existed almost 10 years prior to the commercialization of FPB is due to cytochrome P450-mediated resistance mechanism. This is an example of the threat of nontarget-site resistance toward the evolution of cross-resistance and multiple resistance to herbicides not yet applied in crop fields. Upregulation of multiple P450 genes in response to herbicides or abiotic stress is common, as was observed in this study, indicating the complexity of herbicide x metabolic genes interaction.

Null Models for Evaluating Interactions Between Cover Crop and Herbicide Effects on Weed Population Level Responses. John M. Wallace*[1], Jared S. Adam[2]; [1]Pennsylvania State University, State College, PA, [2]Pennsylvania State University/ Weed Science, State College, PA (217)

A common inference from evaluation of integrating cover crop- and herbicide- tactics for suppression of annual weed species is that though cover crops improve weed suppression but herbicides remain the 'big hammer'. Yet, the presence or absence of multiplicative effects and synergism – a central tenet of the 'many little hammers' – often remains unexplored in field studies. We suggest that multiple stressor research within the ecology discipline offers a useful framework for evaluating alternative null models of IWM tactics that differ in mechanistic assumptions. We use data from a 4 x 2 factorial field experiment that explored the effects of three cereal rye termination timings (14-21 days pre-plant, 14-21 DPP; 3-7 DPP; and 1-3 days after planting, 1 DAP) relative to a no cover crop control at the main plot level and the presence or absence of a PRE herbicide program on total annual weed density 5 weeks after planting (5 WAP) just prior to a POST herbicide application at the split-plot level. Experiments were replicated for three years (2021-2023) prior to no-till corn production and two years (2022-2023) prior to no-till soybean. Data from single-tactic treatments were used to construct three alternative reference, or 'null', models (additive, multiplicative, dominance), which were compared to multi-tactic treatment observations for each site-year (n = 5) and cereal rye termination timing (n = 3), providing 15 sub-models. Additive models assume that the effects of single-tactics on weed responses are dissimilar and negatively correlated. Multiplicative models assume that the effects of single-tactics on weed responses are dissimilar and non-correlated. Dominance models assume that the effects of single-tactics on weed responses are similar and positively correlated. Our results indicated that assumptions of additive models are inappropriate based on observed responses relative to reference models. Only 20% of dominance reference models fit observed data, whereas >50% of multiplicative reference models fit observed data. However, multiplicative model fit varied by cover crop termination timing. A regression model that expressed the departure of observed data from reference models as a function of cover crop biomass at termination provide evidence of synergism between cereal rye and PRE herbicides at biomass levels below 3 Mg ha^{-1} with multiplicative or marginal antagonistic effects at biomass levels above 3 Mg ha^{-1}. We suggest this approach can be employed across a range of cover crop and herbicide management scenarios to deepen our understanding of cover crop and soil-residual herbicide interactions.

Utilization of Cover Crop Roller Crimping for Viable Weed Control and Soil Health Improvement. Alaina M. Richardson*[1], Worlanyo Segbefia[2], Ncomiwe A. Maphalala[3], Dante Elias[1], Aricia Ritter Correa[1], Alyssa L. Miller[1], Sabrina Sastre[1], Te-Ming (Paul) Tseng[4]; [1]Mississippi State University, Starkville, MS, [2]Mississippi State University, Plant and Soil Science Department, Starkville, MS, [3]Mississippi State University-Department of Plant and Soil Sciences, Starkville, MS, [4]Mississippi State University, Mississippi State, MS (218)

Weed control is one of the major production challenges for soybean growers. Common weeds, if not controlled, can cause yield reduction of up to 80%. While chemical controls, including herbicide usage, offer several advantages, their prolonged use can lead to certain drawbacks. These include unintended damage to non-target vegetation, a decline in soil health, the development of herbicide-resistant weeds, and the potential for environmental toxicity if not applied responsibly. To overcome limited weed control options and preserve or improve soybean quality and yield for US growers, there is a great need to find a supplemental and sustainable weed control strategy that can effectively reduce the weed pressure around the crop, protect the yield and quality of the crop, and at the same time improve or conserve soil health. One of the promising weed control strategies is cover crop roller crimping. For organic farming, physical termination of cover crops with a roller-crimper is an excellent way to minimize labor and fuel costs for weed management while decreasing tillage in their production system to lessen potential adverse effects on soil quality. Thus, besides reducing the cost of production, this technique can also increase the organic matter retention and nutrient cycles in soil. This study aimed to evaluate the efficacy of roller crimping as a termination method for a warm-season cover crop (buckwheat) in weed suppression and soil and soybean health improvement. The experiment included four cover crop termination treatments: post-roller crimping, pre-roller crimping, glyphosate treatment, or mowing (control). The pre-roller crimping method showed the most significant reduction in weed density at 68% compared to mowing. Glyphosate application resulted in a 40% reduction in weed density, while post-roller crimping reduced weeds by 31%. Moreover, pre-roller crimping resulted in the tallest soybean plants (19 in), followed by glyphosate at 16 in, and post-roller crimping at 12 in. Mowing, on the other hand, resulted in the shortest soybean plants (10 in). Pre-roller crimping method of cover crop termination demonstrated the most favorable outcomes in this study, resulting in reduced weed density and increased crop heights. Keywords: roller-crimping, soybean, weed control, organic, common weeds, soil health, weed density, plant height

Wheat-Soybean Relay Intercropping in Arkansas: Preliminary Insights on Palmer Amaranth Suppression and Crop Yields. Amar S. Godar*, Jason K. Norsworthy, Leonard B. Piveta; University of Arkansas, Fayetteville, AR (220)

Management of Palmer amaranth remains a significant challenge in Midsouth soybean production. A large-plot (6 m by 30 m) field experiment was conducted at the Pine Tree Research Station near Colt, Arkansas, during the 2022-23 growing season to explore the potential of Palmer amaranth suppression in a wheat-soybean relay intercropping system. Three cropping systems were compared: full-season soybean (planted on May 10), wheat-soybean double crop (soybean planted after wheat harvest), and the relay intercropping system (soybean planted into standing wheat on April 12). The full-season soybean system received a burndown treatment of glyphosate (1255 g ae ha^{-1}) seven days before planting and an application of *S*-metolachlor + glyphosate + glufosinate-ammonium (1390 g ai ha^{-1} + 1255 g ae ha^{-1}+ 660 g ai ha^{-1}, respectively) four weeks after planting. The intercropped and double crop systems received only glyphosate (1255 g ae ha^{-1}) at wheat harvest and no additional herbicide applications. Lower Palmer amaranth pressure was observed at wheat harvest, with the double crop and relay intercropped systems showing 64% and 85% less, respectively, compared to the full-season soybean system. Five weeks after wheat harvest, the intercropped system had 92% less Palmer amaranth than the full-season soybean. Wheat yield in the intercropped system was 75% of that in the double-crop system (4237 kg ha^{-1}), while soybean yield was 57% of the full-season soybean (5246 kg ha^{-1}) in the intercropped system. In optimal, disease-free conditions with minimal wheat harvest damage (clipping off the top), the intercropped system could enhance soybean yield by 15 to 25%. Dry conditions following wheat harvest resulted in an inadequate soybean stand in the double crop system, resulting in high populations of Palmer amaranth later in the season, and subsequent yield reduction (11% of the full-season soybean). This preliminary study provides initial insights into the potential of the wheat-soybean relay intercropping system for Palmer amaranth suppression in the region. This system could be a viable alternative in scenarios where traditional herbicidal solutions are limited or a tool in reducing herbicide selection pressure, thereby enhancing the longevity and utility of existing herbicides for soybean production systems.

The Blue River Technology Agronomy Test Machine Small-Plot Research Program. Lauren M. Lazaro*[1], Michael M. Houston[2], William L. Patzoldt[1]; [1]Blue River Technology, Sunnyvale, CA, [2]Blue River Technology, Greenville, MS (221)

See & Spray™ Ultimate and Premium are among the first targeted application sprayer commercialized for in-crop weed management. See & Spray Ultimate is a collection of new application technology improvements that include: 1) cameras and computers that identify and spray weeds in real-time, 2) a dual tank system allowing for simultaneous broadcast and targeted applications, 3) a new lighter and more stable boom for optimal spray accuracy, and 4) fully integrated in-cab controls and data uploading to John Deere Operations Center generating weed and as-applied maps. See & Spray Premium is a precision upgrade to current spray booms that utilize the same cameras and computers as See & Spray Ultimate. Small-plot equipment, the Agronomy Test Machine, has been designed to mimic See & Spray Ultimate and Premium performance to expand research capabilities and allow for rapid iteration of concepts. Furthermore, the use of small-scale equipment supports collaborations with university and industry partners to optimize the See & Spray platforms and to support growers using this technology.

Comparing the Performance and Robustness of Multi-modal Deep Learning for Cover Crop and Weed Biomass Estimation. Joe Johnson*[1], Ram Ray[2], Ramon G. Leon[3], Chris Reberg-Horton[3], Steven Brian Mirsky[4], Muthukumar V. Bagavathiannan[5]; [1]Soil and Crop Sciences, Texas A&M University, College Station, TX, [2]Prairie View A&M University, Prairie View, TX, [3]North Carolina State University, Raleigh, NC, [4]USDA ARS, Beltsville, MD, [5]Texas A&M University, College Station, TX (223)

Cover crop biomass production can be highly variable under field conditions due to microsite variabilities. Effective estimation and mapping of cover crop performance and biomass production across large field areas is highly valuable for predicting areas of poor weed suppression and plan for subsequent management in a site-specific fashion. In this regard, the use of sensors and object localization applications can be beneficial; two prominent data sources for this purpose include optical imagery and the Light Detection And Ranging (LiDAR) point cloud. Both data sources have their unique characteristics that make them useful in specific field applications. Different deep learning methods suitable for efficiently utilizing the complementary characteristics of both data sources were used for fusing the multi-modal data effectively. In this research, an autonomous cartesian robotic system was designed and developed for multi-modal data collection over a high-performance field-based wheeled robotic platform. Using this data, different data features like canopy spectral reflectance, structure, texture, and category information derived from multiple sensors are investigated for plant biomass prediction within the framework of multi-modal data fusion and deep learning. The proposed data collection pipeline and processing framework achieve satisfactory performance. Here, we successfully demonstrate the potential of multi-modal deep learning for cover crop and weed biomass estimation in agricultural fields, and such information can be useful for site-specific management.

WATTS UP! Exploring Soil Applied Pulse Electric Fieldas an Alternative to Methyl Bromide.
Tatiana Benedetti, Pamela Medeiros dos Santos, Marcelo L. Moretti*; Oregon State University, Corvallis, OR (224)

The Pacific Northwest currently leads tree seedling production in the United States, with tree seedling nurseries predominantly relying on traditional methods like fumigation and manual weeding for soil pathogens, nematode, and weed control. These practices are becoming increasingly unsustainable due to heightened regulations, rising costs, and environmental concerns. In response to these challenges, this research explores the potential of Pulse Electric Field (PEF) as a sustainable alternative to methyl bromide. PEF employs a short pulse of electrical energy to inactivate organisms. Among the factors that influence PEF's efficacy, better performance is expected in higher field strength intensity. Very little is known about the effect of PEF on weed seeds and propagules. Dose-response studies were conducted to determine the energy required to kill *Cyperus esculentus* (CYPES) tuber or *Digitaria sanguinalis* (DIGSA) seeds. Seeds or tuber were soaked for a day, planted in 10 by 10 cm containers filled with sterilized silt-loam soils, and subjected to PEF treatments ranging from 15 to 480 J cm^{-3} of soil at tow field strength levels: 50 or 250 V mm^{-1}. Plant emergence, height, and dry weight were recorded after 28 days. Data were submitted to nonlinear regression, and the effective dose required to reduce growth by 95% (ED_{95}) was used to compare responses. The ED_{95} of CYPES shoot weight was observed with 98 J cm^{-3} unaffected by field strength tested. CYPES roots ED95 was 108 J cm^{-3}. DIGSA was more sensitive to PEF at 250 V mm^{-1}. The shoot and root ED_{95} at 250 V mm^{-1} were 80 and 67 J cm^{-3}, respectively. These energy values were 2.2 times lower than the energy needed at 50 V mm^{-1}. Field studies are ongoing to assess how pulse duration, frequency, and field strength interaction affect PEF performance in controlling important weed species, soil pathogens, and nematodes. Research is underway to assess the practical applicability of PEF under field conditions.

Site-Specific Treatment of Weed Escapes in Cotton Using a Remotely Piloted Aerial Application System. Ubaldo Torres*[1], Daniel E. Martin[2], Bholuram Gurjar[1], Bishwa B. Sapkota[1], Matthew Kutugata[3], Muthukumar V. Bagavathiannan[1]; [1]Texas A&M University, College Station, TX, [2]United States Department of Agriculture, College Station, TX, [3]Texas A&M, College Station, TX (225)

Late-season management of weed escapes is crucial to limit seedbank additions and inhibit future weed infestations. Common waterhemp (*Amaranthus rudis*), a prevalent and problematic weed in southeast Texas cotton, may produce over one million seeds per plant. Thus, there is a need for targeted and effective late-season management strategies to reduce seedbank inputs. One potential solution is the use of a remotely piloted aerial application system (RPAAS) for site-specific treatment of weed escapes. This system can be supported by aerial imagery captured from an unmanned aerial system (UAS) to detect weed escapes and facilitate subsequent treatment using the RPAAS. Field experiments were conducted in 2021 and 2022 at the Texas A&M University Research Farm near College Station, TX. The objectives were to: 1) detect late-season waterhemp escapes in cotton using UAS-based aerial RGB imagery, and 2) evaluate the effectiveness of the RPAAS for site-specific treatment of late-season waterhemp escapes in cotton. The experiment was laid out as a randomized complete block design with 4 treatments and 3 replications. The treatments consisted of: 1) an RPAAS-based herbicide application with weeds located using a ground RTK-GPS unit, 2) an RPAAS-based herbicide application with weeds located in aerial imagery using deep-learning, 3) a backpack spot application of herbicide, and 4) an untreated check. Paraquat herbicide applied at 0.56 kg ai ha^{-1} was used to allow for effective estimation of herbicide spray coverage and injury. The overall accuracy of waterhemp detection using image analysis was 63 and 61% in 2021 and 2022, respectively. In 2022, the efficacy of drone-based applications was lower than that of backpack applications due to insufficient coverage. However, no differences were observed between backpack and drone-based applications with manually located weeds (for drone spray) in 2021. Weed height had no effect on weed control efficacy, but factors such as propeller downwash and positional accuracy may have led to a decline in precisely targeting the weed escapes.This experiment provided valuable insights for improving detection accuracy and RPAAS spray coverage for late-season weed management.

Developing a National Image Repository for Weeds, Cover Crops, and Cash Crops. Matthew Kutugata[1], Chris Reberg Horton[2], Navjot Singh*[1], Søren K. Skovsen[3], Maria Laura Cangiano[2], Muthukumar V. Bagavathiannan[4], Steven Brian Mirsky[5]; [1]Texas A&M, College Station, TX, [2]NCSU, Raleigh, NC, [3]Aarhus University, Aarhus, Denmark, [4]Texas A&M University, College Station, TX, [5]USDA ARS, Beltsville, MD (226)

The National Agricultural Image Repository (NAIR) fills a crucial gap in precision agriculture by providing an extensive, diverse dataset of images of cash crops, cover crops, and weeds. This resource is essential for advancing AI and machine learning projects in weeds and crops recognition and management. For this Image Repository, we are using a two-pronged approach: semi-field and field image collection. In the semi-field setting, a bench-robot system is utilized at three locations: United States Department of Agriculture (USDA), North Carolina State University (NCSU), and Texas A&M. This machine systematically photographs potted plants, capturing images of weeds, cover crops, and cash crops like cotton, soybean, and corn, using Sony cameras with flash until the plants reached 30-40 cm in height. In the field image collection phase, USDA is collaborating with NCSU, Texas A&M, and 10 other institutions across the USA. The field image collection focuses on photographing cover crops and cash crops in rows and weeds as individual plants. To ensure uniformity and minimize background interference, black mats are used to cover the soil, weeds, and debris. The images are captured using a Sony camera with flash mounted on a stick, focusing on plants taller than 30 cm. As of 2023, 49,000 images 40 different plant species have been collected using the semi-field setting. These images were then processed to produce around 700,000 cutouts of individual plants including cash crops, cover crops, and weeds. For the field image repository, 44,000 photos of weeds and 7,000 photos of cash crops have been collected. This open-access image repository can advance the development of precision technologies that can increase efficiency, lower costs, and improve the overall sustainability of farming practices, also promoting open and collaborative research.

Weed Management in Corn with Reduced Rates of Atrazine. Akashdeep Singh Brar*[1], Milos Viric[1], Mark VanGessel[2], Kurt M. Vollmer[3], Vijay Singh[1]; [1]Virginia Tech, Painter, VA, [2]University of Delaware, Georgetown, DE, [3]University of Maryland, Queenstown, MD (1)

Atrazine, besides being an important and widely used herbicide for the control of broadleaf and grass weeds in corn and other row crops, is also a surface water and groundwater contaminant that can enter waterways through runoff from agricultural fields. In the regions where, higher levels of atrazine have been reported in watersheds, the US Environmental Protection Agency (EPA) has proposed certain restrictions on the use of atrazine including avoiding its aerial application, prohibiting application in saturated soils and restricting annual application rates to a maximum of 2lb/A of active ingredient. The majority of corn growing belts of the Delmarva region will be affected by these changes. There is a need to design more environmentally sustainable herbicide programs which can be equally effective but far less dependent on atrazine. A multi-location field trial was conducted in Virginia, Delaware and Maryland to determine the effectiveness of new herbicide programs with reduced atrazine rates. Preemergence applications of atrazine alone as well as atrazine in combination with *S*-metolachlor, pyroxasulfone and *S*-metolachlor + mesotrione, as tank mixes were tested in corn. Apart from it, postemergence applications of various premixes including Acuron Flexi, Halex GT and Acuron GT with and without atrazine were tested. Results from the study conducted in Virginia indicated that the preemergence application of atrazine at the reduced rate of (20 fl oz/A) when tank mixed with *S*-metolachlor, pyroxasulfone or *S*-metolachlor + mesotrione provided an excellent, near 100% weed control which was significantly better as compared to reduced rate of atrazine (20 fl oz/A) alone. Also, results from postemergence treatments indicated that glyphosate + glufosinate treatments were marginally inferior (90%) to treatments that included atrazine and/or Halex GT and/or Acuron GT/Flexi, which provided season-long excellent control. This study would provide a prospective for future research to convince farmers of the region to move away from traditional dependence on atrazine.

A Precision Dual Tank Sprayer to Overcome Antagonism of Mixing Clethodim and 2,4-D for Control of Corn Volunteers in Enlist Corn. Adam E. Leise*[1], Quentin Cooksley[2], Amit J. Jhala[1]; [1]University of Nebraska Lincoln, Lincoln, NE, [2]John Deere- AKRS, Grand Island, NE (2)

Corn production in the United States reached a 10-year high in 2023, eclipsing 15.2 billion bushels. The domination of Herbicide Resistant Crops (HR) with a 94.5% adoption rate should be linked as a factor in the rise of corn production and yield. In corn, the most common HR crops we see planted are Enlist Corn®, Roundup Ready Corn®, and Liberty Link Corn®. In the midwest, continuous corn is an ongoing popular choice for farmers. While these HR traits allow more options for farmers to control weeds, reports of hard to control HR volunteer corn have been noted. If HR volunteer corn does not produce any grain, it can negatively affect the cash crop yield. However, if the HR volunteer corn does produce grain yield, this negative impact is minimized. Current recommended herbicides to control volunteer corn are graminicides (grass herbicides) which include active ingredients such as clethodim, sethoxydim, quizalofop-p-ethyl, among others. While these options may provide effective and quick control of volunteer corn, reports of antagonism have been noted when tank mixing these graminicides with popular corn POST herbicides. When tank mixed, quizalofop and enlist one has been reported to reduce the efficacy of quizalofop and ultimately volunteer corn control. This situation requires farmers either to increase the rate of quizalofop or potentially make 2 passes, which can be detrimental in an already busy season. John Deere's new 612R sprayer comes equipped with new dual tank technology that allows for simultaneous applications of two different herbicides through different nozzles. The objective of this study was to evaluate aryloxyphenoxypropionates (FOPS) for control of Roundup Ready/Liberty Link volunteer corn and their effect on corn injury and yield in using the new dual tank system when compared against a traditional tank mix approach. HR volunteer corn was planted at 22,000 seeds/acre on May 2 using a circular spreader. Two different rates of Quizalofop (36 g ai/ha-1 and 72 g ai/ha-1) were applied using the same tank and using the dual tank system. At 1 week after application (WAA), volunteer corn control using standard rates of quizalofop in a dual tank system (63%) was significantly higher when compared to tank mixing the two active ingredients (35%). At 3WAA, tank mixed applications using a standard rate of quizalofop improved to good control of volunteer corn (76%) yet was still behind excellent control when using a dual tank system (99%). The new innovation of applications using a dual tank system may unlock herbicide combinations that farmers may utilize in the future. Financial analysis should be assessed yearly in both short and long term operations to determine if investing in dual tank technology is appropriate.

Clethodim and Quizalofop Antagonism from 2,4-D on Volunteer Corn Was Not Resolved by Using a Dual-Tank Spray System. Marcelo Zimmer*[1], Diego J. Contreras[2], Wesley Everman[2], Chad J. Lammers[3], Jess J. Spotanski[3], Lauren M. Lazaro[4], William G. Johnson[1], Bryan G. Young[5]; [1]Purdue University, West Lafayette, IN, [2]North Carolina State University, Raleigh, NC, [3]Midwest Research Inc., York, NE, [4]Blue River Technology, Sunnyvale, CA, [5]Purdue University, Brookston, IN (3)

Volunteer corn (*Zea mays* L.) is one of the most prevalent weeds in soybean production in the Midwest. ACCase-inhibiting (Group 1) herbicides such as clethodim and quizalofop are often used to control glyphosate/glufosinate-resistant volunteer corn. The widespread adoption of dicamba- and 2,4-D-resistant soybean varieties across the United States enables farmers to spray synthetic auxin (Group 4) herbicides postemergence to control glyphosate-resistant broadleaf weeds. However, previous research indicated that the addition of Group 4 herbicides and glyphosate may antagonize clethodim and quizalofop efficacy on volunteer corn and annual grasses. Increasing the rate of Group 1 herbicides or performing sequential (split) applications are recommended approaches to overcome the antagonism of Group 1 herbicides. Alternatively, a dual-tank spray system was shown to resolve the antagonism of clethodim from dicamba eliminating the need for a herbicide rate increase or multiple sprayer trips across the field. The effectiveness of separating herbicide applications in space (dual-tank system) depends on whether the antagonistic response is caused by tank incompatibility or by a physiological response within the target weed. A field experiment was conducted in 2023 at three locations (Indiana, Nebraska, and North Carolina) to evaluate the effect of application strategy and Group 1 herbicide rate on volunteer corn control. Three herbicide application strategies were tested: Group 1 herbicide alone; single-tank mixture of Group 1 herbicide with 2,4-D (1065 g ae ha^{-1}) + glyphosate (1260 g ae ha^{-1}); and dual-tank application of Group 1 herbicide with 2,4-D + glyphosate using the John Deere See & Spray™ Ultimate sprayer system. Group 1 herbicides tested included two rates of clethodim (51 and 102 g ai ha^{-1}) and quizalofop (31 and 62 g ai ha^{-1}). Overall, the addition of 2,4-D + glyphosate to clethodim did not reduce volunteer corn control compared with clethodim applied alone. Therefore, the potential benefit of using a dual-tank sprayer system to overcome clethodim antagonism from 2,4-D could not be measured. The higher rate of clethodim (102 g ai ha^{-1}) resulted in 80 to 99% control of volunteer corn across all locations, regardless of application strategy. The addition of 2,4-D + glyphosate to quizalofop reduced volunteer corn control by up to 97% compared with quizalofop applied alone. The dual-tank sprayer system did not resolve the antagonism of quizalofop from 2,4-D. However, in Indiana, the use of the dual-tank system increased control of volunteer corn by 33% for the high rate of quizalofop compared with the single-tank application. The marked reduction in quizalofop efficacy from the addition of 2,4-D + glyphosate is likely a physiological plant response. Therefore, sequential applications of quizalofop and 2,4-D may still be the preferred approach to resolve antagonism.

The Influence of Temperature and Moisture on Corn Tolerance to Amicarbazone. Michael R. Dodde*[1], Jason K. Norsworthy[1], Tom Barber[2], Ryan S. Henry[3]; [1]University of Arkansas, Fayetteville, AR, [2]University of Arkansas, Lonoke, AR, [3]UPL NA Inc., Fort Wayne, IN (4)

Atrazine is one of the predominant herbicides utilized in corn production for preemergence (PRE) and postemergence control of grass and broadleaf weeds. Considering environmental concerns, the Environmental Protection Agency (EPA) proposes reducing the rate of atrazine from 2,240 g ai/ha/year to 1,345 g ai/ha/year for PRE applications. Amicarbazone, and metribuzin are being evaluated as alternatives to PRE application of atrazine in corn. Therefore, a greenhouse experiment was conducted in 2023 at the Milo J. Shult Agricultural Research and Extension Center in Fayetteville, AR, to determine if corn hybrids differ in sensitivity to amicarbazone, metribuzin, and a combination of the two when applied PRE. The experiment was arranged as a two-factor split-plot completely randomized design with four replications. Amicarbazone at 660 g ai/ha, metribuzin at 560 g ai/ha, and amicarbazone plus metribuzin at 660 g ai/ha and 377 g ai/ha, respectively, were applied PRE to 9 different corn hybrids. These rates were above the proposed use rates for these active ingredients in corn, and they were chosen to increase the likelihood of crop injury for data collection. Visible crop injury ratings were collected 2 and 3 weeks after treatment (WAT), and above-ground biomass was harvested and weighed at the last rating. At 3 WAT, 8 corn hybrids had less than 20% visible injury when amicarbazone was applied, and 4 hybrids had less than 20% injury when metribuzin was applied. When amicarbazone was applied with metribuzin, only 1 hybrid had less than 20% injury. DeKalb DKC 67-94 had 66% injury when treated with amicarbazone plus metribuzin, whereas DeKalb DKC 64-22 was injured only 22%. Based on these results, there are varietal differences in corn response to amicarbazone, metribuzin, and the combination. The two most sensitive and tolerant hybrids will be further examined in a field experiment with these treatments.

Carryover of Indaziflam to Soybean and Corn Crops in Sugarcane Reform Areas. Luiz Henrique F de Campos[1], Francielli S de Oliveira*[2], Leonardo de O Semensato[3], Paulo Cesar I. Donadoni[4], Mirella F. Ortiz[2], Pedro J. Christoffoleti[5]; [1]HERB tech - Consultoria e Pesquisa, Iracemápolis, Brazil, [2]Utah State University, Logan, UT, [3]Federal University of São Carlos, Araras, Brazil, [4]Bayer Crop Science, São Paulo, Brazil, [5]HERB tech - Consultoria e Pesquisa, Piracicaba, Brazil (5)

In Brazil, it is common to rotate to soybean or corn after the final sugarcane harvest. However, some herbicides applied to sugarcane stands can negatively impact rotational crops due to the residual activity in the soil. This study investigates crop safety after indaziflam is applied during the sugarcane growing season for soybean and corn. Field trials were conducted in Brazil during the 2022-2023 season using a randomized block design with two soil textures (loamy sand and clay) and two crops (soybean and corn). Indaziflam was applied nine months prior to planting at 0, 15, 30, 45, 60, and 120 g ai ha^{-1} for the loamy sand soil, while for the clay soil, indaziflam was applied at 0, 20, 40, 55, 75, and 150 g ai ha^{-1}. Visual injury was evaluated 15 and 30 days after crop emergence, and yields were collected at the end of the season. No visual injury was observed in corn under both soil types, and yield was not significantly affected by indaziflam rates. Despite observing visual damage up to 25%, soybean yields were not significantly affected by indaziflam rates until 60 and 75 g ai ha^{-1} for loamy sand and clay soil, respectively. These results indicate adequate crop safety for rotational crops following indaziflam applied at recommended rates (50 to 100 g ai ha^{-1}) to sugarcane stands.

Assessment of Cover Crop Adoption and Management in Wisconsin Corn-Soybean Cropping Systems. Guilherme Chudzik*, Nicholas J. Arneson, Jose J. Nunes, Rodrigo Werle; University of Wisconsin-Madison, Madison, WI (6)

The evolution and widespread occurrence of herbicide-resistant weeds pose a major challenge for farmers and crop consultants across North America and beyond, warranting the need of more integrated management strategies. The adoption and proper management of cereal rye cover crop can provide effective levels of weed suppression. Despite the soil health and weed suppression benefits, cover crop adoption and management bring another layer of cropping systems' management complexity to growers and crop consultants. This complexity revolves around the challenge of balancing greater biomass accumulation with the potential for disruptions in daily operations and losses of cash crop yield. A survey, targeting farmers and crop consultants, was conducted during the spring of 2023, aiming to assess and document how cover crops are currently being adopted, managed, and perceived as part of weed management programs in Wisconsin cropping systems. The survey consisted of 26 questions divided in 5 sections: i) respondent profile (occupation, farm size, and crops managed), ii) cover crop adoption and experience, iii) cover crop management ahead of soybean season, iv) cover crop management ahead of corn season, and v) general questions regarding benefits and challenges of cover crop adoption. Farmers and crop consultants represented the majority of respondents, with 63 farmers and 59 consultants, covering 29.5 and 557 thousand hectares, respectively. Waterhemp and giant ragweed are the most troublesome species as pointed out by the respondents. More than 90% of respondents use herbicides to terminate their cover crops, and 67% of the respondents agree to some extent that cover crops improved overall weed control in their farms/clients' farms. Furthermore, results demonstrate a strong consensus (85%) on cover crops positively influencing water retention, with 98% agreement on their efficacy in reducing soil erosion, indicating widespread support for their beneficial impact to water and soil conservation. Results from this survey efforts will contribute to the ongoing mission of the University of Wisconsin-Madison Cropping Systems Weed Science Lab to develop sustainable and efficient research-based weed management strategies for the state of Wisconsin and beyond.

Multifarious Approach to Manage Weeds in Soybean and Subsequent Sugar Beet Crop.
Navjot Singh*[1], Thomas J. Peters[2], Seth Naeve[1], Ryan P. Miller[3], Debalin Sarangi[4]; [1]University of Minnesota, Saint Paul, MN, [2]North Dakota State University, Fargo, ND, [3]University of Minnesota, Rochester, MN, [4]University of Minnesota, St. Paul, MN (7)

Minnesota is the third largest soybean-producing state and first in sugar beet production in the US. Despite having several nutrient and pest management benefits, soybean-sugar beet rotation faces several weed management challenges. Management of waterhemp [*Amaranthus tuberculatus* (Moq.) J.D. Sauer] in this rotation is difficult due to the prevalence of glyphosate-resistant biotypes in the state, longer crop rotation interval restrictions for many soil residual herbicides used in soybean, and limited POST options in sugar beet. Field experiments were conducted in Moorhead, MN, and Rosemount, MN, to evaluate the effect of soybean row spacing (38- Vs. 56-cm) combined with weed management programs for in-season and subsequent season's (sugar beet) waterhemp management. Weed management programs included low- and high-input herbicide programs, and a high-input herbicide program followed by (fb) harvest weed seed control (HWSC). Soybean planted at narrow row spacing achieved 90% green canopy cover (G_{90}) by accumulating 270 and 158 less GDD than wide row in Moorhead and Rosemount, respectively; however, soybean row spacing did not impact waterhemp control, density, and seed production. At both sites, the low-input herbicide program with dimethenamid-P (PRE) fb glyphosate (late POST) resulted in = 55% waterhemp control, whereas the high-input herbicide program with flumioxazin (PRE) fb lactofen plus acetochlor (early POST) fb 2,4-D choline plus glyphosate (late POST) application resulted in zero waterhemp density and seed production. Narrow-row soybean yielded 560 kg ha^{-1} higher than the wide row in Rosemount but the yield was comparable in Moorhead. In Rosemount, all the high-input herbicide programs yielded at least 820 kg ha^{-1} higher than the low-input programs. High-input herbicide programs in soybean reduced waterhemp emergence in subsequent sugar beet at least by 72% compared to nontreated control. When combined with a high-input herbicide program, HWSC did not further reduce waterhemp emergence in subsequent season compared to the same herbicide program. Therefore, the results showed that herbicide options were available for waterhemp management in soybean-sugar beet rotation, and in a short-term study like this, herbicide programs influenced the seedbank size more than the other treatments. Keywords: Herbicide carryover, herbicide resistance, integrated weed management, soybean agronomy, weed seedbank

Using Winter Wheat to Suppress Palmer Amaranth (Amaranthus Palmeri S. Wats.) Emergence in a Variety of Soybean Production Systems. Jared T. Smith*[1], Jason K. Norsworthy[1], Leonard B. Piveta[1], Summer L. Pritchett[2], Michael R. Dodde[1], Tom Barber[3]; [1]University of Arkansas, Fayetteville, AR, [2]University of Arkansas Department of Crop, Soil, and Environmental Science, Fayetteville, AR, [3]University of Arkansas, Lonoke, AR (8)

Chemical control options for Palmer amaranth continue to dwindle as this troublesome weed evolves resistance to commonly used herbicides. Therefore, cultural control options such as cover crops and alternative cropping strategies need to be explored. This research aims to evaluate the use of winter wheat to suppress Palmer amaranth emergence in a variety of soybean production systems and soybean planting dates. This experiment consisted of eight treatments including two soybean monocrops, two soybean crops grown with a wheat cover crop, three wheat-soybean relay intercrops, and one wheat-soybean double crop. Wheat was only harvested in the intercrop and double crop treatments. Wheat in all three intercrop treatments yielded less than the wheat in the double crop, likely due to the mechanical damage done to the wheat at soybean planting. Wheat in the intercrop yielded best when soybean was planted on April 1st opposed to later planting dates. The intercrop and double crop treatments struggled with soybean stand establishment. The intercrops with soybean planted April 1st or 15th were unable to recover from this stand loss and produced the lowest soybean yields. However, the intercrop with soybean planted May 1st yielded on par with both soybean monocrops and the cover crop with soybean planted May 1st. The double crop soybean also recovered, yielding similarly to the monocrop planted May 15th and the intercrop planted May 1st. Overall, soybean yields were highest in both cover crop treatments and in the monocrop planted April 15th. Palmer amaranth emergence was lowest in the intercrops, double crop, and the cover crop with soybean planted May 1st. The monocrop planted May 15th saw the most Palmer amaranth emerge with numbers more than double all other treatments.

Impact of Layered-Residual Herbicide on Soybean Growth and Yield. Sithin Mathew*[1], Aaron Lorenz[2], Seth Naeve[2], Vasudha Sharma[2], Debalin Sarangi[3]; [1]Department of Agronomy and Plant Genetics, University of Minnesota, Minneapolis, MN, [2]University of Minnesota, Saint Paul, MN, [3]University of Minnesota, St. Paul, MN (9)

The competitive ability of cultivated crops for weed suppression is often overlooked in annual row cropping systems. Plant canopy coverage can influence weed emergence and control; however, canopy coverage rate can negatively be affected by various management practices. The objective of this research was to evaluate the influence of 'layered-residual herbicide' application in combination with foliar-active POST herbicides and narrow row spacing on soybean canopy development and yield. A field experiment was conducted in 2023 at the University of Minnesota's Rosemount Research and Outreach Center located near Rosemount, MN, using a split-split plot design. Treatment factors included wide- (76.2 cm) and narrow- (38.1 cm) row soybean as main plot, foliar-active POST herbicides (glyphosate, glufosinate, and lactofen) as subplot, and the very-long-chain fatty acid (VLCFA)-inhibiting herbicides (acetochlor, pyroxasulfone, and *S*-metolachlor) as sub-subplot. At 21 days after POST application (DAA), narrow-row spacing had 75% canopy cover compared to 62% canopy cover in wide-row. Among the foliar-active herbicides, glyphosate and glufosinate resulted in the highest canopy cover (72%). Soybean canopy cover was comparable among the VLCFA inhibitors at 21 DAA; however, the canopy was higher in the plots that did not receive any VLCFA inhibitors as layered-residual herbicide treatment. At 42 DAA, acetochlor treatment had the lowest canopy cover (87%) compared to pyroxasulfone (89%), *S*-metolachlor (90%), and no VLCFA herbicide (91%). When averaged over treatments, soybean yield was not influenced by the row spacing, however, glyphosate in wide-row treatment recorded the highest yield (3,444 kg ha^{-1}), while the yield was lowest in lactofen in narrow-row spacing (3,194 kg ha^{-1}). The plots that did not receive any VLCFA inhibitor treatments recorded the highest soybean yield (3,397 kg ha^{-1}), which was similar to pyroxasulfone treatment (3,312 kg ha^{-1}) and better than *S*-metolachlor and acetochlor (3,259 and 3,221 kg ha^{-1}, respectively). Therefore, depending on the selection of foliar-active herbicides and VLCFA-inhibiting herbicides, some of the layered-residual herbicide treatments can delay soybean canopy growth, and reduce yield.

Early Season Weed Suppression in Soybeans with Cover Crops and Preemergence Herbicides. Wade S. Reiter*, David P. Russell, Audrey Gamble; Auburn University, Auburn, AL (10)

Early Season Weed Suppression in Soybeans with Cover Crops and Preemergence Herbicides Control of herbicide resistant weeds is a growing problem for southeastern row crop producers. Utilizing alternative programs that integrate winter cover crops with preemergence herbicides may be an effective form of weed management. Field studies were conducted at the Tennessee Valley Research and Extension Center in Belle Mina, AL in 2022 and 2023 and at the E.V. Smith Research Center in Shorter, AL in 2023. An experiment using a 2x2x3 factorial design with 4 replications was used to evaluate the ability of different cover crop management practices in conjunction with preemergence herbicides to suppress weeds in soybeans (*Glycine max*). Main factors were two seeding rates of a cereal rye + crimson clover mixture, two cover crop nitrogen fertilization rates, and three preemergence herbicide treatments (untreated, S-metolachlor, acetochlor) applied to soybeans at planting. Cover crop biomass was collected to observe the effects of seeding and fertilization rates on aboveground biomass production. Weed counts were conducted ~14, 28, 42, and 56 days after soybean emergence in two, 1 m^2 areas within each plot. Common weed species observed were large crabgrass (*Digitaria sanguinalis*), Palmer amaranth (*Amaranthus palmeri*), prickly sida (*Sida spinosa*), barnyardgrass (*Echinochloa crus-galli*) and morningglories (*Ipomoea* spp.). Cover crop biomass (P=<0.0001), herbicide treatment (P=<0.0001) and herbicide x time interaction (P=<0.0001) all had a significant effect on weed emergence. Weed emergence was lower for the S-metolachlor and acetochlor treatments compared to the no herbicide treatment. A negative linear correlation (R^2=0.1327) was observed between cover crop biomass and weed emergence. Weed emergence increased over time but preemergence herbicides were able to decrease emergence below levels observed in the nontreated at ~42 DAP. This data suggests that cover crop biomass and preemergence herbicides can help to suppress early season weed emergence in soybeans.

Management of Herbicide-resistant *Phalaris minor* and Broad-leaf Weeds by Sequential Applications of Pre and Post-emergence Herbicides in Wheat (*Triticum aestivum* L.). Deepak Loura*; Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, India, Hisar, India (11)

The present study was executed during the winter season of 2021-22 and 2022-23 at CCS HAU Hisar, Haryana (India). In order to evaluate the efficacy of different pre and post-emergence herbicides against complex grassy and broad leaf weeds, the field experiment was laid out in randomized block design with three replications and total 17 different herbicidal combinations. Treatments consists of sequential application of pre and post-emergence herbicides. Major weed species infesting the experimental field were *Phalaris minor*, *Chenopodium album*, *Anagallis arvensis*, *Rumex dentatus*, and *Melilotus indica*. *P. minor* is resistant to isoproturon (phenylurea herbicide), ACCase inhibitor (clodinafop, fenoxaprop) and ALS inhibitor (sulfosulfuron, pyroxsulam, mesosulfuron) herbicides due to continuous rice-wheat cropping system, extensive use of the same herbicide year after year with the same mode of action, inappropriate application method and, under dose herbicide application. Overall, the most effective treatment for controlling resistance *P. minor* and other complex weed flora involves the sequential application of PRE pendimethalin + pyroxasulfone (1500+127.5 g ha^{-1}) *fb* POST mesosulfuron + iodosulfuron (RM) (14.4 g ha^{-1}). This treatment results in the lowest weed density and dry weight, the highest weed control efficiency, and promotes favorable plant growth and yield attributes, ultimately leading to increased grain yield. However, when dealing with a field dominated solely by *P. minor*, applying pre-emergence pendimethalin + pyroxasulfone alone can achieve control rates of over 80%. On the other hand, the sequential application of PRE pendimethalin + pyroxasulfone (1500+127.5 g ha^{-1}) *fb* POST pinoxaden + metribuzin (50 + 105 g ha^{-1}) provided effective control of resistant *P. minor*. To maintain and safeguard farmers' yield and effectively manage resistance and spread of *P. minor*, the emphasis should be on proactive and reactive management strategies, including the sequential application of herbicides with different modes of action and the incorporation of pre-emergence herbicides

Does Planting Date and Row Width Impact Weed Suppression in Soybean? Matthew S. Goddard*, Christy L. Sprague, Maninder P. Singh; Michigan State University, East Lansing, MI (12)

Unpredictable and more variable weather patterns continue to limit the number of days field operations can be conducted, prompting growers to plant soybeans earlier. However, knowledge of the effects early planting has on weed control and the impact of different row widths in soybean is insufficient. A field experiment was conducted at one location in 2022 and two locations in 2023 for a total of three site-years to evaluate the effects of planting date, row width and herbicide program on weed control and soybean yield. The experiment was setup as a split-split-plot design with planting timing as the main plot, row width as the sub-plot, and herbicide program as the sub-sub-plot. Enlist E3® soybeans were planted in mid-late April (early) and mid-late May (normal) in three row widths. Row widths evaluated included 19 cm at two populations (370,500 and 494,000 seeds ha^{-1}), and 38 and 76 cm rows at 370,500 seeds ha^{-1}. Weed control treatments consisted of: 1) a PRE only of s-metolachlor + metribuzin, 2) the same PRE followed by (fb.) a POST of 2,4-D choline + glyphosate + ammonium sulfate, 3) weed-free control, and 4) weedy control. POST herbicide applications were made when weeds were ~10 cm tall. Similar growing conditions were observed at both sites in 2023 however, severe soil crusting occurred in 2022 (MSU22) in the early planted soybean. At this site, soybean stand was 63% lower for soybean planted in 19 cm rows early compared with those planted at a normal time. At the other two sites, early planting resulted in 7% lower relative soybean stand versus the normal planting time averaged across all row widths and herbicide programs. At MSU22, a PRE herbicide application was beneficial in reducing weed biomass at the time of POST application for all row widths in the early planting and 38 and 76 cm rows in the normal planting. These reductions ranged from 66-88% and 95-99% in the early and normal planted soybean, respectively. However, there was no difference in weed biomass between the weedy and PRE treatments for 19 cm rows regardless of population at the normal planting time. This was likely due to lower weed populations and faster, more uniform canopy development. At the other two sites, planting soybean in 19 cm rows reduced weed biomass by 39% compared with wider row widths in the weedy control for early planted soybeans. At MSU22, there was a planting date by herbicide program interaction that resulted in early planted soybean yield reductions of 42 and 69%, in PRE and weedy treatments, respectively. However, soybean yield in the normal planting was only reduced in the weedy control (35%). These reductions directly correlate to weed competition and biomass present at soybean harvest. At the other two sites, the main effect of row width resulted in 8% higher soybean yield for the high population of 19 cm rows compared with 76 cm rows. Soybean yield benefitted from a PRE fb. POST herbicide program in both planting timings regardless of row width. Nonetheless, when growing conditions were favorable 19 cm rows provided better early-season weed suppression compared with 38 and 76 cm rows regardless of population in the early planting. However, season-long weed suppression and yield benefits of 19 cm versus 76 cm rows were only observed at the higher population across both planting dates. In the event of poor soil conditions, there were no effects of row width, and soybean yield was only lower when a complete weed control program wasn't used. Overall, the impact of row width on weed suppression and soybean yield in early planted soybean was greatly dependent on soil conditions and soybean stand establishment.

Potential Reduction of Non-Imidazolinone (IMI) Rice Grain Yield by IMIs Soil Residual Activity. Diego M. Chiapinotto[1], Luis A. Avila[2], Bianca C. Aranha[1], Vívian E. Viana[1], Edinalvo Camargo*[3]; [1]UFPel, Pelotas, Brazil, [2]Mississippi State University, Starkville, MS, [3]Universidade Federal de Pelotas, Pelotas, Brazil (13)

Imidazolinones (IMIs), widely used herbicides on IMI-resistant rice (Clearfield®), can persist in the soil and affect the plant growth and the grain yield of non-IMI crops.The objective of this study was to evaluate the IMIs soil residual concentration with the potential to reduce non-IMI rice plant height (PH) and grain yield (GY). Two field experiments in randomized complete block design were performed to estimate the herbicide rate that reduce the PH or GY by 10% (D_{10}). The factorial arrangement comprised: A) non-IMI rice (Provisia™, IRGA 417, and IRGA 424); B) rates of imazapyr + imazapic: 0 to 0.25x (x = 147 + 49 g a.i. ha^{-1}). IMIs concentration analyzes were performed through high-performance liquid chromatography tandem mass spectrometry (HPLC-MS/MS) using soil samples collected from up to 0-20 cm depth at rice sowing. Imazapyr and imazapic (individually) and imazapyr + imazapic in the soil were analyzed via linear regression. The means of imazapyr + imazapic were used to fit PH and GY by a nonlinear mixed-effects model. Imazapyr + imazapic soil concentration showed a range of 0-10.08 µg kg^{-1} (Year 1) and 0-20.11 µg kg^{-1} (Year 2). D_{10} values to PH were 5.20, 4.03, 4.07 µg kg^{-1} while to GY were 4.55, 2.76, and 3.84 µg kg^{-1} to Provisia™, IRGA 417, and IRGA 424, respectively. Residual soil concentration of IMIs negatively affects plant height and grain yield in non-IMI rice. Determination of IMIs soil residual concentration with the potential reduction of rice grain yield can contribute as criteria for the transition decision from Clearfield® to non-IMI rice.

Unraveling the Influence of Planting Date, Row Spacing, and Herbicide Programs on Weed Management in Soybean. Salina Raila*, Hannah Buessing, Sarah Lancaster, Alec Adam, Wade Burris, Igor Gustavo Rezende Lima; Kansas State University, Manhattan, KS (14)

Kansas farmers have been planting soybeans earlier, and weed control techniques for soybeans require changes. In 2023, research was conducted at two Kansas locations (Manhattan and Ottawa) to find appropriate practices to help farmers manage Palmer amaranth (Amaranthus palmeri) and waterhemp (Amaranthus tuberculatus) in early-planted soybeans. This study aimed to assess the impact of planting date, herbicide programs, and row spacing on light interception and Amaranthus spp. management in soybeans. Enlist® soybeans were planted either early (before the initial crop insurance date) or late (four weeks after early planting) in both 38 and 76-cm rows. Herbicide program treatments encompassed two pre-emergence herbicide mixes (sulfentrazone + metribuzin or flumioxazin + metribuzin), two post-emergence herbicide mixes (2,4-D choline + glyphosate or 2,4-D choline + glyphosate + S-metolachlor) at labelled field rates, and nontreated and weed-free controls. Planting date, row spacing, and herbicide programs were replicated four times in a factorial arrangement within a randomized complete block design at each location. Percent Palmer amaranth (Manhattan) and waterhemp (Ottawa) control was assessed four weeks after treatment (WAT). Percent light interception was recorded eight WAT and weed biomass was gathered at R7 soybean. Weed control data were subjected to analysis of variance with planting date, row spacing, and herbicide treatment, as fixed effects. In addition, regression analyses were conducted with percent weed control or weed biomass as dependent variables and percent light interception as the independent variable. Analysis of variance revealed that waterhemp control was similar across planting dates, row spacings, and herbicide treatments, both four and eight WAT. A very low coefficient of determination was seen in linear, polynomial, and logarithmic models. Results suggested that a low percentage of variability in percent weed control and weed biomass was explained by light interception. In conclusion, light interception and Amaranthus spp. control were similar at both planting dates for all herbicide programs in both row spacings except weed control by sulfentrazone + metribuzin in early planted soybeans in Manhattan.

Weed Control Efficacy and Rice Response of Pendimethalin Herbicide Mixtures Applied Post-emergence in Water-seeded Rice. Aaron Becerra-Alvarez*, Kassim Al-Khatib; University of California Davis, Davis, CA (15)

Herbicides continue to be an important tool for weed management in water-seeded rice. The lack of available herbicide modes of action and reduced effectiveness have encouraged research on new herbicides for California water-seeded rice. This study evaluated pendimethalin as a post-emergence application for weed control and rice response in a water-seeded system. Pendimethalin was applied alone and in herbicide mixtures at 1.1, 2.3 and 4.4 kg ai ha^{-1} with three broad-spectrum or foliar graminicide herbicides currently available at the 4- to 5-leaf stage rice. At 14 days after treatment, grass weed control levels were greater than 68% when pendimethalin was applied in herbicide mixtures than when applied alone. The herbicide mixtures with bispyribac-sodium and propanil had broad spectrum control of grass, sedge and broadleaf species compared to the mixture with cyhalofop-butyl only, a graminicide herbicide. Additional follow-up treatments were needed for season-long, broad-spectrum weed control. All treatments resulted up to 8% of visual injury. Rice tiller counts and grain yield were not affected by pendimethalin and resulted similar to the standard treatment of clomazone applied at the day of seeding. The results demonstrate pendimethalin can be a valuable tool for water-seeded rice when used in conjunction with other herbicides and does not cause injury of concern on rice when applied at 4- to 5-leaf stage. Pendimethalin would be a new mode of action available for California rice growers and help with herbicide resistance management.

Influence of Deer Repellent and Herbicide Tank-mixes on Weed Control and Deer Browsing in Soybean. Grady L. Rogers*; University of Missouri, Columbia, MO (16)

Influence of Deer Repellent and Herbicide Tank-Mixes on Weed Control and Deer Browsing in Soybean Grady Rogers, Grant Coe, Trace Thompson, Haylee Barlow, Delbert Knerr, Josh Bradley, Kevin Bradley Previous research has shown that nuisance deer browsing can substantially reduce the yield of soybean and certain other agricultural crops. Several deer repellent products are available on the marketplace yet little or no research data exists on the ability of these products to deter deer feeding, or the impacts of these products on weed control when applied in combination with standard herbicide treatments. Two field experiments were conducted in 2023 in soybean fields with heavy deer traffic. Four commercially available deer repellent products (Bobbex, Hinder, Liquid Fence, and PlantSkydd+) were evaluated for their effects on deer browsing of soybean plants. Each product was applied either once, twice, or three times sequentially with the preplant burndown, early postemergence, and late postemergence herbicide applications, respectively. Assessments of deer browsing were conducted at regular intervals following applications. Although all of the deer repellents provided some suppression of deer browsing initially, even three sequential applications of these products did not provide a reduction in deer browsing during the remainder of the growing season. A separate field experiment was conducted to determine the potential effects of herbicide and deer repellent tank mixes on weed control. Results from this experiment revealed that there were no differences in yellow foxtail (*Setaria pumila*), waterhemp (*Amaranthus tuberculatus*), morningglory species (*Ipomoea* spp.), and common cocklebur (*Xanthium strumarium*) control between tank mixes of these products compared to the weed control achieved with the post-emergence soybean herbicides alone. Overall, the results from these experiments suggest that the inclusion of these deer repellents in tank mixtures do not improve or worsen weed control when compared to herbicide treatments alone, however there is also no indication that these repellents prove effective at preventing soybean browsing.

Cereal Rye Cover Crop and Tillage Regime Alters Waterhemp Emergence Pattern Across a Latitudinal Gradient in the United States. Purushottam Gyawali*[1], Ahmadreza Mobli[2], Pavle Pavlovic[3], Rodrigo Werle[4], Jason K. Norsworthy[5], Martin Williams[6], Muthukumar V. Bagavathiannan[7]; [1]Texas A&M University, Department of Soil and Crop Sciences, College Station, TX, [2]University of Wisconsin, Madison, WI, [3]University of Illinois Urbana-Champaign, Champaign, IL, [4]University of Wisconsin-Madison, Madison, WI, [5]University of Arkansas, Fayetteville, AR, [6]United States Department of Agriculture, Agricultural Research Service, Urbana, IL, [7]Texas A&M University, College Station, TX (17)

Understanding and quantifying the emergence patterns of weed seedlings is crucial for effective weed management in agronomic crops. Waterhemp (*Amaranthus tuberculatus*), a highly problematic weed in the Northcentral and Southcentral US, exhibits regional variations in seedling emergence that are influenced by factors such as tillage methods, cover crops, and local environments. The objective of this study was to quantify waterhemp seedling emergence under specific management regimes, focusing on tillage practices and the presence or absence of a cereal rye (*Secale cereale*) cover crop. The study, conducted in 2023, spans a latitudinal gradient in US corn/soybean production region, including Wisconsin, Illinois, Arkansas, and Texas, utilizing a split-plot design with four replications. Three tillage treatments—fall tillage followed by spring tillage, fall tillage only with no spring tillage, and strict no-tillage—were combined with subplot treatments representing the presence or absence of a cereal rye cover crop. Results revealed that employing fall tillage followed by spring tillage led to earlier peaks in waterhemp seedling emergence compared to the no-tillage treatment. Additionally, the presence of a cereal rye cover crop significantly reduced total waterhemp seedling emergence, except in the Wisconsin site. However, tillage practices did not have a significant impact on total emergence across the studied locations. The cumulative emergence of waterhemp followed a sigmoidal pattern, well described by a three-parameter logistic equation. The emergence window exhibited significant variability across locations, starting as early as March 1 in Texas and extending to May 30 in Wisconsin. Peak emergence was observed on July 1 in Texas and on September 15 in Wisconsin. These findings provide valuable insights into how tillage practices and cover crops influence waterhemp emergence patterns in different environments. The information gathered is crucial for designing effective and locally appropriate weed management programs in crop fields, contributing to the development of multi-regional weed population dynamic models.

Effect of Application Timing on Rice Tolerance to Fluridone. Maria Carolina C R Souza*[1], Jason K. Norsworthy[2], Leonard B. Piveta[2], Pamela Carvalho-Moore[2], Summer L. Pritchett[3], Samuel C. Noe[4], Thomas R. Butts[5]; [1]University of Arkanas, Fayetteville, AR, [2]University of Arkansas, Fayetteville, AR, [3]University of Arkansas Department of Crop, Soil, and Environmental Science, Fayetteville, AR, [4]University of Arkansas, Fayetteville, KY, [5]University of Arkansas, Lonoke, AR (18)

Palmer amaranth is a major weed in rice that has evolved resistance to herbicides targeting nine sites of action. Therefore, new sites of action are needed to provide effective control of this weed. Fluridone is an effective herbicide in controlling Palmer amaranth that was labeled for use in rice in 2023. However, further studies must be conducted to evaluate the rice response to this herbicide. Thus, this study aimed to evaluate the rice tolerance to different application timings of fluridone. The experiment was conducted at the Rice Research and Extension Center in Stuttgart, Arkansas, in 2022 and 2023. The experiments were organized as a randomized complete block design with four replications per treatment. The treatments included a nontreated control for comparison and ten application timings [20 and 10 days preplant, preemergence (PRE), delayed-preemergence (DPRE), 1-leaf, 2-leaf, 3-leaf, 4-leaf, tillering (preflood), and immediately after flooding (post-flood)]. Fluridone was applied at all timings at 168 g ai/ha. Injury ratings were collected weekly, and rough rice grain yield was determined at harvest. At 3 weeks after emergence (3 WAE), the injury was minimal in 2022. In contrast, in 2023, PRE and DPRE treatments displayed injury levels of up to 30%. At 10 WAE, the greatest injury levels in 2022 were displayed by the treatments PRE and DPRE, both with 31%, which was comparable to the treatment 1-leaf (26%). In 2023, the treatment PRE obtained the highest injury at 39%. Regarding yield, in 2022, the yield obtained with the treatments 20 and 10 days preplant, 4-leaf, tillering, and post-flood were comparable to the nontreated. In 2023, except for the treatments PRE and post-flood, all other treatments were comparable to the nontreated. These results indicate that application timing influences rice tolerance to fluridone, and rice is more prone to injury from this herbicide in early applications, especially in preemergence.

Effects of Glufosinate and Bioinoculants on Soil Microbiomes and Bioinoculant Associated No-till Practices. Sarobi Das*[1], Angelica Torres[2], Renee Ralston[1], Woo-Suk Chang[1]; [1]University of Texas at Arlington, Arlington, TX, [2]University of Texas at Arlngton, Arlington, TX (19)

Glufosinate is a nitrogen-based, broad-spectrum herbicide and could serve as a robust alternative to glyphosate, which is facing reduced effectiveness because of the growing prevalence of resistant weeds. Despite its popularity, little is known about the effect of glufosinate on the dynamics of the soil microbiome and associated chemical behavior. Thus, a mesocosm experiment was conducted to explore the biodegradation of glufosinate and its impact on the soil microbiome. We compared the effects of single and dual herbicide applications over a 30-day period and quantified the residual herbicide in the soil at day 30. Samples treated with double the amount of glufosinate exhibited a faster breakdown of the herbicide compared to those treated only once. This difference in biodegradation rates can be attributed to the alterations in the soil microbiome. The selection of farming practices and the use of specific types of fertilizers/biofertilizers significantly influence plant growth, thereby affecting the rhizosphere and bulk soil microbiome. These alterations can, in turn, impact the biodegradation of herbicides. Therefore, as an extension, our lab is carrying out field trials in Louisiana and Arkansas, involving a conventional soybean variety. These trials aim to assess two bioinoculants (i.e., a drought tolerant strain and a commercial inoculant) with respect to no-till practices. Preliminary results from the field trials suggest that plant samples obtained from Arkansas exhibit greater height but lower biomass, whereas an inverse pattern is observed in Louisiana. These distinctions could be attributed to contrasting soil properties, potentially influencing the behavior of the herbicides in these different soil types. In conclusion, the combined approach of mesocosm and field trials offers comprehensive insights into its behavior and impact on soil microbial communities. These findings pave the groundwork for the development of more effective herbicide treatments and more efficient no-till farming practices.

Integration of Herbicides and Cover Crops for Effective Weed Management in Peanut.
Gourav Chahal*[1], Annu Kumari[2], Andrew J. Price[3], James C. Bonnell[4]; [1]Auburn University, Auburn, AL, [2]Crop, Soil & Environmental Sciences Department, Auburn University, Auburn, AL, [3]USDA-ARS-NSDL, Auburn, AL, [4]USDA- Technician, Auburn, AL (20)

A field study conducted in Alabama at the Wiregrass Research and Experiment Station from 2022-2023 aimed to evaluate the combined effect of cover crop residue and herbicides for weed control and its effect on the yield of Peanut. The experiment was conducted in split plot design with main plots were six cover crop treatments: cereal rye, wheat, radish, mixture, disk + cultivator, and winter fallow. The subplots were four herbicide treatments: 1) Preemergence (PRE) herbicide included flumioxazin + diclosulam, 2) Postemergence (POST) herbicide included ammonium salt of imazapic, 3) PRE followed by POST, and 4) a non-treated check. We found that three weeks after planting (WAP)_cover crops achieved 10-36% weed control, with cereal rye being the most effective at 36%. At six WAP, PRE plus POST herbicide applications had provided adequate weed control of 83-91%, while there was no overall effect of cover crops. However, no significant effect of cover crops and their interaction with herbicide on yield was observed. Moreover, plots treated with both PRE plus POST herbicides had higher yield than all other treatments. In conclusion, integrating herbicides, along with the incorporation of cover crops, such as cereal rye, is an effective weed management approach to control problematic weeds and sustain peanut yield. Future research is needed at multiple locations to provide a clear understanding of the impacts of various cover crops and herbicide treatments on weed control and peanut yield.

Soil Microbial Activity and Fate of Soil Residual Herbicides in Cover Cropping Systems.
Lucas Oliveira Ribeiro Maia*[1], Bryan G. Young[2], Eileen J. Kladivko[1], Shalamar Armstrong[1], William G. Johnson[1]; [1]Purdue University, West Lafayette, IN, [2]Purdue University, Brookston, IN (21)

The application of soil residual herbicides at cover crop termination has been recommended as part of the integrated weed management. However, the use of cover crops can increase soil microbial activity, which can lead to a reduced persistence of residual herbicides. In addition to the effect on degradation, cover crops can also alter the fate of residual herbicides by interception. Two field trials were conducted at the Pinney and Throckmorton (TPAC) Purdue research centers, in Indiana, from 2019 until 2023, in a corn-soybean rotation, to investigate the influence of cover crop use on soil microbial activity and concentration of residual herbicides in the soil, and the interception of herbicides by cover crop residue. Both trials were conducted in a split-plot design with cereal rye (*Secale cereale* L.), crimson clover (*Trifolium incarnatum* L.), and a fallow control as the main plots and three herbicide programs as subplots. The herbicide programs varied by the number of residual herbicides included in the tank mix - none, two, or three residual herbicides. Herbicides were applied at cover crop termination, two weeks before cash crop planting. Soil samples were collected at 8 sample timings from five days before to 112 days after cover crop termination and used to determine ß-glucosidase (BG) and dehydrogenase (DHA) activities as well as the concentration of residual herbicides in the soil. Weed biomass was determined at 4 weeks after cash crop planting. The use of cover crops resulted in temporary increases in BG and DHA at the two sites, with more consistent increases (at least 7 out of 8 sample timings) being observed at Pinney (low organic matter site) after the second year of cover crop use. No correlation was found between BG and DHA activities and herbicide concentrations in the soil. On average, cereal rye residue intercepted 73% of the residual herbicides applied at cover crop termination. The inclusion of three residual herbicides at cover crop termination resulted in at least 82% reduction in weed biomass at four weeks after cash crop planting, in comparison to the treatment without residual herbicides. Data from this research suggests that the use of cover crops does not result in reduced persistence of residual herbicides even under occasional increases in soil microbial activity. The presence of cover crop residue significantly reduces the initial concentrations of the herbicides in the soil. However, frequent rainfall events following cover crop termination can move herbicide residues from the cover crop biomass to the soil. In the absence of rainfall, lower concentrations of residual herbicides can result in higher selection pressure for herbicide resistant weed biotypes. Author e-mail: oliveirl@purdue.edu

Sorgoleone Production and Rhizosphere Nitrogen Retention in Diverse Johnsongrass Biotypes. Megan L. Schill*; Texas A&M, College Station, TX (23)

The excessive application of nitrogen in agricultural systems results in the cycling of large quantities of nitrogen through the process of nitrification, an inefficient mechanism that fosters nitrogen loss. The regulation of nitrification emerges as a pivotal strategy for enhancing nitrogen use efficiency and reducing its environmental impact. Biological nitrification inhibition (BNI) represents a naturally occurring plant-mediated phenomenon, wherein nitrification-suppressing compounds are synthesized within the plant rhizosphere. This inhibitory action extends to ammonium oxidizing archaea (AOA) and bacteria (AOB), increasing ammonium retention within the rhizosphere. Previous research has demonstrated the capacity of cultivated sorghum (*Sorghum bicolor*) to mitigate nitrification through the release of sorgoleone in root exudates. The current study investigates BNI potential in biotypes of johnsongrass (30 biotypes), a weedy relative of cultivated sorghum, and hybrids of *S. bicolor* X *S. halepense* (3 hybrids), then compares these to the highest documented BNI potential sorghum line by quantifying the amount of sorgoleone produced. Furthermore, sorgoleone production was compared to rhizosphere nitrogen retention in a controlled greenhouse experiment using the same biotypes. The experiment followed a randomized complete block design with three replications for each biotype (1 plant/rep). A high ammonium-to-nitrate ratio is anticipated in the rhizosphere of a plant with substantial BNI potential. This ratio was determined for each plant in the study by assessing available nitrate (at 540 nm) and ammonium (at 650 nm) using a spectrophotometer. The findings reveal significant inter-biotype differences ($p < 0.001$). *S. halepense* and hybrids demonstrate efficacy in maintaining high ammonium levels in the rhizosphere ranging from 80 – 90% ammonium retention, with certain biotypes exhibiting ammonium concentrations comparable to the highest BNI sorghum line. The observed high BNI potential in select biotypes may elucidate, at least partially, the prevalence of S. *halepense* in both agricultural and natural ecosystems. Further, high BNI potential in johnsongrass can be exploited to enhance the nitrogen retention abilities of sorghum, thereby contributing to the development of more resilient and productive varieties for sustainable farming practices.

Evaluation of Biological Nitrification Inhibition Potential in Diverse Cereal Rye Lines. Kapil A. Chobhe*[1], Nithya Rajan[1], Megan L. Schill[2], Nithya K. Subramanian[1], Muthukumar V. Bagavathiannan[1]; [1]Texas A&M University, College Station, TX, [2]Texas A&M, College Station, TX (25)

Nitrogen (N) is the most widely used fertilizer nutrient globally. Efficient use of N is important for crop production, environmental sustainability, and food security. Studies have shown that crops use only 50% of the applied N effectively, while the rest is lost through various pathways such as leaching, volatilization, etc. through nitrification and denitrification processes to the surrounding environment. The regulation of nitrification process is an important strategy to achieve high N use efficiency. Important crop species like rice, wheat, and sorghum have been found to contain root exudates that specifically prevent soil nitrification. The aim of this study wasto find out how well cereal rye, a popular cover crop, exhibitsbiological nitrification inhibition (BNI) potential. Plants exhibiting BNI benefit from the nitrogen in the soil when the root systems of the plants impede the nitrification process. Forthis, preliminary data were collected to assess BNI potential of 6 diverse cereal rye genotypes in comparison with soil without cereal rye as a check. This experiment was conducted in a randomized complete block design with three replications for each genotype; one pot/rep and four plants/pot. Higher ammonium environment (ammonium to total N ratio) is a key indicator for a potentially high BNI genotype. To determine this, ammonium and nitrate present in soil were quantified using spectrophotometer at 650 and 540 nm wavelengths, respectively. Results showed very high levels of ammonium retention, and thus likely a high BNI potential, in one of the 6 cereal rye genotypes investigated here. Preliminary results from this experiment demonstrate the occurrence of genetic variability for ammonium retention, and thereby BNI potential, among cereal rye genotypes. Future research will include additional cereal rye genotypes, and more specifically confirm BNI activity through the characterization of root exudates and studies on microbial inhibition.

Clethodim Efficacy on Texas Panicum (*Urochloa texana*) as Affected by Growth Stage and Adjuvant. Alexis R. Clobas-Celiz*, Michael W. Marshall; Clemson University, Blackville, SC (26)

Texas panicum has become a serious weed in peanut due to its season-long emergence pattern. In addition, soil residual herbicides, such as s-metolachlor, acetochlor, dimethenamid-p, and pyroxasulfone have limited activity on Texas panicum (TP). As a result, clethodim is preferentially used for management of escaped TP. Clethodim activity can be reduced by stress (drought or high temperatures) and/or weed size. This research project evaluated the efficacy of single and two-pass clethodim herbicide applications at different growth stages of TP (Study 1) and different adjuvant combinations on small and large TP (Study 2). Field experiments were conducted at the Clemson University Edisto Research and Education Center located near Blackville, South Carolina. In study 1, TP was sprayed with clethodim at 0.105 kg ha^{-1} at four different growth stages ranging from 10 to greater than 30 cm. In addition, a sequential clethodim application was applied 2 weeks after the 1st application for the 10-15, 15-20, 20-30, and >30 cm TP heights. In study 2, clethodim activity on TP was evaluated using the following adjuvants: Non-Ionic Surfactant (NIS) at 0.25% v/v, COC at 1% v/v, Methylated Seed Oil (MSO) at 1% v/v, and COC and MSO in tank mixture with Ammonium Sulfate (AMS) at 0.25% v/v. Percent visual weed injury ratings and weed height were collected 14 days after each application (DAA) timing. At 21 DAA timing, Texas panicum plants were clipped at the soil surface and biomass were determined. Data were analyzed using ANOVA and means were separated using LSD at the p=0.05 significance level. In Study 1, two applications of clethodim 14 days apart improved control of TP across the different weed sizes. Clethodim provided good TP control (87%) when applied at the single dose at the 10-15 cm growth stage. Sequential dose improved TP control to 100% and 97% at the 10-15 cm and 15-20 cm, respectively. However, TP efficacy declined as weed size increased in both the single and sequential applications. Weed size and adjuvant did impact clethodim performance on TP in study 2. Herbicide programs including clethodim plus COC, COC+AMS and MSO+AMS provided the best TP control at the 10-15 cm growth stage. However, TP control was reduced at the 20-30 cm TP size across the different adjuvants. Ammonium sulfate (AMS) did improve MSO activity on TP but not with COC. Weed size played a role in the efficacy of clethodim on TP where efficacy was better at smaller growth stages. Adjuvant also impacted clethodim efficacy on TP. Growers are advised to treat TP at the 5-15 cm growth stage and use either COC or MSO+AMS adjuvants with clethodim.

Assessing Phytotoxicity and Weed Control Efficacies of Five Newer Herbicides in Fraser Fir Production. Manjot Kaur Sidhu*[1], Debalina Saha[2]; [1]Michigan State University, Lansing, MI, [2]Department of Horticulture, Michigan State University, East Lansing, MI (27)

A field experiment was conducted at a commercial Christmas tree farm on 4-year-old Fraser fir trees. Labeled and doubled rates of newer herbicide combinations (Glystar + Python, Glystar + Classic, Glystar + Envoke, Glystar + FirstRate, Glystar + Hornet) and of commercial standard herbicide combinations (Glystar + Impact, Glystar + Mission, Glystar + Sureguard) and (Glystar + Python + Impact) were applied to the trees to evaluate the phytotoxicity and the weed control efficacy for 4 months. Data collection included visual estimation of phytotoxicity based on a scale of 0%-100% (0% meaning no injury and 100% meaning death of a branch towards the lower 18 inches of the trees. For weed control, visual estimation was also based on a scale of 0%-100% (0% meaning no control and 100% as complete control). Results showed that till 2 months after treatment (MAT), the new herbicide combinations of Glystar + Envoke and Glystar + First rate provided excellent to very good weed control as compared with the commercial standard herbicide combinations in Fraser fir plot. The labeled rates of the newer herbicide combinations are safe on Fraser fir variety of Christmas tree with no significant damages during the current trial. In addition, all the doubled rates of newer combinations except Glystar + Classic provided good control of weeds in Christmas tree production. Doubled rates of Glystar + Python caused mild injury to the Fraser fir trees. All other new herbicides caused no significant damage to the trees at 4 MAT and growth of the plants remained unaffected.

Sensitivity of Pearl Millet (*Pennisetum glaucum* L.) Parental Lines to Clethodim, Quizalofop, Imazamox, and Nicosulfuron. Midhat Zulafkar Tugoo*[1], Vipan Kumar[2], Vara Prasad[1], Ramasamy Perumal[3]; [1]Kansas State University, Manhattan, KS, [2]Cornell University, Ithaca, NY, [3]Kansas State University, Hays, KS (28)

Pearl millet is the 6th most important cereal crop grown worldwide. Weeds pose a serious production challenge and no POST herbicide option is currently available in pearl millet. Greenhouse studies were conducted in 2023 at Kansas State University Agricultural Research Center, Hays, KS to determine the sensitivity of pearl millet parental lines to ALS and ACCase-inhibiting herbicides. A total of 56 diverse parental lines were separately tested with clethodim (135 g ha^{-1}), quizalofop (123 g ha^{-1}), imazamox (53 g ha^{-1}), and nicosulfuron (16 g ha^{-1}) in a discriminate dose study. Furthermore, three selected pearl millet lines were characterized for reduced sensitivity to imazamox and nicosulfuron using dose-response studies. Percent visual injury and survival rates were recorded 7, 14, 21, and 28 days after application (DAA). All pearl millet lines exhibited a 70 to 100% survival rate and 5 to 70% visual injury at 28 DAA with imazamox and nicosulfuron, respectively. All lines showed 0% survival to clethodim, whereas only 4 lines showed 2 to 12% survival with 90 to 95% injury at 28 DAA with quizalofop. Results from the dose-response study indicated that a 6- to 8-fold higher dose (compared to field-use rate of 16 g ha^{-1}) of nicosulfuron was needed to achieve a 90% reduction in shoot biomass of three pearl millet lines. Similarly, an 8-fold higher dose (compared to the field-use rate of 53 g ha^{-1}) of imazamox was needed to achieve 90% shoot biomass reduction in one pearl millet line. These preliminary results indicate that reduced sensitivity to imazamox and nicosulfuron exists among pearl millet parental lines.

Assessing Green Antelopehorn Milkweed (*Asclepias viridis*) Injury from Auxin Herbicides.
Kayla L. Broster*[1], John D. Byrd, Jr.[1], Thomas H. Duncan[2], Chris R. Gregory[2]; [1]Mississippi State University, Mississippi State, MS, [2]Mississippi State University, Starkville, MS (29)

Green antelopehorn milkweed (*Asclepias viridis*) is a native perennial to a large portion of the Midwest and southeastern United States, that due to toxicity can be problematic in hayfields and pastures. Increased interest in pollinator, and other high-profile species like the Monarch butterfly, have affected the desired area for milkweed species. Areas where these species could have a potential role can include rights-of-way, which often have herbicide management applied. An infield study took place in Oktibbeha Co., MS four locations, two locations in 2020 and 2021 and an additional location added in 2022 as well as the fourth added in 2023. All locations had well-established populations of green antelopehorn, with one being within a cattle pasture and others in an active hay production field. A randomized complete block of fourteen treatments with four replications was used to quantify injury to green antelopehorn. Population density averaged 2 plants m^{-2} prior to application of treatments and was recounted at the end of each season and repeated each consecutive year of treatment. Treatments included: Vastlan (triclopyr choline salt) at 4.67 and 2.34 L ha^{-1}, Remedy Ultra (triclopyr butoxy ester) at 4.67 and 2.34 L ha^{-1}, Garlon 3A (triclopyr triethyl amine) at 6.23 and 3.12 L ha^{-1}, Trycera (triclopyr acid) at 6.52 and 3.26 L ha^{-1}, MezaVue (aminopyralid + picloram + fluroxypyr) at 2.34 and 1.17 L ha^{-1}, DuraCor (aminopyralid + florpyrauxifen-benzyl) at 1.46 and 0.73 L ha^{-1}, and Grazon P+D (2,4-D + picloram) at 9.35 and 4.67 L ha^{-1}. Applications took place when most green antelopehorn was juvenile, prior to the set of buds or blooms with a CO_2 backpack sprayer outfitted with XR8003 nozzles pressurized to 310kPa to deliver 281 L ha^{-1}. Visual green antelopehorn control ratings were taken 2 and 4 weeks after application (WAT). Data were subjected to ANOVA, comparing treatments across location and year, separated when differences occurred, then means separated using Fisher's LSD (a = 0.05). Locational differences were found, but differences across years could not be detected. Differences in treatment response were dependent upon location, with DuraCor less injurious to green antelopehorn at the cow pasture and the 2023 hayfield locations, the other locations observed no differences in treatment response. Differences in triclopyr formulations were only observed at one hayfield location, with Vastlan at 4.67 L ha^{-1} less injurious than either rates of Remedy Ultra or the high rate of Garlon 3A. No differences in stand reduction between treatments were observed. Green antelopehorn response to auxin herbicides may be affected by population and environmental conditions.

A Machine Learning Framework for the Detection and Localization of Annual Bluegrass (*Poa annua*) in Bermudagrass Turf. Bholuram Gurjar*[1], Ubaldo Torres[1], Muthukumar V. Bagavathiannan[1], Chase Straw[2]; [1]Texas A&M University, College Station, TX, [2]Texas A&M, College Station, TX (31)

Annual bluegrass (*Poa annua*) is an extremely problematic weed in US turf systems, posing a significant challenge for turfgrass management. Herbicide application is the most popular and economically viable option among other weed control methods in turf systems. However, the widespread use of blanket herbicide applications has harmful effects on the environment, as well as off-target movement of herbicides, reducing the aesthetic look of turfgrass. Additionally, the prolonged use of the same mode of herbicides leads to the development of resistant biotypes. Research on weed detection and site-specific weed management (SSWM) is limited for annual bluegrass, a major weed in turfgrass. To enable precision herbicide applications to annual bluegrass plants we developed a machine learning-based framework for weed detection and localization of this weed present in turfgrass. Drone-based RGB imagery was collected at different growth stages of annual bluegrass in Deer Park, Texas, with the specific objective of developing an annual bluegrass recognition and localization algorithm. The You Only Look Once (YOLO) machine learning model was used for annual bluegrass detection. We compared 12 different architecture variants from YOLO v5, v7, and v8 on low-resolution drone images. The results showed that the YOLOv7-w6 model had the highest detection accuracy (78%), followed by the YOLOv5l model (68%), and the YOLOv8l model (66%). After successfully detecting weeds in the orthophoto, a geotransformation function was developed to map the location of the weeds in the field based on the detected weeds in the image. The output file format of the geotransformation function is a shape file that could be used for site-specific herbicide applications using drones, robots, and GNSS-guided boom sprayers to manage individual weed plants in turfgrass. The accuracy of the weed coordinates depends on the accuracy of the orthophoto georeferencing, with longitude and latitude errors determined to be 5.31 cm and 3.74 cm, respectively. However, this error could be minimized using imagery collected with an RTK-mounted drone. Future developments will include real-time weed detection, site-specific spraying, and testing the model's robustness at different growth stages and with various turf species.

Influence of Adjuvants on Hexazinone Efficacy for Smutgrass (*Sporobolus jacquemontii*) Control. Sudip Regmi*[1], Brent A. Sellers[2], Jose Dubeux[3], Temnotfo Mncube[2]; [1]MS Student, Department of Agronomy, University of Florida, Phalewas, Nepal, [2]University of Florida, Ona, FL, [3]University of Florida, Mariana, FL (32)

Giant smutgrass (*Sporobolus jacquemontii* Kunth.) is a vigorously growing perennial weed species that commonly invades bahiagrass (*Paspalum notatum* Fluggé) pastures in Florida and other areas of the Southeastern United States. Hexazinone is the only herbicide labeled for selective smutgrass control in bahiagrass pastures. However, hexazinone's high cost and inconsistent activity under low and high rainfall conditions necessitate strategies to improve its efficacy. Two greenhouse experiments were conducted using a Tlaloc 3000 rainfall simulator at the Range Cattle Research Center near Ona, FL, to test the influence of adjuvants on hexazinone activity. Hexazinone at 1.12 kg ai ha^{-1} was applied with adjuvant treatments in a 4 × 6 factorial arrangement of three adjuvants (Grounded at 1% v/v, NanoPro at 0.1% v/v, and Sorbyx at 0.3% v/v) along with a control, and six simulated rainfall accumulation volumes (0, 6, 12, 25, 50, and 100 mm) distributed in a completely randomized design with three replicates. Application of adjuvants resulted in greater smutgrass control with at least 65% visual control, and 58% reduction in cumulative smutgrass biomass. Rainfall was found to influence smutgrass control in a quadratic manner. As the rainfall increased, visual control increased reaching maximum control of 96% at 12.5 mm before declining. Similarly, increasing rainfall reduced cumulative biomass by 60% at 12.5 mm and decreased thereafter. Collectively, results indicate that these adjuvants enhanced hexazinone activity.

Quantifying Bermudagrass (*Cynodon dactylon*) and Zoysiagrass (*Zoysia* Spp.) Dew Retention: First Steps Toward Targeted Herbicide Application and Removal. Amy L. Wilber*[1], James D. McCurdy[2]; [1]Mississippi State University, Mississippi State, MS, [2]Mississippi State University, Starkville, MS (33)

Bermudagrass and zoysiagrass are commercially produced warm season turfgrasses for use on golf courses, home lawns, parks, and commercial spaces. To meet certification requirements and consumers' demands, bermudagrass contamination in zoysiagrass is a concern for turfgrass producers. Traditionally, early morning dew patterns have been relied upon to visually identify bermudagrass contamination. Research was conducted in May and Sept 2023 to quantify dew deposition and retention in bermudagrass and zoysiagrass maintained at 0.3, 3.2, and 4.5 cm. Surface moisture was collected approximately every 15 minutes and collection time was recorded relative to sunrise. Collection kits containing gloves, paper towels, and an airtight gallon bag were weighed prior to study initiation. Dew was removed from a 929 cm^2 area using paper towels until no moisture could be removed by a gloved hand. The final weight of each collection kit was recorded to determine the increase in mass, equating to the dew volume collected in L ha^{-1}. Analysis of variance was conducted within RStudio 7.1 with a=0.05. At initial collection times, bermudagrass maintained at 0.3, 3.2, and 4.5 cm held 657, 1463, and 1164 L ha^{-1} of dew, respectively. Zoysiagrass maintained at 0.3, 3.2, and 4.5 cm held 709, 1063, and 901 L ha^{-1} of dew, respectively, at initial collection times. Dew volume significantly decreased as minutes after sunrise increased in turfgrasses maintained at 3.2 and 4.5 cm. Maximum differences in dew deposition and retention between zoysiagrass and bermudagrass are found within 2 hours after sunrise; therefore, scouting missions using aerial imagery should be conducted within 2 hours after sunrise.

Turf Protection Products Influence Floral Reflectance and Pollinator Foraging of Lawn Weeds. Navdeep Godara*, Daewon Koo, Juan Romero, Shawn Askew; Virginia Tech, Blacksburg, VA (35)

The recent decline in pollinator abundance threatens global food production. Pollinators risk exposure to insecticide residue when visiting weedy flowers in urban landscapes. Previous researchers documented that the ultraviolet reflectance (UV-R) of floral features affects pollinator foraging behavior, and we hypothesized that turf protection products (TPPs) will alter the UV-R of weedy flowers and associated pollinator foraging. A study was conducted at Blacksburg, VA in 2023 to assess the effect of TPPs on the UV-A (315-400 nm) reflectance and morphology of dandelion flowers and associated honey bee visitation. Treatments included a nontreated control, TurfScreen® (ZnO, TiO_2, phthalocyanine), Exteris SG® (fluopyram, trifloxystrobin, phthalocyanine); Trimec Classic® (2,4-D, MCPP, dicamba); Halo 75 WDG® (halosulfuron); Dismiss Turf® (sulfentrazone); Pylex® (topramezone); Tinopal® (benzenesulfonic acid); Coppertone® Sunscreen (avobenzone, homosalate, octisalate, oxybenzone); and Coppertone® Sunscreen (sprayed with atomizer). Nontreated dandelion flowers reflected 18% UV-A at petal apex but UV-A reflectance was reduced to 6% by residue of Tinopal and Sunscreen. Tinopal and Sunscreen treatments also reduced honey bee foraging visits by 50% for up to 2 d after treatment (DAT). Similarly, Exteris SG and Trimec Classic also reduced UV-A reflectance to <12%, but this reduction was caused by the morphological alteration in flowers and not residue. Nonherbicidal TPPs discolored petals <20% at 14 DAT. Honey bee foraging on dandelion flowers was transiently suppressed after Exteris SG, Tinopal, and Sunscreen treatment but completely inhibited at 14 d after herbicide treatment except Dismiss. Herbicide effects are temporally dependent on the herbicide mode of action. Practitioners should be aware that certain turf pigments alter honey bee foraging behavior and herbicides cause long-term food shortage. Some of these TPPs, like the optical brightener Tinopal, could be used in conjunction with insecticide sprays to reduce honeybee foraging in treated areas and potentially reduce bee exposure to harmful insecticides.

Determining the Value of Common Turfgrass Forbs as a Pollinator Resource. Sara R. Scott*[1], JoVonn G. Hill[1], David W. Held[2], Gerald M. Henry[3], Isadora G P de Souza[1], James D. McCurdy[1]; [1]Mississippi State University, Starkville, MS, [2]Auburn University, Auburn, AL, [3]University of Georgia, Athens, GA (36)

Turfgrass plant communities provide essential environmental, economic, and cultural benefits, and are an important component of many human-built environments. Turfgrass covers an approximate 2% of the United States land area, making it an abundant potential resource for insect pollinators, which continue to experience rapid declines at the hands of anthropogenic change that limits forage and nesting resources. Relatively little is known about flowering forb inclusion in low-maintenance turf scenarios in the Southeastern United States and its potential to increase pollinator forage resources. In this study, we selected sites containing ten candidate forb species in Starkville, Mississippi: bulbous buttercup (Ranunculus bulbosus), Carolina desert-chicory (Pyrrhopappus carolinianus), dandelion (Taraxacum officinale), deadnettle (Lamium purpureum), hairy buttercup (Ranunculus sardous), henbit (Lamium amplexicaule), lyreleaf sage (Salvia lyrata), spring beauty (Claytonia virginica), Virginia buttonweed (Diodia virginiana), white clover (Trifolium repens), and yard aster (Symphyotrichum divaricatum). These species were selected based upon their availability, abundance, and variations in phenology. Incorporating multiple forb species that encompass a variety of life strategies such as spring and fall annuals, biennials, and perennials provides more continuous forage availability across a wide range of insect niches. Square-meter sites of each forb species were replicated four times (each > 100 m distant) over a two year period and provided data on insect visitor diversity and abundance, as well as bloom seasonality across weekly five-minute observation and insect collection events. Provisional results suggest that forb inclusion in turf scenarios in the Southeastern United States promotes insect forage supply in these communities, with forbs blooming in fall and winter providing resources to insect visitors during crucial periods of decreased nutrient availability. The most attractive of the included forb species to insect visitors were those that maintained bloom throughout these crucial periods. White clover and lawn aster attracted the highest numbers of insect visitors, with white clover attracting an average of 0.22 more insect visitors than lawn aster per observation. Additionally, this data suggests that native insects are marginally more attracted to native forbs, while introduced insects were approximately 30% more likely to pollinate an introduced forb species than a native one. For example, roughly 60% of all insect visitors observed foraging from the introduced plant white clover were European honey bees (Apis mellifera), a species introduced to the Southeastern United States. By contrast, honey bees made up only 40% and 36%, respectively, of the insect visitors observed foraging from the native forbs lawn aster and spring beauty. This distinction is significant, as populations of the European honey bee have been found to outcompete wild bees and introduce pathogens to native insect populations, while also pollinating less effectively on average than native pollinators. Understanding how insect visitors interact with forbs in low-maintenance turf communities in the Southeastern United States will provide key insights into how urban environments can support pollinator sustainability. Further, the development of seed mixes and vegetative cultivation techniques of forb species valuable to pollinators and other insects in the Southeastern United States will make the establishment of pollinator-friendly landscapes more accessible to landscape managers.

Annual Bluegrass (*Poa annua* L.) Herbicide Resistance in Oregon Hazelnut Orchards. Joshua W. Miranda*, Marcelo L. Moretti; Oregon State University, Corvallis, OR (37)

Annual bluegrass, a ubiquitous allotetraploid weed, has evolved resistance to 12 herbicide modes of action worldwide. In recent years, Oregon hazelnut growers reported survival of annual bluegrass following herbicide treatments, including indaziflam, pendimethalin, and clethodim. Single-seed descendants of putative herbicide-resistant accessions were developed from plants surviving discriminating herbicide rates for three generations. Seed- and whole-plant dose-response assays were used to confirm resistance. The preemergence dose-response assays with indaziflam included two lines exhibiting high resistance (determined by seed-assays) and one susceptible line, with the other nine resistant lines assessed at a rate of 50 g ai ha^{-1} to estimate plant survival. The whole-plant assay confirmed preemergence indaziflam resistance in the two resistant lines evaluated, which tolerated 5.9 to 9.1 times more than the susceptible line (LD_{50} and LD_{90} of 1.2 and 4.4 g ai ha^{-1}) and survived between 2.5-5% indaziflam at 50 g ai ha^{-1}. Among the remaining resistant lines, five lines had between 5-10% survival with indaziflam at 50 g ai ha^{-1}, while four lines were indaziflam-susceptible. Pendimethalin resistance was confirmed in two resistant lines, with resistance levels ranging from 2.7 to 8.8-fold compared to the susceptible line (LD_{50} and LD_{90} of 393 and 1,892 g ai ha^{-1}). Clethodim resistance was confirmed in three lines, surviving >10% clethodim at 270 g ai ha^{-1}. This marks the first report of preemergence indaziflam resistance in any weed, as well as pendimethalin and clethodim resistance in annual bluegrass. Future research will focus on unraveling the resistance mechanisms and exploring strategies for effective control.

Radiant Heat, Hot Water, and Organic Chemicals Control Annual Bluegrass in Dormant Turf. Juan Romero*, Shawn Askew; Virginia Tech, Blacksburg, VA (38)

Warm-season turfgrass such as bermudagrass (*Cynodon dacdactylon* (L.) Pers. Var. *dactylon*) and zoysiagrass (*Zoysia japonica* Steud.) remain dormant from late fall through the winter months in northern temperate climates. Winter annual weeds can still germinate during this time and infest the area, while desirable turfgrass is not actively growing. Turf managers use selective and nonselective herbicides to control winter weeds during turf dormancy. Recent litigation issues regarding glyphosate, increasing cases of herbicide-resistant weeds, and heightened public pressure to reduce synthetic pesticide use have increased the need for alternative or organic weed control options in turfgrass. Multi-year field trials were conducted at the Glade Road Research Facility of Virginia Tech in Blacksburg, VA to evaluate organic chemicals to control winter annual weeds on bermudagrass and zoysiagrass fairways. Sequential applications of Axxe (ammonium nonanoate), AvengerAG (d-limonene), Green Gobbler (20, 30, 40% acetic acid), BurnOut (24% citric acid) were compared with single application of glufosinate (1400 g ai ha^{-1}) and glyphosate (700 g ai ha^{-1}). Trials were arranged as randomized complete block design with 4 replications. Treatments were initiated in late February in 2022 and 2023. At 21 DAT, Green Gobbler 30% and 40% controlled annual bluegrass 87 and 89%, respectively, which was equivalent to glufosinate. However, annual bluegrass was only transiently discolored from organic products other than Green Gobbler. At 91DAT, glufosinate and glyphosate controlled annual bluegrass more than all organic products, however, Green Gobbler 40% still controlled 70% of annual bluegrass. All Green Gobbler concentrations applied thrice controlled >93% corn speedwell and >95% common chickweed. The data suggest that organic products differed in weed control efficacy, but Green Gobbler might offer a costly alternative to synthetic herbicides in dormant turf.

Critical Timing of Palmer Amaranth (*Amaranthus palmeri*) Removal in Stevia (*Stevia rebaudiana*). Stephen J. Ippolito*[1], Katherine M. Jennings[1], David W. Monks[1], Sushila Chaudhari[2], David L. Jordan[1], Levi D. Moore[3], Colton D. Blankenship[1], Kira Sims[1], Chitra Lnu[1]; [1]North Carolina State University, Raleigh, NC, [2]FMC, East Lansing, MI, [3]Southeast Ag Research, Inc, Chula, GA (39)

Stevia (*Stevia rebaudiana* Bertoni) is a zero-calorie sweetener, 200 to 400 times sweeter than sucrose. Stevia has been grown commercially as a sugar substitute in much of Asia since 1995; however, only recently has stevia been authorized for use as a food additive in the US by the FDA. With the authorization of stevia as a food additive, several companies have released stevia products including Coca-Cola (Truvia) and Pepsi (PureVia). Stevia is sensitive to weed competition, in particular large broadleaf weeds such as Palmer amaranth (*Amaranthus palmeri*) compete with stevia for light and other resources. Characterization of when Palmer amaranth competition is most detrimental to stevia growth may help to inform grower decisions concerning the control of Palmer amaranth. Thus, a field study was conducted in 2021 to determine the critical timing of Palmer amaranth removal in stevia. Stevia plugs were transplanted at a density of 6.5 plants m^{-1} of row on 1.37 m white plastic mulch. Treatments consisted of timed Palmer amaranth removal at 0, 1, 3, 5 ,7, and 9 wk after transplanting (WAT). Delaying Palmer amaranth removal 4.2 WAT reduced stevia yield to the 95% threshold.

Evaluating Biodegradable Mulches (BDMs) for Longevity in Strawberry-Cucumber Relay Cropping Systems. Emily Witt*[1], Nathan Boyd[2]; [1]UF IFAS GCREC, Wimauma, FL, [2]University of Florida, Balm, FL (40)

Agricultural plastic mulches, particularly polyethylene (PE), are extensively utilized in specialty crops like strawberries and cucumbers, offering various advantages but posing financial challenges and significant environmental impacts. The removal of PE plastic mulch demands high labor costs and faces disposal issues due to recycling limitations caused by field contaminants. Biodegradable mulch (BDM) emerges as a potential alternative to PE mulch, potentially offering similar benefits while addressing disposal challenges by allowing tilling into the soil at the season's end. An innovative approach involves relay cropping, where secondary crops are planted before terminating the primary crop, providing additional income for growers. This ongoing experiment aims to assess the performance of BDM compared to PE mulch throughout a growing season, especially concerning its durability while accommodating secondary crop planting. Preliminary data from the initial year's trial will be presented, offering early insights into the viability and efficacy of BDM in this context.

Effects of Preemergence *S*-Metolachlor Alone or its Co-application with Fertilizer Enhancer and Chelated Iron on Weed Control Efficacy and Crop Safety in Tomato (*Solanum lycopersicum*) Plasticulture Production. Ruby Tiwari*[1], Ramdas Kanissery[2]; [1]University of Florida/Southwest Florida Research and Education Center, Immokalee, FL, [2]University of Florida - IFAS, Immokalee, FL (41)

Purple nutsedge (*Cyperus rotundus* L.) is a major challenge for tomato (*Solanum lycopersicum* L.) producers in Florida because it can puncture plastic mulch, has difficult-to-remove tubers, and proliferates rapidly through rhizomes. Utilizing preemergence herbicides for purple nutsedge suppression in tomatoes under plastic mulch is highly effective. However, its application is hindered by the risk of crop phytotoxicity and subsequent plant stress. The co-application of herbicides with fertilizers has been studied in row crops; however, its potential in vegetable plasticulture systems remains unexplored. Therefore, the objective of this study was to assess the effectiveness and crop safety of the preemergence herbicide *S*-metolachlor, both as a standalone treatment and in combination with a fertilizer enhancer or a chelated iron in tomato plasticulture. Repeated field trials were conducted at the University of Florida's Southwest Florida Research and Education Center, Immokalee, Florida. The experiments were arranged in a randomized complete block design with 5 replications. *S*-metolachlor was applied at the recommended rate of 1 kg ai ha^{-1} on the raised beds before the plastic mulch was installed either as a blanket spray by itself, mixed with fertilizer enhancer, or coated on chelated iron fertilizer. Tomato seedlings were transplanted two weeks after treatment application. Data were recorded for purple nutsedge counts, crop vigor (visual ratings on a scale of 0 to 10, where 0 = completely desiccated tomato plants, 10 = healthy tomato plants), chlorophyll content (SPAD Index), and tomato yield. Our results show that using *S*-metolachlor alone effectively reduced purple nutsedge density compared to the nontreated control in both trials I and II. Combination of *S*-metolachlor with fertilizer enhancer or chelated iron reduced purple nutsedge density by >30% and 57%, respectively, compared to the nontreated control in trial II. Also, the treatments did not have any adverse impact on chlorophyll content or crop yield ($P > 0.05$) when compared to the nontreated control. Tomato yield substantially ($P < 0.05$) decreased with the increase in purple nutsedge density at 4-, 8-, and 12-WAT (weeks after transplanting). Tomato yield was also found to be positively correlated ($P < 0.01$) to the crop's vigor and chlorophyll content at 4- and 8-WAT. The results from both trials suggest that using *S*-metolachlor is an effective approach to reduce purple nutsedge infestation in plastic-mulched raised beds without negatively impacting the health and productivity of tomatoes.

Use of Silage Tarps for Early-season Weed Management in Small-scale Potato Production.
Josue D. Cerritos*[1], Stephen L. Meyers[1], Jeanine Arana[2], Emmanuel G. Cooper[1], Carlos A. López Manzano[1]; [1]Purdue University, West Lafayette, IN, [2]Purdue University/Horticulture, West Lafayette, IN (42)

While significant research and resources have traditionally focused on weed management in large-scale agriculture, small farms are essential contributors to local food systems. Small-scale farmers can benefit from innovative practices like reusable materials such as silage tarps that can be used for creating a stale seedbed or to facilitate emergence of slow-germinating crops such as carrots. In 2023, a field study was conducted to evaluate the use of silage tarps for early season weed management in potato production to determine if tarping could potentially replace an at-planting PRE herbicide application. In this study we employed a split plot design which allow us to divide 8 beds into 4 blocks. Each block consisted of two beds, one covered with a tarp and a second that remained uncovered. The experiment had a factorial treatment arrangement consisting of three at-planting PRE applications (*S*-metolachlor at 800 g h^{-1}, flumioxazin at 82 g ha^{-1} + pyroxasulfone at 104 g ha^{-1}, and tarping) by three layby applications made after hilling (no herbicide, rimsulfuron at 26 g ha^{-1} , and metribuzin at 670 g ha-[1]). A non-treated weedy control was also included. On May 5, 'Eva' potato seed pieces were planted, and tarps were laid on the ground immediately after planting, also PRE herbicides were applied broadcasted over-the-top of the rows not covered by tarps. Tarps were removed 3 weeks after planting (WAP) and layby herbicides were applied over-the-top of the bed on June 6 (4 WAP) just after hilling. Crop injury and weed control data were rated visually on a scale of 0 % (no injury/no weed control) to 100 % (crop death/complete weed control) at 2, 4, 6, and 8 WAP. Weed biomass was collected 2 weeks before harvest. Potatoes were harvested, graded into marketable and non-marketable tubers, and tuber weight and counts were recorded for each plot. Marketable tubers were defined as those that exhibited no significant mechanical, insect, or disease-related damage. All data were subjected to ANOVA and a mean comparison was performed using Tukey's HSD test. The prevalent weeds found throughout the field included giant ragweed (*Ambrosia trifida*), common lambsquarters (*Chenopodium album*), ivyleaf morningglory (*Ipomoea hederacea*), velvetleaf (*Abutilon theophrasti*), and common purslane (*Portulaca oleracea*). For weed control, significant differences ($P<0.05$) were observed when comparing flumioxazin + pyroxasulfone to *S*-metolachlor on PRE applications, were flumioxazin + pyroxasulfone performed better through the four weeks of data collection. Layby applications followed by hilling demonstrated significant differences ($P<0.05$), with metribuzin outperforming rimsulfuron at 6 and 8 WAP. Significant differences ($P<0.05$) were observed on weed biomass for PRE applications, with flumioxazin + pyroxasulfone performing better compared to other PRE applications; no differences were found between tarp and *S*-metolachlor. No differences in tuber weight or count were observed among any of the PRE or layby applications. This may be attributed to a generally low yield across the entire study, which may affect treatment variations. These results suggest tarps may be a valuable tool for early-season weed management, performing comparably to herbicides.

First Report of Multiple Herbicide-Resistance in *Echinochloa walteri* (Walter's Barnyardgrass) in Texas Rice. Tamara T. Mundt*, Caroline Valiati, Gabriela Elizarraras, Muthukumar V. Bagavathiannan, Nithya K. Subramanian; Texas A&M University, College Station, TX (43)

Walter's Barnyardgrass (*Echinochloa walteri*), though not a common weed species in Texas rice, a suspected herbicide-resistant population was collected from a rice field near Beaumont, TX, following field control failure with multiple herbicide applications. The objective of this study was to evaluate the response of this putative-resistant population to a number of commonly used herbicides in rice. Initial herbicide screening documented that the population was resistant to six different herbicides belonging to three different herbicide modes of action [acetolactate synthase (ALS)-inhibitors (imazethapyr, penoxsulam, bispyribac-sodium, nicosulfuron), auxin analog (quinclorac), and PSII-inhibitor (propanil)], and susceptible to cyhalofop and fenoxaprop (ACCase inhibitors), and glyphosate (EPSPS inhibitor). A dose-response analysis was conducted for penoxsulam (0, 1, 2, 4, 8, 16, 32, and 64X) and propanil (0, 1, 2, 4, 8, 16X) with 5-8 seedlings per dose. Preliminary results showed that this population survived up to 64X rate for penoxsulam. Little to no visible injury was present on plants that survived. For propanil, 62.5%, 75%, and 25% of the plants survived the 1, 2, and 4X rates, respectively, with some injury reported; no plants survived the 8X and 16X rates. Sanger sequencing of the ALS gene is currently ongoing to identify any mutations in the ALS gene that confer resistance. Dose-response studies are currently underway to further confirm and identify the extent of resistance for other herbicides. This is the first case that this species has been reported as resistant globally. Weed resistance increases the cost and difficulty of management, and the development of alternative management strategies is important to tackle resistance.

Integrated Strategies to Manage Volunteer Potatoes and Colorado Potato Beetle. Hannah M. Johnson*, Erin E. Burns; Michigan State University, East Lansing, MI (44)

Volunteer potatoes (*Solanum tuberosum*) are potatoes left in the field after harvest and are a very problematic weed in crops grown the following season. Historically harsh winter temperatures kill volunteers, however increasing winter temperatures has enhanced volunteer survivorship. Volunteer potatoes also enhance survival of two major pests that cause significant economic damage to potato production annually: late blight of potato (*Phytophthora infestans*) and Colorado potato beetle *(Leptinotarsa decemlineata*, CPB). Therefore, the main objective of this research is to evaluate integrated strategies to manage volunteer potatoes and CPB. To address this objective two field studies were conducted in Montcalm County, MI at the Michigan State University Potato Research Station. The first study evaluated the impacts of tillage intensity, herbicide, and insecticide treatments on volunteer potato management in corn (*Zea mays*). This study followed a split plot design with four replications. Potatoes were hand spread to simulate volunteers, then two tillage treatments were applied (moldboard plow-aggressive vs. disk-light intensity), followed by corn planting. Subplot factors included factorial combinations of tank-mixed herbicides and insecticides applied at two corn growth stages: V5 and V7. Herbicide treatments included mesotrione or topramezone plus atrazine. Insecticide treatments included spinetoram or chlorantraniliprole. Percent corn injury was evaluated 7, 14, and 21 days after application (DAA). Injury data was analyzed in R using linear mixed effects models and means were separated using Tukey's HSD. Treatments including mesotrione when applied at V5 resulted in greater corn injury than all other treatments at all evaluation timings ($p = 0.0018$, <0.0001, and <0.0001). Mean injury associated with this treatment was 5.4%, 5.4%, and 3.5%, 7, 14, and 21 DAA, compared to 0.6% for all other treatments. Corn ears were evaluated at the end of the season and had no visible signs of injury. There was no difference in volunteer emergence amongst tillage intensities due to dry hot conditions at planting. The second study evaluated the use of late planted potato trap crops to manage second generation CPB populations. This study followed a randomized complete block design with four replications. Treatments included planting the potato trap crop 0, 2, and 4 weeks after the primary potato crop. Percent canopy loss and CPB density were assessed throughout the season. Yield data was collected at the end of the season. Canopy data was analyzed in R using the drc package. Beetle density and yield data were analyzed in R using linear mixed effects models and means were separated using Tukey's HSD. Canopy loss from CPB defoliation decreased when trap crop planting was delayed by 4 weeks ($p < 0.05$). There was no difference in CPB density between trap crop planting timings ($p > 0.05$). Yield was impacted by trap crop planting timing. At the field edge, yield increased by 41% in the 4-week delayed planting treatment compared to the 0-week delayed planting treatment ($p = 0.03$). Both field trials will be repeated in 2024. Overall, the integrated management techniques investigated in these studies can be combined to reduce yield loss from volunteer competition in corn rotations and reduce yield loss from CPB damage in potato rotations.

Evaluating Herbicide Resistance in Waterhemp (*Amaranthus tuberculatus*) Populations from Southern Illinois. Cristiana B. Rankrape*[1], Eric J. Miller[1], Avery Shikanai[2], Karla L. Gage[3]; [1]Southern Illinois University, Carbondale, IL, [2]North Dakota State University, Fargo, ND, [3]Southern Illinois University Carbondale, Carbondale, IL (45)

Waterhemp (*Amaranthus tuberculatus* (Moq.) J. D. Sauer) is a summer annual broadleaf weed ranked as the most common and the second most troublesome weed in the U.S. soybean fields. Due to the rapid evolution of herbicide resistance, waterhemp is resistant to seven herbicide site of action (SOA) groups (2, 4, 5, 9, 14, 15, and 27) in Illinois. Therefore, this scenario presents a significant challenge for control due to the limited effectiveness of chemical control options on some populations. The objective of this study was to identify potentially resistant populations in Southern Illinois. The samples were collected from September through October 2022 from five counties and a total of seven suspected resistant populations. The seeds were sown separately by population in flats. Once the plants reached the first true leaf stage, plants were individually transplanted into 0.7 L plastic pots. The greenhouse trial was a randomized complete block design with four replicates. Applications were made when the plants reached 10 to 15 cm and/or 5 to 6 leaves with five rates of each herbicide as follows: 2,4-D rates 266 (0.25x), 532 (0.5x), 1068 (1x), 2131 (2x), and 4258 (4x) g ae ha^{-1}, dicamba rates 140 (0.25x), 280 (0.5x), 560 (1x), 1121 (2x), and 2242 (4x) g ae ha^{-1}, and glufosinate rates 163 (0.25x), 328 (0.5x), 656 (1x), 1310 (2x), and 2621 (4x) g ai ha^{-1}, plus AMS at 2.5% v.v. The 1x rate is the full field rate applied over the top (OTT) in postemergence. Four weeks after the application, aboveground plant biomass was collected, dried, and weighed. The dose response data was analyzed using the drc package in R to estimate the dose that caused 50% injury (ED50) based on the biomass data. The populations' ED50 values varied widely for the three herbicides tested. The 2,4-D ED50 ranged from 0.12 ±0.2 g ae ha^{-1} for Pop4 to 1137.6 ±448.6 g ae ha^{-1} for Pop7. Dicamba ED50 ranged from 8.4 ±32.4 g ae ha^{-1} for Pop5 to 97.8 ±41.4 g ae ha^{-1} for Pop7. The glufosinate ED50 ranged from 82.5 ±53.9 g ai ha^{-1} for Pop4 to 443.1 ±131.5 g ai ha^{-1} for Pop1. These ED50 values corroborate the visual control ratings and survivorship of the plants. The active ingredient dicamba still provides up to 95% control of waterhemp for the populations/individuals tested at the 1x rate; however, for 2,4-D and glufosinate, some populations expressed less sensitivity with high ED50 values and efficacy ratings as low as 30% (Pop7) and 54% (Pop1), respectively. Therefore, this preliminary research indicates that there is variability in susceptibility in these populations. More research is ongoing to characterize these populations for resistances to other SOA groups and active ingredients. These initial results underscore the necessity to take a proactive approach to delay the evolution of herbicide resistance and preserve new technologies.

Inheritance and Segregation of Non-Target-Site Resistance to *S*-Metolachlor in Waterhemp (*Amaranthus tuberculatus*). Isabel Werle*[1], Lucas Bobadilla[2], Filipi Machado[1], Aaron Hager[1], Patrick Tranel[1]; [1]University of Illinois, Urbana, IL, [2]University of Illinois, Champaign, IL (47)

A waterhemp population, hereafter referred to as CHR, has evolved multiple resistance spanning six site-of-action herbicide groups. *S*-metolachlor metabolism facilitated by genes within the cytochrome P450 family previously was confirmed in this population. In this study, we provide information on the genetic and evolutionary dynamics that help to explain the evolved resistance to *S*- metolachlor in CHR. Seedling dose-response was conducted on the parental populations CHR and WUS (herbicide sensitive), and F_1 progenies. *S*-metolachlor rates ranged from 8.5 to 8,456 g ai ha^{-1}. Survival count was assessed at 21 days after treatment (DAT). The effective dose needed to reduce waterhemp emergence by 50% (ED_{50}) was determined using a three-parameter Weibull II model with the drc package in R. The dominance degree (D) of the resistance trait was calculated based on the ED_{50} values of each population. Segregation of *S*-metolachlor resistance was conducted on 93 F_2 backcross populations (F_2BC; to sensitive parent). *S*-metolachlor was applied at a discriminating dose of 803 g ai ha^{-1}. Phenotyping evaluation consisted of survival count and dry weight biomass at 21 DAT. Dose-response analysis revealed an ED_{50} of 105 g ai ha^{-1} of *S*-metolachlor for the WUS population. The ED_{50} of the CHR and pooled-F_1 populations were 476 and 261 g ai ha^{-1}, respectively. The CHR population was five-fold more resistant than WUS, but a lower resistance level (two-fold) was recorded for the pooled-F_1 population. The degree of dominance resulted in D=0.20, indicating that *S*-metolachlor resistance in CHR is incompletely dominant. The distribution of phenotypic responses of the F_2BC populations did not appear to fit a single-gene model. A quantitative trait loci (QTL) analysis to determine the number of loci associated with *S*-metolachlor resistance in CHR is ongoing. isabels6@illinois.edu

Management of Problematic Weeds in Truvera Sugarbeet. Ian G. Waldecker*, Christy L. Sprague; Michigan State University, East Lansing, MI (48)

Michigan sugarbeet growers struggle to control several weed species in glyphosate-resistant sugarbeet. Problematic weeds that commonly escape management strategies include glyphosate-resistant (GR) waterhemp (*Amaranthus tuberculatus*), GR horseweed (*Conyza canadensis* L.), and common lambsquarters (*Chenopodium album L.*). 'Truvera' is a new herbicide-resistant trait package in sugarbeet that confers resistance to glyphosate, glufosinate, and dicamba. Implementing these additional sites of action into current weed management strategies will help growers improve weed control. A field experiment was conducted in 2023 at three locations to examine various weed management strategies in 'Truvera' sugarbeets. Locations were chosen based on the presence of GR waterhemp, GR horseweed, and common lambsquarters. Each study consisted of 20 different treatments including a non-treated control. Treatments requiring the 'Truvera' trait were compared with three current strategies for waterhemp, horseweed, and common lambsquarters control, as well as three POST applications of glyphosate. Herbicide programs were separated into three different application timings: PRE followed by (fb.) 2- and 8-leaf sugarbeet (8 total treatments); 2- fb. 6- and 12-leaf sugarbeet (6 total treatments), and 2- fb. 8-leaf sugarbeet (5 total treatments). Herbicides used in the PRE treatments consisted of dicamba or a reduced rate of S-metolachlor (0.53 kg ha^{-1}); dicamba, glyphosate, glufosinate, and various combinations of these products were applied alone and in combination with acetochlor as a residual at the 2-, 6-, and 8-leaf applications. The 12-leaf application only included glyphosate. Each herbicide treatment was kept within the maximum application amounts for each product. At the waterhemp location, eight of the 19 herbicide treatments examined provided greater than 90% waterhemp control at sugarbeet harvest. One or more applications of an effective POST of glufosinate or dicamba combined with POST acetochlor was needed to control waterhemp. These treatments provided significantly greater control than the current strategy of overlapping residual applications of acetochlor alone or S-metolachlor PRE followed by overlapping acetochlor. At the horseweed location, 16 of the 19 treatments provided 95% or greater horseweed control at harvest. At least two applications of an effective POST, glufosinate, dicamba, or clopyralid, were needed. There was no difference between treatments that contained either glufosinate and/or dicamba compared with the current strategy of multiple applications of clopyralid. At the common lambsquarters location, 10 of the 19 treatments provided 94% or greater common lambsquarters control. The best treatments included a 12-leaf application of glyphosate, or treatments with 8-leaf applications of glyphosate tank-mixed with acetochlor. Poorest control occurred in treatments with glufosinate only, which provided only 30% common lambsquarters control. Similar treatments of glufosinate only with dicamba PRE improved control to 86%. Sugarbeet yields at the horseweed and common lambsquarters locations were not different between the herbicide treatments. However, sugarbeet yield was 38 and 75% lower when weeds were not controlled at the horseweed and common lambsquarters locations, respectively. 'Truvera' sugarbeet will provide growers with additional effective herbicide options that can be combined with residual herbicides for improved control of problematic weeds, especially GR horseweed and waterhemp.

Investigating Dicamba Resistance Across Kochia and Palmer Amaranth Populations from Colorado. André Lucas Simões Araujo*, Jacob S. Montgomery, Todd A. Gaines; Colorado State University, Fort Collins, CO (49)

In 2021, a dicamba survey in Colorado identified survivors among populations of kochia and Palmer amaranth. Our study aimed to investigate and confirm dicamba resistance in both weeds. For kochia, a known marker for dicamba resistance at the degron region of the *AUX/IAA16* gene was utilized. In the case of Palmer amaranth, a dose-response was conducted, given the absence of a currently identified marker. We investigated four kochia populations and one Palmer amaranth population classified as resistant in the survey. The *AUX/IAA16* gene was sequenced to verify the presence of the $G_{73}N$ substitution in the degron region in dicamba kochia survivors. Three populations did not possess any mutation at this site, suggesting a different and new resistance mechanism is involved. One kochia population possessed a deletion at the degron region of the *AUX/IAA16* gene, which might be involved with the resistance. The Palmer amaranth population survived higher doses than the known susceptible population. Our findings suggest diverse and new resistance mechanisms in kochia populations and confirm the resistance observed in a Palmer amaranth population identified in the survey. Further research is crucial to enhance our understanding of resistance and guide effective weed management strategies.

Understanding Metabolic Resistance to Imazamox in Feral Rye (*Secale cereale*) Through Transcriptomics. William B. Kramer*, Franck E. Dayan, Todd A. Gaines, Neeta Soni; Colorado State University, Fort Collins, CO (51)

The introduction of Clearfield wheat varieties resistant to imazamox marked a significant shift in managing winter wheat weeds, particularly with the prominent role of Group 2 acetolactate synthase (ALS) inhibiting herbicides. Feral rye (Secale cereale) has emerged as a major contributor to yield losses in winter wheat fields among the challenging weeds. Overuse of imazamox in wheat field has led to an increased likelihood of resistance development. Detecting herbicide resistance early is crucial for proactive mitigation, leading to the necessity for herbicide resistance surveys. A multi-year survey conducted across Clearfield wheat fields in Colorado identified feral rye populations displaying resistance to imazamox, as confirmed through dose-response experiments. Populations without ALS gene sequence variation were subjected to herbicide metabolism gene inhibitors, specifically malathion. Application of malathion resulted in resistance reversal, indicating a non-target site resistance mechanism associated with metabolic differences. Based on this evidence, this research aims to comprehend the molecular mechanism(s) underlying metabolic resistance in this population.To elucidate the transcriptomic response linked to metabolic resistance, segregating F2 populations were developed through a biparental cross between imazamox-resistant and -susceptible individuals. Four confirmed resistant and four susceptible plants from the F_2 population were sprayed with a field rate of imazamox, and leaf-tissue was sampled 8-hours after application. Total RNA extraction was performed to generate paired-end cDNA Illumina libraries for sequencing. Preliminary results from the analysis of differential gene expression suggest that various herbicide detoxification genes respond to imazamox applications. This study utilizes transcriptomics and intends to incorporate functional genomics to identify the specific gene(s) responsible for metabolic resistance. The overarching goal of this study is to enhance our understanding of the molecular basis of ALS herbicide resistance, providing insights for short-term management practices and contributing to herbicide discovery in the long term.

Evaluating Potential Glyphosate Resistant Johnsongrass (Sorghum Halepense) Biotypes in Texas. Ryan A. Matschek*[1], Reagan Noland[2], Muthukumar V. Bagavathiannan[3], Cody Scott[1], Clay Cole[2]; [1]Angelo State University, San Angelo, TX, [2]Texas A&M AgriLife Extension, San Angelo, TX, [3]Texas A&M University, College Station, TX (54)

Johnsongrass (Sorghum halepense) is among the most problematic weeds in Texas croplands. A Johnsongrass biotype with potential glyphosate resistance was identified in the Rolling Plains of Texas. Indoor dose-response trials were coordinated in 2022 and 2023 to verify whether glyphosate resistance is present in rhizome- and seed-propagated plants. Experiments were each arranged as randomized complete block designs with 7 to 10 replications and 7 or 8 treatment doses ranging from 0× to 50× the labeled rate applied to glyphosate-susceptible (GS) and suspected resistant (SR) biotypes. Dose-response relationships were characterized with four-parameter logistic regression. Rhizome-propagated SR Johnsongrass was 17 times less sensitive to glyphosate with an LD50 of 4,102 g a.e. ha-1 compared to the GS biotype at 237 g a.e. ha-1. The SR biotype also exhibited less reduction of biomass due to glyphosate, with an effective dose to reduce biomass by 50% (ED50) of 1,420 g a.e. ha-1, compared to the GS biotype at 433 g a.e. ha-1. Seed-propagated SR plants were also less sensitive with an LD50 2.3 times greater than GS seedlings. Additional trials were initiated in 2023 to screen biotypes with suspected resistance from three other populations in western Texas. Rhizome-propagated plants were treated with 0×, 1×, 2.5×, and 5× the labeled rate of glyphosate (924 g a.e. ha-1) with a minimum of 3 replications. All suspected resistant biotypes exhibited reduced sensitivity ($P < 0.05$) to glyphosate at the 1× rate (mean = 31.4% damage) compared to the GS biotype (76.3% damage), although all biotypes were equally damaged at the 2.5× rate ($P > 0.05$). The findings of this work confirm reduced sensitivity and mortality due to glyphosate in multiple Johnsongrass biotypes in western Texas.

Genome Assembly and Analysis of *Digitaria ischaemum* (Smooth Crabgrass). Claudia A. Rutland*[1], Eric L. Patterson[2], Todd A. Gaines[3], Luan Cutti[4], Victor Llaca[5], Brian Zeka[6], Leslie Goertzen[7], Jinesh Patel[7], Joseph S. McElroy[7]; [1]Auburn University Department of Crop, Soil, and Environmental Sciences, Auburn, AL, [2]Michigan State University, East Lansing, MI, [3]Colorado State University, Fort Collins, CO, [4]Federal University of Rio Grande do Sul, Porto Alegre, Brazil, [5]Corteva Agriscience, Johnston, IA, [6]Corteva, Johnston, IA, [7]Auburn University, Auburn, AL (55)

The lack of weed genomes has been an issue in the pursuit of gaining a better understanding of weed species in general. The International Weed Genomics Consortium has dedicated its resources to alleviating this issue so more robust molecular research focused on weedy traits can be produced. *Digitaria* spp. are severely underrepresented in the world of genomes, and as one of the most troublesome weed species infesting turfgrass systems, there is a need for molecular research in order to more thoroughly understand the genus. A reference-quality genome was then produced for *Digitaria ischaemum* (smooth crabgrass), as this species in particular is especially troublesome for turfgrass with regard to spread and herbicide resistance. Post genome assembly, BUSCO, Assemblathon, karotype, EDTA, and other gene statistics were run in order to ascertain the quality of the genome. The genome had 19 scaffolds at 64483057 nucleotides long, with 16.40% of the assembly appearing in scaffolded contigs, and 86.60% of the assembly appearing in unscaffolded contigs. EDTA was run in order to annotate all the transposable elements (TE), where 43.74% of the base pairs were masked as TEs in the genome. Ploidy analysis determined *Digitaria ischaemum* is a tetraploid genome, identified as subgenomes C and D, each with 9 chromosomes. This genome will be essential for further molecular analyses in understanding resistance to auxinic herbicides.

Herbicide Resistance in Major Weed Species in Virginia. Milos Viric*[1], Vipin Kumar[2], Akashdeep Singh Brar[1], Michael L. Flessner[3], Vijay Singh[1]; [1]Virginia Tech, Painter, VA, [2]University of Nebraska-Lincoln, Lincoln, NE, [3]Virginia Tech, Blacksburg, VA (56)

Italian ryegrass is one of the most troublesome weeds in the wheat production system in Virginia. Field surveys were conducted in the summer of 2020 and 2022 to document the distribution of herbicide-resistant *Lolium* spp. infesting winter wheat production fields in the region. A total of 32 samples were collected, dried, threshed and initially screened in a greenhouse for sensitivity to diclofop-methyl (516 g ai ha^{-1}), pinoxaden (59.43 g ai ha^{-1}), mesosulfuron (17.5 g ai ha^{-1}), pyroxsulam (17.94 g ai ha^{-1}), glyphosate (1,032 g ai ha^{-1}), and pyroxasulfone (102.97 g ai ha^{-1}) at 1X field rate. The herbicide screenings were followed by dose-response assays of the most resistant ryegrass population at eight rates (0.5, 1, 2, 4, 8, 16, 32, and 64X), compared to a susceptible population at six rates (0.0625, 0.125, 0.25, 0.5, 1, and 2X). The initial screening, as well as dose-response experiments, were conducted in a completely randomized design with three replications and two experimental runs. Survivors were characterized as highly resistant (0-20% injury) or moderately resistant (21-79%) and susceptible (<80% injury). Results showed a high level of resistance to individual ALS- and ACCase-inhibitor herbicides and also cross and multiple herbicide resistance in four populations. Ratio of GR_{50} values indicated that most resistant population had 20-, 87-, and 161- fold resistance to pinoxaden, mesosulfuron, and pyroxsulam, respectively. GR_{50} ratio for diclofop-methly-resistant population could not be calculated as none of the doses provided 50% control. No resistance to glyphosate and pyroxasulfone was observed in these populations. As Italian ryegrass is an obligate outcrosser, multiple herbicide resistance can spread to neighboring fields though hybridization. Similarly, Palmer amaranth populations were collected from soybean, corn and cotton fields and screened for herbicide-resistance. Preliminary screening indicated that 15% of Palmer amaranth populations in Virginia are multiple-resistant to glyphosate (EPSPS-inhibitor, and ALS-inhibitor), and further investigations are on-going. The proliferation of multiple herbicide resistant weeds is a challenge to sustainable crop production in Virginia and warrants Integrated Weed Management strategies.

Optimizing Protoplast Isolation in Waterhemp (*Amaranthus tuberculatus*): Analysis of Oxidative Stress by Flow Cytometry. Peter E. Beerbower*, Robert Sabba, Michael J. Christoffers; North Dakota State University, Fargo, ND (57)

Waterhemp (*Amaranthus tuberculatus*) has evolved resistance to at least seven herbicide modes of action. The spread of herbicide-resistant waterhemp and related *Amaranthus* spp. throughout the midwestern United States is a pervasive challenge in weed management, and more research tools are needed to address this issue. We are developing a protocol for generating protoplasts from waterhemp cell suspension cultures in order to facilitate waterhemp cell culture transformation for genetic studies. Oxidative stress resulting from the generation of reactive oxygen species (ROS) by the action of cell wall degrading enzymes (CWDEs) during protoplast production is reported to inhibit protoplast recovery and cell wall regeneration, hindering cell division after transformation. Stemming from anecdotal evidence that the commercial source of CWDEs affects protoplast viability and recovery, we used flow cytometry to measure the levels of oxidative stress generated by CWDEs from four commercial sources. Cellulase Onozuka R-10 and macerozyme R-10 CWDEs were used in combination to generate protoplasts from a waterhemp hypocotyl cell suspension culture, with each treatment consisting of enzymes from the same commercial source. Resulting protoplast samples were then stained with dichlorodihydrofluorescein diacetate (DCFH-DA), which forms a fluorescent product when oxidized by ROS in live cells. Flow cytometry was used to detect resulting protoplast fluorescence levels. Staining with fluorescein diacetate (FDA), which fluoresces in live cells and is independent of ROS levels, was used to normalize the fluorescence readings. Results were analyzed by single factor ANOVA followed by Tukey's HSD as a post-hoc test to compare waterhemp protoplast oxidative stress levels generated by CWDEs from different commercial sources, as measured by DCFH-DA fluorescence. Of the four commercial sources, CWDEs from Yakult (Tokyo, Japan) were found to produce significantly less oxidative stress than CWDEs from two other sources, but no significant oxidative stress differences were observed between CWDEs from Yakult and RPI (Mount Prospect, IL). These results point to the importance of commercial CWDE source when generating waterhemp protoplasts.

Herbicide Resistant Redroot Pigweed Populations in North Carolina. Ronel J. Argueta*[1], Eric Jones[2], Diego J. Contreras[1], Jackson W. Alsdorf[1], Wesley Everman[1]; [1]North Carolina State University, Raleigh, NC, [2]South Dakota State University, Brookings, SD (58)

Farms have limited chemical options to control *Amaranthus spp.* in conventional soybeans, relying mainly on acetolactate synthase (ALS)-inhibting and protoporphyrinogen oxidase (PPO)-inhibiting herbicides. In 2019 (Camden County) and 2020 (Pasquotank County), complaints of control failures with acetolactate synthase- and protoporphyrinogen oxidase-inhibiting herbicides on *Amaranthus retroflexus* L. (redroot pigweed) were reported by two different farmers in North Carolina. Greenhouse dose-response assays were conducted with imazethapyr, thifensulfuron-methyl, and fomesafen on both of the putative herbicide-resistant *Amaranthus retroflexus* populations. The putative herbicide-susceptible *Amaranthus retroflexus* (Wake and Yadkin [A&B] County) were included in each dose-response assay as well. Lethal doses that control 50% of the population (LD_{50}) were compared across the putative herbicide-resistant and – susceptible *Amaranthus retroflexus* populations to derive resistance ratios (LD_{50} R/ LD_{50} S). The lactofen LD50 on the Camden County *Amaranthus retroflexus* population was 1709 g ai ha^{-1} (8.6x the maximum labeled rate) which resulted in resistance ratios of 143 (Wake County) and 61 (Yadkin [A] County). These results provide evidence of the evolution of ALS-, PPO-inhibiting and multiple herbicide-resistant *A. retroflexus* populations in North Carolina; representing the first confirmed case of PPO-inhibiting herbicide-resistant *A. retroflexus* in the United States. We confirm the evolution of ALS- and PPO-inhibiting herbicide resistance to two North Carolina populations of *A. retroflexus*.
Keywords: *ALS*; herbicide resistance; *PPO*; redroot pigweed; *Amaranthus retroflexus*; weed management

Potential Maladaptive Impact of Transgenerational Memory of Weed Competition on Spring Wheat. Albert O. Kwarteng*; University of Idaho, Moscow, ID (59)

Competition for resources among plants has long been considered a stress-generating factor for plants. Studies have shown that plants can store and recollect memories of past stress events which may affect their response to future stress. This study evaluated how multigenerational weed exposure affects phenotypic plasticity, hormonal and gene expression, and DNA methylation in wheat (*Triticum aestivum* L.). Wheat was planted in the center of 3L plastic pots surrounded by either 8 kochia (*Bassia scoparia*), 8 Italian ryegrass (*Lolium multiflorum*), 8 wheat, or no surrounding plants in a completely randomized design with 15 replications. Seeds harvested from the first generation were used to plant the second generation, and the process was repeated under the same conditions to obtain the second, third, fourth, and fifth generations. The original seed and seeds from the five generations were grown in the greenhouse at the same time in a factorial common garden experiment. Wheat on wheat competition was the treatment with the most significant impact on yield and biomass reduction. Ryegrass competition also highly reduced wheat biomass and yield compared to kochia competition. Wheat-only treatment produced more tillers, spikes, number of seeds, and yield in all generations, but peaked in the 3rd or 4th generation and began to either plateau or decline afterwards. These suggest a potential maladaptive impact of transgenerational memory of weed stress on wheat. The gene expression and epigenetic data would provide a better understanding of the mechanisms involved in these observations.

Initial Herbicide Screening of Pigweed (*Amaranthus* Spp.) in Alabama. Debra R. Smitherman*[1], David P. Russell[1], Steve Brown[1], Bridgette C. Johnson[1], Aniruddha Maity[1], Claudia A. Rutland[2], Joseph S. McElroy[1]; [1]Auburn University, Auburn, AL, [2]Auburn University Department of Crop, Soil, and Environmental Sciences, Auburn, AL (60)

A comprehensive statewide screening in Alabama assessed herbicide resistance in *Amaranthus* species. This evaluation aimed to gain detailed insights into resistant populations, covering various *Amaranthus* species. Populations were collected throughout the state and subjected to an initial first-pass greenhouse herbicide screening at Auburn University Herbicide Resistance Lab. Treatments included non-treated, glufosinate (0.48 kg ai/ha), 2,4-D (2.5 kg ai/ha), dicamba (0.56 kg ai/ha), *S*-metolachlor (2.3 kg ai/ha), atrazine(2.8 kg ai/ha), and glyphosate (2.5 kg ai/ha). Each population was evaluated as a completely randomized design with four replicates. A total of seventy-three individual populations were collected for this study. Of these, we are reporting the evaluation of fifteen populations that have completed the screening process. Each pot was rated on a 0 or 1 scale where 0 is a similar response to a known susceptible and 1 was minimal visual injury compared to a known susceptible. Of these screened populations, two were glufosinate resistant, and five were glyphosate resistant, while all populations were susceptible to dicamba, atrazine, and 2,4-D. *S*-metolachlor resistance screening would be better conducted as a preemergence screen; however, we evaluated post-applications to determine if populations were uniform. *S*-metolachlor induces thin, pine needle-like leaf formation and increases primary stem woodiness in susceptible plants. Further research will be conducted in 2024 to complete our collection survey, screen all collected populations, and sequence populations of interest for possible target site mutations.

Transcriptome Analysis to Identify Genes Involved in Metabolic Resistance to Multiple Herbicides in Palmer Amaranth (*Amaranthus palmeri)*.. Rishabh Singh*[1], Yaiphabi Kumam[1], Mohit Mahey[2], Eric L. Patterson[2], Sanzhen Liu[1], Mithila Jugulam[1]; [1]kansas State University, Manhattan, KS, [2]Michigan state university, East Lansing, MI (64)

Evolution of multiple herbicide resistance in Palmer amaranth (*Amaranthus palmeri* S. Watson) is a serious threat to crop production in the United States. Recently, a Palmer amaranth population (KCTR) from Kansas was found resistant to six herbicide modes of action groups including ALS-, PS II-, EPSPS-, PPO-, HPPD-inhibitors and synthetic auxins. The collection field did not have a history of extensive use of PPO- or HPPD-inhibitors. Moreover, predominance of metabolic resistance to multiple herbicides possibly mediated by P450 or GST enzyme activity was reported in this population. This study was conducted to identify the specific genes involved in multiple herbicide metabolism in this Palmer amaranth population via transcriptome analysis. Vegetative clonal cuttings were prepared from 3 mother plants of both resistant (KCTR) and susceptible (KSS) Palmer amaranth populations. Ten – 12 cm tall plants were treated with labelled doses of chlorsulfuron, atrazine, lactofen, mesotrione and 2,4-D. Leaf samples were collected for RNA isolation at 6 hours after treatment (HAT) with the above herbicides along with non-treated plants. RNA sequencing was outsourced, and paired end reads that were generated were mapped to the Palmer amaranth transcriptome using HISAT. Differential gene expression analysis conducted using DEseq2, revealed up-regulation of 174, 182, 112 and 111 transcripts following chlorsulfuron, atrazine, mesotrione and 2,4-D treatments, respectively, in KCTR compared to KSS. Additionally, two genes, *CYP72A218* and *CYP82D47* were found to be constitutively upregulated across all treatments. Work is in progress to validate the expression levels of the two CYP genes in KCTR and KSS Palmer amaranth plants via real time-quantitative PCR analysis. Identification and confirmation of genes involved in multiple herbicide metabolism in this Palmer amaranth will be valuable to demonstrate that metabolic resistance predisposes weed populations to evolve resistance to other herbicides without selection.

Studying How Genes Influence Crossbreeding Between *Sorghum bicolor* and *S. halepense* with the Help of Sorghum Recombinant Inbred Lines. Usha R. Pedireddi*, Nithya K. Subramanian, George Hodnett, Patricia E. Klein, William Rooney, Muthukumar V. Bagavathiannan; Texas A&M University, College Station, TX (65)

RILs (Recombinant Inbred Lines) serve as powerful genetic mapping tools. To understand how chromosomal regions influence the outcrossing potential between sorghum (Sorghum bicolor) and johnsongrass (S. halepense), an experiment is being conducted at Texas A&M University, College Station. The outcrossing potential of sorghum inbreds with a high outcrossing potential (Tx623) and a low outcrossing potential (Tx378) was investigated in this study. A completely randomized design was used to plant 192 RIL lines in a field naturally infested with johnsongrass in three replications. Trifluoromethanesulfonamide (TFMSA) was applied to the foliar tissue of sorghum, its female parent, 3 to 10 days before flag leaf emergence to prevent self-pollination. A total of 15 panicles were harvested from each plot at seed maturity. Initial results indicated substantial variations in seed set among the RIL lines evaluated. The progeny from these RIL crosses were planted in the field to evaluate their phenotype under field conditions. The results revealed that 99.79% of recovered hybrids were tetraploid and only 0.2% were triploid, the tetraploids resulting from 2n gametes present in the sorghum female parent. The formation of these 2n gametes is genotype-dependent. A Genotyping by sequencing (GBS) analysis of sorghum was conducted to determine the locations of chromosomes that affect gametic factors. The genetic data will be compared with the phenotypic data. The genetic linkage map was constructed using the SNP sequencing data derived from the GBS analysis. Additionally, QTL (Quantitative Trait Loci) analysis was performed using the field's phenotypic and genotypic data (SNP data). Based on the QTL analysis, we found a potential QTL region on chromosome 8 of Sorghum bicolor with a LOD (Logarithm of Odds) score of 2.6158 and a PVE (Percent Variation Explained) of 6.85. Subsequent investigations involving fine mapping in this QTL region are anticipated to identify candidate genes responsible for this interspecific hybridization.

Effects of Microgravity, Moisture, & Light on the Germination of Palmer Amaranth. William Yates*[1], Muthukumar V. Bagavathiannan[2], Aniruddha Maity[1]; [1]Auburn University, Auburn, AL, [2]Texas A&M University, College Station, TX (66)

Recently, space agencies in different countries have started exploring the potential of plant growth under extraterrestrial conditions that are not typical of terrestrial environments. Other than various adversities such as anhydrous, anoxic conditions, and galactic cosmic rays, altered gravity is considered a significant limitation for plant growth under those conditions. So far, scientists have grown various food crops and model plant species with contradictory responses in the space station. However, the reactions of weed species that have an inherent ability to withstand extreme stresses have never been tested against significant extraterrestrial stresses such as microgravity. If found suitable, relevant genes can be of tremendous potential for space crop breeding for extended human space missions. Palmer amaranth (*Amaranthus palmeri*) seeds were exposed to microgravity using a standard clinostat to test this. Of the three variables tested on the germination of palmer amaranth, the light treatment was the only significant factor. Palmer amaranth showed the ability to germinate in a microgravity environment with similar results to normal atmospheric gravity. These preliminary results indicate that extraterrestrial conditions can impact Palmer amaranth germination and call for further experimentations.

Sublethal Herbicide Application Effects on the Chemical Plant Defenses of Honey Mesquite (*Prosopis glandulosa*). Rebecca D. Burson*[1], Morgan L. Treadwell[2], Douglas R. Tolleson[3], James P. Muir[4], Caitlyn E. Cooper-Norris[5]; [1]Texas A&M University/Department of Rangeland, Wildlife and Fisheries Management, San Angelo, TX, [2]Texas A&M AgriLife Extension Service/San Angelo Research and Extension Center, San Angelo, TX, [3]Texas A&M AgriLife Research/Sonora Research Station, Sonora, TX, [4]Texas A&M AgriLife Research/Stephenville Research and Extension Center, Stephenville, TX, [5]Texas Tech University/Department of Natural Resources Management, Lubbock, TX (67)

Honey mesquite (*Prosopis glandulosa Torr. var. glandulosa*) is an aggressive shrub that accumulates alkaloids in the leaves as a chemical defense against herbivory. Mesquite can also quickly form dense thickets at the expense of valuable forage plants, and therefore, is often subject to chemical treatment. Plants managed with herbicide may be susceptible to basal regrowth and the development of multiple stems from the root crown or only partially top-killed and exhibit stem-flagging, particularly when treated under adverse rangeland conditions like severe drought. Herbicides formulated for mesquite control are mostly classified as synthetic auxins, or growth regulators, that may not explicitly interfere with secondary compound metabolism but could have indirect implications on plant phytochemistry through non-specific mechanisms. Our objective was to measure the alkaloids in the honey mesquite trees that survived treatment with various common herbicides. Treatments containing clopyralid, picloram, and/or aminopyralid were aerially applied to plots in Tom Green, Mitchell, and Coleman counties. Basal and stem-flagging leaves were subsequently collected at 1- and 2 years following treatment. Results indicated that there was no significant effect of herbicide rate or active ingredient on the alkaloid content of leaf tissue. Likewise, the location of regrowth on the tree did not affect leaf alkaloids. Time after treatment was significant, with trees sprayed 2 years previously possessing higher levels of alkaloids than trees that were sprayed the previous year. A comprehensive evaluation of the effects of herbicides on plant phytochemistry could provide important insights for the future of integrated brush management.

Buffering the Effects of a Changing Climate: Halophytes as a Source of Osmotic Stress Tolerance. John M. Lemas*, Cynthia S. Brown, Troy Ocheltree, Philip Westra, Todd A. Gaines; Colorado State University, Fort Collins, CO (68)

In this era of climate change, the frequency of abiotic stress exposer in agricultural systems is on the rise. Given this context, unraveling the complex innerworkings of plant response to abiotic stress is sorely needed. The C4 annual tumbleweed Russian thistle (*Salsola tragus*) is known to be tolerant to many forms of abiotic stress and is especially resistant to osmotic stress. During this experiment, 224 experimental units were split into 14 blocks and screened for tolerance to salinity (150 mM NaCl), drought, heat (37ºC), nutrient, and cold stress (4ºC). Uninterrupted exposure to these conditions occurred for 21 days. Pairwise comparisons of collected biomass reported no difference between the salt-treated and control groups, and no difference between cold, drought, and heat-treated plants. Results from this screening were used to design a transcriptome analysis that will identify differentially expressed genes under cold and salt stress conditions. Results from the transcriptome analysis will be analyzed to elucidate possible abiotic stress tolerance mechanisms in this species and to identify possible genes of interest for increasing environmental resilience in desirable species.

Chalcones: Novel Cell Division Inhibitors. Raphael M. Garrido*[1], Patrick Rômbola Ozanique[2], Luis Octávio Regasini[2], Rosana Marta Kolb[1], Franck E. Dayan[3]; [1]São Paulo State University, Assis, Brazil, [2]São Paulo State University, São José Do Rio Preto, Brazil, [3]Colorado State University, Fort Collins, CO (69)

Chalcones exhibit numerous biological activities such as insecticide, fungicide and nematicide. On the other hand, the herbicidal activity has been less investigated. Here, the mode of action of chalcones as herbicides was evaluated. The mitotic index evaluated the effect of chalcones on cell division. Onion seeds were germinated for 7 d in Petri dishes on wet filter paper in the presence of chalcones and precursor at 25°C under a 14 h photoperiod. Test substances were prepared in x100 stock solutions (10 mM) in 50% ethanol. The control received the same amount of solvent. Twenty root apices (1 cm sections) per treatment and one per plant were fixed in glacial acetic acid:absolute ethanol (1:3 v/v) for 30 min. The segments were hydrolyzed in 5 N HCl at RT for 1 h and washed several times with distilled water. Segments were stained with Schiff's reagent for 45 min in the dark at RT. Root segments were transferred to a drop of 45 % acetic acid on top of a microscope slide. A razor blade was used to cut the tips and remove the remaining root segments. A cover slip was placed over the tips and squashed by applying slight and constant pressure directly over the tissues. The edge of the cover slip was sealed with nail polish. The mitotic index was calculated by tallying the cells in various stages of mitosis. At least 1,000 cells per slide and in triplicate were counted. Cells with abnormal mitotic configurations were counted as a separate class. Results were analyzed with a one-way ANOVA test followed by a Tukey test ($p < 0.05$). The chalcones and the precursor caused unusual elongation of the formed cells, with lower proportion of cells in different phases of mitosis and significantly increased the proportion of abnormal cells. Treatment with chalcone (CH2) showed 26% of abnormal cells. These results support that the substances alter the process of cell division and may promote disorganization of root tissues. Treatments with chalcones (CH1 and CH2) reduced the proportion of cells in interphase when compared to the control, thus we can infer that they reduced the number of cells available for cell division. The substances significantly reduced the proportion of cells in prophase and metaphase when compared to the control. Therefore, we can infer that the substances probably bind to tubulin and inhibit microtubule polymerization. All treatments had the same proportion of cells in anaphase as the control. Thus, we can infer that the substances do not inhibit the separation of sister chromatids. Only chalcone (CH1) reduced the proportion of cells in telophase when compared to the control. Therefore, we can infer that CH1 reduces the number of cells available for cytokinesis. If we consider that chalcones and the precursor inhibit microtubule polymerization, we can infer that phragmoplasts would not be formed, interrupting cytokinesis. The modes of action experiments suggest that chalcones interfere with cell division, leading to abnormal growth and development in plants. By disrupting the cell cycle, they can prevent the formation of new tissues and hinder plant growth. However, more research is needed to better clarify the mode of action and optimize their use for practical weed management strategies.

MOA Study on New Natural Herbicide Discovered by Artificial Intelligence. Alyssa Twitty*[1], Franck E. Dayan[1], Noa Levy[2], Yaniv Mizrahi[2], Yosef Geva[2], Yael Phillip[2]; [1]Colorado State University, Fort Collins, CO, [2]Agrematch, Revohot, Israel (70)

AS9057 is a natural product consumed in the human diet, identified as a novel herbicide with a potentially new mode of action using Agrematch AI platform for predictive herbicide discovery. Greenhouse trials demonstrated that the herbicidal activity of AS9057 was light-dependent. The rapid burn down symptoms developing on treated plants, combined with its chemical structure, suggested that AS9057 may target photosystem II. Measurements of photosynthetic electron transport rates in treated plants alongside data from oxygen evolution assays did not support this hypothesis. Further experiments suggested that AS9057 may instead act as an electron diverter. Oxygen consumption assays in isolated thylakoid membranes using a variety of electron transport inhibitors revealed that AS9057 likely acts on photosystem I in a similar manner to paraquat, but differently at a potentially new step between P700 and $NADP^+$. This is consistent with other research reporting that AS9057 can act as an electron acceptor for a variety of flavoproteins, and ferredoxin-$NAPD^+$reductase, is a flavoprotein with a redox potential similar to that of AS9057. Thus, it is currently hypothesized that AS9057 acts as an electron acceptor at or near the ferredoxin to form a radical and generate reactive oxygen species which causes the light-dependent herbicidal effect which is observed in treated plants from greenhouse trials. AS-9057 highlights a unique safety profile that opens the door to the development of a safe natural herbicide as a supplemental alternative for weed management.

Detection of Male and Female Plants of Palmer Amaranth and Waterhemp Using RGB Sensor and Machine Learning. Bismark Anokye*[1], Ubaldo Torres[2], Bholuram Gurjar[3], Navjot Singh[4], Muthukumar V. Bagavathiannan[3]; [1]Texas A&M, Collage Station, TX, [2]Texas Tech University, Lubbock, TX, [3]Texas A&M University, College Station, TX, [4]University of Minnesota, Saint Paul, MN (71)

Palmer amaranth (*Amaranthus palmeri*) is a diecious species with male and female plants resembling in appearance. As an invasive weed, Palmer amaranth has developed resistance to multiple herbicide modes, posing a significant challenge to crop producers. The ability to rapidly discriminate between these two sexes creates the opportunity for the development of weed management strategies that focus on reproductive development, and reduce seedbank replenishment. This research has aimed at developing a recognition algorithm integrating RGB image data and machine learning techniques to effectively differentiate between male and female Palmer amaranth plants at the reproductive stage. The RGB images of male and female Palmer amaranth plants were captured using a handheld digital camera positioned at a height of 11 feet and angles of 90/65° during late summer 2023 at the Texas A&M Research Farm in College Station, TX. A total of 350 RGB images per sex were employed for the model's training process, alongside an additional 150 images for validation purposes for each sex. The YOLOv8 (You Only Look Once) machine learning (ML) model was used to develop a recognition algorithm from the collected images. Three distinct architectural variants i.e., YOLOv8n, YOLOv8m, and YOLOv8I were compared. Among these, the YOLOv8m variant demonstrated the highest mean average precision (mAP) scores of 0.94 and 0.83 for female and male plants, respectively, while YOLOv8n achieved scores of 0.89 and 0.85, respectively. However, YOLOv8I exhibited the lowest mAP scores, with 0.88 for females and 0.73 for male plants. The resulting confusion matrix from the YOLOv8m model demonstrated high accuracy in detecting females (1.00) and males (0.95) of Palmer amaranth plants. It was also found that the model was unable to accurately predict the sex when the Palmer amaranth seed head was not clearly visible in the image. Preliminary findings indicate that an ML-based recognition algorithm developed from RGB images can distinguish between male and female Palmer amaranth plants. These findings demonstrate the potential for plant sex-specific targeted applications of weed control strategies. Future efforts will focus on improving detection accuracy by increasing the size of the training dataset for diverse biotypes, and also investigate the potential of ML algorithms in identifying the sex of the plants before flowering.

Effect of the *S*-Metolachlor Herbicide Applied in Pre-emergence on the Production of Weeds Leaves Epicuticular Wax, and in the Efficiency of Post-emergent Herbicides. Diogo M. Link*[1], Luis A. Avila[1], Maurício Files[2], Luiza Jacobsen[1], Edinalvo Camargo[2], Renan S. Silva[2]; [1]Mississippi State University, Starkville, MS, [2]Universidade Federal de Pelotas, Pelotas, Brazil (72)

The low absorption capacity of glyphosate may explain the natural tolerance of some species due to the lipophilic character of epicuticular wax on the leaf surface. The use of group 15 herbicides (VLCFAs-inhibiting), such as *S*-metolachlor, in preemergence may enhance the efficacy of the post-emergent herbicides. Our hypothesis is that VLCFAs inhibitors in preemergence reduces the amount of wax in the leaf cuticle, enhancing the activity of postemergence herbicides. This study investigated whether group 15 herbicides affected the efficacy of post-emergent herbicides in on weed control and how it affected their epicuticular wax biosynthesis in milkweed and littlebell, and to evaluate the efficacy of post-emergent herbicides on pigweed and barnyardgrass under field conditions as affected by the application of *S*-metolachlor and pyroxasulfone. Three studies were, the first and the second under controlled growth chamber and the third under field conditions. The first experiment it was applied sub-lethal rate (GR_{50} rates) of *S*-metolachlor in preemergence to evaluate the efficacy of glyphosate in postemergence (Experiment 1) and on the production of epicuticular wax of the weeds (Experiment 2), these studies were repeated in time; the third experiment was conducted under field conditions in Starkville, MS to evaluate the effect of *S*-metolachlor and pyroxasulfone applied in preemergence on the efficacy of glyphosate+dicamba, ghyphosate+fomesafen, and glyphosate+acifluorfen in postemergence. The application of *S*-metolachlor reduced the production of epicuticular waxes until 21 DAE (days after emergence) for littlebell and 14 DAE for milkweed and promoted an increase in glyphosate efficacy in postemergence; the results from our field experiment demonstrated that the application of both group 15 herbicides in preemergence enhanced the efficacy of all the post-emergent herbicides treatments on pigweed and barnyardgrass. The herbicide *S*-metolachlor in preemergence reduced the amount of wax deposited in the leaf surface, increasing glyphosate efficiency in postemergence, especially at the beginning of the phenological stage of the studied species. This result was observed under field conditions as well.

Investigating the Role of Plant Morphology, Growth Stage, and Diversity in Weed Recognition. Matthew Kutugata*[1], Søren K. Skovsen[2], Maria Laura Cangiano[3], Chris Reberg-Horton[3], Steven Brian Mirsky[4], Muthukumar V. Bagavathiannan[5]; [1]Texas A&M, College Station, TX, [2]Aarhus University, Aarhus, Denmark, [3]North Carolina State University, Raleigh, NC, [4]USDA ARS, Beltsville, MD, [5]Texas A&M University, College Station, TX (73)

This research explores the use of a transformer-based framework for semantic segmentation that combines transformers with lightweight multilayer perceptron (MLP) decoders, focusing on its application in agricultural weed recognition. The study specifically investigates the influence of weed morphology and growth stages on the performance of this model. Utilizing transfer learning, the model is fine-tuned with a dataset comprising images of potted plants from semi-controlled nursery environments. This approach allows for an in-depth analysis of how various morphological characteristics of weeds, such as their shape, size, and growth stages, impact the accuracy and effectiveness of the segmentation process. Additionally, the research includes cross-dataset validation using field images to assess the model's real-world applicability. The findings provide valuable insights into the complexities of weed recognition, facilitating advancements in precision agriculture and effective site-specific weed management strategies.

Enabling WeedID with Printable Moisture Sensors. Akhil Naik Banothu*[1], Vinay Budhraja[1], Prabha Sundaravadivel[2], Reginald Fletcher[3], Krishna Reddy[3]; [1]Dept. of Electrical and Computer Engineering, The University of Texas at Tyler, Tyler, TX, [2]The University of Texas at Tyler, Tyler, TX, [3]United States Department of Agriculture, Agricultural Research Service, Stoneville, MS (74)

This research focused on using advanced printed board circuit (PCB) printing technology and prototyping platforms to create a functional moisture sensor that can potentially enable weed identification (WeedID). These printed moisture sensors are equipped with unique identification numbers, allowing them to collect data from different weed infestations in the target area. The project mainly focused on utilizing the Voltera V-One PCB printer and the NOVA high-resolution electronics prototyping platform to design and create a humidity sensor that can be applied to flexible materials for agricultural purposes. The technology discussed in this research offers an inexpensive alternative for growers, researchers, and consultants to use for monitoring weed development and their identification at the field level.

Developing a Near Real-time Weed Detection and Site-specific Drone Spray Module.
Swarnabha Roy*[1], Ubaldo Torres[1], Bholuram Gurjar[1], Navjot Singh[2], Aashay Kadakia[1], Bishwa B. Sapkota[1], Martin Wnorowski[1], Stavros Kalafatis[1], Muthukumar V. Bagavathiannan[1]; [1]Texas A&M University, College Station, TX, [2]Texas A&M, College Station, TX (75)

The agricultural sector faces substantial challenges due to the pervasive impact of weeds, necessitating transformative solutions for effective and sustainable weed management. Traditional broadcast herbicide applications lack precision, increasing management costs and amplifying environmental concerns. In response, this study introduces an innovative Real-time Weed Detection System, seamlessly integrating Unmanned Aerial Vehicles (UAVs) with a modular architecture tailored for site-specific weed management. Leveraging cutting-edge advancements in machine vision and Artificial Intelligence (AI) technologies, the system achieves real-time detection of weeds at the individual plant level. Central to the system's functionality are two pivotal components: an advanced on-board processing module boasting a high-resolution camera, a Jetson Nano®/Raspberry Pi 4 for instantaneous image processing, and an Emlid Reach® – M GPS module for precise geo-coordinate recording. The integration of these components onto a survey drone facilitates streamlined data acquisition and onboard processing for weed detection. Subsequently, a second drone autonomously navigates to identify points of interest (geolocation), precisely spraying herbicides based on weed localization position data. Thus, this system represents a near real-time solution for site-specific herbicide application, based on a real-time sensor-based weed detection. The anticipated outcomes of this research encompass a series of crucial enhancements to the existing paradigm, including 1) the development of a modular design allowing for the seamless integration of interchangeable cameras; 2) the implementation of a real-time weed localization system as opposed to traditional classification methods that take 1 to 2 days to obtain weed geolocations in the drone imagery; 3) increasing the computing power of the system to enhance onboard processing without the need to upload data to a cloud; 4) the integration of an independent spray nozzle control system for heightened precision in herbicide application; and 5) the incorporation of drone path planning algorithms to optimize spraying operations. These advancements collectively contribute to the creation of a highly effective near real-time UAV-based weed detection and treatment system, offering a paradigm shift in precision agriculture practices.

Evaluation of Electrocution for Weed and Tall Fescue Seedhead Management in Pastures.
Grant D. Coe*; University of Missouri, Columbia, MO (76)

Evaluations of Electrocution for Weed and Tall Fescue Seedhead Management in Pastures Grant Coe, Haylee Barlow, Trace Thompson, Grady Rogers, Delbert Knerr, Kevin Bradley Electrocution has been shown to provide effective control of weed escapes in soybean, however little to no research has been conducted to evaluate the potential for electrocution to control common weeds that invade pastures. Additionally, electrocution could potentially be utilized as a tool to prevent tall fescue seedhead formation. Livestock that graze endophyte-infected tall fescue seedheads can develop a condition known as fescue toxicosis which can lead to elevated body temperature and reductions in weight loss, milk production, and conception rates. Two experiments were conducted in mixed tall fescue and legume pastures in Missouri in 2023 to: 1) determine the effects of electrocution on tall fescue seedhead reduction, and 2) compare the forage injury and weed control from common pre-packaged pasture herbicide combinations to that achieved with electrocution. In the first experiment, electrocution of tall fescue plants occurred in two pastures with the Weed Zapper™ between April 27 and May 4. Metsulfuron-containing herbicides were applied at the same time as electrocution treatments for comparison of tall fescue seedhead reduction. In both locations, sequential same day electrocution passes or sequential passes spaced two weeks apart resulted in similar tall fescue seedhead reductions and tall fescue forage yields as the metsulfuron-containing herbicide treatments. In the second experiment, a variety of pre-packaged herbicide combinations and electrocution treatments were applied in five separate pastures between July 21 and September 1, during the semi-dormant period in tall fescue's growth habit when weed emergence and density is often highest. Overall, sequential same day electrocution passes provided more effective weed control than a single pass, and many times sequential passes two weeks apart provided better overall weed control than single or sequential same day electrocution passes. Most common pre-packaged herbicide combinations eliminated white clover (*Trifolium repens* L.) whereas electrocution allowed white clover to remain. Results from these experiments indicate that electrocution can be a tactic for reducing tall fescue seedheads and can provide weed control comparable to standard pasture herbicide combinations without substantial reductions in forage yield or legume injury.

Effect of Spray Volume and Application Timing on Weed Control Efficacy Using a Remotely Piloted Aerial Application System in Rice. Reuben Senyo Kudiabor*, Bholuram Gurjar, Xin-Gen Zhou, Muthukumar V. Bagavathiannan; Texas A&M University, College Station, TX (77)

Spray drones offer a convenient option for of applying herbicides in flooded rice fields. Limited information is available to optimize the application parameters for spray drones in rice production. The current study investigates the efficacy of spray drones for herbicide application in rice. An experiment was conducted at the rice research station in Eagle Lake, Texas, to assess four herbicide tank mixes and two application methods (drone vs backpack) on weed control at the MPOST and PREFLD growth stage. The drone application had significantly lower weed control efficacy than the backpack application, which had 85-100% weed control efficacy at 28 days post-application for all herbicide treatment-timing combinations. Under the current spray parameters, drones exhibited reduced herbicide deposition (52.71%) and an uneven distribution within the treated plots, compared to the backpack application (85.78%) based on the spray card droplet deposition data. The treatments applied at MPOST had a significantly higher weed control efficacy than those applied at PREFLD 28 days post-application, regardless of the application method. At the PREFLD timing, the plots generally had higher weed density, which may have led to reduced weed control efficacy. Results suggest that current spraying parameters, including lower flight speed and increased application rate, must be optimized especially for PREFLD applications to achieve effective weed control. Specific parameters need to be fine-tuned for both MPOST and PREFLD application periods.

Exploring Various Deep Learning Architectures for Crop and Weed Detection. Rutvij S. Wamanse*[1], Dhiraj Srivastava[2], Vijay Singh[3]; [1]Virginia Tech, Blacksburg, VA, [2]Donald Danforth Plant Science Center, St Louis, MO, [3]Virginia Tech, Painter, VA (78)

Using Unmanned Aerial Systems (UAS) in combination with cutting edge machine learning algorithms is an effective way to monitor weeds. This research aims to find a lightweight and fast object detection model to detect common ragweed (Ambrosia artemisiifolia) in soybean (Glycine max for spot spraying applications using UAS. Robust machine learning models can be developed by rigorously training them on high-quality image data, a resource which is currently lacking in weed science. The image dataset was collected in 2021 at Painter, Virginia, where DJI M-300 drone was flown at a height of 12 m at various growth stages of common ragweed and soybean. In order to feed classification models, a collection of 500*500 pixels were collected from the orthomosaic image and the image data was annotated using the VGG Image annotator (VIA). The dataset was subjected to generative modeling to produce previously unexplored versions or object orientation. Several model architectures using the most recent YOLOv8 series were used to detect weeds. Metrics for precision and recall were used to compare the models. With a prediction speed of 0.854 ms and a precision of 82.2%, YOLOv8 nano (YOLOv8n) was found to be the fastest model, while YOLOv8 extra-large (YOLOv8x) was the best model with a precision of 97.2%. According to the study's findings, the YOLOv8 model has potential for site-specific real-time operations. Subsequent research efforts will focus on creating lightweight machine learning models with high accuracy for weed prediction, which can be deployed on edge devices.

Smart Sprayer Applications: Role of Nozzle Type, Number, and Height. Zaim Ugljic*[1], Bruno Canella Vieira[1], Ryan P. DeWerff[2], Rodrigo Werle[1]; [1]University of Wisconsin - Madison, Madison, WI, [2]University of Wisconsin, Madison, WI (79)

New emerging agricultural technologies such as optical smart sprayers are progressively making their way into the global agricultural market. These innovative sprayers come equipped with cameras that enable real-time weed detection and with high-speed computer units responsible for processing images and activating the necessary nozzles, all that within milliseconds. Different sprayer manufacturers may adopt different approaches concerning the activation of nozzles upon weed detection by the camera system. Some systems may activate multiple nozzles whereas others may activate only a single nozzle upon weed detection within the nozzle spray coverage area. Additionally, various nozzle types are being tested and recommended for these systems. The objective of this research was to investigate the role of nozzle type, boom height, and number of nozzles triggered upon weed detection on weed control. The weed control studies were conducted in 2023 at two Wisconsin locations, Arlington (ARL) and Janesville (ROK). The studies were conducted as 2x2x2 factorial experiment plus a weedy check. A three-nozzle boom (CO2 pressurized and calibrated to deliver 140 l/ha with nozzles positioned 38 cm apart and 53 cm above the target) mounted on a bicycle wheel was built to conduct this research. Two different nozzle types with similar droplet size classification were selected: a flat fan nozzle (Teejet DG80015) and an even flat fan nozzle (Teejet TP40015E). Nozzles were evaluated at two different boom heights: 53 cm from the target, which represents the theoretical ideal height for the selected nozzle spacing versus 76 cm from the target, representing a high boom scenario. Lastly, the efficacy of one versus three nozzles was compared. All treatments received glufosinate POST (656 g ai/ha assuming 38 cm nozzle spacing and 53 cm boom height) and application occurred when weeds were ~10 cm in height. Biomass samples were collected 14 days after treatment (DAT), *Ambrosia artemisiifolia* at ARL and *A. trifida* at ROK. According to our preliminary results, the activation of three nozzles, regardless of their type or boom height, provided more effective and consistent weed biomass reduction (>90%) across treatments within the target area at both research locations. When only one nozzle was activated, the even or flat fan at the ideal target height (53 cm) provided 61-82% control in the target area at ARL and 49-80% at ROK whereas the higher boom treatment resulted in lower weed control (<68%). However, triggering multiple nozzles can provide more consistent and effective weed control, but the potential herbicide savings could be affected. Additional research investigating application technology parameters for optical smart sprayers is highly warranted.

Influence of Application Parameters on Spray Coverage and Weed Control with DJI Agras T40 UAV. Trace M. Thompson*; University of Missouri, Columbia, MO (80)

Influence of Application Parameters on Spray Coverage and Weed Control with DJI Agras T40 UAV Trace Thompson, Haylee Barlow, Grant Coe, Grady Rogers, Delbert Knerr, Kevin Bradley The use of unmanned aerial vehicles (UAVs) show promise as a potential new method of herbicide application, however relatively few studies have been conducted to determine the effects of various UAV application parameters on spray quality and weed control. Two field experiments were conducted in soybean fields in 2023 to: 1) evaluate weed coverage, spray coverage and uniformity, and off-target movement following herbicide applications from a DJI Agras T40 compared to two common commercial ground-based sprayers, and 2) determine the effects of application speed, height above the crop canopy, and application rate on spray coverage with the DJI Agras T40. In the first experiment, post-emergence applications of 2,4-D choline plus pyroxasulfone plus fluthiacet-methyl plus glyphosate or glufosinate were made in two separate soybean fields with either the DJI Agras T40 or a Case IH 3340 or John Deere 4830 ground-based sprayer. The DJI Agras T40 was equipped with two centrifugal atomization nozzles set to deliver extra coarse droplets at 28 liters per hectare (lph) while the Case IH 3340 and John Deere 4830 ground-based sprayers were set to deliver 187 lph and were equipped with Wilger MR110-10 combo-jet nozzles and Turbo TeeJet 11005 nozzles, respectively. Spray coverage was more than twice as high and off-target movement was less with the ground-based sprayers compared to the DJI Agras T40 UAV. Average spray droplet diameter from the UAV were also substantially smaller than those from the ground-based sprayers and could not be characterized as extra coarse. However, there were no differences in weed control between the ground-based sprayers compared to the UAV. In the second experiment, a variety of different UAV spray application parameters were assessed for their effects on spray coverage and waterhemp [*Amaranthus tuberculatus* (Moq.) J.D. Sauer] control following post-emergence applications of glufosinate. There was no difference in spray coverage or waterhemp control between application speeds of 4 meters per second (m/s) and 8 m/s. Increasing the spray volume from 28 to 56 lph resulted in greater spray coverage but did not affect waterhemp control while increasing the height of application above the soybean canopy from 3 to 4.5 m resulted in a reduction in spray coverage and waterhemp control. The results from this research indicate that under certain conditions and with specific application settings, similar levels of waterhemp control might be achieved with UAVs compared to ground-based sprayers, but additional improvements in the sprayer settings are needed in order to increase droplet sizes and reduce the likelihood of off-target movement.

Standardization of Unmanned Aerial System-Based Herbicide Application in Row-Crops.
Fatemeh Esmaeilbeiki*[1], Dhiraj Srivastava[2], Daniel E. Martin[3], Vijay Singh[4]; [1]Virginia Tech, Blacksburg, VA, [2]Donald Danforth Plant Science Center, St Louis, MO, [3]United States Department of Agriculture, College Station, TX, [4]Virginia Tech, Painter, VA (81)

Unmanned Aerial System (UAS) has the potential for effective weed management with both blanket and targeted herbicide spray applications. Studies were conducted at Painter, Virginia, to standardize UAS-based applications for preemergence herbicides in row crops. The current study highlights the two experiments conducted in corn, 1) evaluating three volumes, 2) evaluating two nozzle types (air-induction and regular flat fan). Grass and broadleaf weed seeds were broadcasted at corn planting, and weed density was recorded before spray application. In experiment 1, a spray mixture was applied at 18.7 L ha^{-1} (UAS-2; 2 gallons/A), 37.4 L ha^{-1} (UAS-4; 4 gallons/A), and 74.8 L ha^{-1} (UAS-8; 8 gallons/A), compared with a CO_2 pressurized backpack sprayer at 140 L ha^{-1} (BP-15). Artificial samplers, specifically water-sensitive papers (WSP), were placed in plots (50 x 20 m) to determine droplet spectra and visual weed control was recorded. These experiments, designed in a completely randomized block design with four replications, utilized *S*-metolachlor and a mixture of atrazine, bicyclopyrone, mesotrione, and *S*-metolachlor. Analysis of Variance (ANOVA) was performed, and Tukey's HSD (a=0.05) was employed for means separation. Notably, the spray application treatments exhibited significant differences in weed control concerning 18.7 L ha^{-1} and 37.4 L ha^{-1} volumes. Experiment 2 highlighted the importance of nozzle selection, revealing that air-induction nozzles effectively reduce drift and provide postemergence weed control but may not be optimal for preemergence applications that require finer droplet sizes. The regular flat fan nozzle, on the other hand, demonstrated 30% greater weed control compared with the air-induction nozzle when used at the preemergence stage.

Weed Detection Using Computer Vision and Deep Learning. Akhilesh Sharma*, Vipan Kumar, Louis Longchamps, Bharat Hariharan; Cornell University, Ithaca, NY (82)

The rapid evolution of herbicide-resistant (HR) weed populations and increasing cost of their control warrant the development of site and specie-specific weed management strategies (SSSWMS). Successful deployment of various SSSWMS further requires rapid and accurate detection of weed species in various cropping situations. The main objectives of this research were to (1) develop an annotated image database of cocklebur, dandelion, common waterhemp, Palmer amaranth and common lambsquarters to fine-tune object detection algorithms (YOLOv8 and Detectron2 (Faster RCNN)), and (2) investigate the comparative performance (speed and accuracy) of both algorithms in detecting those weed species. Field sites with natural infestations of cocklebur, dandelion, and common lambsquarters were identified during 2023 growing season at Cornell University Musgrave Research Farm, Aurora, NY. In addition, a grower field in Seneca County, NY was identified with natural infestations of common waterhemp in soybeans. Images of each weed species were manually collected at early growth stages (cotyledons to 30 cm tall) using a GoPro Hero RGB camera. Palmer amaranth images (cotyledons to up to 76 cm tall) were collected from corn and soybean fields during 2022 growing season at Kansas State University Agricultural Research Center near Hays, KS. All collected images were pre-processed to a size of 640 x 640 pixels, augmented by blurring, adding noise, and rotations. Total number of images for each weed species were as follows: 858 for Palmer amaranth, 720 for common lambsquarters: 352 for common waterhemp, 227 for dandelion, and 191 for cocklebur. The images were then manually annotated with bounding boxes, producing 2,348 annotated images. The annotated images were used to train the Detectron2 and YOLOv8 algorithms. Mean average precision (mAP) and inference speed metrices were used to evaluate the accuracy and speed of both algorithms in identifying and locating each weed species. Results indicated that YOLOv8 outperformed Detectron2 in detecting all weed species. The YOLOv8m algorithm achieved an mAP score of 93% @0.5 IoU and an inference speed of 23 milliseconds with a Tesla T4 GPU. In contrast, the Detectron2 with Faster R-CNN configuration had an mAP of 68% @0.5 IoU and an inference time of 210 milliseconds. The mAP @0.5 IoU with YOLOv8 testing was 90% for Palmer amaranth, 87% for common lambsquarters, 93% for common waterhemp, 97% for dandelion, and 96% for cocklebur. These preliminary results conclude that the YOLOv8m algorithm can play a crucial role for weed detection more accurately and about 9 times faster than Detectron2 in agricultural fields. Contact E-mail: as3774@cornell.edu

Development of a Robotic Flaming Weed Control System Using a Six-axis Manipulator Mounted on a Quadruped Robot. Joe Johnson*[1], Di Wang[2], Shuangyu Xie[2], Chengsong Hu[2], Dezhen Song[2], Muthukumar V. Bagavathiannan[2]; [1]Soil and Crop Sciences, Texas A&M University, College Station, TX, [2]Texas A&M University, College Station, TX (83)

This work presents the systematic design and development of a robotic thermal weeding system, which is expected to offer a non-chemical management option for late-season weed escapes that are sparsely distributed in a production field. The proposed system uses a legged mobile robotic platform (Boston Dynamics SPOT robot) to carry a robotic six-axis manipulator holding a flame torch, computing system, and energy source. This approach of using a legged mobile robot is novel and overcomes the disadvantages of using conventional wheel-based mobile robots in agricultural fields. The proposed robotic thermal weeding system includes hardware integration and software pipeline that detects weeds using a pre-trained deep learning model, moves to a suitable position to target the detected weed, reorients and positions its manipulator (with the flame torch) over the weed, activates flaming for a predefined period, and repeats the process for the next weed. The temperature generated by the flame torch was measured using a thermal camera, and effects of wind on the flame direction were also observed. The robotic system was tested on natural infestations of weedy sunflower, smell mellon, and devil's claw in a cotton field. The experiment has successfully demonstrated the working system, with our model and algorithm achieving a mean average precision (mAP) of >76%. Research is ongoing to further improve the field efficiency of the robotic flaming system.

Directed Energy: A Possible Solution to Control Weed Seeds? Caroline Beatriz Wayhs Backes*[1], Sarah A.d. Chu[1], Lauren M. Lazaro[2], Jon Jackson[3], Neil Sater[3], Muthukumar V. Bagavathiannan[1]; [1]Texas A&M University, College Station, TX, [2]Blue River Technology, Sunnyvale, CA, [3]Global Neighbor Inc., Xenia, OH (84)

Farmers can prevent seedbank replenishment by using harvest weed seed control (HWSC) tactics, which target weed seeds as they exit the back of the combine with chaff. An innovative technology, the directed energy (DE) Unit, is being developed by Global Neighbor, Inc., which uses blue light and mid-infrared wavelength heating to kill weed seeds. The purpose of the experiment is to determine the DE unit's efficacy on the seed of four weed species, Palmer amaranth (*Amaranthus palmeri*), green foxtail (*Setaria viridis*), hemp sesbania (*Sesbania herbacea*), and morningglory (*Ipomoea* spp.). The experiment consisted of three treatments: *i*) untreated, not exposed to the DE unit, *ii*) exposed to the DE unit only (i.e., no heat or blue light) at 100 rotations per minute (RPM), *iii*) exposed to DE unit with only blue light and no heat at 100 RPM. The treatments to test the efficacy of the DE unit with the blue light and the mid-IR temperatures at 149°C, 163°C, 177°C, 191°C, 204°C, and 218°C at 100 RPM. Morningglory germination was not impacted by the DE Unit (P=0.2); however, Palmer amaranth (P<0.001), green foxtail (P<0.001), and hemp sesbania (P<0.001) germination rates were impacted by the DE Unit. At 149°C DE treatment, germination decreased by 89% for Palmer amaranth and 34% for green foxtail, but it was not significantly different hemp sesbania . At 218°C, hemp sesbania germination decreased by 65% compared to seeds not exposed to the DE Unit. Results demonstrate that the DE Unit can reduce weed seed germination, but the optimum temperature required to reduce germination may vary across species.

Evaluation of Electrical Weed Control in California Orchards. Tong Zhen*, Bradley D. Hanson; University of California, Davis - Department of Plant Sciences, Davis, CA (85)

Managing weeds is challenging in sustainable and organic tree crops in California, and the current non-chemical weed control programs cannot provide cost-effectiveness and support soil conservation goals simultaneously. Electrical weed control (EWC) is a potential alternative to achieve both goals. The Zasso™ Tractor-Based electrical weeding machine controls orchard weeds in the tree row by physical contact with the applicator electrodes, which can transfer electrical current to the target vegetation. This project aims to evaluate the weed control efficacy and crop safety of EWC in California orchards. In July 2023, an EWC efficacy study was conducted in a young walnut orchard. The treatments included four speed-and-power combinations: two tractor speeds (1.1 and 2.1 $km \cdot h^{-1}$) and two power settings (4 and 5). Weed cover percentage data were collected at 5, 10, and 20 days after treatment (DAT), and the number of weed regrowth was counted at 20 DAT. The results indicated that all the EWC treatments maintained less than 5% weed cover at 5 and 10 DAT, whereas the untreated plot had 91% and 83% weed cover, respectively. Even though the weed cover percentage increased at 20 DAT for all EWC treatments, the weed cover percentages were still significantly lower than that of the untreated plot. There was no significant difference in weed cover percentages and number of regrowth among all EWC treatments, implying that selected speeds and power settings did not affect weed control efficacy. In April 2023, an organic almond orchard crop safety and soil health study was initiated to examine how newly planted almond trees and the soil microbial community respond to four EWC applications during the first growing season. Four EWC treatments were applied at different speeds (1.1 and 2.1 $km \cdot h^{-1}$), power settings (3 and 5), and number of pass combinations. Tree trunk diameters and height were recorded at the end of the season to measure young tree growth. Soil samples were analyzed in October 2023 to measure soil microbial respiration as a biological indicator of soil health. No significant differences were found in the tree trunk diameter and height data among all treatments, indicating that multiple EWC events did not impact young almond tree growth in the first year of planting. The soil respiration data showed no significant difference in EWC-treated and non-treated soil. For future research, EWC efficacy studies will be conducted under different field conditions and with varying species of weed, and the EWC orchard crop safety will be continued in the 2024 and 2025 growing seasons.

Impact of Electricity on Soil Health and Weed Control in Blueberries. Luisa C. Baccin*, Marcelo L. Moretti; Oregon State University, Corvallis, OR (86)

Electric weed control (EWC) is a new technology that uses an electric current applied to the weed foliage to disrupt cellular function, leading to tissue dissection. The effectiveness of EWC depends on plant species, growth stage, and edaphic conditions. This study investigates the interaction of EWC and soil mulching on soil health, weed control effectiveness, and weed species composition in an organic highbush blueberry. The study was organized as a two-factor factorial design with three mulch levels (bare ground, sawdust, synthetic mulch) and weed control strategies (mowing, EWC at 15 and 75 MJ ha^{-1}). EWC was administered six times between May and October 2023 using a tractor-powered electrical weeder (EH30 Thor). EWC did not affect the soil's physical and chemical properties nor the biological indicators such as CO_2 respiration, microbial biomass, and ß-glucosidase activity across treatments. EWC at 15 and 75 MJ ha^{-1} reduced weed species number by 80% compared to mowing, and all management practices showed a reduction in weed species relative to the control. No differences between EWC energy levels in weed control or biomass were observed. Blueberry plants didn't show a difference in growth or chlorophyll levels regarding weed control strategies. EWC weed control outperformed mowing without adversely impacting soil health. These findings suggest EWC is a promising weed control option for sustainable weed management in organic agriculture, balancing effective control with environmental stewardship.

Utilizing Direct-Injection Technology to Mitigate Auxin + Graminicide Herbicide Antagonism. Jake A. Patterson*[1], Darrin M. Dodds[2], Antonio Augusto Tavares[1], Sydney C. Baker[1]; [1]Mississippi State University, Starkville, MS, [2]Mississippi State University, Mississippi State, MS (87)

Herbicide antagonism poses severe economic and environmental challenges for numerous growers throughout the United States. Existing literature indicates that the combination of certain herbicides mixed in solution leads to antagonistic effects, eliciting reduced weed control compared to individual herbicide applications. Although herbicide antagonism is extensively documented, there is limited knowledge regarding methods that can effectively mitigate antagonistic effects without the need for elevated herbicide rates or repeated applications. Field experiments were conducted in 2022 and 2023 at the Black Belt Branch Experiment Station near Brooksville, MS to evaluate grass weed control in response to the application of dicamba, 2,4-D, glyphosate, and clethodim using a commercially available direct-injection system compared to tank-mix combinations of these herbicides. A sprayer equipped with a commercially available direct-injection system was used to apply treatments as follows 1) the two herbicides tank-mixed and sprayed through a single boom, 2) the auxin herbicide applied from the bulk tank and the grass herbicide direct-injected into the spray boom, 3) the grass herbicide applied from the bulk tank and the auxin herbicide direct-injected into the spray boom, and 4) the grass herbicide applied alone. Each herbicide combination was applied with the application methods listed above. In 2022 and 2023, 28 days after treatment, regardless of which auxin herbicide was included, glyphosate generally provided greater barnyardgrass [*Echinochloa crus-galli* (L.) Beauv.] control than clethodim. In 2022, 28 days after treatment, when dicamba was used, no differences in barnyardgrass control were observed within glyphosate- nor clethodim-containing treatments; however, in 2023, when dicamba was injected into clethodim, greater control was observed compared to tank-mix and clethodim injected into dicamba treatments. In 2023, when 2,4-D was injected into clethodim, greater control was observed compared to clethodim alone, tank-mix, and clethodim injected into 2,4-D treatments. These findings suggest that auxin + graminicide treatments applied via direct-injection can provide greater barnyardgrass control compared to tank-mix treatments, but results may vary from year to year, likely due to environmental conditions. Furthermore, these results indicate that both dicamba and 2,4-D, injected into clethodim, can provide greater barnyardgrass control compared to tank-mixing. While only slight variations in barnyardgrass control were noted with dicamba, employing this application method still holds merit in potentially mitigating auxin tank contamination.

Exploring a Toolbox of Technology: Possibilities for Future Weed Control Solutions. Mandeep Singh*, Amit J. Jhala; University of Nebraska-Lincoln, Lincoln, NE (88)

Herbicide resistance is on the rise. Currently, 530 unique cases of herbicide-resistant (HR) weeds have been reported with 132 cases in the U.S. alone. With herbicides being limited, there is a need for alternative weed management approaches. Peptides, Protelysis-targeting chimera (PROTAC), and RNA interference (RNAi) technology can be possibilities for weed control in the future. In recent years, peptides gained attention in plant protection as they are more environmentally friendly with acceptable activity and easy availability of their raw materials. Recently discovered peptides such as Romidepsin are very effective on pigweeds and are being reviewed by the United States Environmental Protection Agency. Peptides are likely to be common in future plant protection and could be a future avenue for research among other bioherbicides. PROTAC is a novel technology aimed at treating human diseases with potential applications in agriculture. This technology avoids the challenge of finding specific target sites and directly breaks down enzymes, structural proteins, and transcription factors. It is reasoned that PROTAC can help manage HR weeds and broaden the range of biochemical targets for controlling weeds. RNAi is gene-silencing technology, where small RNAs are sprayed to target specific sites in the plant. This technology is being explored for weed management which if successful would be used similarly to herbicides for selective weed control. Overall, herbicide resistance is a big challenge in weed management, however, many technological advancements are happening with potential assurances to tackle this challenge in the future.

The Importance of Adjuvants to Agricultural Distributors and Retailers. Jeff Bunting*; Growmark, Bloomington, IL (426)

Agricultural Distributors and Retailers play a central role in delivering agricultural technology and information to growers in the form of products, services, and recommendations. Agronomically, adjuvants are a very important component of that product mix that can maximize pesticide performance, and function as part of a complete solution to the grower customer. Adjuvants are also an important business tool in that they provide differentiation, brand awareness, brand loyalty and profitability. FS Adjuvants play in a significant role in delivering an agronomically sound offering and the importance of this input for the GROWMARK crop protection business will be discussed.

CPDA - Giving Relevance and Credibility to the Adjuvant Industry. Terry Kippley*; CPDA, Arlington, VA (427)

For over 35 years, the Council of Producers and Distributors of Agrotechnology (CPDA) has been the national voice for the manufacturers, formulators, distributors, and retailers of spray adjuvants, inert ingredients, post-patent crop protection and biorational products. CPDA member companies distribute 80% of U.S. crop protection products which includes inert ingredients and spray adjuvants. Our focus as an organization today is on addressing federal and state regulatory and legislative issues. Our 2024 policy objectives include working with EPA to implement the Pesticide Registration Improvement Act of 2022 (PRIA) to reduce the registration backlog for PRIA submissions as well as those submissions that do not have a PRIA code. Another major focus is working with EPA to include drift reduction adjuvants as a key mitigation tool into their Endangered Species Act strategies to reduce pesticide no-spray buffers. With a new Farm Bill up for debate, we have four primary objectives. First, we are supporting the establishment of United States Department of Agriculture (USDA) Centers of Excellence at both the 1862 Land Grant Universities and the 1890 Historically Black Colleges to focus on adjuvant research and education. Second, we are pressing for Farm Bill inclusion of provisions allowing private agronomists to serve as USDA Natural Resource Conservation Service (NRCS) Technical Service Providers (TSPs) to address the current shortage of TSPs. Third, we are seeking increases in the Code 595 Practice Standards mitigation index values for adjuvants making them more attractive for growers to include in their conservation plans. Fourth, we are urging Congress to include language in the next Farm Bill that requires the Secretary of Agriculture to develop a comprehensive economic impact study that measures the effects to the farm economy, on food prices and on U.S. food security due to ESA's impact on the pesticide regulatory process. With adjuvant use increasing, CPDA's Adjuvant Certification Program is in place to ensure products meet robust quality standards so that users have confidence in the products they are using.

Optimizing Droplet Size and Reducing Drift with Novel Deposition Aids. Susan Sun*; Croda Crop Care, Philadelphia, PA (429)

Spray Quality refers to the droplet size distribution produced by a particular nozzle under a specific pressure in agrichemical applications. The droplet size distribution is used to describe the potential for spray coverage and spray drift associated with the droplet size. Spray quality could be significantly impacted not only by the spray equipment but also the pesticide formulation itself under various application conditions. In practice, many droplet modifiers have been added either as tank-side adjuvants or built into the pesticide formulation to best manage potential off target drift and improve the biological efficacy. Conventional polymer drift control agents function by increasing the extensional viscosity of the spray liquid, enabling it to resist disruption as it emerges from the spray nozzle, leading to an increase in the median droplet diameter of the spray droplets. Addition of a conventional polymer-based droplet modifier to the spray tank, increases the break up length of the spray sheet upon exiting the nozzle. Emulsion-based droplet modifier products do not significantly change the length of the coherent spray sheet, but have an impact on the perforation of the sheet. Firstly, this talk will classify the basic chemistries of the current droplet modifiers in the market and review the two fundamental mechanisms mentioned above. Secondly, the talk will focus on demonstrating the impact of different adjuvants and pesticide formulations on spray quality via two case studies. The first case study examines effect droplet modifiers paired with a range of formulations in conventional ground and aerial applications. The second case study examines the effect of droplet modifiers in high concentration UAV applications. The results of these studies are expected to guide droplet modifier selection in agricultural applications. By analyzing and contextualizing the study outcomes, hopefully it helps to deepen our understanding of how adjuvants may affect spray quality, extending awareness beyond engineering factors.

Improvements in CPDA's Application Enhancement Certification Program, A Novel Tool for Improving Selection of Nozzles & Adjuvants. James Reiss*[1], Susan Sun[2], Bradley Fritz[3]; [1]Council of Producers and Distributors of Agrotechnology, Arlington, VA, [2]Croda Crop Care, Philadelphia, PA, [3]United States Department of Agriculture, Agricultural Research Service, College Station, TX (430)

For over twenty years applicators have been searching for guidance in making more efficacious and on-target applications. To meet this industry need, and at the urging of academia, the CPDA (Council of Producers and Distributors of Agrotechnology) has developed the Application Enhancement Certification Program. This program recognizes that drift control without biological efficacy is not a successful application and is intended to provide applicators a more complete picture of the likely outcome of an application based on the interactions between pesticide formulation type, nozzle design and adjuvant selection. To accomplish this objective, the test protocol was designed to compare the pesticide formulation type alone to the inclusion of a single adjuvant and use-rate across a combination of four different nozzle type designs and four pesticide formulations known to influence spray droplet spectra. The four nozzle design types chosen are: a single orifice flat fan, an air-induction flat fan, a turbulence chamber and an air-inducted turbulence chamber nozzle. The four pesticide formulations used in the test protocol are: an emulsifiable concentrate (EC), a soluble liquid (SL) formulated with anionic surfactant, a soluble liquid (SL) formulated with cationic surfactant, and a soluble liquid (SL) with minimal inerts/adjuvancy). All nozzles were 11004 in size and solutions were sprayed at 276 kPa and analyzed with Sympatec Helos Vario KR laser diffraction particle size analyzer in a low speed (15 mph air flow) wind tunnel. With the R7 lens installed, it can detect particle sizes ranging from 18 to 3500 microns. For ease of use the data distribution set is segregated into three classification categories based on the actual reference nozzle data. The three categories are: percentage of spray volume less than ~160 m (too small); percentage of spray volume between ~160 m to ~840 m (effective); and the percentage of spray volume greater than ~840 m (too large). The test results, from the adjuvant presented here, will demonstrate how this information can be used by applicators to make better decisions for matching nozzles and adjuvant selection with various tank mixes. These better choices should increase the likelihood of a more efficacious application while reducing the risk of off-target movement. Of course, this information and program are not intended to supersede any pesticide manufacturer's label requirements but rather, when possible, to help applicators make better decisions relative to the variables involved in a specific application.

Adjuvant Use and Opportunity in Drone Applications. Steve Li*[1], Livia Ianhez Pereira[2], Thiago Bento Caputti[1]; [1]Auburn University, Auburn, AL, [2]University of Nebraska-Lincoln, North Platte, NE (431)

Spray drone is being rapidly adopted in the US across multiple regions due to its low purchase cost, versatility and ability to fly over wet fields and obstacles during an application. Many farmers and custom applicators have purchased spray drones in the last two years to apply pesticides on row crops, specialty crops, forestry, pasture, non-crop area, etc. Considering this is a very new technology in the US, most operators do not have sufficient knowledge and experience in drone operation. A big concern from the industry is spray drift and pesticide off-target movement when spraying with small droplets and low spray volume (18-27 L/ha). Existing data and published studies to address this problem are very limited. Therefore, multiple field trials were conducted in 2022 and 2023 in Alabama to evaluate drift reducing agents (DRA) for mitigating drift and increasing deposition and canopy penetration. Results have shown that DRA significantly increased spray dye deposition on corn ear leaves when applied with drones at vegetative tassel stage. DRA also effectively reduced downwind deposition compared to when spraying with only water in windy conditions. In addition to DRA evaluations, other factors contributing to spray drift during drone applications will also be discussed in this presentation.

Role of New Technologies in the Evaluation and Requirements for Adjuvants. William L. Patzoldt*[1], Lauren M. Lazaro[1], Michael M. Houston[2], Jesaelen Gizotti de Moraes[3]; [1]Blue River Technology, Sunnyvale, CA, [2]Blue River Technology, Greenville, MS, [3]Blue River Technology, Santa Clara, CA (432)

A new generation of sprayers are being introduced into the marketplace for weed management using computer vison and machine learning that allows for targeted applications of herbicides to weeds. Several sprayers, such as See & Spray™ Ultimate by John Deere, offer a dual tank delivery system with the ability to make both targeted and broadcast applications in the same pass using independent plumbing systems that extend from the tank to the nozzle tips. The addition of dual tank systems on sprayers is intriguing because they not only provide greater flexibility in creating novel herbicide programs, but also opportunities to further optimize nozzle tips and adjuvants for herbicide products within each tank independently. Furthermore, these new generation of sprayers have the ability to collect data that includes estimation of sprayed area and weed area. Using this information, it may become possible to assist adjuvant optimization by the collection of unbiased data as either a replacement or as corroborating data to visual weed control assessments. Collectively, the technological advances of sprayers being introduced into the market will provide greater opportunities to both access and improve the use of herbicides for weed management through optimization of programs, adjuvants, and nozzle tip combinations.

Historical Survey of Herbicide Resistance Cases. New Technologies Challenge for an Update of Resistance Criteria. Roland S. Beffa*[1], Craig M. Alford[2], Mark Peterson[3], Caio Rossi[4], David M. Simpson[5], Harry J. Strek[6], Ian Heap[7]; [1]Senior Scientist Consultant, Frankfurt, Germany, [2]Corteva, Ankeny, IA, [3]Agri-logos Consulting, West Lafayette, IN, [4]Corteva Agriscience // HRAC Global, Uberlandia, Brazil, [5]Corteva, Indianapolis, IN, [6]Bayer AG, Frankfurt Am Main, Germany, [7]Weedscience LLC, Philomath, OR (457)

From 3,840 peer reviewed publications selected with key words related to herbicide resistance, 80 representative ones were selected stochastically for a detailed critical review. The publications represented 22 countries with 3 countries, USA, Brazil, and China, representing 50%. In addition, the reports were published in a broad range of Journals (#30). The fulfill of the resistance confirmation criteria defined by the WSSA and the HRAC Global was assessed and taken one by one they were found correctly studied in most reports. However, only 55% of the reports discussed the practical field impact of the label dose, while only 35% confirmed weed species identification and only 33% provided information on history of herbicide used in the field. The increase knowledge about the mechanisms of weed resistance to herbicides as well as the increased use of new technologies, e.g., genomics, molecular biology, analytics, lead to revised the guidelines for validating cases to be submitted to the International Herbicide-Resistant Weed Database (weedscience.org), especially in case of non-target site resistance, like herbicide detoxification. In addition, in many publications there are confusions related to the definition of complicated resistance patterns, as cross-resistance and multi-resistance. These topics will be discussed with new proposals as the basis of discussions in the scientific community to come to a consensus approach and an update of resistance confirmation criteria.

Regulatory Perspectives on the Potential Value of Herbicide Resistance Screening. Cameron H. Douglass*[1], Bill Chism[2]; [1]USDA, Washington, DC, [2]Retired from U.S. Environmental Protection Agency, Point Of Rocks, MD (460)

In the United States pesticides, such as herbicides, are regulated by the Environmental Protection Agency, using guidelines and policies stipulated by applicable federal laws and codified in the Code of Federal Regulations. The registration, or re-registration, of a given herbicide relies on the submission of a wide variety of data to EPA, including available information from registrants and the scientific community on the occurrence of herbicide resistance.

Connecting the International Weed Genomics Consortium with Herbicide Resistant Weed Screening. Todd A. Gaines*[1], Eric L. Patterson[2], Mithila Jugulam[3], Roland S. Beffa[4], Dana R. MacGregor[5]; [1]Colorado State University, Fort Collins, CO, [2]Michigan State University, East Lansing, MI, [3]Kansas State University, Manhattan, KS, [4]Senior Scientist Consultant, Frankfurt, Germany, [5]Rothamsted Research, Harpenden, United Kingdom (461)

While herbicides are the most effective and widely adopted weed management practice, the evolution of multiple herbicide resistance in damaging weed species threatens the yield and profitability of many crops. This presentation will discuss how genomics and molecular biology can contribute to improving weed management through herbicide resistance diagnostics. The International Weed Genomics Consortium (IWGC) is a public-private collaboration with the vision to 1) develop genomics resources for major weed species, 2) make the data and analysis tools broadly available, and 3) to foster networking and training for weed scientists to use genomics tools. Through the IWGC and global collaborating groups, over 50 weed species now have high quality annotated reference genomes. The availability of this information provides opportunities for future research in developing and improving rapid, in-field herbicide resistance diagnostics to assist on-farm decision making, as well as new and improved options to characterize resistance in lab assays. Genomics approaches can also contribute to higher throughput identification of resistance cases to improve herbicide resistance database coverage and accuracy.

Plant Extracts to Kill Weeds. Gustavo M. Sosa*; INBIOAR GLOBAL LTD, Rosario, Argentina (374)

Plant secondary metabolismo may produce useful active ingredients for the crop protection industry. From INBIOAR we collect plants to find bio-herbicides and at the same time in the same sample we check for insecticide, fungicide and stimulant activity. At the end we obtained a competitive bio-herbicide and many others specific tools for the crop protection industry. We transfer the technology to the global industry.

Biocontrol of Striga (Witchweed): Maize Seed Coating Employing Virulence-selected *Fusarium*.. Claire S. Baker*; Toothpick Company Ltd., Kakamega, Kenya (375)

Historically, bioherbicides have not been a sufficient alternative to the dominant use of synthetic chemical herbicides. To be used safely as bioherbicides, plant pathogens need to be host specific, non-toxic, and yet sufficiently virulent to control a specific weed. To be commercialized the bioherbicides must be affordable and require a functional shelf life for distribution. *Striga hermonthica* (witchweed) is a soilborne parasitic weed that causes high yield losses in staple crops such as maize and sorghum across sub-Saharan Africa. An endemic host-specific plant pathogen (*Fusarium oxysporum* f.sp *strigae)* offers some biocontrol, but like most fungal plant pathogens, the wildtype's virulence is not sufficient for effective biocontrol. Too boost the virulence to a level that would benefit the farmer, strains of the fungus were selected for excretion of leucine, methionine, and tyrosine amino acids to inhibit Striga and protect the crop. Initially, the fungus was delivered on toothpicks to the village level where farmers were trained to grow a fresh secondary inoculum in cooked rice, inoculating for three days before co-planting it with maize seeds. This application method was effective in controlling Striga in farmer's fields and was successfully registered and commercialized in Kenya in 2021. However, the fresh inoculum system presented some challenges related to the cost of the rice substrate and the short shelf life of the fresh inoculum. Therefore, the company formulated the active ingredient strain as a spore powder to use as a seed coating. In 2023, this product was approved for commercial distribution of the seed coating, allowing the company to reduce the price, extend the shelf life, and expand the distribution opportunities. With this commercially successful pilot, the goal is to now replicate the pilot's model in other countries in Africa. Additionally, the core technology (virulence enhancement) can now be applied for biocontrol of other weeds using the evidence that many weeds are attacked by a host-specific strain of *Fusarium oxysporum,* and these fungi are able to excrete the specific amino acids that inhibit the specific weeds. The business development of future bioherbicide applications is an important and timely discussion, particularly in regard to food security and herbicide resistant weeds.

Overcoming the Challenges of Developing Microbial Bioherbicides. Louis Boddy*; ProFarm Group, Davis, CA (376)

Weed control with biological or natural products can follow various paradigms, including burn-through, infection and toxicity, each of which presents its own advantages and market opportunities. Remarkably few biologically-based weed control products have come to market following the toxicity paradigm, and this may be due to several scientific, technical and commercial challenges. ProFarm Group is tackling these challenges in the development of two natural product herbicides: a cellulose biosynthesis inhibitor produced in *Streptomyces acidiscabies* fermentations, and a plant gene transcription disruptor produced by *Burkholderia rinojensis* fermentations. In both cases, once fermentation cycles are complete, all living cells are deactivated and the formulated products are built around the activity of the natural products released by the microbes.

Harnessing Targeted Protein Degradation to Develop the Next Generation of Crop Protection Chemistry. Samuel G. Gattis*; Oerth Bio, Durham, NC (379)

Oerth Bio was founded as a joint venture by Arvinas and Bayer Crop Science to translate the groundbreaking technology of Targeted Protein Degradation to agriculture. We have developed our proprietary ATTUNE platform to identify and harness E3 ligases unique to plants, fungi, and insects, and to create degraders of key targets. The power of the platform will be showcased, and key proof of concept data will be presented.

ENKOMPASS: A Platform for Target-Based Discovery of Novel Crop Protection Chemistries. Karthik Putta*, Tim Panosian, Peter Stchur, Jacqueline Heard, Thomas Meade; ENKO, Mystic, CT (380)

Sustainable innovation is required to deliver crop protection products that address key challenges in a rapidly evolving agricultural environment including pest resistance, changing pest patterns due to climate change, and the need to create chemistries that are safe to people and the environment. We built a scalable, target-based platform (ENKOMPASS™) to address these needs. ENKOMPASS™ is the integration of DNA-Encoded libraries (DELs), Artificial Intelligence (AI), Machine Learning (ML) and Structure-based Design, that we use to rapidly discover and develop novel and diverse chemistries for existing and novel targets. One successful herbicide project was the discovery of a novel class of plant protoporphyrinogen oxidase (PPO) inhibitors with activity on both wild type and commonly selected PPO mutations. Another successful example is the discovery of novel chemistry for an under-utilized herbicide mode of action. We have also used ENKOMPASS™ to discover novel fungicide, insecticide and nematicide chemistries. The ENKOMPASS™ platform continues to evolve, incorporating innovations in DEL, data analysis, and other emerging technologies to continuously accelerate the discovery and development of novel crop protection chemistries.

Developing Herbicide-tolerant Crops Through Target-site Protein Evolution and CRISPR Editing. Lucas Lieber*; BioHeuris, St. Louis, MO (381)

Developing herbicide-tolerant traits is an established way to manage weeds. Herbicide-tolerant GMO crops are commercially available in many countries and are being widely used by farmers. Bringing these transgenic traits to the market takes more than 15 years and more than 100M dollars. Another way of obtaining tolerance is by using traditional mutagenesis but the process is also slow and the type of mutations that can be obtained are random and limited in type.Using CRISPR editing it is possible to introduce precise mutations in plants that can include several nucleotide changes.We developed a high-throughput microbial platform to discover and measure the level of herbicide-tolerance in plant genes variants.We introduced equivalent single amino acid changes in target-site enzymes from different crops and observed not only different levels of tolerance but that some mutations had a positive effect only in certain species. Also, the same residue change in the target-site enzyme of a crop provided different tolerance when tested with herbicides of the same site-of-action group.This suggests that using known mutations in target-site enzymes from crops (or weeds) in genes from other species might not provide the expected herbicide-tolerance.We have used this approach to edit elite varieties and obtained confirmation from different countries that these plants are not considered GMOs. Field trials are underway and we expect that it will only take six years in total to bring these traits to farmers with a cost 50 times less than a GMO event.

Herbicide Discovery from Plant Pathogens Using Genomic Methods. Jack Kloeber[1], Alexander Polidore*[1], Amit J. Jhala[2]; [1]MicroMGx, Chicago, IL, [2]University of Nebraska Lincoln, Lincoln, NE (382)

Metabologenomics (MGX) is a technology-based platform designed to efficiently discover bioactive natural products. A genomics-driven strategy is an effective natural product discovery method and makes up half of the MGX discovery platform. Through these methods, we discovered a novel phytotoxic compound, pantaphos, a secondary metabolite of the phosphonate class of natural products, produced from the plant pathogen, *Pantoea ananatis*. Not only has pantaphos been shown to cause the hallmark lesions of onion center rot, but it has also been shown to cause devastating disease in a variety of other plants suggesting a potential commercial use as an herbicide. Pantaphos has the ability to control many broadleaf weeds, and evidence suggests it has a novel mechanism of action.

Projini's Platform for Discovering New Mode-of-Action Herbicide Leads Inhibiting Protein-Protein Interactions: Example Targeting O-Acetylserine Sulfhydrylase. Jonathan Gressel[1], Dotan Peleg*[2]; [1]Weizmann Institute, Rehovot, Israel, [2]Projini AgChem, D.n. Upper Galil, Israel (383)

The widespread evolution of herbicide resistance poses a significant challenge to current agriculture. Most herbicides function by binding to specific pockets on target enzymes, enabling a single mutation to confer resistance. An alternative approach is the disruption of protein-protein interactions that occur when enzymes must act as complexes or when peptide sub-units are separately synthesized and then complex to form an enzyme. For resistance to evolve against inhibitors of protein-protein interactions there must be complementary mutations on both interacting partners to preclude herbicide binding while retaining enzymatic activity. Projini is focused on the discovery and design of small molecule inhibitors that target the interfaces of such protein-protein complexes. Based on the 3 dimensional analysis of "hot spots" on the interacting surfaces, Projini targeted the complex of O-acetylserine sulfhydrylase (OASS) and serine acetyltransferase (SAT), key plant enzymes that act in tandem in the two step biosynthesis of the essential amino acid cysteine. Using in silico filtering techniques using proprietary software on a virtual library of 30 million small molecules, Projini identified initial hits capable of binding OASS and interfering with its interaction with a peptide derived from SAT. Subsequently, Projini conducted chemical optimizations to evaluate biophysical enzyme disruption, and then demonstrated cellular and in-planta herbicidal activity on weeds. These new compounds described herein can serve as promising leads for further optimization as herbicides acting on a new mode of action target. Projini has a pipeline of other protein-protein interaction targets.

Overview of Pesticide Registration Process in the United States, Legislation, and Standards.
Zahoor A. Ganie*; FMC, Newark, DE (366)

The objective of this talk is to provide an overview of the pesticide registration process in the United States. The United States Environmental Protection Agency (EPA) Office of Pesticide Programs (OPP) plays a pivotal role in this process, conducting a thorough scientific assessment before rendering regulatory decisions. Governed primarily by the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Federal Food, Drug, and Cosmetic Act (FFDCA), the EPA enforces its regulations through 40 CFR Parts 150-189, establishing the framework within which registrants must operate.The basic requirement for registration is data from comprehensive studies on various aspects of the product, including product chemistry, toxicology, environmental fate, ecological effects, residue chemistry for food use, and product performance. The completed data package, along with the product label containing directions for use and precautionary language, forms the basis of the submission package. The EPA/OPP conducts a comprehensive evaluation of the submission package which includes determining the potential risk posed by the product to human health and the environment by scientifically rigorous risk assessment method. These assessments undergo scrutiny by scientific experts through a peer-review process. However, the journey towards registration is not without challenges, with unpredictability and timing of the regulatory decision being a key issue. The presentation also highlights recent challenges encountered during the registration process, including EPA's compliance with the Pesticide Registration Improvement Act (PRIA) and the Endangered Species Act. As regulations continue to change, the presentation concludes with a forward-looking perspective on the potential shifts and advancements in the agricultural sector.

Ecotoxicology Data Requirements, Methodologies and Risk Assessment. Tessa Scown*; FMC, Newark, DE (367)

Registration of pesticides in the US requires registrants to conduct and submit toxicity studies on a wide array of non-target organisms in order to demonstrate that use of products containing pesticide actives are not going to cause harm to organisms that may be exposed. The data generated in these studies is used to conduct risk assessments based on the estimated environmental concentrations resulting from the label application rates to demonstrate safe uses. Studies are conducted on model organisms, covering multiple taxa and multiple ecosystems, to determine the short- and long-term effects of exposure, under worst-case conditions. These model organisms are considered representative of all the species that might be exposed to an active ingredient as a result of its use. Risk assessments compare predicted exposure levels in the environment to levels that caused effects in the model organisms. Regulatory authorities, including EPA commonly require 10- or 100-fold margins of safety for a passing risk assessment. The Environmental Protection Agency's ecotoxicological data requirements as well as a description of the methodologies and required standards will be discussed, along with an overview of the risk assessment process, what steps can be taken to refine challenging risk assessments and how EPA's requirements might impact risk assessments for other regions.

Environmental Sustainability and Industry Perspectives of Changes in EPA Regulations on Pesticide Use with Advanced Technologies. Sarah Hovinga*; Bayer Crop Science, Orangevale, CA (368)

National strategies such as the Endangered Species Act (ESA) will have the potential to broadly affect pesticide registration by EPA and use in the field by growers, respectively. The implementation of such strategies will be complex and requires an approach that enhances value for all stakeholders, encompassing growers, regulators, government entities, industry, and broader society. Concurrently, advancements in agricultural inputs, digital systems (such as electronic labeling), and application methods (like drones, targeted application, and machine-readable/actionable capabilities) are rapidly evolving and need to be harnessed for the potential solutions they bring to this complexity. The utilization of available site-specific information (e.g., soil composition, wind patterns, weather conditions) and specific application needs (i.e., less-than-whole-field) has the potential to drive the adoption of these technological advancements. This adoption could lead to comprehensive benefits, such as achieving ESA protection goals and ensuring a return on investment for growers. However, the EPA's current risk assessment methodology involves considering the maximum application rate for crops, assuming a maximum runoff rate, and utilizing worst-case scenarios to estimate exposure for off-site movement (e.g., drift). This approach diminishes incentives for the adoption of agricultural and technical advancements by end-users. Furthermore, the complexity introduced by field-level use instructions and mitigations necessitates connected digital systems and databases. Growers and pesticide users require straightforward, efficient, and timely means of comprehending labeling requirements and usage recommendations. Additionally, they need the ability to participate in emerging markets and sustainability programs, such as carbon sequestration and conservation certifications. This presentation envisions a digitally connected system that facilitates these possibilities. It explores examples of databases, digital approaches, and associated benefits. To achieve these goals, ongoing engagement with diverse stakeholders within transparent, science-based, and flexible regulatory frameworks that support the integration of these technologies for the sustainable future of farming is imperative.

Industry Perspectives on Endangered Species Act (ESA): Regulatory Issues and Natural Wildlife. Scott B. Clewis*, Tony Burd; Syngenta Crop Protection, LLC, Greensboro, NC (369)

The Endangered Species Act was signed into law in 1973 and Section 7 of ESA "requires federal agencies to ensure that actions they authorize, fund, or carry out do not jeopardize the existence of any species listed under the ESA, or destroy or adversely modify designated critical habitat of any listed species." Since that time, EPA has not fully complied with Section 7 which has resulted in various lawsuits. To bring EPA into compliance with ESA, they have released many documents since 2020 detailing their efforts to become compliant with ESA. The two most recent documents (Vulnerable Species Pilot and Herbicide Pilot) outline particular mitigations that growers would need to use in order to be compliant. These proposals have in some cases led to overly restrictive mitigations that would affect many growers across the country. Moving forward, it will be important that growers are aware of these potential changes and offer input for the most appropriate mitigations for their farm. All parties ((growers, EPA, U.S. Fish & Wildlife Services (FWS), National Marine and Fisheries Services (NMFS), USDA, Industry, NGOs, and academia)) need to work together to offer solutions for protecting endangered species while allowing growers the access to the tools needed to grow their crops.

What Can Happen When You Don't Get it Right? Environmental and Societal Implications of Off-target Herbicide Movement. Kevin W. Bradley*; University of Missouri, Columbia, MO (371)

Most university weed scientists would suggest that the off-target movement of dicamba that occurred after the introduction of dicamba-resistant cotton and soybean is incomparable in its scope and scale to any other herbicide drift event in our agricultural history. It also resulted in a time where great divisiveness existed between herbicide registrants and university weed scientists, between farmers and registrants, and even between one farmer and another. It is not an exaggeration to say that this has been an unprecedented time in the history of our industry. In this session, I will provide a brief description of the situation as it unfolded (from the perspective of a state extension weed scientist), and discuss potential implications of herbicide registrations gone wrong, especially in light of pending ESA requirements and future herbicide registrations.

Survey of Herbicide-Resistant Weeds in the South

Please refer to **www.herbicideresistance.org** for up-to-date information on herbicide resistant weeds in the Southern region.

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