RESEARCH CONFERENCE ABSTRACTS

VOLUME 20

November 29-30, 2016
Hilton Garden Inn
Fayetteville, Arkansas

STUDENT COMPETITIONS
SPONSORED BY:

BASF

Dow AgroSciences

Gowan USA

Syngenta Crop Protection

Valent USA

Tuesday, November 29, 2016

12:00 noon Registration

MODERATOR: Aaron Cato
Student Contest Chair: Mohammad T. Bararpour
Audio-Visual Coordinator: Donna L. Frizzell

12:30 p.m. **Upload Presentations**

12:55 p.m. **Opening Remarks**

1:00 p.m. **Developing Post-Season Diagnostic Tools in Rice.**
K.A. Hoegenauer*, T.L. Roberts, R.J. Norman, N.A. Slaton, and J.T. Hardke. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 1

1:15 p.m. **Effect of Sorghum Planting Date on Sugarcane Aphid Populations and Associated Natural Enemies.**
A. Miskelley*, N. Seiter, N. Joshi, G. Lorenz, and G. Studebaker. Dept. of Entomology, University of Arkansas, Fayetteville, AR. 1

1:30 p.m. **Evaluating the Potential for Insecticide Seed Treatments to Reduce Herbicide-Related Injury to Soybean.**
N.R. Steppig*,[1], J.K. Norsworthy[1], R.C. Scott[1], and G.M. Lorenz[2]. [1]Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR; [2]Dept. of Entomology, University of Arkansas, Fayetteville, AR. 2

1:45 p.m. **Influential Soil Characteristics That Promote Hydrogen Sulfide Toxicity in Rice.**
J.M. Fryer*, T.L. Roberts, Y. Wamishe, J.T. Hardke, and D.M. Miller. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 2

2:00 p.m. **Evaluation of Topramezone Applied Alone and in Combination with Other Herbicides in Rice.**
M.H. Moore*, J.K. Norsworthy, R.C. Scott, M.E. Fogleman, and J.A. Godwin. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 3

2:15 p.m. **Understanding Rice Yield and Quality Issues From the 2016 Season.**
J. Hardke. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas System Division of Agriculture, Stuttgart, AR. .... n/a

2:45 p.m. **Break**

*Denotes M.S. Student **Denotes Ph.D. Student

Tuesday, November 29, 2016 (cont.)

MODERATOR: Kelsey Hoegenauer

3:00 p.m. **Residual Activity of thiencarbazone-methyl and Other Residual Herbicides.**
Z.D. Lancaster*, J.K. Norsworthy, J.K. Green, C.J. Meyer, and N.R. Steppig. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 4

3:15 p.m. **Comparison of Rice Tolerance to Several Very-Long-Chain Fatty Acid Inhibiting Herbicides.**
J.A. Godwin*, J.K. Norsworthy, R.C. Scott, M.L. Young, R.R. Hale, and M.R. Miller. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 5

3:30 p.m. **Comparison of Soil-Applied ALS-Inhibiting Herbicides on Conventional and Inzen Grain Sorghum.**
H. Bowman*, T. Barber, J.K. Norsworthy, N. Steppig, J. Rose, A. Ross, and M. Houston. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 5

3:45 p.m. **Why Does Variability Exist Among Soybean Cultivar Chloride Inclusion/Exclusion Ratings.**
D.D. Cox*, N.A. Slaton, T.L. Roberts, R.E. DeLong, T.L. Richmond, and D.A. Sites. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 6

4:00 p.m. **Horizontal Transmission of *Helicoverpa* Nucleopolyhedrosis Virus (NPV) in Soybean Fields Infested with Corn Earworm, *Helicoverpa zea*.**
J. Black* and G.M. Lorenz. Dept. of Entomology, University of Arkansas, Fayetteville, AR. 7

4:15 p.m. **Field Characterization of Warrant in Mid-South Rice.**
M.E. Fogleman*, J.K. Norsworthy, Z.D. Lancaster, N.R. Steppig, and R.C. Scott. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 8

4:30 p.m. **Impact of Neonicotinoid Insecticides on Honey Bees in the Mid-South.**
G. Lorenz. Dept. of Entomology, University of Arkansas System Division of Agriculture, Lonoke, AR. .... n/a

5:00 p.m. **Conclude for the day**

*Denotes M.S. Student **Denotes Ph.D. Student

Wednesday, November 30, 2016

MODERATOR: Chester Greub

8:00 a.m. **Upload Presentations**

8:15 a.m. **Effectiveness of Herbicide Programs in Bollgard II Xtend Cotton in the Absence of Tank-Mix Partners with Dicamba.**
J.S. Rose*, L.T. Barber, J.K. Norsworthy, H.D. Bowman, and A.W. Ross. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 8

8:30 a.m. **Preemergence and Postemergence Control of PPO-Resistant Palmer Amaranth in LibertyLink Soybean.**
M. Houston*, T. Barber, J.K. Norsworthy, J. Rose, H.D. Bowman, and A. Ross. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 9

8:45 a.m. **Effect of Delaying the Preflood Nitrogen Application and Flood on Rice Nitrogen Uptake and Yield.**
T.L. Richmond*, N.A. Slaton, J.T. Hardke, T.L. Roberts, R.J. Norman, D.D. Cox, and D.A. Sites. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 10

9:00 a.m. **Efficacy of Selected Insecticides and Rates for Control of Tarnished Plant Bugs in Cotton.**
L. Rice*, G.M. Lorenz, and N. Taillon. Dept. of Entomology, University of Arkansas, Fayetteville, AR. 11

9:15 a.m. **Response of Non-Xtend Soybean to Low Rates of Dicamba and Glyphosate Applied During Reproductive Development.**
G.T. Jones*, J.K. Norsworthy, L.T. Barber, J.A. Godwin, J.K. Green, M.E. Fogleman. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 11

9:30 a.m. **Wheat Tolerance to Standard and New Herbicides.**
T. Penka*, N. Burgos, and C. Rouse. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 11

9:45 a.m. **Xtend and Enlist Cropping Systems in Arkansas.**
B. Scott. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas System Division of Agriculture, Lonoke, AR. .... n/a

10:15 a.m. **Break**

*Denotes M.S. Student **Denotes Ph.D. Student

Wednesday, November 30, 2016 (cont.)

MODERATOR: Garrett Lee

10:30 a.m. **Benzobicyclon: A New Opportunity for Control of Weedy Rice.**
M. Young*,[1], J.K. Norsworthy[1], R.C. Scott[1], C. Sandoski[2], and M. Moore[1]. [1]Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR; [2]Gowan Co. .. 12

10:45 a.m. **The Effects of Soil Temperature, Moisture, and Texture on Field-Scale Spatial Variability of Cotton Stands and Seedling Diseases.**
K.D. Wilson*, C.S. Rothrock, and T.N. Spurlock. Dept. of Plant Pathology, University of Arkansas, Fayetteville, AR. 13

11:00 a.m. **Influence of Soybean Maturity Group on Yield and Soil-Nitrogen Credits.**
C. Ortel*, T.L. Roberts, J.T. Hardke, R.J. Norman, N. Slaton, and L. Purcell. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 14

11:15 a.m. **Barnyardgrass Control with Sharpen Tank-Mixes in Provisia Rice.**
R.R. Hale*, J.K. Norwsworthy, Z.D. Lancaster, J.A. Godwin, and R.C. Scott. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 15

11:30 a.m. **On Farm Demonstration with ESN – Environmentally Smart Nitrogen.**
S. Runsick[1], K. Lawson[2], J. Kelley[2], and T.L. Roberts[2]. [1]Cooperative Extension Service, University of Arkansas, Corning, AR; [2]Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 15

11:45 a.m. **What Antagonistic Tank-Mixtures in Enlist and Roundup Ready Xtend Technologies Mean for Growers.**
C.J. Meyer**, J.K. Norsworthy, J.K. Green, and R.R. Hale. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 16

12:00 p.m. **Lunch**

*Denotes M.S. Student **Denotes Ph.D. Student

Wednesday, November 30, 2016 (cont.)

MODERATOR: Donna Frizzell

1:00 p.m. **Population Dynamics of Palmer Amaranth in Response to HPPD-based Herbicide Programs.**
L.M. Schwartz[1], C.J. Meyer, J.K. Norsworthy, and A. Cotie[2]. [1]Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR; [2]Bayer CropScience. 16

1:15 p.m. **A Comprehensive Summary of Soybean Sensitivity to Off-Target Movement of Loyant™ Herbicide.**
M.R. Miller**, J.K. Norsworthy, M. Young, and M. Moore. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.. 17

1:30 p.m. **Evaluation of Rice Stink Bug, *Oebalus pugnax*, Damage to Maturing Rice Kernels.**
A. Cato**[,1], J. Hardke[2], and G. Lorenz[1]. [1]Dept. of Entomology, University of Arkansas, Fayetteville, AR. [2]Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 18

1:45 p.m. **Palmer Amaranth Biology and Population Dynamics in Wide-Row Soybean.**
N.E. Korres, J.K. Norsworthy, J. Green, and J. Godwin. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 18

2:00 p.m. **Cover Crops in Arkansas: Do the Positives Outweigh the Negatives?**
T. Roberts. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas System Division of Agriculture, Fayetteville, AR. .... n/a

2:30 p.m. **Presentation of Awards**

3:00 p.m. **Adjourn**

*Denotes M.S. Student **Denotes Ph.D. Student

ABSTRACTS

Developing Post-Season Diagnostic Tools in Rice.

K.A. Hoegenauer*, T.L. Roberts, R.J. Norman, N.A. Slaton, and J.T. Hardke. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Arkansas is the leading rice producing state in the United States. Nitrogen serves important roles in photosynthesis and biomass production for many row crops, such as rice and is the most limiting nutrient in Arkansas rice production systems. The recommended N rates for rice in Arkansas range from 112 to 245 kg N ha^{-1} and have traditionally been based on cultivar and soil texture. Excessive N application rates can have negative impacts on crop yield such as lodging and increased disease pressure, which could decrease yield and profits for producers. The recent development and release of N-STaR, the N Soil Test for Rice has provided producers with a way to determine a field-specific, season-total N fertilizer rate. The implementation of N-STaR has allowed producers to determine the precise amount of fertilizer required to maximize yields on a field by field basis. Research has shown that preflood N management is critical for maximal yield potential in rice, but if adverse soil and environmental conditions occur during fertilization and flooding this can lead to a reduction in N use efficiency and overall yields. Work is currently being conducted to implement the use of normalized difference vegetative index (NDVI) as a means to predict rice response to midseason N using a Greenseeker handheld device. Producers that use the Greenseeker can identify fields or areas of fields that do not have enough N to produce maximal yields and address these issues in-season. In recent years rice yields have been plagued by a number of environmental factors that have led to lower than expected yields. Producers with suboptimal yields are often left wondering why. Under-fertilization with N is often to blame for less than stellar yields when there are no other definitive factors that can be singled out and identified. There is a need for a post-season test that can determine if excessive or insufficient N was applied to rice; therefore, the objective of our research is to develop a post-season N test for rice. This study will consist of procedures modeled after the Corn Stalk Nitrate Test, which is a post-season N test developed to evaluate the N status of corn based on NO_{3-} accumulation in the lower part of the corn stalk. Specifically, we will collect above ground biomass samples from existing N rate x variety trials. The rice stems will be analyzed for NO_{3-}, NH_4, amino acids, and total N in 5 cm sections. The N concentrations in the rice stalks and relative rice yield will be used to develop protocol for a post-season N test for rice.

Effect of Sorghum Planting Date on Sugarcane Aphid Populations and Associated Natural Enemies.

A. Miskelley*, N. Seiter, N. Joshi, G. Lorenz, and G. Studebaker. Dept. of Entomology, University of Arkansas, Fayetteville, AR.

The sugarcane aphid, *Melanaphis sacchari* (Hemiptera: Aphididae), has recently become a major pest of grain sorghum in southeastern Arkansas and elsewhere in the southern U.S. There are currently few effective insecticides labeled for sugarcane aphid control on grain sorghum [*Sorghum bicolor* (L.) Moench], and although field research on the sugarcane aphid is limited, primary literature suggests potential control mechanisms using natural enemies. An experiment was set up with four replicate blocks and eight treatments to investigate the population dynamics of sugarcane aphids and their associated natural enemies in sorghum planted on different dates. Treatments were arranged using a full factorial structure, including four planting dates (14-Apr, 10-May, 1-Jun, 21-Jun) that were either sprayed with flupyradifurone (Sivanto) for sugarcane aphid control or left unsprayed. Sugarcane aphids were monitored each week for twelve weeks. Sugarcane aphid populations in the untreated plots showed a decrease in density shortly after flowering in all planting dates; in the first two planting dates, this initial peak was followed by a second, larger surge at the beginning of August. Sudden declines in aphid populations that then occurred could be explained by dispersal behavior as well as the buildup of natural enemies, including several species of Coccinellidae which were observed in abundance on the respective planting dates at the times of these peaks.

Evaluating the Potential for Insecticide Seed Treatments to Reduce Herbicide-Related Injury to Soybean.

N.R. Steppig*,[1], J.K. Norsworthy[1], R.C. Scott[1], and G.M. Lorenz[2]. [1]Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR; [2]Dept. of Entomology, University of Arkansas, Fayetteville, AR.

Insecticide seed treatments have been shown to partially safen rice against drift from some herbicides. These results are of great interest following the 2016 growing season, where numerous growers suffered injury to their crops following off-target movement of dicamba onto sensitive soybean varieties. If insecticide seed treatments could provide similar safening effects in soybean production as seen in rice, monetary losses associated with crop damage following herbicide drift could be greatly reduced. In order to evaluate the potential for insecticide seed treatments to reduce crop injury from herbicide drift, field trials were conducted at the Lon Mann Cotton Research Center (2015 and 2016), the Northeast Research and Extension Center (2016), and the Pine Tree Research and Extension Center (2016). Treatments were arranged in a randomized complete block design as a two factor factorial (insecticide x herbicide). Two seed treatments (thiamethoxam and clothianidin) were evaluated in combination with eight herbicides (dicamba, 2,4-D, glyphosate, glufosinate, halosulfuron, mesotrione, tembotrione, and propanil). Herbicides were applied 3 weeks after planting at 1/10x labeled rates. Visual ratings of crop injury were collected weekly following application and assessed on a 0-100 scale (0 = no injury, 100 = complete plant death), plant heights and densities were taken 2 weeks following application, and yield data was collected at the end of the season. A significant reduction in injury from drift rates of halosulforun was observed when paired with clothianidin or thiamethoxam; however, injury was not reduced in the other 7 herbicides evaluated. Since soybean is often grown in close proximity to rice fields, where an application of halosulfuron is common, the use of insecticide seed treatments may be more widely adopted in Arkansas in the years to come to effectively reduce concerns of halosulfuron drift.

Influential Soil Characteristics That Promote Hydrogen Sulfide Toxicity in Rice.

J.M. Fryer*, T.L. Roberts, Y. Wamishe, J.T. Hardke, and D.M. Miller. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Hydrogen sulfide toxicity (HST) is a poorly understood soil disorder that affects rice (*Oryza sativa* L.). This disorder has many potential influential factors but appears to be caused by excessive sulfur in the rhizosphere. This disorder occurs when sulfate is excessively reduced to hydrogen sulfide in the two-three week time after permanent flood has been established. The distinctive symptom is root blackening caused by the buildup of iron sulfide, while above-ground symptoms appear similar to nutrient deficiencies though are not correctable by fertilizer applications. A better understanding of the soil physical and chemical components that influence the production of hydrogen sulfide is needed in order to identify the cause of HST.

A greenhouse study was designed to investigate potential influencing soil factors while growing rice. Four Arkansas soils were used to represent where HST always occurs, Hunter (H) and Hickory Ridge-West (HR-W), sometimes occurs, Hickory Ridge-East (HR-E), and has never occurred, Pine Tree Research Station (PTRS). A rice cultivar susceptible to HST was planted and standard recommendations of nitrogen, phosphorus, and potassium were added to each pot. During the course of the trial redox potential was monitored, and soil solution samples were extracted and analyzed for sulfate concentration.

Results from preliminary soil tests indicated that H, HR-W, and HR-E contained more silt and sulfur than PTRS, but PTRS contained more Fe^{2+}. An analysis of variance was performed to determine any differences between location by day, and Student's t test was used to separate means. The ANOVA showed significantly different sulfate concentrations between locations for the first 28 days of sampling ($p = 0.0091$-0.045). Days 63 and 77 after flooding also had significant differences between locations ($p = 0.0095$; $p = 0.0164$). For the duration of the experiment, soil from H had the highest concentration of SO_4^{2-} and PTRS had the lowest concentration. All locations had a rapid decline in SO_4^{2-} concentrations between days 14-28, consistent to when hydrogen sulfide toxicity typically occurs. Sulfate concentrations in H soils increased over the first two weeks before declining. This is likely due to organic sulfur being mineralized into sulfate, then as redox potential dropped, the sulfate was reduced into sulfide.

The redox data supports the findings in the sulfate concentrations. Redox potential for H reached -100 mV, the potential where sulfate is the main terminal electron acceptor, earliest at around day 28. Redox potential for PTRS reached -100 mV by day 52. This data supports the theory that redox potential and sulfate reduction in HST prone soils declines at a faster rate compared to soils where HST never occurs. However, HST is a multilevel disorder. Quantities of substrates, presence of microorganisms, and variety and amount of terminal electron acceptors all influence the occurrence and severity of HST.

Evaluation of Topramezone Applied Alone and in Combination with Other Herbicides in Rice.

M.H. Moore*, J.K. Norsworthy, R.C. Scott, M.E. Fogleman, and J.A. Godwin. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Arkansas is the largest producer of rice in the United States, with over 40% of total production. Much like other crops, one of the essential management practices to producing high yields is maintaining an effective level of weed control within a production field. Barnyardgrass (*Echinochloa crus-galli*) is particularly difficult to control in rice cropping systems due to its highly competitive nature and large risk for evolution of resistance to herbicides. As of 2015, barnyardgrass biotypes have been documented to be resistant to five herbicide modes of action (MOA) including WSSA Groups 1 (ACCase), 2 (ALS), 4 (synthetic auxins), 7 (PSII), and 13 (DOXP). It is important for new MOAs to be used in rice production to assist in preventing further spread of resistance. Topramezone, a Group 27 (HPPD herbicide) is currently used in corn production for control of broadleaves and some annual grasses, including barnyardgrass under the tradenames Armezon® and Impact®. Although topramezone is not labeled in rice, other HPPD-inhibiting herbicides have been effectively used in the past for control of rice weeds. Field studies were conducted during the summer of 2016 at the University of Arkansas-Pine Bluff Research Farm near Lonoke, Arkansas to assess crop tolerance and level of weed control. Treatments in both tests included Armezon alone at 0.5 fl oz/acre (1/2X proposed labeled rate) and 1.0 fl oz/acre (1X proposed labeled rate) and in combination with 6 common rice herbicides including Facet L®, Ricestar HT®, Riceshot® LC, Newpath®, Sharpen®, and Command® 3ME. All treatments were applied when the rice was at the 3- to 4-leaf growth stage. Results from the weed control study show that barnyardgrass control increased when Armezon® was tank mixed at both 1/2X and 1X and, for some mixtures, a tank-mix interaction was identified using Colby's Method. For example, 4 weeks after treatment (WAT), a synergistic interaction was observed for Armezon (1X) + Command, which controlled barnyardgrass 97% compared to either Armezon (79%) or Command (52%) alone. Antagonism was observed for Armezon (1X) + Sharpen (65%) compared to Armezon (79%) or Sharpen (27%) alone. Crop injury in the rice tolerance study was less than 10% for all treatments. It appears that topramezone could safely and effectively be incorporated in Arkansas rice weed control programs as a tank-mix option; however, tank mixtures that result in antagonism should be avoided.

Residual Activity of thiencarbazone-methyl and Other Residual Herbicides.

Z.D. Lancaster*, J.K. Norsworthy, J.K. Green, C.J. Meyer, and N.R. Steppig. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

With the spread of herbicide resistance across the Midsouth, growers are increasingly relying on residual herbicides to achieve season-long weed control. With the pressure that herbicide-resistant weeds place on current residual herbicides, new options are needed to effectively rotate herbicide modes of action, and slow the evolution of additional herbicide resistance. Bayer CropScience is currently evaluating thiencarbazone-methyl (TCM), an acetolacate synthase (ALS)-inhibiting herbicide, which could provide preemergence and postemergence activity on many troublesome weeds in soybean. A field experiment was conducted at the Agricultural Research and Extension Center in Fayetteville, Arkansas in the summer of 2016 to determine the residual activity of TCM compared to several common residual herbicides. The experiment was set up as a two-factor randomized complete block design, with the first factor being TCM rate and the second factor being tank-mix partner. Herbicides mixed with TCM were evaluated at labeled rates and included Dual Magnum, Valor, Zidua, Tricor, and Balance. TCM was applied at 0, 0.03, and 0.06 lb ai/A. Herbicides were applied to freshly tilled soil. Data were collected on Palmer amaranth (*Amaranthus palmeri*), pitted morningglory (*Ipomoea lacunosa*), entireleaf morningglory (*Ipomoea hederacea*), yellow nutsedge (*Cyperus esculentus*), and broadleaf signalgrass (*Urochloa platyphylla*) control at 14, 28, 42 days after application (DAA). Overall, TCM provided excellent control of broadleaf signalgrass with 94% and 97% respectively for 0.03 and 0.06 lb ai/A at 28 DAA. Control of the native ALS-resistant Palmer amaranth population only 69% with 0.06 lb ai/A of TCM at 28 DAA. However, the addition of 0.06 lb ai/A of TCM to the labeled rate of Tricor resulted in a significant increase in Palmer amaranth control with 84% control from Tricor alone and 96% control from Tricor + 0.06 lb ai/A TCM. Likewise, the addition of 0.06 lb ai/A TCM to Dual Magnum increased entireleaf morningglory control from 75% alone to 100% with TCM. This research shows that TCM alone provides excellent residual weed control of broadleaf signalgrass, both morningglory species, and yellow nutsedge, with some added Palmer amaranth control (48 to 69%). Furthermore, the addition of TCM increases the spectrum of activity and length of residual control for many common residual herbicides.

Comparison of Rice Tolerance to Several Very-Long-Chain Fatty Acid Inhibiting Herbicides.

J.A. Godwin*, J.K. Norsworthy, R.C. Scott, M.L. Young, R.R. Hale, and M.R. Miller. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Very-long chain fatty acid (VLCFA)-inhibiting herbicides have been used widespread in U.S. corn (*Zea mays*), cotton (*Gossypium hirsutum*), and soybean (*Glycine max*) production, along with Asian rice (*Oryza sativa*). Due to the resistance evolution of problematic weeds in U.S. rice production such as barnyardgrass (*Echinochloa crus-galli*) and red rice (*Oryza sativa*), it is important that alternate herbicide sites of action be integrated when possible. If appropriate tolerance can be established, VLCFA-inhibiting herbicides may be a viable option to combat herbicide resistance in rice. The hypothesis of this experiment was that at least one VLCFA-inhibiting herbicide could be applied to rice with minimal crop injury. In this experiment, VLCFA-inhibiting herbicides including pethoxamid, acetochlor, pyroxasulfone, and S-metolachlor were evaluated for rice tolerance in 2015 and 2016 following a delayed preemergence, spiking, and 1- to 2-leaf rice application. Herbicides were applied at the following rates: pethoxamid at 0.75 lb ai/A, acetochlor at 0.95 lb ai/A, pyroxasulfone at 0.05 lb ai/A, and S-metolachlor at 0.95 lb ai/A. Much more injury was observed in 2016 than in 2015 across all treatments due to differences in timing and amount of rainfall. However, in both years, less injury occurred with all herbicides from applications at later rice growth stages. Rice treated with pethoxamid or acetochlor at the 1- to 2-leaf rice stage showed the least amount of injury across all ratings, and no significant reduction in yield compared to the nontreated control. In 2016, rice injury of up to 49% from pyroxasulfone and 82% from S-metolachlor applications occurred, even at the 1- to 2-leaf rice stages. In 2015, rice treated with S-metolachlor and pyroxasulfone had statistically less density and height compared to the nontreated control. In 2016, rice density was decreased compared to the nontreated control for all treatments except for the 1- to 2-leaf rice treatments of pyroxasulfone, pethoxamid, and acetochlor, and 2016 crop height was decreased compared to the nontreated control for all treatments other than the 1- to 2-leaf rice treatments of pethoxamid and acetochlor. Due to little injury and reduction in yield to rice from pethoxamid and acetochlor at later application timings, these herbicides should be further pursued for the control problematic weeds in rice.

Comparison of Soil-Applied ALS-Inhibiting Herbicides on Conventional and Inzen Grain Sorghum.

H. Bowman*, T. Barber, J.K. Norsworthy, N. Steppig, J. Rose, A. Ross, and M. Houston. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Grain sorghum (*Sorghum bicolor*) was harvested on more than 430,000 acres in Arkansas in 2015; a significant increase from the 135,000 acres harvested in 2014. As such, the need for a more effective weed control program for grass species was apparent. DuPont™ recently announced the development of a new, non-GMO crop herbicide trait called Inzen™ which provides grain sorghum tolerance to acetolactate synthase (ALS) herbicide. Nicosulfuron, an ALS herbicide used in corn for grass weed control, was recently labeled for use in Inzen™ grain sorghum. DuPont's nicosulfuron-based Zest™ is an ALS-inhibiting herbicide within the Sulfonylurea family that provides control of many grasses including johnsongrass (*Sorghum halepense*). With this new tolerance trait and herbicide, there is a need for research to assess crop tolerance to Zest™ and other ALS herbicides. Tests were conducted in 2016 at the Arkansas Agriculture Research & Extension Center in Fayetteville; Lon Mann Cotton Research Station in Marianna; and Pine Tree Research Station near Colt to evaluate the tolerance of conventional and Inzen™ varieties to preemergence-applied ALS herbicides. ALS-inhibiting herbicides from five different families were represented in each test. Plots were arranged using a split-plot design with grain sorghum cultivar representing the main plot. Herbicide treatments were arranged in a randomized complete block design for each cultivar across four replications. Results were averaged across all locations at three weeks after application show that the conventional cultivar displayed wide ranging crop injury from all five herbicide families, while the Inzen™ cultivar displayed little to no injury, regardless of herbicide applied. Zest (sulfonylurea family) applied preemergence to the conventional cultivar caused 54% injury, while Permit caused minimal injury (less than 1%) averaged across all locations. Permit is labeled in grain sorghum, thus the lack of injury was expected. Herbicides from the imidazolinone family such as Cadre, caused 93% injury while applications of Scepter® averaged 16% injury. Herbicides from the triazolopyrimidine family such as FirstRate 84 DG®, Phython®, Grasp®, and Strongram® resulted in relatively similar injury on the conventional cultivars from all treatments. The pyrimidinyl(thio)benzoate family, caused 83% injury with Staple® and 3% average injury from Regiment®. The sulfonlyaminocaronyl-trazolino family was also injurious, depending on which herbicide was used. Conventional grain sorghum was injured 99% with thiencarbazone-methyl but only 13% injury with Everest®. These results prove that herbicide injury on conventional sorghum cultivars varies depending on which ALS-inhibiting herbicide is used and is not strongly dependent on herbicide family. However, the Inzen™ cultivar displayed a wide range of tolerance to most ALS herbicides, which will result in promising new alternatives for weed control in grain sorghum with this technology.

Why Does Variability Exist Among Soybean Cultivar Chloride Inclusion/Exclusion Ratings.

D.D. Cox*, N.A. Slaton, T.L. Roberts, R.E. DeLong, T.L. Richmond, and D.A. Sites. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Soybean [*Glycine max* (L.) Merr.] varieties are known to differ in their sensitivity to chloride (Cl) toxicity and are classified as Cl-excluders that are more tolerant and perform better than sensitive Cl-includer varieties in field environments with excess Cl. Soybean varieties are screened and assigned a Cl-rating based off of the response of five plants exposed to high Cl concentrations in a hydroponic growing medium. This method sometimes produces inconsistent Cl ratings, which most commonly involve varieties receiving a Cl-includer or -excluder rating in one year and a mixed Cl-rating in another year. Our objective was to field evaluate the variability in leaf-Cl concentration across multiple soybean varieties representing each Cl-rating.

The field experiment included eleven total varieties with five categorized as Cl includers (Armor 47-R13, Armor 47-R70, Asgrow 4934, Dynagro S52RY75, Pioneer 49T09BR), four Cl excluders (GoSoy 4914GTS, NK S48-D9, Pioneer 49T80R, Progeny 4900RY), and two segregating or mixed varieties (Asgrow 5233 and Progeny 5333RY). Soybeans were planted on raised beds in strips that were 200 m long and 8-rows wide. Once plants reached the V6 growth stage, 16 individual plants in the two center rows were selected at random and flagged in three different blocks (48 plants per variety). At the R2 growth stage, the top four trifoliate leaves (trifoliolate leaf and petiole) of each individual plant were collected, dried, ground, tissue Cl was extracted with water, and the extract was analyzed for Cl providing the Cl concentration of 528 individual plants (48 individual plants of each variety).

This study aims to answer two questions: do individual plants of a single variety have similar leaf-Cl concentrations, and why are variety Cl ratings inconsistent among years or screening times? Spatial variability in the form of plant location in the field (Block) had no significant (P-value = 0.33) effect on Cl concentration ensuring that differences were due to the Cl rating and not due to Cl movement with irrigation water or soil properties. Leaf-Cl concentrations averaged across plants within a single variety ranged from 221 mg Cl kg^{-1} ($\sigma = 55$ mg Cl kg^{-1}) to 3309 mg Cl kg^{-1} ($\sigma = 2092$ mg Cl kg^{-1}).

Plants of the four varieties categorized as Cl-excluders were comprised of 13 to 100% with very low Cl concentrations of <500 mg Cl kg^{-1} and 0 to 72% of the plants with low Cl concentrations between 501 and 1000 mg Cl kg^{-1}. The varieties rated as Cl-includers contained no plants with very low Cl concentrations and from 0 to 34% of plants with low Cl concentrations. The two varieties rated as 'mixed' had 43 to 79% of the plants with very low Cl concentrations and 4 to 11% with low Cl concentrations. Only one variety (Pioneer 48T80R) had 100% of its plant population as Cl excluders.

The results indicate that true Cl-excluder plants have low and similar Cl concentrations, Cl-includer plants have Cl concentrations that are 7 to 10 times greater than excluder plants, and some varieties are a mixed population of Cl includer and excluder plants. The greenhouse screening method uses only five plants which is unlikely to consistently identify the correct Cl trait and a different screening method is needed to improve accuracy.

Horizontal Transmission of Helicoverpa Nucleopolyhedrosis Virus (NPV) in Soybean Fields Infested with Corn Earworm, Helicoverpa zea.

J. Black* and G.M. Lorenz. Dept. of Entomology, University of Arkansas, Fayetteville, AR.

Helicoverpa armigera nuclear polyhedrosis virus (NPV) known as *Hear*NPV, is a viral biopesticide used to control corn earworm, *Helicoverpa zea*, populations. These viruses are very host specific and pose no threat to off-target species. NPV's are known for reaching high epizootic levels and in many cases can persist in the environment for extended periods. The virus is applied like other foliar insecticides and once ingested by a larva it multiplies within the host. Once the infected host dies it liquefies and becomes a "virus factory" resulting in horizontal transmission to infect other corn earworm larvae. Several well documented routes of horizontal transmission have been previously observed, including transmission via predators, parasitoids, other larvae, and viral replication within initially infected larvae. Horizontal transmission is an important aspect of *Hear*NPV when considering it as an effective insecticide, however; only lab studies have sought to quantify the horizontal transmission. The objective of this study was to quantify the horizontal transmission of *Hear*NPV when applied to soybean fields infested with corn earworm.

Horizontal transmission was evaluated by spraying a 50' by 50' area with *Hear*NPV, and taking 3 samples within zones of distance including 0, 0-25, 25-50, 50-100, and 100-200 feet from the application. Samples were taken pretreatment, 3, 7, 14, and 21 days post application. Polymerase chain reaction (PCR) was conducted to determine the presence of *Hear*NPV within each sample. *Hear*NPV was only found in the area initially sprayed 3 days after application, but by 7 days it was found 100 feet from the initial application. Fourteen days post application the *Hear*NPV was only found in three of the samples: 1 at 0 feet, 1 at 50 feet, and 1 at 100 feet. At 21 days no virus was detected. This data suggests that horizontal transmission of *Hear*NPV peaks 7 days after application and dissipates by 21 days.

Field Characterization of Warrant in Mid-South Rice.

M.E. Fogleman*, J.K. Norsworthy, Z.D. Lancaster, N.R. Steppig, and R.C. Scott. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Evolution of resistance to common rice herbicide chemistries such as acetolactate synthase (ALS) and acetyl-CoA carboxylase (ACCase) inhibitors continue to complicate weed management strategies for growers in the state. Alternative herbicide modes of action are needed to combat problematic weeds of rice such as barnyardgrass (*Echinochloa crus-galli*) and red rice (*Oryza sativa*). Very-long chain fatty acid-inhibiting (WSSA Group 15) herbicides such as acetochlor have relatively low risk for evolution of resistance and could have a potential fit in Arkansas rice. A field experiment was conducted in 2016 to evaluate the efficacy of acetochlor, formulated as Warrant, in several different rice herbicide programs. The experiment was designed as a three-factor randomized complete block design with factors being 1) herbicide, 2) rate, and 3) timing along with a nontreated, weedy control for comparison. The herbicides included Warrant (acetochlor at 0.94 and 1.31 lb ai/A), Command (clomazone at 0.3 lb ai/A), Newpath (imazethapyr at 0.06 lb ai/A) and Facet L (quinclorac at 0.38 lb ai/A). Warrant or Command was applied delayed preemergence (DPRE) 1) alone, 2) followed by Newpath early-postemergence (EPOST), or 3) followed by Newpath EPOST followed by Newpath pre-flood (PREFLD). Newpath was also applied EPOST followed by PREFLD without additional herbicides. At 2 weeks after planting (WAP), >90% control of barnyardgrass was observed for all Command treatments while Warrant provided 64% and 71% control at the low and high rate, respectively. At 40 days after PREFLD application, both programs containing Command provided ≥99% control of barnyardgrass, while Warrant-containing programs provided ≥96% control. No more than 6% injury was observed from all treatments, and those programs consisting of Command or Warrant yielded ≥ 200 bu/A, indicating that Warrant used in a rice herbicide program is comparable to standard programs used today.

Effectiveness of Herbicide Programs in Bollgard II Xtend Cotton in the Absence of Tank-Mix Partners with Dicamba.

J.S. Rose*, L.T. Barber, J.K. Norsworthy, H.D. Bowman, and A.W. Ross. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Roundup Xtend technology was released for planting in cotton and soybean in 2016. However, no label was issued for any herbicides containing dicamba for use in Xtend technology. Proposed dicamba labels state that tank mixtures of dicamba with other herbicides such as glufosinate or metolachlor will not be allowed. Tank-mix partners are known to potentially increase efficacy of targeted species and also aid in the prevention of weed resistance development. Tests were conducted in 2016 at the Lon Mann Cotton Research Station near Marianna, AR and the Rohwer Research Station near Rohwer, AR to determine the effectiveness of dicamba herbicide in Bollgard II XtendFlex cotton when applied in absence of a residual or postemergence tank-mix partner. This experiment was conducted using Deltapine 1518 Bollgard II XtendFlex cotton cultivar and was arranged using a randomized complete block design. Treatments consisted of postemergence and preemergence herbicide combinations alone and in tank mixtures with dicamba at multiple timings. Treatments were applied at 40 PSI using a TTI 110015 nozzle on 19-inch spacing at the rate of 12 gallons per acre with a tractor-mounted sprayer. Weed control data recorded at 3 weeks after preemergence application indicated the plots where Brake FX was applied had a higher level of control of Palmer amaranth than those where Cotoran (fluometuron), Warrant (acetolchlor), or Clarity (dicamba) were applied. This also holds true for the control of morningglory. When comparing the application timing of Clarity to applications containing a tank-mix of Roundup (glyphosate) and Dual Magnum (S-metolachlor) or Liberty (glufosinate) and Dual Magnum, or Clarity applied in sequential applications, differences in control were observed. Applications where Roundup and Dual Magnum were followed by Clarity saw a reduction in control of Palmer amaranth 3 weeks after both applications (less than 70% control), in relation to the others where Clarity was followed by Clarity or when Clarity was applied either before or after applications of Roundup and Dual Magnum or Liberty and Dual Magnum (greater than 90% control). Similar results were seen in the control of morningglory. When looking at the control of broadleaf signalgrass and goosegrass, treatments where Roundup and Dual Magnum were applied at a later timing saw a higher level of control (greater than 95% control) than treatments where Liberty and Dual Magnum were tank mixed (less than 80% control) or Clarity was applied alone. Based on this research, control of Palmer amaranth, morningglory, and grasses is affected based on timing of when applications of Clarity are made in relation to tank mixes of Liberty or Roundup or Dual Magnum or if Clarity is applied alone.

Preemergence and Postemergence Control of PPO-Resistant Palmer Amaranth in LibertyLink Soybean.
M. Houston*, T. Barber, J.K. Norsworthy, J. Rose, H.D. Bowman, and A. Ross. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Producers in Arkansas plant an average of 3 to 3.3 million acres of soybean each year. The rapid spread of glyphosate-resistant Palmer amaranth across the state has resulted in growers relying heavily on PPO (protoporphyrinogen oxidase) herbicides such as Valor® (flumioxazin) and Flexstar® (fomesafen). In 2015, samples of Palmer amaranth populations resistant to common PPO herbicides were identified. In 2016, PPO-resistant Palmer amaranth spread to at least 15 counties in eastern Arkansas. With PPO herbicides becoming a limited option in some parts of Eastern Arkansas, postemergence (POST) control of Palmer amaranth has become a bigger issue. With crop traits such as LibertyLink® in soybeans, applications of glufosinate (Liberty®, Cheetah®, Interline™) can control Palmer amaranth more effectively than alternative POST options in a Roundup Ready® system. In 2016, trials were conducted on farms near Crawfordsville, Gregory, and Marion, AR with populations of PPO-resistant Palmer amaranth. These trials were designed as randomized complete blocks with four replications. The objective of these trials was to determine effectiveness of commonly used preemergence (PRE) herbicides in a Liberty Link® soybean system. Preliminary results show that PRE herbicide programs consisting of only PPO herbicides such as Valor® have a significant decline in control versus treatments with multiple herbicide modes of action (MOA). Valor, one of the most widely used herbicides in soybeans, at 21 days after treatment (DAT) had an average control rating of 75% or less. PRE options that provided 85% control or higher at 21 DAT were Boundary® 6.5EC, Zidua® (pyroxasulfone) + Verdict®, Canopy® (metribuzin + chlorimuron ethyl), and Fierce® (flumioxazin + pyroxasulfone). Data also show that for plots with declining control, Liberty tank mixed with Prefix™ (s-metolachlor + fomesafen) can regain some control. At the Marion location, two applications of Liberty were made, the first with Prefix and the second without (15 days apart). After the first application, control in the Valor plots was increased to 65% and 73%% after the second application of Liberty. Boundary 6.5EC plot control increased by 4.75% after the first application, and did not change significantly after the second application of Liberty. Liberty treatments were more effective in a program for weed control after a solid PRE herbicide program due to the overall loss of control from the PPO herbicides like Valor, Sonic®, and Surveil™. PPO-resistant Palmer amaranth can be managed through the use of multiple herbicide MOA PRE followed by two applications of Liberty plus a residual POST as long as Liberty applications are made prior to pigweed reaching 6 inches tall.

Effect of Delaying the Preflood Nitrogen Application and Flood on Rice Nitrogen Uptake and Yield.

T.L. Richmond*, N.A. Slaton, J.T. Hardke, T.L. Roberts, R.J. Norman, D.D. Cox, and D.A. Sites. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Urea-N fertilizer is typically applied at the 5-leaf stage to rice (*Oryza sativa* L.) grown in a dry-seeded, delayed-flood production system. Application of urea to a dry soil is needed to maximize fertilizer-N recovery efficiency (FNRE) and rice grain yield potential. How long the preflood-N can be delayed without an adverse effect on yield potential is poorly understood and requires additional research because untimely and frequent rainfall events may occur for two or more weeks and prevent preflood fertilizer application. Our objective was to determine the effects of delaying preflood-N fertilizer application and flooding past the 5-leaf stage on growth and grain yield of rice grown on silt loam soils. Trials were established at two locations during 2016 using the ‘Roy J’ rice cultivar. This presentation will focus on the response of Roy J rice to flood time at the Pine Tree (PTRS) and Stuttgart (RREC) locations. Urea-N fertilizer was applied at 0, 40, 80, 120, and 160 lb acre^{-1} on six or seven different dates spanning 6 or 7 weeks (227-1843 DD50 units) with urea-N applications beginning near the 3-leaf growth stage (350 DD50 units). Aboveground-N content at early heading was measured for Roy J and grain yield was measured for all cultivars and hybrids. Regression analysis was performed to examine how each growth variable was affected by time expressed as growing degree units after rice emergence (e.g., DD50). The model allowed for linear and quadratic terms of flood times while the intercepts were dependent upon urea-N rate.

Aboveground-N content within each site was a positive linear function of time with only the intercept depending on preflood urea-N rate. At both locations, N-uptake by rice receiving no fertilizer-N increased as flooding was delayed indicating that FNRE was constant across time for each N rate. The FNRE, calculated using the difference method, averaged 81% (σ =4%) at PTRS and 94% (σ =9%) at RREC.

At the PTRS, grain yield was a quadratic response of urea and flood application time and was characterized by each urea-N rate having unique intercept, linear slope, and quadratic slope coefficients. Maximum yield was produced when 160 lb urea-N acre^{-1} was applied 425 DD50 units after rice emergence. The optimal cumulative DD50 units for preflood-N application increased as the urea-N rate decreased with yields ±5% of the maximum produced when fertilization and flooding occurred between 300 and 800 DD50 units at the PTRS. At the RREC, grain yield was a linear response of urea-N and flood application time and was characterized by each urea-N rate having unique intercept and linear slope coefficients. Maximum yield was produced when 160 lb urea-N acre^{-1} was applied at 227 DD50 units, the earliest flood time. However, yields ±5% of the maximum were produced when fertilization and flooding were delayed until 1200 DD50 units. Plant development and maturity were also delayed by delaying urea-N application and flood time. Based on the results from two sites in 2016, preflood fertilizer-N and flood application can be delayed up to 800 DD50 units with minimal effect on grain yield.

Efficacy of Selected Insecticides and Rates for Control of Tarnished Plant Bugs in Cotton.

L. Rice*, G.M. Lorenz, and N. Taillon. Dept. of Entomology, University of Arkansas, Fayetteville, AR.

Tarnished plant bug (TPBs; *Lygus lineolaris*) is the most important pest in cotton (*Gossypium spp.* L.) in the Mid-South. The objective of this study was to evaluate the efficacy of flonicamid (Carbine) and imidacloprid (Admire Pro) at label and above label rates compared to the established standards, sulfoxaflor (Transform) and acephate, for control of TPBs. Treatments included Carbine at the rates of 1.7, 2.85, which are the current labeled rate range & 4.2 oz/acre which is above the rate range. Admire Pro was applied at the current labeled rate of 1.7, as well as 2.0, 2.5, & 3.0 oz/acre. The standard use rates were acephate at 0.75 lb/acre, and Transform at 2.0 oz/acre. Assessments were taken 3 days after the first application; 3, 8, 11, and 14 days after the second application. After raising the rates of both Carbine and Admire Pro, results indicated that neither product even at the higher rates were very effective for plant bugs.

Response of Non-Xtend Soybean to Low Rates of Dicamba and Glyphosate Applied During Reproductive Development.

G.T. Jones*, J.K. Norsworthy, L.T. Barber, J.A. Godwin, J.K. Green, M.E. Fogleman. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Monsanto's Xtend cotton and soybean varieties, engineered for resistance to dicamba, have been deregulated by the EPA and were commercially launched in 2015 and 2016, respectively. A full registration for use of dicamba over-the-top of soybean and cotton is being sought, but the timeline for its approval is uncertain. It is well known that non-dicamba soybean is highly sensitive to dicamba. However, there is limited knowledge on the effect of low drift rates of dicamba plus glyphosate tank mixes on soybean – a likely mixture to be used on vast acres of dicamba/glyphosate-resistant soybean. The objective of this study was to assess the risk to glufosinate-resistant soybean when drift rates of dicamba and glyphosate are applied in combination and alone. Experiments were established in 2015 and 2016 at the Arkansas Agricultural Research and Extension Center in Fayetteville, AR and the Pine Tree Research and Extension Center near Colt, AR. When drift rates of dicamba, glyphosate, and dicamba plus glyphosate were applied at R1, R3, and R5, the addition of glyphosate to dicamba (35%) significantly increased injury to R1 soybean over dicamba alone (29%) at 28 days after application. Pod malformation at maturity resulting from R3 application was also significantly greater when the two herbicides were applied in mixture (53%) versus dicamba alone (37%). The effect seen by the addition of dicamba to glyphosate could be somewhat explained by herbicide coverage but additional factors may be contributing to the increased injury. Experiments conducted at the Pesticide Application Training Laboratory in North Platte, NE revealed the addition of glyphosate to dicamba decreases the volume median diameter of spray droplets. Increasing the percentage of fine droplets associated with a spray solution may result in greater coverage and absorption, leading to increased amounts of the herbicide entering the plant and causing the observed injury.

Wheat Tolerance to Standard and New Herbicides.

T. Penka*, N. Burgos, and C. Rouse. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Many herbicides are labeled for wheat in the US. However, wheat producers in Arkansas have less herbicide options for preplant (PPL), preemergence (PRE) or delayed-preemergence (DLYPRE) timings. Herbicides such as Valor SX (flumioxazin), Fierce (flumioxazin + pyroxasulfone), Zidua (pyroxasulfone), Bolero (thiobencarb), Command (clomazone), and Sharpen (saflufenacil) could help broaden this range of options for producers. This experiment aimed to evaluate these herbicides, as well as new compounds, at early-season to tillering application timings for crop safety in wheat.

Two field experiments were conducted in November 2015 through June 2016 at both the Arkansas Vegetable Research Station (VRS), Kibler and the Arkansas Agricultural Research and Extension Center (AAES), Fayetteville, Arkansas. The experiments were setup in randomized complete block design (RCBD) with four replications. The early-season applications included a 14 day preplant (14 D PPL), seven day preplant (7DPPL), preemergence, delayed preemergence , spike, and two-leaf (2LF) applications. Wheat (Croplan SRW 9606) was planted at 100 lb/A on November 3, 2015 at the VRS and on November 10, 2015 at the AAES. In each location, 100 pounds of nitrogen was applied two months after planting. The crop was not irrigated the whole season and was harvested on June 10, 2016 at the VRS and June 13, 2016 at the AAES.

In trial 1, high rates of Valor SX (3 oz/ac), Fierce (3 oz/ac), and Zidua (1.5 oz/ac) caused the highest injury (50-75%) 14DPPL. The high rate of Fierce also caused the greatest injury (25%) at the AAES at 14DPPL. The number of plants per square foot did not differ between treatments at the AAES location, but at the VRS where injury was greater than 50%, stand loss was significant. The Valor SX, Fierce, and Zidua treatments all had 11 plants/ft^2 whereas the non-treated check had 23 plants/ft^2. Injury from the treatments mentioned above declined to 40-48% at 6WAP, and dropping further to 20% at 9WAP in both locations. Three months after planting, the most injury observed (15-20%) was with the high rate of Zidua and Fierce at both locations. The spike and 2LF applications caused less than 10% injury at this time. Despite the high injury observed in some treatments, wheat recovered fully and there was no difference in yield between treatments. The yield ranged from 38 to 50 bu/ac in Kibler and 55 to 71 bu/ac in Fayetteville.

In trial 2, in both locations, the high rate of Command (0.8 pt/ac; PRE) caused around 75% injury at 3WAP while Sharpen caused the least injury at 7.5%. At 6 WAP, injury from Command had dropped only slightly (60-70%). The 2LF applications did not cause any injury. Three months after application, wheat sprayed with the high rate of Command PRE still showed 60% injury. Even with the high injury with this treatment, wheat yield was still comparable to the nontreated check. Yields at both locations averaged 55 bushels per acre. The impact of these herbicides should be further evaluated in additional years to determine consistency of crop response to these herbicides.

Benzobicyclon: A New Opportunity for Control of Weedy Rice.

M. Young*,[1], J.K. Norsworthy[1], R.C. Scott[1], C. Sandoski[2], and M. Moore[1]. [1]Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR; [2]Gowan Co.

Rice growers in the Midsouth are running out of viable options to control weeds that have evolved herbicide resistance. With increasing selection pressure on currently registered herbicides, a new mode of action is needed in rice production. A new post-flood herbicide, benzobicyclon, is being developed by Gowan Company. Benzobicyclon, a Group 27 herbicide, controls a broad spectrum of grasses, aquatics, broadleaves, and sedges, including those currently resistant to Group 2 herbicides. This will be the first 4-hydroxyphenylpyruvate dioxygenase (HPPD) herbicide commercially available in U.S. rice production. In

2015, an unexpected observation was made from a field study conducted at the Rice Research and Extension Center near Stuttgart and at the Pine Tree Research Station near Colt, Arkansas. At both locations, bays treated post-flood with benzobicyclon at 247 or 494 g ai/ha had a high level of weedy rice control relative to bays not containing benzobicyclon. This observation prompted a greenhouse evaluation in the spring followed by a field evaluation in the summer of 2016 of the efficacy of benzobicyclon on weedy rice accessions collected across Arkansas, Mississippi, and southeast Missouri. A total of 100 accessions were screened in the greenhouse and field. Percent mortality ratings were collected in the greenhouse and percent control was reported in the field. It appears that benzobicyclon at 371 g ai/ha plus 1% crop oil concentrate will effectively control 29% of the accessions in the greenhouse and 29% of the accessions in the field, based on a minimum acceptable level of 80% mortality or control. This implies that the sensitivity of weedy rice to benzobicyclon varies tremendously across the Midsouth and more research must be conducted to investigate why.

The Effects of Soil Temperature, Moisture, and Texture on Field-Scale Spatial Variability of Cotton Stands and Seedling Diseases.

K.D. Wilson*, C.S. Rothrock, and T.N. Spurlock. Dept. of Plant Pathology, University of Arkansas, Fayetteville, AR.

Seedling diseases are important factors in cotton stand establishment and seedling disease pathogens are widespread in fields in Arkansas. However, little is known about the variability of seedling disease pressure within fields. As planting rates decrease to reduce input cost, predicting seedling disease pressure becomes of greater importance to cotton producers. The cotton seedling disease pathogens include the soilborne pathogens *Thielaviopsis basicola*, *Rhizoctonia solani*, *Pythium spp*., and *Fusarium spp*. These pathogens can survive in soil for long periods and act individually or in combination to cause a range of symptoms on seed, roots and hypocotyls which affect germination, emergence, and early-season growth and development of the crop when the environment is conducive. Cool and wet soils are known for being favorable for disease, which are often the conditions many cotton producers encounter at planting.

In this study, trials were planted in 2014, 2015, and 2016 at Judd Hill Cooperative Research Foundation in Poinsett County in Northeast Arkansas. The field examined was planted in 5, 4 row strips in which each strip was divided into 10, 15.25 meter long replicates. Each 4-row replication had a randomly selected row planted with Delta Pine 1044B2RF (*Gossypium hirsutum*) seed which was treated with one of each of the four fungicide seed treatments. Treatments were (1) non-treated, (2) Allegiance FL, (3) RTU-PCNB, and (4) Vortex + Spera + Allegiance + Evergol Prime + Evergol Energy. Minimal soil temperature, soil water content, and soil texture were measured for each replication 1 and 5 days after planting and marked with a GPS unit. Stands were counted 21 days after planting. Moran's *I* was calculated for each variable to determine spatial auto correlations, and regression analyses were performed to model the relationships between variables.

Under favorable planting conditions in 2014 and 2016, stand counts were strongly associated with the spatial variability of soil temperature, but under cool and wet planting conditions of 2015, stand counts were found to be less associated with spatial variability of soil temperature. Stand improvement from fungicide seed treatments increased where soil temperature decreased and decreased where soil temperature increased in the three years of this study. Unpredictable weather in the spring often leads to difficult planting decisions for producers in the Mid-South. This research may be valuable for producers when looking at soil environment for assistance in determining planting dates and seeding rates. This study also supports the use of combination fungicide seed treatments across various soil environments for preventing stand loss from seedling diseases. In addition, this research suggests the field-scale spatial variability of seedling disease pressure may be predicted based on easily measurable soil factors which would be valuable for site-specific management practices.

Influence of Soybean Maturity Group on Yield and Soil-Nitrogen Credits.

C. Ortel*, T.L. Roberts, J.T. Hardke, R.J. Norman, N. Slaton, and L. Purcell. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Soybean (*Glycine max*) is a common crop used in rotation with rice (*Oryza sativa*) in Arkansas. The biological N fixation which soybean plants conduct through a symbiotic relationship between the nodules on the soybean root and rhizobia bacteria, *Bradyrhizobium japonicum*, found in the soil is one of the benefits of this rotation. Soybean maturity group influences the amount of time spent in vegetative growth stages and the growth habit of the plant as determinate or indeterminate, which can impact overall soybean yield and the total amount of N fixed by the crop.

It is hypothesized that the maturity group of soybean and the overall yield potential will have a direct impact on the amount of N credits in the soil, allowing for a more specific N fertilizer recommendation for the following rice crop. Such a relationship can be used to help select the best maturity group of soybean for a cropping system and help increase N use efficiency within the soybean-rice rotation. The objective of this study is to determine the impact made on N credits in the soil from different maturity groups of soybean and to determine the influence on the following rice crop’s response to fertilizer-N, total N uptake and yield.

Different maturity groups of soybean grown in the same field produce a different yield due to day length sensitivity. Relative maturity groups 3.5, 4.7, 5.4, and 5.6 were grown in a randomized block design at Pine Tree Research Station in Colt, Arkansas in 2016. The field was planted on June 9, 2016 on a Calhoun Silt Loam soil, and organized as sixteen rows of soybean 1.7 m wide by 45.7m deep. Analysis of variance indicated yield differences between the four relative maturity groups. The MG 3.5 produced an average of 2380 kg/ha, 5.6 relative MG produced 3020 kg/ha, relative MG 4.7 produced 3115 kg/ha, and 5.4 relative MG produced 2797 kg/ha. Statistically this showed significant differences between the groups, with relative maturities 4.7 and 5.6 statistically equal, followed by relative maturity 5.4, and relative maturity 3.5 with the lowest overall yield.

During the spring, following soybean harvest, soil samples will be collected from each block of the soybean maturity groups to estimate potential differences in N credits using N-STaR the Nitrogen Soil Test for Rice. The following rice crop will receive six different treatments of N rates including 0 kg/ha, 45 kg/ha, 90 kg/ha, 135 kg/ha, 180 kg/ha, and 225 kg/ha; all as a single pre- flood treatment of urea. This same experimental design, along with an added fallow strip for comparison, will be repeated again at multiple locations and years to collect a minimum of six site years of data.

Barnyardgrass Control with Sharpen Tank-Mixes in Provisia Rice.

R.R. Hale*, J.K. Norwsworthy, Z.D. Lancaster, J.A. Godwin, and R.C. Scott. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Barnyardgrass [*Echinochloa crus-galli*] is one of the most problematic weeds in Midsouth rice production. The physiological and biochemical capability of barnyardgrass to quickly evolve resistance continues to limit herbicide options for control. Provisia™ rice is a new technology being developed by BASF that will allow for the use of Provisia herbicide (quizalofop), an acetyl CoA carboxylase inhibitor, for control of grass weeds. Sharpen is a contact herbicide labeled for broadleaf weed control in rice. When tank-mixing systemic herbicides with contact herbicides, antagonism or a reduction in efficacy is often observed. Hence, field studies were conducted at the Pine Tree Research Station (PTRS) near Colt, AR in 2015 and 2016, and the University of Arkansas Pine Bluff Farm (UAPB) near Lonoke, AR in 2016 to determine whether the addition of Sharpen with grass herbicides in Provisia rice reduces barnyardgrass control. The experiment was arranged as a randomized complete block design with three common rice herbicides applied at the 1/2X and 1X rate with and without a 1/2X and 1X rate of Sharpen. Treatments were applied when barnyardgrass reached the 3- to 4-leaf growth stage, and all treatments contained crop oil concentrate (COC) at 1% (v/v). Treatments contained a 1/2X and 1X rate that included Sharpen at 0.5 and 1 fl oz/A, Clincher at 7.5 and 15 fl oz/A, Ricestar HT at 12 and 24 fl oz/A, and Provisia at 10.3 and 20.7 fl oz/A, respectively, along with a nontreated check. An additive response was observed with the addition of Sharpen for barnyardgrass control at 2 and 4 to 5 weeks after treatment (WAT) at all site years. Based on Colby's method for assessing herbicide interactions, antagonism was observed for the 1/2X rate of Clincher + Sharpen in 2015 at PTRS and 2016 at the UAPB farm, the 1X rate of Ricestar HT + Sharpen in 2015 and 2016 at PTRS, and the 1X rate of Provisia + Sharpen in 2016 at PTRS and the UAPB farm. At 4-5 WAT, antagonism was observed for the 1/2X rate of Clincher + Sharpen in 2015 at PTRS and 2016 at the UAPB farm. Overall, main effects of herbicide and rate were significant at 2 WAT in 2015 at PTRS and 2016 at the UAPB farm. From these results, Sharpen at times may reduce grass control when tank-mixed with a graminicide.

On Farm Demonstration with ESN – Environmentally Smart Nitrogen.

S. Runsick[1], K. Lawson[2], J. Kelley[2], and T.L. Roberts[2]. [1]Cooperative Extension Service, University of Arkansas, Corning, AR; [2]Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Nitrogen is one of the most crucial nutrients for corn production. The two major sources of nitrogen used in Arkansas are 32% UAN and urea. Getting the correct amount of nitrogen applied timely is difficult some years if wet weather delays sidedress applications. Urea is widely used in Arkansas due to its ease of application and is usually the most economical source. Drawbacks of urea include weather conditions at the time of application that may delay application and rainfall or irrigation is needed to incorporate into the soil. If soil conditions are wet at application, a significant amount of nitrogen may be lost if not incorporated timely. A possible solution to reduce risks of using urea would be to use Environmentally Smart Nitrogen (ESN). ESN is a urea granule contained within a flexible polymer coating. A large-plot field demonstration was established in a Northeast Arkansas corn field in Clay County in 2016 to evaluate yield differences between ESN, urea, and 32% UAN. Treatments included: 1) 200 units of nitrogen as ESN applied preplant incorporated, 2) 200 units of 32% UAN applied at sidedress and, 3) 40 units of nitrogen preplant incorporated plus 33 units of nitrogen at the V4 growth stage followed by 126 units of nitrogen as 32% UAN a week later. Treatments were replicated three times. Each plot was harvested and measured with a weigh wagon to evaluate differences in yield.

What Antagonistic Tank-Mixtures in Enlist and Roundup Ready Xtend Technologies Mean for Growers.

C.J. Meyer**, J.K. Norsworthy, J.K. Green, and R.R. Hale. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

The registration of 2,4-D for the Enlist system and dicamba in the Roundup Ready Xtend system will cause postemergence herbicide combinations of glyphosate, glufosinate, dicamba, and 2,4-D to be more common. Prior research suggests combinations of dicamba or 2,4-D plus glyphosate, and glyphosate plus glufosinate, could be antagonistic. Thus, field experiments were conducted in 2015 and 2016 at the Northeast Research and Extension Center in Keiser, AR, to further evaluate potential herbicide interactions that could occur in Enlist and Roundup Ready Xtend cropping systems. Various rates and combinations of glufosinate, glyphosate, dicamba, and 2,4-D were applied and evaluated for percent weed control. Control of Palmer amaranth, prickly sida, and barnyardgrass by these herbicide treatments were evaluated 5 weeks after application (WAA) and analyzed for herbicide interactions based on Colby's method. In the Enlist experiment, glyphosate (dimethylamine salt) at 24 fl oz/A controlled barnyardgrass 88%, whereas a premix of glyphosate and 2,4-D (Enlist Duo herbicide, 56 fl oz/A) only controlled barnyardgrass 80% 5 WAA. Similarly, in the Roundup Xtend experiment, glyphosate (potassium salt) at 22 fl oz/A controlled barnyardgrass 86 % and glyphosate + dicamba (16 fl oz/A) only controlled barnyardgrass 79%. In both experiments, control of Palmer amaranth was >85% for all mixtures, control of prickly sida was > 90% for all mixtures. For the broadleaf weeds, control with mixtures of two or more products was equal to or greater than control with either product alone. Based upon these results, applying glyphosate with 2,4-D or dicamba on large (30 cm) barnyardgrass produces antagonism compared to glyphosate alone. These results indicate growers may not receive the weed control they expect based on what species are present and what herbicide mixture is used. Furthermore, spraying two herbicides that are antagonistic could lead to an increased likelihood of herbicide resistance.

Population Dynamics of Palmer Amaranth in Response to HPPD-based Herbicide Programs.

L.M. Schwartz[1], C.J. Meyer[1], J.K. Norsworthy[1], and A. Cotie[2]. 1Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR; 2Bayer CropScience.

Herbicides are used extensively worldwide to control weeds in diverse cropping systems. Even with the extensive use of herbicides, complete control or eradication of weeds is rarely achieved. Palmer amaranth (*Amaranthus palmeri* (S.) Watson) is a summer annual weed species that can greatly reduce the yield of corn (*Zea mays* L.), soybean (*Glycine max* L. Merr), and cotton (*Gossypium hirsutum* L.). Herbicides that inhibit 4-hydroxyphenylpyruvate dioxygenase (HPPD) constitute one of the newest commercially available herbicide classes. However, there has already been resistance cases to Palmer amaranth in two states. Thus, the objective of this study was to determine the effects of various HPPD herbicide programs and crop rotation on Palmer amaranth populations. A field study was conducted in Keiser, Arkansas over two years. In 2015, corn and soybean plots were established with three corn and one soybean HPPD-based herbicide program. The three corn programs were classified as high, moderate, and low risk for HPPD resistance. The following year, corn, soybean, and cotton plots were established with crop rotation and continuous cropping systems in place. Before the crop was planted, the soil seedbank was sampled. Within each plot, six one-m^2 plots were set up in which three plots were covered during application and three were left uncovered. Every two weeks weed species were counted in each plot. At the end of the growing season, weed seed production was determined as well as crop yield. The results showed that after the second year Palmer amaranth emergence decreased with crop rotation and with the lowest risk herbicide programs, remained constant without crop rotation and the best herbicide programs, increased 10% without crop rotation and a bad herbicide program, and increased 22% without crop rotation and worst-case program. The soil seedbank showed a similar trend to emergence. With a continual increase in herbicide resistance, preservation of currently effective herbicide programs is paramount. This study highlights the fact that reducing the weed seed soil seedbank cannot rely on one management practice, but requires the use of a multi-tactic approach with various control methods. Currently, HPPD herbicide programs seem to be effective on Palmer amaranth when coupled with crop rotation and should be used with other best management practices.

A Comprehensive Summary of Soybean Sensitivity to Off-Target Movement of Loyant™ Herbicide.

M.R. Miller**, J.K. Norsworthy, M. Young, and M. Moore. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

In response to the overwhelming need for new herbicide active ingredients Dow AgroSciences recently announced Loyant™ with Rinskor™ Active (florpyrauxifen-benzyl), a new synthetic auxin herbicide for use in rice (*Oryza sativa*). While this new herbicide provides an alternative mode of action for rice, it is not uncommon for soybean (*Glycine max*) to be planted adjacent to rice. Given these circumstances, there is potential for herbicides applied in rice to drift onto soybean. Historically, dicamba drift has concerned soybean growers due to the high level of sensitivity to this herbicide. Drift concerns from existing synthetic auxin herbicides, multiple field studies were developed to understand the susceptibility of common row crops, such as soybean, to Rinskor relative to dicamba. In one experiment, a field study was conducted during the summers of 2014 and 2015 to: (1) evaluate the sensitivity of soybean to low concentrations of Rinskor and (2) compare soybean injury and yield following applications of Rinskor and dicamba at two soybean growth stages and concentrations. Soybean were treated with 1/10, 1/20, 1/40, 1/80, 1/160, 1/320, or 1/640 of the 1X rate of Rinskor (30 g ai/ha) or dicamba (560 g ae/ha) at the V3 or R1 growth stage. Rinskor applied at 1/10 to 1/40x rates caused significant visual foliar injury and subsequent height reduction. In comparison, dicamba applied at the same rates caused similar injury and growth reductions. As the drift rate of Rinskor was decreased from 1/10 to 1/640X the level of soybean injury declined quickly. Dicamba caused substantial injury at rates as low as 1/640X. Soybean yield reduction was greatest when highest concentrations of the two herbicides were applied. In additional field experiments, soybean were treated with 1/20 or 1/160 of the 1X rate of Rinskor or dicamba at the R1, R2, R3, R4, or R5 growth stage. Sensitivity of soybean during reproductive development indicated 1/160x drift rates of dicamba and Rinskor are less damaging to soybean compared to 1/20x. In addition, more concentrated rates such as the 1/20x drift rates of Rinskor and dicamba will result in significant soybean injury. However, as reproductive growth stage increases from R1 to R5 visible soybean injury from a drift event of Rinskor decreased but seed collected from the progeny exhibited greater reduction in percent germination, vigor, and plant height when planted in the field the following season. Soybean are sensitive to Rinskor at low rates, but we believe the weed control provided by this new herbicide will outweigh the slight risk for off-target movement to soybean. (™Trademark of the Dow Chemical Company ("Dow") or an affiliated company of Dow. Loyant™ is not registered with the US EPA at the time of this presentation. The information presented is intended to provide technical information only.)

Evaluation of Rice Stink Bug, *Oebalus pugnax*, Damage to Maturing Rice Kernels.

A. Cato**,[1], J. Hardke[2], and G. Lorenz+. [1]Dept. of Entomology, University of Arkansas, Fayetteville, AR. [2]Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

The stages of rice grain maturity that are most susceptible to rice stink bug damage have been properly identified; however, the question of when rice stink bugs are no longer capable of causing significant economic loss is less clear. Previous studies have shown that rice stink bugs are able to damage rice plants from the soft dough to hard dough stage by causing an increase in damage in the form of kernel discoloration, referred to as "pecky rice". As rice matures and kernels reach full maturity, referred to as hard dough, rice stink bugs cannot penetrate the kernel and cause damage. It is not fully understood what percentage of rice kernels need to reach hard dough before rice stink bugs are no longer able to injure rice to the point that an insecticidal response is warranted. The objective of this study was to determine the percentage of hard dough rice kernels at which rice stink bugs no longer caused significant damage.

Potential damage to rice was examined using 5 hard dough percentages ranging from 20-100%. Sleeve cages were placed over individual rice panicles, containing either 0 or 2 rice stink bugs, which were added at the beginning of the targeted percentage and removed immediately before harvest. Survival of the stinkbugs was confirmed every 48 hours after introduction until the cages were harvested, and any dead stink bugs observed were replace. For each hard dough percentage by rice stink bug combination, 10 replications were performed using 2 different rice cultivars. Rice panicles within the cages were harvested and blank kernels were not considered in analysis. Weight-per-seed measurements were then taken for rough rice, and after dehulling, a light box was used to determine the percentage of pecky kernels within each panicle. Rice panicles containing 20-60% hard dough when infested exhibited appreciable levels of peck ranging from 21%-12% respectively, but panicles at 80% and 100% hard dough did not exhibit appreciable levels of peck. Mortality of stinkbugs in the 20%-60% cages was almost non-existent, but was significant in the 80%-100% cages. This data shows that rice stink bugs were not capable of significantly damaging rice panicles after they reached 80% hard dough, although this could be a relic of survival at those stages rather than the ability to damage.

Palmer Amaranth Biology and Population Dynamics in Wide-Row Soybean.

N.E. Korres, J.K. Norsworthy, J. Green, and J. Godwin. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Knowledge of Palmer amaranth biology and population dynamics is essential for the development of effective weed management systems. A field experiment was conducted in Fayetteville to investigate the effects of Palmer amaranth density on weed population dynamics and biological characteristics in a wide-row soybean system. Higher mortality rates of Palmer amaranth population were recorded at higher weed population densities within 30 to 40 days after Palmer amaranth emergence (DAE), but also the higher the biomass and seed production per unit area (i.e. 0.135 lbs ft^{-2} and 139,353 seeds ft^{-2} for 2014 and 0.033 lbs ft^{-2} and 23,225 seeds m^{-2} for 2015). Light interception by the soybean and Palmer amaranth canopy affected negatively the weed population density whereas the opposite was observed for flowering. This in combination of early time for flowering initiation (i.e. between 30 to 40 DAE) at higher Palmer amaranth densities indicates a trade-off between flowering and survival at higher mortality rates, hence higher Palmer amaranth population densities. The contrasting behavior of Palmer amaranth in relation to male-to-female sex ratio (i.e. 1.3 and 1.9 at high

Palmer amaranth densities compared to 0.6 to 0.7 and 0.7 to 0.8 at low densities for experiment 2014 and 2015 respectively) and its plasticity to adapt at various levels of intraspecific competition (i.e. high and low population densities) merits further investigation. Based on this research the most appropriate period for Palmer amaranth control is within 40 DAE as the mortality of the population is higher and inflorescence emergence has not commenced. However, the easiness of Palmer amaranth for late flowering necessitates additional measures later in the growing season to prevent late additions in soil seedbank. The potential for optimization of management practices implementation can be effectively addressed through this research.