RESEARCH CONFERENCE ABSTRACTS

VOLUME 17

Arkansas Crop Protection Association

December 2 – December 3, 2013
Guesthouse International Inn
Fayetteville, Arkansas

STUDENT COMPETITIONS
SPONSORED BY:

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Monday, December 2, 2013

12:00 noon Registration

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

01:00 p.m. **Opening Remarks**

01:15 p.m. **Validation of Soil-Test-Based Phosphorus and Potassium Fertilizer Recommendations for Rice and Soybeans.**
Matthew S. Fryer*, Nathan A. Slaton, Trenton Roberts, Richard Norman, and Russell DeLong. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR 1

01:30 p.m. **Herbicide Programs for Edamame Over Two Years and Two Locations.**
Reiofeli A. Salas**[1], James Dickson[1], Hussain H. Tahir[1], Nilda R. Burgos[1], and Bob Scott[2]. [1]Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR; [2]Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas Cooperative Extension Service, Lonoke, AR 1

01:45 p.m. **High Throughput Phenotypic Evaluation of Drought-Related Traits in Soybean.**
Hua Bai** and Larry C. Purcell. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR 2

02:00 p.m. **Early Season Herbicide/Insecticide Interactions in Cotton.**
D.L. Clarkson*[1], G. Lorenz[2], N. Taillon[2], B. Thrash[1], M. Everett[1], L. Orellana[1], S. Flynn[1], A. Plummer[2], and M. Chaney[2]. [1]Dept. of Entomology, University of Arkansas, Fayetteville, AR; [2]Dept. of Entomology, University of Arkansas Cooperative Extension Service, Lonoke, AR 3

02:15 p.m. **Evaluating Dormancy of Inbred Mapping Populations Derived from U.S. Red Rice Biotypes.**
Vijay Singh**[1], Nilda R. Burgos[1], David R. Gealy[2], Howard Black[2], and Shilpa Singh[1]. [1]Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR; [2]USDA-ARS, Dale Bumpers National Rice Research Center, Stuttgart, AR 3

02:30 p.m. **Rice Yield and Nitrogen Uptake as Affected by Nitrogen Rate and Urease Inhibitor.**
Randy J. Dempsey*, Nathan A. Slaton, Trenton L. Roberts, Richard J. Norman, Russell E. DeLong, and Colin G. Massey. Dept. of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville, AR 4

02:45 p.m. **Impact of Spider Mites (*Tetranychus urticae*) Pre-Flowering Infestations on Cotton Growth.**
Luis Orellana*[1], Gus Lorenz[2], Ashley P.G. Dowling[1], Nichole M. Taillon[2], Andrew Plummer[2], Michael Chaney[2], Ben C. Thrash[1], Derek L. Clarkson[1], Mallory Everett[1], and Sean L. Flynn[1]. [1]Dept. of Entomology, University of Arkansas, Fayetteville, AR; [2]Dept. of Entomology, University of Arkansas Cooperative Extension Service, Lonoke, AR 5

03:00 p.m. **Break**

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

MODERATOR: Donna L. Frizzell

Tuesday, December 3, 2013

MODERATOR: Nichole M. Taillon

08:00 a.m. **Osmotic Adjustment in Leaves and Ovaries of Commercial Cotton Cultivars Under Water-Deficit Stress.**
Cristiane Pilon**, Derrick M. Oosterhuis, Glen Ritchie, and Eliege Aparecida de Paiva Oliveira. Dept. of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville, AR.......... 9

08:15 a.m. **Determining the Rate of Fluridone for Extended Control of Palmer Amaranth in Cotton.**
Zachary T. Hill*, Jason K. Norsworthy, Holden D. Bell, Chris J. Meyer, Brandon W. Schrage, Dilpreet S. Riar, and Mohammad T. Bararpour. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.......... 9

08:30 a.m. **Characterizing Leaf N with Greenness Measurements Made with Digital Camera Images and a Smartphone Application.**
A. Rhezali*, L.C. Purcell, and T.L. Roberts. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.......... 10

08:45 a.m. **Preplant Fertilizer Nitrogen Uptake Efficiency of Furrow-Irrigated Corn in Arkansas.**
Chester E. Greub**, Trenton L. Roberts, Nathan A. Slaton, and Richard J. Norman. Dept. of Crop, Soil, and Environmental Sciences, Fayetteville, AR 10

09:00 a.m. **Morphology Variation in Junglerice (*Echinochloa colona*) in Arkansas.**
Hussain Tahir*, Nilda R. Burgos, Reiofelli A. Salas, Vijay Singh, L. Estorninos, Muhammad A. Nadeem, Srichai Sathuwijam, Fernando Ramirez, and Seth A. Abugho. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 11

09:15 a.m. **Cotton Tolerance to Glufosinate as Influenced by Cloud Cover, Variety Selection, and Application Timing.**
Brandon W. Schrage*, Jason K. Norsworthy, Zach T. Hill, and Dilpreet S. Riar. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.......... 11

09:30 a.m. **Development of an Available Soil Water Index to Characterize Site Water-Deficit Stress Experienced in Cotton Variety Trials.**
Tyson B. Raper** and Derrick Oosterhuis. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.......... 12

09:45 a.m. **Determining a Treatment Threshold for Green Stink Bug on Edamame Soybean.**
B.C. Thrash*[1], G.M. Lorenz[2], N.M. Taillon[2], W.A. Plummer[2], H.M. Chaney, Jr. [2], M. Everett[1], D.L. Clarkson[1], and L.R. Orellana Jimenez[1]. [1]Dept. of Entomology, University of Arkansas, Fayetteville, AR; [2]Dept. of Entomology, University of Arkansas Cooperative Extension Service, Lonoke, AR 12

10:00 a.m. **Break**

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

Tuesday, December 3, 2013 (cont.)

MODERATOR: Nichole M. Taillon

ABSTRACTS

Validation of Soil-Test-Based Phosphorus and Potassium Fertilizer Recommendations for Rice and Soybeans.

Matthew S. Fryer*, Nathan A. Slaton, Trenton Roberts, Richard Norman, and Russell DeLong. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Soil-test-based fertilizer recommendations are used to determine how much phosphorus (P) and/or potassium (K) fertilizer is needed to maximize crop yields and maintain soil fertility. Our objectives were to validate the accuracy of the University of Arkansas' soil test P (STP) and K (STK) recommendations for rice (*Oryza sativa* L) and soybeans [*Glycine max* (L) Merr.] and examine the relationship between soil test properties of samples collected from the 0-4 and 0-12 (clay soils) or 0-18 (silt loam) inch depths.

Phosphorus and K trials were established at nine sites for each crop during 2013. Each site contained six treatments that included a combination of two P rates (0 and 60 lb P_2O_5 $acre^{-1}$) and four K rates which differed for rice (0, 60, 90, and 120 lb K_2O $acre^{-1}$) and soybean (0, 60, 120, and 160 lb K_2O $acre^{-1}$). Only two P rates were used because Arkansas research shows the correlation between Mehlich-3 STP and crop yield response to P fertilization is weak. The actual recommended P and K fertilizer rates were determined from soil samples (0-4 inch depth) collected from the no fertilizer control in each replicate before fertilizer treatments were applied. Soil samples were also collected from the 0-12 (clayey soils) or 0-18 (loamy soils) inch depths to compare P and K levels between soil depths.

Significant (P<0.05) correlations existed between the 0-4 and 0-12 inch depths of clayey soils (n=33) for soil pH (r=0.92) and STP (r=0.91) and STK (r=0.91). For the silt loams (n=67), significant correlations existed between the 0-4 and 0-18 inch depths for STP (r=0.93) and STK (r=0.93), but not for soil pH (r=0.22). Despite the strong STP and STK relationships between depths for the silt loams, the mean difference between STP and STK fluctuated among sites. The subsoil STP was 14 to 89% and subsoil STK was 55 to 128% of topsoil soil test values. The significant variability between depths could explain why soil samples collected from the topsoil sometimes do not accurately predict crop response to fertilization.

Harvest has not yet been completed in four rice and three soybean trials. Among the five harvested rice sites, STK and STP were below optimum in the 0-4 inch depth. Rice yields were not affected by P and/or K fertilization at any of the five sites. Of the six harvested soybean sites, yield increases were expected at two sites for P and three sites for K. Regardless of STP, soybean did not respond to P fertilization. At two of three sites with suboptimal STK, K fertilization increased soybean yields by an average of 8.2% (~5 bushels). Soil tests accurately predicted no yield response to fertilization at sites with optimal soil-test levels. This research is ongoing as a large number of site-years are needed to assess the accuracy of soil-test-based recommendations.

Herbicide Programs for Edamame Over Two Years and Two Locations.

Reiofeli A. Salas**[1], James Dickson[1], Hussain H. Tahir[1], Nilda R. Burgos[1], and Bob Scott[2]. [1]Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR; [2]Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas Cooperative Extension Service, Lonoke, AR.

Edamame is a specialty soybean harvested as a vegetable when the seeds are immature. The edamame consumed in the country is mostly imported from Asia. Although many herbicides are labeled for grain soybean, only few herbicides are registered for use on edamame, which limits expanded commercial production. Field experiments were conducted in Fayetteville and Newport, AR in 2012 and 2013 to evaluate the effectiveness of various herbicide programs and to examine the tolerance of edamame to different herbicides. Herbicide programs included various combinations and sequences of Dual Magnum (*S*-metolachlor), 1.12 kg ai/ha; Flexstar (fomesafen), 0.33 kg ai/ha; Sencor (metribuzin), 0.43 kg ai/ha; Linex

(linuron), 1.12 kg ai/ha; Blazer (acifluorfen), 0.28 kg ai/ha; Basagran (bentazon), 0.56 kg ai/ha; Prefix (fomesafen, 0.27 kg ai/ha + *S*-metolachlor, 1.21 kg ai/ha), Spartan Charge (carfentrazone, 0.0303 kg ai/ha + sulfentrazone, 0.273 kg ai/ha); Broadaxe (sulfentrazone, 0.154 kg ai/ha + *S*-metolachlor, 1.38 kg ai/ha); Pursuit (imazethapyr), 0.067 kg ai/ha; Valor XLT (flumioxazin, 0.109 kg ai/ha + chlorimuron, 0.0376 kg ai/ha); Zidua (pyroxasulfone), 0.123 kg ai/ha; and a nontreated weedy check. There were 9 treatments in 2012; with additional 6 treatments in 2013. The experimental design was randomized complete block with 4 replications. Postemergence herbicides were applied to V3 soybean and 5- to 8-cm Palmer amaranth. The test in Newport had a natural population of Palmer amaranth. Crop injury was minimal (5% at most) at 2 WAT PRE with Linex, Sencor, and Zidua PRE treatment in both years. In 2012, season-long control of Palmer amaranth (91-96%) was achieved with Dual + Sencor PRE fb Flexstar POST and Linex + Sencor PRE fb Prefix POST. Weed control was not evaluated in 2013 because of poor weed emergence.

In Fayetteville, the field was overseeded with morningglory, hemp sesbania, prickly sida, and Palmer amaranth; however Palmer amaranth failed to get established in 2013. In 2012, all herbicide treatments controlled Palmer amaranth 94-100%. Morningglory was controlled (≥92%) by Dual Magnum PRE fb Flexstar POST and Linex + Sencor PRE fb Prefix POST. All herbicide treatments, except Dual Magnum PRE fb Blazer + Basagran POST, controlled hemp sesbania and prickly sida ≥90%. In 2013, morningglory control (50-89%) was similar among treatments. Season-long control of hemp sesbania (≥90%) was achieved by Linex + Sencor PRE fb Prefix POST. All herbicide treatments controlled prickly sida (≥90%) except for Dual Magnum PRE fb Blazer + Basagran POST. The preemergence herbicides did not affect crop stand, however moderate crop injury (8-21%) was observed at 3 WAT PRE with Spartan Charge and Linex + Sencor treatments. Soybean injury was highest at 1 WAT POST with Prefix (50%), followed by Flexstar (30-43%) treatments; however the crop recovered at 4 WAT POST in both years. Plant density, number of pods, and grain weight per plant did not differ among treatments across years. Grain yield (2229-3079 kg/ha) was relatively similar among herbicide treatments in both years. Effective overall weed control can be achieved with Linex + Sencor PRE fb Prefix POST, Zidua PRE fb Flexstar POST, Linex PRE fb Prefix POST, Zidua + Linex PRE fb Pursuit POST, and Dual + Sencor PRE fb Flexstar POST.

High Throughput Phenotypic Evaluation of Drought-Related Traits in Soybean.

Hua Bai** and Larry C. Purcell. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

A bottleneck for developing drought-tolerant soybean genotypes is having appropriate phenotypic screens that are amenable for evaluating large populations. We evaluated two potential screening methods for drought in two different experiments during reproductive development. For the first experiment, five cultivars ranging from maturity group II through V were included in well-watered (WW) and drought (DR) treatments. The WW treatment was irrigated when the estimated soil-water deficit reached 30 mm, while the drought treatment received irrigation every third time as the well-watered treatment after canopy closure. Beginning at R5, leaf N concentration was measured by taking weekly leaf samples. Pictures of individual plots were taken against a pink board with both green and yellow standards, which served as internal standards, to determine the Dark Green Color Index (DGCI). DGCI values are directly related to the intensity of green leaf color, which is associated with leaf N concentration. In addition, aerial images were taken using a 2m-diameter balloon or a kite for aerial DGCI measurements. The results showed that leaf N concentration was highly associated with ground DGCI, and ground DGCI significantly agreed with aerial DGCI. This opens up the possibility of identifying genotypes that senesce quickly due to drought stress. In the second experiment, a line-source experiment was established with genotypes previously characterized as fast or slow wilting type. The experiment included three water treatments: well watered (WW), medium watered (MW), and rainfed (RF). Carbon isotope discrimination ($\Delta^{13}C$) was determined from leaves sampled at late R5 and from seed at harvest as a surrogate measure for water use efficiency. The results indicated that $\Delta^{13}C$ values for soybean leaf and seed decreased with increasing drought stress (i.e., higher water use efficiency). Likewise, slow wilting genotypes had lower $\Delta^{13}C$ values for soybean seed compared to fast wilting genotypes. These results indicate that DGCI measurements from aerial platforms and $\Delta^{13}C$ measurements of leaf and seed hold promise for characterizing drought-related traits in soybean.

Early Season Herbicide/Insecticide Interactions in Cotton.
D.L. Clarkson*[1], G. Lorenz[2], N. Taillon[2], B. Thrash[1], M. Everett[1], L. Orellana[1], S. Flynn[1], A. Plummer[2], and M. Chaney[2]. [1]Dept. of Entomology, University of Arkansas, Fayetteville, AR; [2]Dept. of Entomology, University of Arkansas Cooperative Extension Service, Lonoke, AR.

Insecticide seed treatments have been applied to 99% of all cotton seed planted in Arkansas for the last several years. The last two seasons (2011 and 2012) a reduction of insecticide seed treatment efficacy on thrips has been documented and multiple post-emergence insecticide applications have been needed to control thrips populations. Increased applications of pre-emergence herbicides seem to correlate with this reduction in insecticide seed treatment efficacy. Growth and development of cotton also was slowed during 2011 and 2012, even under optimum growing conditions. The objective of this research is to investigate potential interactions between pre-emergence herbicides and insecticide seed treatments with respect to thrips control and early season cotton development.

One trial was conducted and replicated in two locations in East Arkansas. Trials were planted on 5/15/13 and 5/21/13 using ST 4946GLB$_2$ cotton variety. Two commonly used insecticide seed treatments (Aeris, Avicta, +check) were crossed with 3 commonly used pre-emergence herbicides (Diuron, Cotoran, Reflex, +check) creating a 3x4 factorial. The trial design used was a randomized complete block design containing four replicates. Independent variables consisted of: pre-emergence herbicides, insecticide seed treatments, and crosses between these. Thrips densities were recorded three times between 5/30/13 and 6/10/13 (2-4 leaf stage). Stand counts were taken at emergence and plant heights were recorded once weekly until flowering. Plant injury (necrosis or chlorosis) was recorded when necessary, nodes above ground (NAG) counts were taken weekly from flowering until cutout, nodes above white flower (NAWF) was recorded once near cut-out, and yield data will be recorded at harvest. After these data were collected, both trials were treated identically for pests the remainder of the season. Data was analyzed using analysis of variance and means were separated with Tukey's HSD method.

Significant differences were seen in thrips counts between the three seed treatments. However, pre-emergence herbicides and their interaction with insecticide seed treatments had no significant impact on thrips efficacy. As for plant growth, insecticide seed treatments were the only factor that caused significant differences in plant heights. Necrotic herbicide damage recorded on 6/20/13, caused by a later post-emergence herbicide application of Liberty, could possibly be the reason for differences in maturity (NAG,NAWF) but, this again was only significantly different between seed treatments and no differences were seen between various pre-emergence herbicides. In conclusion, pre emergence herbicides or their interactions with insecticide seed treatments had no significant impact on plant growth or thrips counts within this trial. While there were significant differences in efficacy of insecticide seed treatments other causes may be responsible for this gradual loss of efficacy. Recently reported data from Syngenta, on tobacco thrips resistance to thiamethoxam, has a potentially large impact on this research.

Evaluating Dormancy of Inbred Mapping Populations Derived from U.S. Red Rice Biotypes.
Vijay Singh**[1], Nilda R. Burgos[1], David R. Gealy[2], Howard Black[2], and Shilpa Singh[1]. [1]Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR; [2]USDA-ARS, Dale Bumpers National Rice Research Center, Stuttgart, AR.

Red rice is a weedy form of cultivated rice (*Oryza sativa*) that competes aggressively with rice in the southern U.S., reduces yields & contaminates rice grains. Understanding the molecular dynamics and prediction of evolutionary adaptive traits in red rice populations have become necessary for its control. Two recombinant inbred line (RIL) populations were made by crossing a strawhull weedy rice ecotype 1135-01 (RR9) and a blackhull ecotype 1996-9 (RR20), with an *indica* cultivated rice variety Dee Geo Woo Gen (DGWG). The F7 RILs populations were evaluated in the field in summer 2012 and the harvested seeds tested for germination after 150 days. Red rice panicles from a total of 234 RILs (RR20) of blackhull (BH X DGWG) ecotype and 185 RILs (RR9) of strawhull (SH X DGWG) were harvested between October and November 2012. Samples were air-dried in paper bags for 5 months at room temperature. Dormancy test was conducted at 30 C, dark for 12 d with twenty seeds of each accession in Petri dishes. Germination count was carried out two times (6 days interval) at 6d and 12d. The RR9 population, strawhull cross, in general showed higher germination (79%) overall than RR20 population, blackhull cross (74%). K-means cluster analysis grouped RR20 and RR9 populations into 4 and 3 clusters, respectively. We conclude that the blackhull-derived population has higher dormancy and higher variability.

Rice Yield and Nitrogen Uptake as Affected by Nitrogen Rate and Urease Inhibitor.
Randy J. Dempsey*, Nathan A. Slaton, Trenton L. Roberts, Richard J. Norman, Russell E. DeLong, and Colin G. Massey. Dept. of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Rice (*Oryza sativa* L.) requires a significant amount of nitrogen (N) fertilizer to optimize grain yields. Ammonia (NH_3) volatilization is one of the primary N-loss mechanisms in Arkansas rice production and represents a financial loss to the grower and a threat to the environment. Our objective was to compare the effect of urease-inhibiting amendments and N rate on N uptake and grain yield of rice.

Two field experiments were conducted in 2013 at the Pine Tree Research Station on an alkaline Calhoun silt loam soil. The treatments included untreated urea (Urea) and urea treated with two formulations of N-(n-butyl) thiophosphoric triamide (NBPT), Agrotain Ultra (ATU) and Factor (FTU), with each N source applied at 0, 30, 60, 90, 120, and 150 lb N ac^{-1}. The permanent flood was established 8 (Trial A) or 7 d (Trial B) after N was applied to a dry (Trial A) or moist (Trial B) soil surface. The experiment was a randomized complete block with a 3 (N source) × 5 (N rate) factorial treatment structure and contained four blocks. Nitrogen uptake and rice grain yield were regressed across N rates, allowing for both linear and quadratic terms with coefficients depending on N source. Non-significant ($P > 0.15$) model terms were removed sequentially and the model was refit until a satisfactory model was obtained. Nitrogen uptake was evaluated only in Trial B at 60, 90, and 120 lb N ac^{-1}.

Rainfall occurred 36 hr following the urea-N application in Trial A and may have reduced the potential for NH_3-N loss by incorporating the urea-N into the soil. Rainfall occurred 6 d following urea-N application for Trial B and this is enough time for significant NH_3-N loss to occur. Nitrogen uptake for Trial B increased at a common linear rate (0.85 lb N lb^{-1} Urea-N) as N rate increased but the N sources had different intercepts. Regardless of N rate, rice fertilized with ATU (intercept = 47 lb N ac^{-1}) and FTU (50 lb N ac^{-1}) had similar N uptake amounts that were greater than that of rice receiving Urea (23 lb N ac^{-1}).

For Trial A, grain yields of rice receiving 30 to 150 lb N ac^{-1} ranged from 121 to 207 bu ac^{-1} and increased linearly across N rates with no differences among N sources (bu ac^{-1} = 0.64x + 109, where x = preflood N rate). For Trial B, grain yield increased nonlinearly (e.g. quadratic) with all N sources sharing common linear (1.37) and quadratic (-0.00408) terms but having different intercepts. Rice fertilized with ATU (intercept = 107 bu ac^{-1}) and FTU (108 bu ac^{-1}) produced equal yields across N rates that were greater than yields from rice fertilized with Urea (93 bu ac^{-1}). These results suggest that Factor and Agrotain Ultra help prevent N and yield loss when urea is applied to a moist soil surface, an environment conducive for NH_3 volatilization. However, N loss from NH_3 volatilization does not always occur (e.g., Trial A) and result in rice yield loss. Results from Trial B suggest that the use of an effective urease inhibitor did not change the shape of the yield curve but increased the yield produced per unit of applied fertilizer N.

Impact of Spider Mites (*Tetranychus urticae*) Pre-Flowering Infestations on Cotton Growth.

Luis Orellana*[1], Gus Lorenz[2], Ashley P.G. Dowling[1], Nichole M. Taillon[2], Andrew Plummer[2], Michael Chaney[2], Ben C. Thrash[1], Derek L. Clarkson[1], Mallory Everett[1], and Sean L. Flynn[1]. [1]Dept. of Entomology, University of Arkansas, Fayetteville, AR; [2]Dept. of Entomology, University of Arkansas Cooperative Extension Service, Lonoke, AR.

In recent years cotton growers of the Mid-South have seen an increase of early season spider mites infestations. To better understand the effects of spider mites infestations on cotton development, experimental plots were established in two planting dates (early and late) during the summer of 2013. Cotton plants were artificially infested with two-spotted spider mites during cotyledon and 4th true leaf. Within each infestation time, cotton plants were exposed to mites for 3 days, 10 days, and continuously until squaring. Results will be discussed. Spider mite infestation did not affect growth. Planting date explained most of the observed differences.

Glyphosate Translocation in Resistant and Susceptible *Paspalum paniculatum* L. Accessions of Costa Rica.

Fernando Ramirez**, Sirichai Sathuwijarn, Nilda R. Burgos, and Bernal E. Valverde. Dept. of Crop, Soil, and Environmental Sciences, Fayetteville, AR.

Glyphosate is the most widely used herbicide worldwide. This herbicide inhibits 5-enol-pyruvylshikimate-3-phosphate synthase (EPSPS) which is the enzyme in the aromatic amino acid biosynthesis pathway. *Paspalum paniculatum* L. is a perennial grass in many tropical crops, which recently evolved resistance to glyphosate and its mechanism of resistance is not known. Two glyphosate-resistant (R) accessions from palm heart fields in Costa Rica, exhibit a resistance index between 3.8 and 8.8 relative to the susceptible (S) accession. To determine if differential translocation is the mechanism of resistance, greenhouse-grown seedlings were sprayed with commercial glyphosate formulation and spotted with radiolabelled glyphosate. The middle 1.5-cm portion of the second fully expanded leaf of five- to six-leaf seedlings was marked and covered with aluminum foil. Formulated glyphosate solution was applied at 870 g ae/ha with an automated sprayer and 4 *u*l of ^{14}C-labeled glyphosate was applied to the marked portion. Plants were harvested 24, 48, 72 and 96 HAT and sectioned into five parts: tip of treated leaf (including the treated zone), base of treated leaf, tissue above treated leaf, below treated leaf, and roots. After rinsing the treated portion to remove nonabsorbed glyphosate, all plant parts were oven-dried for 72 h at 50 C, and oxidized. The evolved CO_2 was trapped in a scintillation cocktail and radio assayed. Treatments were replicated five times, and the experiment was conducted twice. The distribution of ^{14}C in plant parts was expressed as a percentage of absorbed radio-activity. Data was analyzed with JMP Pro by analysis of variance and means were compared using least significant difference (LSD). Glyphosate absorption did not differ between R and S accessions; absorption increased from 82% at 24 HAT to 87 % at 96 HAT. In all plants, R and S, the majority of absorbed glyphosate (53.4 to 62.9%) remained in the upper half of the treated leaf, with small amounts translocated to the base of the treated leaf (5.5–7.5%) and to the tissues above treated leaf (2.1–5.4%). Translocation below the treated leaf was between 8.0-20.2% for all accessions and was higher at 96 HAT (25%) than 24 HAT (13%). The ^{14}C percentage in the roots was not different between accessions. Glyphosate translocation pattern was confirmed by phosphor imaging of entire plants. Differences in absorption or translocation were not observed among the R and S plants studied here, although this is a common mechanism in several glyphosate-resistant weeds. For *P. paniculatum* accessions of Costa Rica, reduced absorption or translocation is not the resistance mechanism to glyphosate.

Palmer Amaranth Control as Influenced by Row Width, Seeding Rate, and Herbicide Programs in LibertyLink® Soybean.

H.D. Bell*, J.K. Norsworthy, Z.T. Hill, M.T. Bararpour, B.W. Schrage, M.V. Bagavathiannan, D.S. Riar, C.J. Meyer, and J.R. Brennan. Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Palmer amaranth, the most troublesome weed in Arkansas row crop production, is causing Arkansas soybean producers to rely heavily on preemergence (PRE) in addition to postemergence (POST) herbicide programs. In 2012 and 2013, a field experiment was conducted at the University of Arkansas Research and Extension Center in Fayetteville, AR, to determine the influence of row spacing, seeding rate, and herbicide program in LibertyLink® soybean on Palmer amaranth survival and seed production. This experiment was arranged in a split-split plot design replicated four times. The main plot factor was row widths (17.5-, 45-, and 90-cm). The subplot factor was seeding rates (250,000 and 437,500 seed/ha) and the sub-subplot factor was herbicide programs [*S*-metolachlor + metribuzin (Boundary®) applied PRE (PRE-only), *S*-metolachlor + metribuzin applied PRE followed by (fb) glufosinate (Liberty®) + *S*-metolachlor + fomesafen (Prefix™) applied at 21 days after planting (DAP) (PRE fb POST at 21 DAP), *S*-metolachlor + metribuzin applied PRE fb glufosinate + *S*-metolachlor + fomesafen applied 21 DAP fb glufosinate + acetochlor (Warrant™) applied 42 DAP (PRE fb POST at 21 and 42 DAP), *S*-metolachlor + metribuzin applied PRE fb glufosinate + acetochlor applied 42 DAP (PRE fb POST at 42 DAP),glufosinate + *S*-metolachlor + fomesafen applied 21 DAP fb glufosinate + acetochlor applied 42 DAP (POST-only), and a nontreated control] applied at labeled field rates. Palmer amaranth control was evaluated at 21 DAP, 42 DAP, and harvest. Greater control was observed in PRE and PRE + POST herbicide programs compared to POST-only programs, regardless of seeding rate and row spacing. Herbicide application had more of an impact on control than either row spacing or seeding rate for both years. Inclusion of PRE herbicides in weed control programs is vital in reducing Palmer amaranth density and ultimately Palmer amaranth seed production, which will in turn lessen the selection for new cases of resistance.

Effects of Carrier Volume and Spray Nozzle Selection on Efficacy of Engenia Tank-Mixtures.

C.J. Meyer*[1], J.K. Norsworthy[1], G.R. Kruger[1], B.W. Schrage[1], H.D. Bell[1], Z.T. Hill[1], D.S. Riar[1], M.T. Bararpour[1], J.R. Brennan[1], and L.T. Barber[2]. [1]Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR; [2]Dept. of Crop, Soil, and Environmental Sciences, University of Arkansas Cooperative Extension Service, Lonoke, AR.

With the anticipated release of auxin-type herbicide-resistant soybean (Roundup Ready Xtend), carrier volume and nozzle selection will become more important variables in maintaining efficacy of herbicide solutions while minimizing off-target movement. A field experiment was conducted in 2013 at the Northeast Research and Extension Center in Keiser, AR to evaluate the efficacy of four herbicide tank-mixtures using various nozzle and spray volume combinations. This experiment was arranged as a randomized complete block factorial with three factors; nozzle size, nozzle type, and herbicide treatment. Two nozzle sizes (11003 and 11006 rated at 0.3 gal/min and 0.6 gal/min, respectively, at 40 PSI) were used to vary spray volume from 10 gal/A to 20 gal/A for TeeJet AIXR, AITTJ60, and TTI nozzles. Applications were made with a tractor-mounted research sprayer at 40 PSI and 9 mi/hr, 21 days after planting. Herbicide treatments were labeled rates of dicamba (as the product Engenia) + glufosinate (Liberty), dicamba + glyphosate (Roundup PowerMax), dicamba + glufosinate + glyphosate, and dicamba + glufosinate + glyphosate + *S*-metolachlor (Dual Magnum). Percent weed control was evaluated four weeks after application (WAA) for Palmer amaranth, velvetleaf, hemp sesbania, pitted morningglory, and barnyardgrass. Additionally, three barnyardgrass plants were harvested at 4 WAA to determine overall biomass reduction of the herbicide treatments compared to the nontreated check. The three-way interaction among nozzle type, nozzle size, and herbicide treatment was significant for all weed control ratings and biomass, indicating the effect of one factor on weed control is dependent upon the other two factors. Overall, weed control was highest for all herbicide treatments with AIXR nozzles, providing greater than 98%

control of Palmer amaranth, velvetleaf, and hemp sesbania, and greater than 95% control of pitted morningglory and barnyardgrass. On average, AIXR nozzles reduced biomass of barnyardgrass by 97% at 4 WAA. These results indicate the importance of nozzle selection on efficacy of the herbicide treatment.

Busting Soybean Yield Barriers Without Breaking the Bank.
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The 2012 Arkansas soybean [*Glycine max* (L.) Merr.] average grain yield of 2890 kg ha^{-1} was the highest recorded statewide yield; however, further yield improvements may be possible. Based upon observations and research in maximum yield environments at Mr. Kip Cullers' farm and small plots at the Univ. of Arkansas in Fayetteville, several key management practices were identified as having potential to increase soybean yield. The goal of this research was to achieve a yield of 6720 kg ha^{-1} (100 bushels $acre^{-1}$) without an unreasonable increase of inputs. Large-scale on-farm experiments were conducted at two (2011) or three (2012-13) locations in Eastern Arkansas to demonstrate the potential yield of a high yield management program involving supplemental poultry litter, early planting, narrow rows, frequent irrigation, N fertilization and strict pest management. Each site-year involved slightly different soil types, row widths, plant densities and irrigation systems but the overall management program was similar. Each trial included five to six Pioneer cultivars with an indeterminate stem growth habit and a relative maturity (RM) range from 4.2 to 5.1 planted in randomized strips (each strip 0.2 to 0.4 ha) spanning the length of the field and replicated five or six times. Mean grain yield across cultivars and locations was 5080 kg ha^{-1} (76 bushels $acre^{-1}$) in 2011, 5900 kg ha^{-1} (88 bushels $acre^{-1}$) in 2012, and 6260 kg ha^{-1} (93 bushels $acre^{-1}$) in 2013. At England in 2013, two cultivars had mean yields of 6930 and 6990 kg ha^{-1} (103 and 104 bushels $acre^{-1}$). Economic analysis indicated that each grower spent ~$438 ha^{-1} ($175 $acre^{-1}$) more than their normal practices. This research demonstrates that these management practices can be used at locations throughout Eastern Arkansas to achieve soybean yields double of the statewide average without a drastic increase in inputs.

Rainfastness of Selected Insecticides with Adjuvants for Control of *Lygus lineolaris* in Cotton.
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Growers who have to make timely chemical applications in mid-summer sometimes run into the problem of "pop-up" showers coming shortly after their applications. These showers can have a significant cost to growers if the chemicals being used do not have rainfastness labeling. Studies were conducted both in the field and greenhouse to evaluate the rainfastness of four insecticides and whether the rainfastness of the insecticides could be improved by mixing four adjuvants into the application. The insecticides, Centric (thiamethoxam), Orthene (acephate), Bidrin (dicrotophos), and Transform (sulfoxaflor); all are currently recommended for control of tarnished plant bug (*Lygus lineolaris*) in Arkansas and the Midsouth. The four adjuvants used in the study were: 1% crop oil concentrate, 0.25% nonionic surfactant, 0.25% organosilicate, and 0.5% methylated seed oil/ nonionic surfactant. The studies simulated rainfall at 0, 1, 3, 6, 12, and 24 hours after application, with a no rain check used for comparison. Insect mortality was checked at 24 hours (greenhouse) and 48 hours (greenhouse and field) after infestation.

Efficacy of Rice Insecticide Seed Treatments at Selected Nitrogen Rates for Control of the Rice Water Weevil.

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The value of insecticide seed treatments in rice has been well documented in recent years, but there have been instances where these treatments have not performed as expected. Soil fertility, nitrogen in particular, is thought to contribute to this variability in performance. Trials were conducted at the Pine Tree Research Station and Rice Research Extension Center to examine the response of rice plants receiving different insecticide seed treatments and nitrogen rate combinations. Nitrogen was applied at 0, 45, 90, 135, and 180 lb urea-N/acre to rice plots. Insecticide seed treatments included label rates of clothianidin (NipsIt Inside 5FS®), thiamethoxam (CruiserMaxx Rice 5FS™), and a non-treated (fungicide only) control. Both NipsIt Inside and CruiserMaxx had significantly fewer rice water weevil larvae compared to the non-treated control with an equivalent level of nitrogen; however, no differences were found between the two seed treatments at equal nitrogen levels. Nitrogen uptake at panicle differentiation and early heading was not affected by insecticide seed treatments. As nitrogen rate increased, grain yield increased up to 90 lb urea-N/acre and then plateaued. Averaged across nitrogen rates, both insecticide seed treatments had similar yields that were greater than the grain yields of the control. Preliminary results indicate that nitrogen has no effect on the efficacy of rice insecticide seed treatments but does influence the magnitude of leaf scarring and rice water weevil larvae number.

Soybean Yield and Seed Potassium Concentration Responses to Long-Term Potassium Fertilization.

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The specific effects of K deficiency on soybean [*Glycine max* (L.) Merr] yield and seed composition across the nodes of soybean plants is needed to better understand the nutritional requirements needed for the production of high yields and to develop efficient K fertilization methods. Our research objective was to evaluate soybean seed yield and seed K concentration among nodes of an indeterminate and determine variety as affected by annual K-fertilization rate. Research was conducted during 2012 in a long-term K fertilization trial at the Pine Tree Research Station (Colt, AR) on a Calhoun silt loam. The experiment was a strip-plot design with two soybean varieties [Armor 48-R40 (indeterminate) and Armor 53-R15 (determinate)] strip planted across five annual K rates (0, 40, 80, 120, and 160 lb K_2O acre^{-1}). Four representative whole plants of each variety were collected at maturity from plots that received 0, 80, and 160 lb K_2O acre^{-1}. The plants were dissected into segments consisting of two nodes and two internodes to evaluate seed K concentration and seed yield. On average, Armor 48-R40 and Armor 53-R15 had 10 (20 nodes) and 7 (14 nodes) nodal segments plant^{-1}, respectively. For each variety, seed yields and K concentrations were regressed across nodal segments using a model that included the linear, quadratic, and cubic nodal position terms and their interaction with annual K rate. The four plant seed yields of soybean receiving K fertilizer were similar ranging from 78 to 84 g for Armor 53-R15 and 83 to 88 g for Armor 48-R40, but 30-50% greater than yields from soybean receiving no K. For Armor 48-R40, annual K fertilizer rate had no significant effect on seed yield for the bottom one-half of the plant. Soybean fertilized with 80 and 160 lb K_2O acre^{-1} produced 33 to 44% greater seed yield on the top one-half of the plants nodal segments than soybean that received no K. For Armor 53-R15, seed yield was different among annual K rates at the two upper segments and the very bottom nodal segment. The K concentration of Armor 48-R40 seed was numerically greatest on the bottom nodes and decreased linearly across nodes towards the top of the plant. The rate of decrease depended on annual K rate with the greatest rate of decline occurring for plants that received no K fertilizer (0.060% K node segment^{-1}) compared with soybean fertilized with 80

(0.029%) and 160 (0.024%) lb K_2O acre^{-1}. For Armor 53-R15, the seed K concentration followed a quadratic pattern across the nodal segments. The K concentration of seed produced on the middle nodal segments was greatest and K concentration declined on nodal segments above and below the middle. The results suggest that the yield loss from K deficiency occurs on the top one-half of nodes of a non-branching indeterminate soybean variety and that seeds produced on the lower nodes receive K preferentially due to their position in relation to the location of K uptake (e.g., roots). The determinate variety exhibited a different pattern of yield loss and seed K concentration among nodes in which yield loss and seed with low K concentrations occurred on the top and bottom nodal segments, which was attributed to the determinate variety's extensive branching on the lower nodes.

Osmotic Adjustment in Leaves and Ovaries of Commercial Cotton Cultivars Under Water-Deficit Stress.
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Water is one of the most important factors for crop growth and productivity. Cotton is considered to be a relatively drought tolerant crop but plant metabolism and yield are still compromised under drought conditions. Differences in drought tolerance exist between cultivars but the metabolic reasons for this that could be used to find traits for enhancing drought tolerance have not been clearly elucidated. Under drought stress, osmotic adjustment occurs in plant cells through accumulation of compatible solutes in the cytosol and plays a role of reducing the osmotic potential of the cell in order to maintain cell turgor and growth. Proline is the most important compatible solute found in plants under drought stress. Proline accumulation may represent a biochemical marker of metabolic disturbances generated mainly by water deficit stress.
The objective of this study was to evaluate the osmotic adjustment in leaves and ovaries of two commercial cotton cultivars under water-deficit stress. A field experiment was conducted in Lubbock, TX in 2013. Treatments consisted of two cotton (*Gossypium hirsutum* L.) cultivars, ST5288 and PHY499, and two water regimes, well-watered and water-stressed, with four replications. Plants were stressed by withholding water for 10 days at flowering, after which the field was re-watered for 12 hours before measurements were made. Osmotic potential were measured using commercially available thermocouple psychrometers and samples were collected for proline content analysis.
Osmotic adjustment was greater in leaves and ovaries under water stress in both cultivars compared with well-watered conditions. Water-stressed ovaries from PHY499 had a notable increase in osmotic potential comparing with the control. However, the leaf response to osmotic potential was significant only for ST5288 with an increase of 60% in the water-stressed leaves in relation to the well-watered treatment. Water stress enhanced proline concentrations in both organs of the two cultivars. However, the proline accumulation due to the water stress was considerably higher in the ovaries than in the leaves in both cultivars. As in most plants, leaf osmotic potential is reduced under drought conditions, but cotton seems to have the ability to osmotically adjust and maintain a higher leaf turgor potential. This could be used for breeding selection of new cultivars with higher tolerance to drought.

Determining the Rate of Fluridone for Extended Control of Palmer Amaranth in Cotton.
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Herbicide-resistant Palmer amaranth control requires that diverse mechanisms of action be used in a herbicide program; albeit, no new modes of action have been discovered and commercialized for over 30 years. In order to maintain some level of control, emphasis has been placed on evaluating older herbicide candidates that were never commercialized in crops. Currently, there are seven residual herbicide applications recommended to control Palmer amaranth throughout the growing season, which consists of using two to three herbicides multiple times per season. In order, to maintain the sustainability of our currently effective residual herbicides, older herbicides that exhibit high persistence in the soil are needed. The herbicide fluridone was discovered in the early 1970's but was never marketed in cotton even though earlier research showed that cotton exhibits a high level of tolerance to preplant incorporated and preemergence applications. An experiment was conducted in 2012 and 2013 to determine if fluridone would control Palmer amaranth in cotton throughout the season. Herbicide treatments in cotton included fluridone applied preemergence at five rates from 0.1 to 0.5 lb ai/A, fluometuron and diuron applied preemergence at 0.75 and 1.0 lb ai/A, and fluridone at 0.3 lb/A and fomesafen at 0.25 lb ai/A applied preplant incorporated 14 days prior to planting cotton. In 2012, increasing PRE-applied fluridone rates above 0.1 lb/A did improve Palmer amaranth control, where fluridone at 0.5 lb/A maintained at least 80% control through 47 days after application (DAA). Lower rates of fluridone and both rates of fluometuron did not effectively control Palmer amaranth throughout the season with less than 85% by 18 DAA, with further decreases in control throughout the remainder of the season. In 2013, all herbicide treatments provided similar control of Palmer amaranth with greater than 80% control at 61 DAA. Season-long control of Palmer amaranth was greater in 2013 than 2012. Although the cotton was irrigated in both years, frequent rainfall in the spring and summer of 2013 enhanced activation, and hence, the greater control.

Characterizing Leaf N with Greenness Measurements Made with Digital Camera Images and a Smartphone Application.
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Nitrogen (N) fertilization is essential in maximizing maize yield. However, over–fertilization of N can reduce crop yield and profitability and may lead to increased nitrate-N concentrations in ground and surface water. Using N efficiently requires the adoption of precise and accurate methods that can help producers determine the correct rates of N fertilizer to be applied. The objective of this study was to characterize leaf N concentration with greenness measurements as determined by the dark green color index (DGCI). Measurements of DGCI were made using a digital camera and a smartphone application (GreenIndex) under field and laboratory conditions and compared with SPAD measurements and leaf concentration data. Field experiments were conducted at two sites during summer of 2013 with N rates ranging from 0 to 360 kg N ha^{-1}. All N fertilizer treatments were broadcast in three split applications: before planting, at V6, and at V8 growth stage. The upper most leaf was sampled at tasseling for DGCI, SPAD and leaf N concentration. Results showed a good relationship between leaf N (%) and SPAD values with values of 0.66 and 0.78 at our two locations. The relationship between GreenIndex DGCI measurements made in the laboratory and Camera DGCI was highly correlated with r^2 values of 0.66 and 0.73. The relationship between GreenIndex DGCI measurements in the field with camera DGCI measurements had r^2 values of 0.40 and 0.60 for the two locations. Leaf N and Camera DGCI values were closely associated (r^2=0.68, 0.70), but the relationship between leaf N and GreenIndex DGCI showed considerably more variability. Preliminary results support the need for continued research on DGCI to validate the accuracy in estimating plant N status and improve N fertilization of maize in Arkansas.

Preplant Fertilizer Nitrogen Uptake Efficiency of Furrow-Irrigated Corn in Arkansas.
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Corn (*Zea mays* L.) is becoming an increasingly important row-crop in the Mid-south and irrigation is required to produce optimal yields. Nitrogen fertilizer is the largest line-item input cost for most producers and can represent as much as 28% of total operating costs. Current recommendations suggest that 1/3 of the N be applied preplant with the remainder applied prior to the V8 growth stage. Previous research indicates ~ 9% of the total plant N is taken up by the corn plant prior to the V6 growth stage. The objective of this research is to investigate the influence of preplant N rate and application strategy on Fertilizer N Uptake Efficiency (FNUE) in a furrow-irrigated corn production system. Preplant N rates ranged from 0 to100 kg N ha^{-1} and were applied using common application strategies including: preplant N incorporation, broadcast over the surface, and in-furrow application. All N fertilizer was applied immediately prior to planting using NBPT treated ^{15}N-labeled urea. There was a significant two-way interaction involving preplant N rate by N application strategy (P=0.0009). Preplant FNUE for all treatments ranged from 1.6 to 13.3% with maximum FNUE being achieved when 67 kg N ha^{-1} was applied preplant N and incorporated into the bed. The broadcast N application displayed a linear increase in N uptake as N rate increased indicating that it was limited by N fertilizer placement. The in-furrow application strategy slightly increased in fertilizer N uptake as N rate increased, only reaching 1/3 the maximum amount of N taken up by the most efficient treatment, with a FNUE of only ~ 2.4%. Results of this research suggest that corn producers should incorporate their preplant N into the bed and only apply up to 67 kg N ha^{-1} in order to maximize preplant FNUE.

Morphology Variation in Junglerice (*Echinochloa colona*) in Arkansas.
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Junglerice (*Echinochloa colona* (L.) Link) was reported to be the most common species in the Southern United States. This was observed to be true also for Arkansas. Field experiments were conducted in 2012-2013 to examine the morphological variations in junglerice ecotypes collected in Arkansas. Seeds were collected from rice and soybean fields, quasi-randomly picked, along state and county roads with late-season infestation in 2010-2011. Accessions were grown as single plants in a common garden at the Arkansas Agricultural Research and Extension Center, Fayetteville on Captina silt loam (fine-silty, siliceous, mesic Typic Fragiudults) with a pH of 6.1, 18% sand, 70% silt and 12% clay. The accessions were arranged in a randomized complete block design (RCBD) with four replicates. Seven morphological traits pertaining to panicle, culm, leaf, and spikelet were measured. Emergence date, flowering time, and days of maturity were also evaluated. The average height, leaf width, leaf length, and panicle length were greater in ecotypes from Prairie and Lawrence counties than from other counties. Accessions from Lawrence and Arkansas counties flowered and matured the earliest. The accessions also showed differences in tolerance to selected herbicides.

Cotton Tolerance to Glufosinate as Influenced by Cloud Cover, Variety Selection, and Application Timing.
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With ever-increasing populations of glyphosate resistant weeds like Palmer amaranth, many Arkansas growers have resorted to glufosinate as the only effective postemergence control option in cotton. Our objective was to determine if degree of injury to Phytogen (Widestrike) and Liberty Link cotton is influenced by cotton growth stage and light quantity prior to application. The introduction of induced shade in this trial was intended to be reflective of prolonged periods of cloudy conditions prior to applying glufosinate.

An experiment having a split-split-split plot design was conducted in Fayetteville, Arkansas in 2012 and 2013. The main plot consisted of cotton variety (PHY 375 WRF, PHY 499 WRF, and Stoneville 4145 LLB2). The sub-plot factor was degree of shading: shaded cotton (50% shading) and non-shaded cotton. The sub-sub plot factor was application timing (1-, 4-, and 6-leaf stage). The sub-sub-sub plot included two rates of glufosinate [0.79 (1X) and 1.58 lb ai/A] and a nontreated check. Plots were shaded for 3 d prior to application and irrigated 0.25 in 1 d prior to their respective applications. Glufosinate was applied using a $C0_2$-pressurized backpack sprayer calibrated to deliver 15 GPA. In 2012, injury was visually assessed at 2 and 4 to 5 weeks after treatment (WAT), and seedcotton was harvested upon maturity. In 2013, injury was assessed weekly until 8 WAT and likewise seedcotton harvested at maturity.

Cotton tolerance to glufosinate differed by variety at 2 WAT, but injury was observed on all varieties, including Liberty Link cotton. In general, cotton plants that were shaded prior to applying glufosinate were injured to a greater extent than non-shaded plants. Injury at 2 WAT following the 1-leaf application was generally greater for 375 WRF and 499 WRF compared to 4145 LLB2. At 4 to 5 WAT, all varieties showed similar potential for recovery. Seedcotton yield was reduced when glufosinate was applied at the 1X rate to 1-leaf cotton or at the 1X and 2X rates to 4-leaf cotton when plants were shaded for 3 d prior to glufosinate application. Our results indicate that in general, shading (cloudcover) 3 d prior to glufosinate application at 1X and/or 2X rates increases injury, irrespective of variety.

Development of an Available Soil Water Index to Characterize Site Water-Deficit Stress Experienced in Cotton Variety Trials.

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Although the large number of dryland cotton (*Gossypium hirsutum,* L.) variety trials conducted each year allow producers to examine the yield response of varieties in similar growing conditions to their own, local trials may not fully express all varietal characteristics, specifically those of drought stress. The ability to characterize the drought stress of these trials would allow for a larger extrapolation of varietal yield response. The main objective of this initiative was to develop and test a crop/soil sensor-based index to accurately characterize location drought-stress.

During the 2012 and 2013 growing seasons, 9 index development trials, each consisting of 48+ Decagon 5TE Capacitance, Frequency Domain Soil Moisture Sensors (Decagon Devices, Inc., Pullman, WA), were conducted from AZ to SC. Treatments included multiple varieties and irrigation regimes. Monitored data included standard meteorological parameters at the site scale and soil moisture, physiological growth parameters, and seedcotton yield at the plot scale. This dataset was subsequently used to develop an Available Soil Moisture Stress Index (ASMSI), which is a function of plant available water (PAW) adjusted for rooting depth and crop susceptibility during the growing season. Strongest relationships between accumulated ASMSI units and seedcotton yield were found when the upper and lower limits of PAW were determined from laboratory texture analysis and then adjusted for in-season sensor readings (r^2=0.593). Response curves did indicate a potential interaction between varietal yield response and soil water depletion, which suggests sensors used to characterize dryland variety trials should initially be deployed under a standard variety.

In order to test the developed ASMSI, an additional 8 index testing trails consisting of 16 Decagon EC-5 Sensors were deployed in dryland variety trails located in MS, AL, GA and SC during the 2013 growing season. Although dataset construction is ongoing, preliminary results from testing trials suggest a limited number of sensors under a standard variety could be used to characterize locational drought stress, therefore increasing the utility of dryland variety trials. Still, further research is needed to accurately define the response of accumulated ASMSI units to variety and spatial variability and to refine the crop susceptibility factor.

Determining a Treatment Threshold for Green Stink Bug on Edamame Soybean.

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Edamame soybeans are an emerging crop in Arkansas and as with our customary soybeans the green stink bug is a major pest of this crop. Due to edamame's use as a food crop, as opposed to the soybean typically used in industry and animal feed, appearance of the pod and bean is a major factor in crop value. As with any new crop, new economic thresholds must be determined for each production region.

In 2012, lumite cages (6ft x 6ft x 6ft) were placed over edamame soybeans to contain stink bugs at densities of 0, 1, 3 and 6 stinkbug nymphs for 7 and 14 days. In 2013 a similar trial was conducted using densities of green stinkbug adults at densities of 0, 2, 6, or 12 nymphs per cage and left to feed for 7 days. Yields were taken from one row in each cage and evidence of feeding was confirmed by staining and counting salivary sheaths on 50 pods per cage using Bowling's method.

There were no differences in yields between insect density levels. However there was a correlation between insect density and the number of pods injured from stink bug feeding.

Efficacy of Selected Insecticides for Control of Rice Stink Bug, *Oebalus pugnax*, in Arkansas.
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The Rice Stink Bug, Oebalus pugnax, is one of the most destructive insect pests of rice production in the mid-south. Rice stink bug feeding can result in yield loss and/ or a loss in quality. For the purpose of this presentation we will discuss trials conducted in grower fields from 2011-2013 to evaluate the impact of foliar insecticides for control of rice stink bug. In 2011, assessments were taken 6 day after treatment (DAT) 1 and 7 and 10 DAT 2. Results showed no treatments reduced insect populations below threshold after the first application. However, all treatments except Declare 1.54 oz/a, Mustang Max 2.65 oz/a and Karate Z 1.8 oz/a had fewer stink bugs compared to the untreated check (UTC). At 7 and 10 DAT 2 all treatments reduced rice sting bug numbers below threshold. In 2012, Endigo ZC 5 oz/a, Endigo ZCX 5 oz/a, Karate Z 2.56 oz/a, Centric 3.5 ozwt/a, and Tenchu 9 oz/a were evaluated. At 4 and 7 DAT 1 all treatments had fewer stink bugs than the UTC, although Tenchu did not reduce numbers below threshold. At 3 DAT 2 all treatments reduced stink bugs below threshold. In 2013, only one application was needed to reduce numbers below threshold. At 5 DAT 1 Centric 3.5 ozwt/a reduced stink bug numbers better than all treatments except Endigo ZCX 6 oz/a. In these trials new insecticides not currently labeled were compared to recommended standard insecticides. Results indicate that new insecticides may have potential value for control of stink bugs in rice.

Assessment of the Tolerance of Various Crops to Different Rates of Pre-Applied Fluridone.
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The evolution of glyphosate-resistant Palmer amaranth is posing a serious threat to crop production in the southern United States. With estimates of a 50% reduction in cotton yield potentially being attributed to herbicide-resistant weeds, non-conventional herbicides are being considered for weed management programs. In 2012, the EPA temporarily allowed an emergency exemption for the use of fluridone (Brake) in cotton production in an effort to control glyphosate-resistant weeds. Fluridone has traditionally been used to control aquatic weeds such as hydrilla and Eurasian milfoil, but research has shown that cotton has a strong tolerance to the herbicide. There is concern that pre-applied fluridone has the potential for injury on other crops due to its long persistence in the soil. A study was conducted in 2013 in Fayetteville, AR to assess the tolerance of various crops to different rates of pre-applied fluridone (simulated half-lives). This study was setup as a randomized complete block arrangement with four replications. Fluridone was sprayed as a pre-applied herbicide at 7 different rates of application (0.3, 0.2, 0.1, 0.05, 0.025, 0.0125, and 0.0063 lb ai/A). Sunflower, corn, wheat, grain sorghum, rice, soybean, and cotton were planted and visually rated for crop injury at 2 weeks after treatment (WAT) and 4 WAT. Among the crops that were evaluated, cotton showed no injury to any rates of application. Sunflower showed some tolerance to fluridone; however, 0.3 lb/A and 0.2 lb/A resulted in injury of 37% and 23% at 4 WAT and no significant difference in the remaining treatments at injuries of <3%. Corn injury at 4 WAT showed similar results, with the highest two rates of application causing 47% and 67% injury and the rest of the treatments showing no significant difference between them, with injury ranging from 0 to 9%. Wheat, grain sorghum, rice, and soybean all showed low tolerance to fluridone, with injury being reported at 2 WAT and 4 WAT for all rates of application, with the exception of wheat at 2 WAT at the lowest rate. Application rate of 0.3 lb/A caused ≥85% injury to wheat, sorghum, rice, and soybean. At the lowest rate of 0.0063 lb/A wheat showed 8% injury at 4 WAT, grain sorghum and rice had 11% injury at 4 WAT, and soybean had 3% injury 4 WAT, with injury rising steadily to corresponding application rates. Previous research has shown fluridone to persist in the soil for more than 8 months after application, and with a low tolerance of many crops to this herbicide, there exist the possibility for crop injury to occur, especially if wheat is sown behind cotton. More research is needed to evaluate the longevity of fluridone in the soil to reduce any potential crop damage for producers.

Comparison of Acetochlor, Metolachlor, and Pyroxasulfone Applied POST to Cotton.
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Applications of pyroxasulfone, acetochlor, and metolachlor were evaluated to determine crop injury and residual weed control when tank mixed with glufosinate and applied post emergence to cotton. These applications were made in a Liberty Link system using Stoneville cultivar 4946 GLB2.

Palmer amaranth (Amaranthis palmeri L.), pitted morningglory (Ipomoea lacunose L.), barnyardgrass (Echinochloa crus-galli L.), and broadleaf signalgrass (Brachiaria platyphylla Nash) were over seeded at planting to provide a consistent weed population. Also at planting, an application of fluometeron was applied at 1 lb ai/A across all treatments. Weed efficacy and cotton injury were noted at 7, 14, 21 and 28 days. Cotton yields were recorded at the end of the season. Residual herbicides; pyroxasulfone, acetochlor, and metolachlor were tank mixed with gluphosinate at 0.5 lb ai/A and applied over-the-top at 1-2 leaf or 4-6 leaf growth stages. Each residual was observed at four different rates within the two growth stages. Pyroxasulfone was applied at rates of 0.053, 0.08, 0.106 and 0.213 lb ai/A. metolachlor was applied at rates of 0.475, 0.713, 0.95 and 1.9 lbs ai/A. acetochlor was applied at rates of 0.56, 0.843, 1.13, and 2.25 lbs ai/A. All plots recieved a layby application at bloom to maintain weed control until harvest.

Crop injury was present with higher rates of all residual herbicides at both 1-2 leaf and 4-6 leaf applications. Metolachlor at 1.9 lbai/A produced 25% damage at 14 days after the 1-2 leaf application, by 21 days there was no visual damage. There was 13% injury present with 1.9lb ai/A metolachlor 7 days after the 4-6 leaf applications, but by 14 days the plants recovered and there was no visible injury present. The acetochlor tank mixtures provided 18% injury at 14 days after the 1-2 leaf application and 26% at 7 days after the 4-6 leaf application. Cotton recovered 21 days in either application. Pyroxasulfone produced significant damage at high rates at both 1-2 leaf and 4-6 leaf applications. At 14 days after the 4-6 leaf treatment there was still 44% damage, but only the highest rate of 0.213lb ai/A of pyroxasulfone produced significant damage at 21 days after application. Though significant injury was observed, there was no substantial yield reduction. Also, there were no notable differences in weed efficacy.

Survey of Exotic Pests of Corn in Arkansas.
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Corn production in Arkansas is on the increase. In 2011, 560,000 acres were planted with an estimated market value of $485 million. Corn acreage for 2012 is estimated at 660,000 acres. With the 2012 drought in the Midwest, corn acreage is on the rise and is becoming a very important crop for Arkansas agriculture. This increase in corn acreage magnifies the need for early detection of new, invasive pests. A Corn Commodity

Survey was conducted in 4 corn fields in each of 9 counties to determine if any of a group of five potentially damaging exotic insect pests of corn are present in Arkansas. Pests surveyed for included: Silver -Y moth, *Autographa gamma* L.; Old World Bollworm, *Helicoverpa armigera;* Asian Corn Borer, *Ostrinia furnacalis;* Egyptian cotton leafworm, *Spodoptera littoralis;* and False Codling Moth, *Thaumatotibia leucotreta.* Results of the survey will be discussed.

Comparison of Select Insecticides for Control of Bean Leaf Beetle in Soybeans.

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Control of Bean Leaf Beetle (BLB) in Soybeans has become difficult. Resistance to insecticides has been documented in the Midsouth in recent years. A trial was conducted in Elaine, AR on a grower field with a pre-treatment count of 114 BLB / 25 sweeps. Plots were sprayed using a Mud Master sprayer at a rate of 10GPA. Treatments included Besiege 1.25 ZC 7oz/a, Leverage 360 3F 2.8oz/a, Declare 1.25 CS at 1.02oz/a and at 1.28oz/a, Warrior II 2.08CS 1.54oz/a, Belay 2.13 SC 4oz/a, Endigo ZCX 2.06SC 4.5oz/a, Bifenthrin 2EC 3.2oz/a, Leverage 360 3F 2.8oz/a plus Belt 4SC 2oz/a, Declare 1.25CS 1.02oz/a plus Dimethoate 4EC 4oz/a, and Belay 2.13SC 4oz/a plus Brigade 2EC 3.2oz/a. Plots were sampled using a standard 15 in sweep net at 25 sweeps per plot at 3, 7, and 10 days after application. Belay and Belay plus Brigade had fewer bean leaf beetles compared to all other treatments except Brigade.

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