ABSTRACTS RESEARCH CONFERENCE

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Arkansas Crop Protection Association

November 26 – November 27, 2012
Clarion Inn
Fayetteville, Arkansas

Monday, November 26, 2012

10:00 a.m. Business Meeting
12:00 noon Registration

MODERATOR: Ryan Doherty
Student Contest Chair: Mohammad T. Bararpour
Audio-Visual Coordinator: Robert C. Scott

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

Tuesday, November 27, 2011

MODERATOR: Jason Meier

The Rapid Growth of Brazilian Agriculture and the Influence of the United States on its Agriculture.
Sean Flynn*, Gus Lorenz, Entomology Department, University of Arkansas, Fayetteville, AR.

Brazil is a country with large room for economic and agricultural growth. Agriculture in Brazil has been rapidly expanding since the late 1980's. Since then, Brazil has become a worldwide leader in agricultural production. This rapid growth and ascent to top five status has been made possible because of the country's large land mass of 2.1 billion acres and the American influence on the Brazilian agricultural practices. The United State's influence on Brazilian agriculture has come from many areas within the industry. For example, John Deere has 7 different manufacturing plants located in Brazil making it the largest manufacturer of John Deere products in Central and South America. U.S. company, Case IH, as well as most of the major chemical companies are also well represented in Brazil. Brazil has shown steady increases in yields over the last 20 years; this is because of the U.S. investments in agriculture practices and maintenance over this same time period. Overall Brazilian agriculture looks to have a bright future ahead of it with much more land ready to be put into production.

Effects of Early Infestations of Two-spotted Spider Mites (*Tetranychus urticae*) on Cotton Growth and Yield.
Luis Orellana*, Ashley G. P. Dowling and Gus Lorenz. Department of Entomology, Divison of Agriculture, University of Arkansas, Fayetteville, AR.

Spider mite infestations in cotton have been reported as early as first and second node growth since 2005. Early infestations have been associated with changes in seed treatments as well as applications of broad spectrum insecticides against plant bugs or thrips at early stages of cotton growth. These outbreaks are normally attributed to the disruption of natural enemies. The objective of this study was to evaluate the impact of the timing infestation initiation and duration of the infestations of spider mites on early season cotton growth and yield. Two trials were established three weeks apart during May 2012 at the Lon Mann cotton research station in Marianna, Arkansas. Cotton plots were infested with two-spotted spider mites (TSSM) at 4th true leaf, 6th true leaf and squaring. For the infestations starting at 4th and 6th true leaf, mites were eliminated after 3 d, 7 d, or squaring. In plots where infestations started at squaring, mites were eliminated after 3 d, 7 d, or at bloom. Oberon® or Zeal® was applied to kill TSSM. TSSM counts and leaf damage scores were taken to assess levels of infestation. Plant heights and counts of nodes of first fruiting branch were taken during squaring to assess growth differences. The number of nodes above white flower (NAWF) was taken before cutout to assess differences in maturity and yield was assessed. In the plots where infestation started at 6th true leaf and at squaring showed significantly more damage than control plots. Preliminary results suggest that the level of TSSM damage seen during this experiment were not severe enough to reduce growth or delay maturity on cotton.

Effects of Herbicide/Insecticide Tank Mixes on Efficacy for Thrips Control and Phytotoxicity on Seedling Cotton.
D.L. Clarkson*, G.M. Lorenz, N.M. Taillon ,W.A. Plummer, B.C. Thrash, L.R. Orellana Jimenez, University of Arkansas, Division of Agriculture, Department of Entomology

Tank mixes of herbicides and insecticides may alter the efficacy of either product, or may have an impact on cotton plant development. The extent of these interactions may change on transgenic cultivars (e.g., Round-up Ready or Liberty Link). Preliminary studies conducted in 2011 indicated that little injury was apparent to small cotton in both Liberty Link and Round-up Ready flex systems with various insecticide/herbicide tank mixtures. However, these studies evaluated the non-selective herbicides applied over healthy cotton; under optimal growing conditions. The objective of this research study was to continue this work using sub-optimal planting dates, different product mixtures, and different stress circumstances to determine if there were any significant impacts on both maturity and yield. A treatment using insecticide-treated seed was added to examine efficacy changes after herbicide application. Four different trials were established in eastern Arkansas. Planting dates included an early season trial planted on April 13th, two trials planted May 31st, and a late season trial planted June 7th. When thrips reached treatment thresholds, applications of various tank-mixed insecticides and herbicides were made on 2-4 leaf cotton. Thrips densities, plant height and stand counts were monitored 5-7 days post treatment. Plant injury (necrosis or chlorosis) was also recorded at this time. After these data were collected, all trials were treated identically for pests the remainder of the season. Nodes above white flower counts were made once just prior to cutout to determine differences in maturity, and yield was measured in each treatment. Within the seed treatment trial, an application of one herbicide was sprayed to monitor the efficacy of the seed treatment after application. While thrips levels fluctuated among treatments, the efficacy of the tested insecticides was not significantly affected by tank mixtures of the selected herbicides. In addition, cotton seedling phytotoxicity caused by the tested herbicides was not influenced by the presence of the selected insecticides in tank mixtures. However, the efficacy of seed treatments was disrupted by application of an over-the-top herbicide. Future evaluation of this disruption will be expanded through experiments with different herbicides at various application rates and multiple seed treatments.

Spotted Wing Drosophila: New Pest in Arkansas, Management, Monitoring, and Alternative Identification.

Soo-Hoon S. Kim**, Amber Tripodi, Donn T. Johnson, Allen L. Szalanski. Department of Entomology, University of Arkansas, Fayetteville, AR

Spotted wing drosophila (SWD), *Drosophila suzukii*, is a fairly new invasive pest damaging small fruit throughout the United States since 2008. Trap monitoring detected the presence of this pest in several Arkansas counties in 2012. Unlike other *Drosophila spp.* that feed on decaying fruit, this species causes damage to ripening, soft-skinned fruit. The spray programs recommend a 5 to 7 day spray interval using insecticides with 3 day pre-harvest interval or less. Efficient monitoring and identification of SWD presence aid in timing insecticide sprays that prevent economic damage. Monitoring traps consist of a clear, 1 quart plastic beverage cup with 3/16" entry holes in both the side and lid with both a lure (apple cider vinegar or a mixture of yeast + wine or grape juice) and yellow sticky card placed inside the cup. Misidentification of this pest can occur when using only adult morphological features such as wing spots and presence of front leg combs on males or a serrated ovipositor in females. There are no methods to identify SWD larvae. This project was conducted to determine if molecular diagnostics could be used to identify SWD among other *Drosophila spp.* flies captured in the traps or SWD larvae in fruit samples.

Rice Grain Yield as Affected by Urea Amendment and Simulated Rainfall Timing.

Randy J. Dempsey*, Colin G. Massey, Nathan A. Slaton, Russell E. DeLong, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Rice (*Oryza sativa* L.) production in Arkansas requires a significant amount of nitrogen (N) fertilizer to produce high grain yields. With the increasing cost of commercial fertilizers, urea [$(NH_2)_2CO$] especially, the applied N needs to be used efficiently. Ammonia (NH_3) volatilization and denitrification are the primary N-loss mechanisms in rice production and represent a financial loss to the grower and a threat to the environment. There is little to no research describing in-field manipulation of soil moisture or simulated rainfall on rice N fertilization strategies. The research objective was to compare the effects of simulated rainfall timing and urea amendment on rice grain yield. A single experiment was conducted in 2012 at the Pine Tree Research Station (Colt, AR) on an alkaline Calhoun silt loam. We evaluated urea (Urea), urea + the urease inhibitor N-(n-butyl) thiophosphoric triamide (Urea-NBPT), and urea + NBPT + Nitrapyrin (a nitrification inhibitor, Urea-I) applied at 120 lb N/acre plus a no N control that were each subjected to three simulated rainfall timings of no water, 0.33 inch rainfall applied 18 hours before N application, and 0.33 inch rainfall applied 4 hours after N application. The permanent flood was established 6 days after N application. The experiment was a randomized complete block with a 4 x 3 factorial treatment structure. Grain yield data was analyzed using Fisher's least significant difference method with an α of 0.10. Grain yield was influenced by the significant N source and simulated rainfall timing interaction ($P<0.0044$). Rice receiving no N produced the lowest grain yields (80 to 86 bu/acre, LSD0.10 = 9 bu/acre) which were similar regardless of simulated rainfall. Rice fertilized with Urea-NBPT (196 bu/acre) and Urea-I (192 bu/acre) and had no simulated rainfall produced the greatest overall yields that were greater than the yield of rice fertilized with Urea (176 bu/acre). Similarly, rice fertilized with Urea-NBPT (183 bu/acre) and Urea-I (173 bu/acre) applied to a moist soil following the simulated rainfall produced greater yields than rice fertilized with Urea (144 bu/acre). Rice fertilized with Urea and no rainfall applied produced similar yields as all three N sources (170 to 176 bu/acre) when the simulated rainfall was applied following N application. The yield results clearly indicate that ammonia volatilization was greatest when untreated urea was applied to a moist soil. The results also suggest that the most efficient plant use of N occurred from urea treated with the urease inhibitor and applied to a dry soil with no rainfall before the permanent flood was established. Nitrification followed by denitrifcation may also have contributed to N loss and the lower yield of some treatments, but more research is needed to clarify this possibility. The preliminary experiment's results suggest that a rainfall simulator can be effectively used to create field situations that exacerbate ammonia loss from urea and can be used to assess the efficacy of different urea amendments under field conditions.

Sensitivity of Determinate and Indeterminate Soybean Variety to Potassium Deficiency.
Md. Rasel Parvej** and Nathan A. Slaton, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR

Soybeans [*Glycine max* (L.) Merr.] are regarded as a potassium (K) responsive crop in Arkansas. Arkansas farmers now grow a considerable acreage of determinate and indeterminate soybean varieties. Indeterminate varieties continue main stem elongation several weeks after flowering, while determinate varieties terminate elongation at or soon after flower initiation. This difference in growth habit may influence soybean nutrient uptake and yield response to K fertilization as well as the plant's susceptibility to K deficiency. Our research objective was to evaluate the yield response of a determinate and indeterminate soybean variety when grown in soils differing in K availability as a result of different annual K fertilization rates. This research was conducted in a long-term K fertilization trial that was established in 2002 at the Pine Tree Research Station (Colt, AR) on a Calhoun silt loam. In 2012, a determinate (Armor 53-R15) and indeterminate (Armor 48-R40) variety was drill seeded in 15 inch wide rows on 24 April with the annual application of muriate of potash ranging from 0 to 160 lb K_2O acre^{-1}. The experiment was a split-plot design with nine replications where annual K rate (0, 40, 80, 120, and 160 lb K_2O acre^{-1}) was the main plot and soybean variety was the subplot. A mature trifoliate leaf from one of the top three nodes was collected from 15 plants and analyzed for K concentration when the determinate variety was at the R2 stage and the indeterminate variety was at the R4 stage. Leaf K concentration was significantly affected ($P<0.0001$) only by annual K rate. Trifoliate leaf K concentration increased linearly as K rate increased and ranged from 1.18% for soybean fertilized with 0 lb K_2O acre^{-1} to 2.10% for soybean receiving 160 lb K_2O acre^{-1}. The leaf K concentrations of soybean receiving no K fertilizer were considered deficient (<1.50%) and both varieties exhibited K-deficiency symptoms (chlorosis) during the growing season. Soybean yield was affected significantly by the main effects of annual K rate ($P=0.0317$) and variety ($P<0.0001$). Averaged across annual K rates, the indeterminate variety yielded 72 bu acre^{-1} compared to the determinate variety yield of 56 bu acre^{-1}. Soybeans receiving K fertilizer produced similar yields ranging from 64 to 66 bu acre^{-1} compared to the no K control yield of 60 bu acre^{-1}. The significant yield increase of both varieties from K fertilization was expected because the same K rates have been applied to the same plots for 10 years. The results of this study suggest that the indeterminate variety (Armor 48-R40) had a greater yield potential than the determinate variety and that the two varieties responded similarly to the range of soil and fertilizer K availability present. Additional research is needed to verify the consistency of these results and understand how soybean with the two growth habits partition K among plant parts in response to different levels of K availability.

Comparison of Urease Inhibitors for Use in Direct-Seeded, Delayed-Flood Rice Production.

Christopher W. Rogers*, Richard J. Norman, Kristofor R. Brye, Trenton L. Roberts, Nathan A. Slaton, Alden D. Smartt, Donna L. Frizzell, and Anthony M. Fulford. Department of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Urea fertilizer is the most widely used nitrogen (N) source for direct-seeded, delayed-flood rice (*Oryza sativa* L.). This is largely due to its high N content (46%) and relatively low cost as compared to other N sources; however, urea is prone to ammonia (NH_3) volatilization when fields are not flooded in a timely manner. To minimize these losses urease inhibitors are often used for preflood N applications. While many substances are marketed as urease or NH_3 volatilization inhibitors, the only products currently recommended by the University of Arkansas Cooperative Extension Service contain the urease inhibitor [N-(n-butyl) thiophosphorictriamide] (NBPT), which has been shown to be effective at minimizing NH_3volatilization. Static diffusion chambers were used in the laboratory and the field to further investigate inhibitors marketed to decrease NH_3volatilization. Laboratory studies were conducted using static diffusion jars at 25º C where 50g of soil was added to the jars and urea added at a rate of 180 lb N ac^{-1} (202 kg N ha^{-1}) and 4% boric acid traps were used to collect volatilized NH_3. Field studies were conducted using plexiglass static diffusion chambers driven into the soil to a depth of 15 cm, urea was added at a rate of 90 lb N ac^{-1} (101 kg N ha^{-1}), and volatilized ammonia captured in H_3PO_4 impregnated polyurethane foam sorbers. Both studies investigated urea and the NBPT containing products Agrotain and Arborite as well as an experimental product, which did not contain NBPT but was marketed to inhibit NH_3 loss. In both studies, NBPT containing products lost statistically less N over the 20 day study than any other product. The laboratory study results indicated that Experimental A was not statistically different than urea throughout the study. The field study further confirmed the effectiveness of NBPT in decreasing NH_3 volatilization, and Experimental C was not statistically different from urea and was thus, ineffective at minimizing NH_3volatilization. These studies confirm the effectiveness of NBPT at decreasing NH_3 volatilization of urea and the ineffectiveness of the other inhibitors tested.

Evaluating Salt Tolerance of Conventional and Hybrid Rice Varieties.

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Maintaining a permanent flood with irrigation water derived from surface reservoirs or a subsurface well represents the second highest production cost typically encountered during the growing season for direct seeded, delayed-flood rice (*Oryza sativa* L.) production. Water management strategies that can potentially improve water-use efficiency (WUE) are intermittent flooding and furrow irrigation. While these strategies can lower irrigation costs, the repeated use of irrigation water or tailwater that is high in soluble salts (i.e., calcium, magnesium, sodium, chloride, sulfate and nitrate) and/or bicarbonates can gradually contribute to a change in soil pH and soil structure. Tailwater recovery systems recirculate irrigation water allowing soluble salts to increase in concentration rather than being diluted with a continuous supply of 'fresh' water and this can increase salt content at the soil surface. Saline surface soil contributes to osmotic stress that can reduce seed germination and root growth leading to non-uniform stand establishment and a reduction in grain yield. The response of rice to saline environmental conditions differs based on growth stage and cultivars exhibit differences with respect to salt tolerance; therefore, the objective of this study was to conduct a rapid (7 d) salinity screening to assess the salt tolerance of conventional and hybrid rice varieties.

Seed germination was evaluated in response to increasing salt concentration for 30 rice cultivars entered into the 2012 Arkansas Rice Performance Trials (ARPT). For each cultivar, 10 seeds were placed on a filter paper-lined petri dish, subjected to 5 mL of salt solution, covered and placed in an incubator for 7 d at a constant temperature of 30° C. The salt solutions utilized in this study had an electrical conductivity (EC) of: 0, 2.5, 5, 7.5, 10, 12.5, 17.5, or 20 mmohs/cm. Percent germination was calculated for each variety and seeds were

considered to have germinated when, following the 7 d incubation period, the radicle was > 0.5 cm in length. A complete factorial of cultivar (30) x salt concentration (8) was utilized and treatments were arranged in a randomized complete block design with four blocks. Data were normalized to evaluate the influence of salinity on rice germination and statistical analysis conducted using JMP 10.0 with significant differences among percent germination determined using Fisher's protected LSD.

Percent germination exhibited a significant interaction ($P<0.0001$) between salinity level and variety indicating that salt concentration had an effect on germination and this effect differed among the varieties evaluated in this study. Percent germination of the medium-grain varieties and a majority of the hybrid varieties did not exhibit a decline in response to increasing salt concentration even at the highest (i.e., 17.5 and 20 mmohs/cm) EC, while the long-grain pureline varieties exhibited a tendency to decline below 80% germination when EC was $\geq$17.5 mmohs/cm. The current regulation on rice seed sold in Arkansas has established a range of 72 to 88% germination for seed containing a label of 80% germination. Therefore, using 80% germination as a threshold, the medium-grain varieties as well as a majority of hybrids evaluated did not fall below 80% germination at any of the salinity levels evaluated in this study. The results of this research may be useful for the rapid determination of rice varieties that can be successfully cultivated under saline growing conditions. However, additional research is needed in order to determine if a higher percent germination under saline conditions has any influence on salt tolerance at other growth stages.

Influence of Poultry Litter on N-STaR Soil Test Values on Silt Loam Soils.
C.E. Greub*, T.L. Roberts, N.A. Slaton, R.J. Norman and A.M. Fulford. Department of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Rice (*Oryza sativa* L.), an important global cereal crop, is grown on approximately five hundred thousand hectares in Arkansas each year. Arkansas is the leading rice producing state in the United States, growing 48% of the total production. Poultry litter (PL) is one of the most nutrient rich soil amendments and is applied to a large amount of row crop hectares each year in Arkansas. Poultry litter is typically applied to satisfy phosphorus and potassium recommendations, however Golden et al. (2006) indicated that 25% of the total-N (TN) applied as PL was recovered by the rice crop. For N fertilization recommendations, it is important to be able to accurately predict the amount of soil nitrogen (N) which can become available to plants which is influenced by applications of PL. Depending on time of application and management practice, 15 to 75% of the TN content of PL is plant available within the first year for summer crops (Slaton et al., 2005). Most of the N in PL is in the organic form (75%), with the remaining 25% of the TN found in PL as inorganic-N, mainly in the form of NH_4-N. The most recent advancement in predicting N fertilizer needs for rice production in Arkansas is the correlation and calibration of the Nitrogen-Soil Test for Rice (N-STaR) by Roberts et al. (2011). The N-STaR is a soil-based N test that predicts N fertilizer needs for rice production, quantifying alkaline hydrolyzable-N (AH-N) in the form of amino sugars, amino acids, and NH_4-N. The use of N-STaR to predict field-specific N rates is expected to become a standard procedure for rice produced on silt loam soils; however PL is applied to a large portion of rice acreage in Arkansas and N-STaR has not been adequately researched on soils that have recently received an application of PL. The objective of this study is to evaluate the ability of N-STaR to quantify N release from a pelletized PL application and identify how a PL application influences N-STaR recommendations over time.

Four field experiments, two each in 2011 and 2012, were established to evaluate soil responsiveness to PL as a fertilizer for an estimated N credit in rice using N-STaR. Rice variety CL 261was seeded at the Pine Tree Branch Station (Pine Tree, AR) and the South East Research and Extension Center (Rohwer, AR), on Calhoun and Hebert silt loam soils, respectively. The two PL application times were 4 wk and 8 wk prior to flooding. The four poultry litter applications were applied by hand and incorporated at rates of 0 kg, 2240 kg, 4480 kg, and 6720 kg litter ha^{-1}. Soil samples were collected three times from the plots devoid of rice in 2-wk intervals prior to flooding. Poultry litter rate as a main effect significantly increased in AH-N as PL application rate increased. Alkaline hydrolyzable-N was also significantly influenced by the two-way interaction of soil sample time and location, with the Pine Tree location having higher numerical values at all three sample times when compared to the Rohwer location. Poultry litter application time by soil sample time interaction resulted in a significant difference between the PL application times only at the first soil sampling time, with a 7 mg N kg soil^{-1} difference in AH-N. Results of this study allowed the development of N-STaR sampling protocols in rice on silt loam soils, recommending that rice producers applying PL should wait a minimum of two wk following application to collect N-STaR soil samples.

Soybean Yield Response to Maximum Yield Environment.

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Mr. Kip Cullers reported the highest recorded soybean yield of 161 bu/A for the 2010 Missouri Soybean Association yield contest. A maximum yield environment was created in small plot research at Fayetteville, AR using many of the same management practices as Mr. Cullers. These practices included soil testing and amending nutrients to high levels, application of 7.6 (2011) to 9.7 (2012) tons/A poultry litter, deep tillage, early planting (9 May in 2011 and 11 Apr. in 2012), overhead irrigation at a 1 in. deficient, N, K and S fertilization via the irrigation system, preventative fungicide applications, and strict pest management. Twelve or fourteen indeterminate cultivars of relative maturity (RM) 4.2 to 5.5 were evaluated for crop and seed-growth characteristics and yield. In addition, two 4.9 RM cultivars were selected to evaluate the yield response to even intra-row spacing or plant height at emergence, lactofen +/- crop oil, carfentrazone-ethyl, or fluthiacet-methyl herbicide burn at the V3 growth stage, Optimize-400, Bio-Forge, Accolade-(P), and fungicide/insecticide seed treatments, and mechanically preventing lodging. In 2012, yield of the 12 cultivars ranged from 115 to 86 bu/A and yield for the management treatments across two cultivars ranged from 109 to 95 bu/A. Abnormally high temperatures from late June through early August likely suppressed yield. In 2011 and 2012, additional seed treatments did not increase yield over the fungicide/insecticide seed treatment. In 2011, a 21% yield increase was observed with the lactofen with 2% v/v crop oil application, however, in 2012, herbicide burn treatments were not significantly different from the control. There was no response to even intra-row spacing, even height, one or two applications of 1-MCP (ethylene inhibitor), or preventing lodging in either year. These results indicate that none of these single factors increased yield in our maximum yield environment. This research also confirms that Mr. Cullers' management practices are capable of producing soybean yields in excess of 100 bu/A.

Crop Residue Influence on N-STaR Values.

Lana A. Clark*, Trenton L. Roberts, Richard J. Norman, Nathan A. Slaton. Crop, Soil, and Environmental Sciences, Fayetteville AR

Crop residues play a significant role in soil N cycling. The type of residue, C:N ratio, tillage, and soil moisture can dictate potentially mineralizable soil-N. Previous studies indicate that for crops possessing wide C:N ratios, a net N immobilization will occur, whereas crops with low C:N ratios can increase N mineralization in the soil. This study was established to estimate the N mineralization potential of various crop residues using Direct Steam Distillation (DSD) and the Illinois Soil Nitrogen Test (ISNT). Corn (*Zea mays*), soybean (*Glycine max*), wheat (*Triticum aestivum L*), rice (*Oryza sativa*), and grain sorghum (*Sorghum bicolor*) residues were labeled with ^{15}N using 10 atom% urea. To assess the N mineralization potential of various crop residues, 0.2g of residue was subjected to both the DSD and ISNT. Hydrolyzed-N was captured and analyzed for ^{15}N content to compare fertilizer atom % ^{15}N to that of the original residue. Total N was quantified to establish percent recovery. For percent N recovery there was a significant residue by method interaction ($p<0.0001$) indicating that the two methods recovered varying amounts of N based on the type of residue. Atom % ^{15}N recovered from the soybean residue as alkaline hydrolyzable-N was significantly lower than what was quantified in the plant tissue. Conversely, atom % ^{15}N recovered from the rice residue as alkaline hydrolyzable-N was significantly greater than that which was quantified in the original plant tissue. Comparison of atom % ^{15}N in the residue and recovered alkaline hydrolyzable-N suggested that certain crop species may partition N fertilizer differently and thus influence the quantification of alkaline hydrolyzable-N using the DSD and ISNT. Additional studies are needed to compare N mineralization potential to actual N mineralization in controlled incubations. Specific estimation of N mineralization potential of crop residues could aid producers in determining N fertilizer needs and help encourage the development and incorporation of soil-based N tests.

Does the Addition of 2, 4-DB to Glufosinate + *S*-Metolachlor Improve Palmer Amaranth Control in Liberty Link® Soybean?

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Glyphosate-resistant Palmer amaranth is the biggest problem facing soybean producers in the Midsouth. Use of glufosinate-resistant soybean cultivars has helped manage glyphosate-resistant Palmer amaranth; however, glufosinate alone is not recommended because use of a single herbicide intensely selects for resistance. Furthermore, Palmer amaranth control with glufosinate is often less than acceptable when applications are not made in a timely manner. A tank-mixture containing multiple effective herbicide modes of action can improve weed control and is an excellent resistance management strategy. A field study was conducted in the summer of 2012 at Keiser, AR, on a Sharkey clay to determine if the addition of 2,4-DB (Butyrac) to glufosinate (Liberty) plus *S*-metolachlor (Dual Magnum) would improve Palmer amaranth control. The experiment was organized as a factorial arrangement of treatments in a randomized complete block design with four replications. Treatments included Dual Magnum at 1 pt/A in combination with either Liberty at 29 fl oz/A or Butyrac at 4 fl oz/A and a tank-mixture of all three herbicides. All treatments were applied on 4-, 12-, and 24-inch Palmer amaranth. Weed control and crop injury were visually rated weekly throughout the season. Treatments containing Butyrac + Dual Magnum resulted in $\leq$ 8% injury 2 weeks after treatment (WAT), and no crop injury was detectable by 4 WAT. All herbicide treatments provided $\geq$ 91% control of 4-inch-tall Palmer amaranth. For the 12- and 24-inch application timings, all herbicide treatments resulted in 61 to 87% control, with the three-way combination providing significantly greater control than Liberty + Dual Magnum or Butyrac + Dual Magnum. Butyrac alone is not an effective option for controlling large Palmer amaranth. Butyrac tank-mixed with Liberty will improve control in a salvage situation and does protect against the evolution of glufosinate-resistant Palmer amaranth when applied in a timely manner.

Measuring the Response of Two Soybean Cultivars to Salt Stress Through Microarray Analysis and Non-invasive Plant Sensing.

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Soybean is an important agronomic crop grown worldwide and prized for its oil as well as the leftover pulp serving as animal feed. Cultivation is limited by pathogen and pest pressures and environmental factors. Some soybeans are tolerant of salt stress whereas others are sensitive; the lines and cultivars that are tolerant are referred to as excluders, as they exclude chloride from their leaves, and those that are sensitive are referred to as includers, as chloride is not excluded from the leaves. Much work has been done on breeding for salt tolerance in soybean and several genomic regions have been associated with tolerance. However, the exact mechanism and genetic cause for salt tolerance in soybean has not been characterized. To elucidate the genetic basis for salt responses, two cultivars of soybean differing in tolerance, Clark and Manokin, were exposed to salt stress. Three plants each of Clark, an includer, and Manokin, an excluder, were exposed to 100 mM NaCl by flooding for six days and three plants each of Clark and Manokin were flooded with distilled water as a control. Tissue was collected from these plants and RNA extracted for microarray analysis. The resulting data were analyzed using multiple experiment viewer and genes up-regulated or down-regulated in response to salt stress were identified. Three genes each that were either up- or down-regulated in each cultivar were used to validate the microarray data using semi-quantitative RT-PCR. In order to develop non-invasive methods for measuring salt stress in soybeans, several techniques were investigated including photosynthesis measured via a LiCor Li-6400 XT gas exchange monitor, chlorophyll measured by a SPAD meter, and soil electrical conductivity was measured by a FieldScout Direct EC Probe.

Insecticide Combinations to Improve Tarnished Plant Bug (*Lygus lineolarus*) Control.

B. C. Thrash*, G. M. Lorenz III, N. M. Taillon, W. A. Plummer, D. B. Clarkson, Department of Entomology, University of Arkansas Division of Agriculture

The past four years tarnished plant bug, *Lygus lineolarus*, populations have been extremely high and increasingly difficult to control with the majority of currently labeled insecticides. Along with decreasing spray intervals, tankmixes and premixes of insecticides consistently enhance control of this pest. Trials evaluating insecticide efficacy were conducted during the 2009 – 2012 growing seasons in Eastern Arkansas. Cotton was planted on furrow-irrigated 38 inch rows with plots 4 rows wide and 50 feet long. Applications were made by ground using a modified Bowman MudMaster at 10 GPA. Results from these tests have been compiled to assess the amount of control insecticide mixes provide compared to single products. Of all single products Transform provided the best control. Tankmixes and premixes containing bifenthrin and/or novaluron were among the most effective combinations. These studies suggest that substantial control increases can be obtained when insecticides are mixed.

Potassium Fertilizer Effects on Edamame Yields in Arkansas.

M.E. Crownover* T.L. Roberts, W.J. Ross, N.A. Slaton, Crop, Soil, and Environmental Science, Fayetteville, AR.

Edamame is a specialty soybean (*Glycine max* L. Merrill), that is harvested as a vegetable crop when the seeds are immature. Edamame, also known as a vegetable soybean, is a relatively new crop for Arkansas. This study was done to establish the importance of potassium (K) fertilizer rates and type on edamame yield and quality. Since edamame does not require nitrogen (N) because it can fix N, K is the next most limiting nutrient. Potassium is used to produce nodes on soybean plants to help with N fixation and growth. For this study we are looking at two sources of fertilizer; Muriate of Potash (KCL) and Sulfate of Potash (K_2SO_4). These sources are similar in analysis, but vary greatly in composition due to the difference in anions. Although the chloride anion could inhibit growth of the plant, the sulfate anion would not influence growth to the same degree. Traditionally sulfate of potash has been more expensive, but has now become more comparable in price due to the recent increases in muriate price. This has made the two more competitive in use among growers.

Three field studies were conducted to evaluate the influence of K rate and source on edamame yield and quality during 2012. The field studies were conducted at Newport Research Station (Newport, AR), Vegetable Research Station (Kibler, AR), and at Pine Tree Branch Station (Pine Tree, AR). The two types of K fertilizer were applied KCL and K_2SO_4. They were applied by hand at rates of 0lb, 60lb, and 120lb K_2O equivalent. The two commonly grown varieties of edamame, the JYC-2 and the Kirksey were used. They were grown on slit loams to more accurately predict the growth since most silt loam soils require K applications. Once they were harvested they were weighed and graded. The amount of fertilizer applied showed an increase in yield, but not a significant amount of change in pod size.

The Effect of Drill-Seeded Soybean Population on Palmer Amaranth Emergence With and Without a Residual Pre-Applied Herbicide.

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Palmer amaranth is the most troublesome weed in Arkansas row crops, causing producers to rely heavily on residual herbicides to successfully produce a profitable crop. In 2012, a field experiment was conducted at the University of Arkansas Research and Extension Center in Fayetteville, AR, to determine the effect of drill-seeded soybean population density on Palmer amaranth emergence. This experiment was arranged in a split-plot design replicated four times. The main plot factor was soybean seeding rate. The subplot factor was no preemergence-applied residual herbicide or a preemergence application of Fierce (flumioxazin + pyroxasulfone) at 3.5 oz/A. Palmer amaranth emergence was counted weekly in two half meter quadrants in each plot and Palmer amaranth seedlings were removed after counting. Plots that had no residual herbicide applied were sprayed weekly with Liberty at 29 oz/A. Additionally, soybean groundcover was monitored throughout the season, and daily soil temperature (maximum and minimum) was measured in selected treatments. The application of Fierce helped maintain a season-long Palmer amaranth control, irrespective of soybean population density. In plots that did not receive Fierce, greater Palmer amaranth emergence was observed under low soybean densities and vice versa, suggesting the value of crop canopy in preventing Palmer amaranth emergence in the absence of residual herbicides or when residual herbicides are not activated. Although the residual herbicide was sufficient to achieve effective weed control, exploitation of crop canopy effects can help reduce the selection pressure exerted by residual herbicides. Thus, manipulation of plant densities could be a valuable tool in integrated weed/resistance management.

Palmer Amaranth Control with Brake: A New Herbicide for Cotton and Ditchbanks.

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The evolution of herbicide resistance in Palmer amaranth has had a detrimental effect on Arkansas crops with resistance now confirmed to four mechanisms of action. The discovery and commercialization of a new mechanism of action does not appear imminent; hence, emphasis has been placed on evaluating older herbicide candidates that were never commercialized in crops. In cotton, the current recommendations for Palmer amaranth are the use of seven applications of residual herbicides throughout the growing season. There is no effective over-the-top option for controlling glyphosate- and acetolactate synthase-resistant Palmer amaranth in glyphosate-resistant cotton. The herbicide fluridone (tradename Brake) 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 preemergence applications. In addition to controlling Palmer amaranth in cotton, this weed must be managed on cotton turnrows and along ditchbanks to prevent weed seed production, reduce dispersal, and diminish the soil seedbank. Two separate experiments were conducted to determine if fluridone would control Palmer amaranth in cotton and on ditchbanks when applied as a preemergence application. 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. The ditchbank trial consisted of two rates of fluridone at 1.0 and 2.0 lb/A, six rates of diuron ranging 2.0 to 12 lb/A, imazapyr at 0.19, 0.38, and 0.63 lb ai/A, aminopyralid at 0.1 lb ae/A, indaziflam at 0.085 lb ai/A, and saflufenacil at 0.14 lb ai/A all applied in late March prior to Palmer amaranth emergence. In cotton, increasing PRE-applied fluridone rates above 0.1 lb/A did not improve Palmer amaranth control nor was effective control achieved at any rate. Generally, Palmer amaranth control with fluridone was comparable to both rates of diuron and fluometuron. In the ditchbank trial, diuron at 12 lb/A provided 92% control of Palmer amaranth at 76 days after application (DAA), while control with all other treatments was no more than 80%. By 128 DAA control with diuron at 12 lb/A had declined to

61% and no herbicide providing effective control. The absence of season-long control in both experiments may be partially a result of the lack of rainfall throughout much of the spring and summer months.

Monitoring Insect Pest Populations Across Soil EC Based Management Zones in Midsouth Cotton With and Without Wheat Cover Crop.

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Cotton producers in NE Arkansas typically plant cereal winter cover crops such as wheat or oats to protect cotton seedlings from damage due to blowing sand. Additional benefits from use of cereal cover crops in these cotton ecosystems can include improvements in weed suppression, run-off water quality and pest management. One objective of this 2012 field study was to contrast infestation levels of cotton insect pests. Across spatially variable fields of cotton grown with a winter weed fallow field and wheat winter cover crop. Paired commercial fields on three NE Arkansas farms were separated into four management zones based on soil electrical conductivity (EC) properties classified from measurements using a dual depth Veris 3150 Soil Surveyor. In each management zone, thrips infestations were monitored by collecting 10 plants per site; there were three sites per zone. Plants were cut at ground level, placed in plastic bags, and taken to the laboratory where the thrips were washed onto filter paper and counted under magnification. After the crop began to produce squares, insect pest sampling was expanded to include weekly counts of tarnished plant bug (*Lygus lineolaris* Palisot de Beauvouis) using drop cloth sampling. Crop maturity measures using the COTMAN crop monitoring system were used to document date of physiological cutout (flowering date of the last effective boll population). Thrips infestations (primarily tobacco thrips (*Frankliniella fusca* (Hinds)) and western flower thrips (*Frankliniella occidentalis* (Pergande)) were detected in the first two to three weeks following crop emergence. High thrips numbers (exceeding UA Extension action levels) were observed on only one of three farms. At that location, significantly fewer thrips were associated with cotton grown with a wheat cover crop (20 thrips/sample) compared to cotton without wheat (109 thrips/sample). There was no apparent spatial component associated with thrips distribution in the six fields with no differences in thrips numbers observed among soil EC based management zones. Plant bug numbers did not exceed the Arkansas action threshold prior to cutout (3 bugs per 5 row feet(h))) Late season numbers were higher in management zones where plants continued to produce squares in late season. Early maturing plants had fewest plant bugs. The late season plant bugs numbers had no significant impact on yield.

Weed Control Programs for Edamame Soybean.

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Edamame is a food soybean harvested when the seeds are at the immature R6 stage. Few herbicides are registered for use on edamame, which constrains expanded commercial production in the US. A field study was conducted in the summer 2012 at Fayetteville and Newport, AR to evaluate the effectiveness of different herbicide programs and the tolerance of edamame to different herbicides. The experimental design was a randomized complete block with nine treatments and four replications. Treatments were: 1) Dual Magnum (*S*-metolachlor), 1 lb ai, preemergence (PRE) followed by (fb) Flexstar (fomesafen), 0.29 lb ai, postemergence (POST); 2) Dual Magnum, 1 lb ai + Sencor (metribuzin), 0.38 lb ai/A PRE fb Flexstar, 0.29 lb ai/A POST; 3) Linex (linuron), 1 lb ai/A PRE fb Flexstar, 0.29 lb ai/A POST; 4) Dual Magnum, 1 lb ai/A PRE fb Blazer (acifluorfen) at 0.25 lb ai/A + Basagran (bentazon) at 0.5 lb ai/A POST; 5) Linex, 1 lb ai/A PRE fb Blazer, 0.25 lb ai/A + Basagran, 0.5 lb ai/A POST; 6) Linex, 1 lb ai/A PRE fb Prefix (fomesafen, 0.24 lb ai/A + *S*-metolachlor, 1.08 lb ai/A) POST; 7) Linex, 1 lb ai/A + Sencor, 0.38 lb ai/A PRE fb Prefix (fomesafen, 0.24 lb ai/A + *S*-metolachlor, 1.08 lb ai/A) POST; 8) Linex, 1 lb ai/A + Dual Magnum, 1 lb ai/A PRE fb Blazer, 0.25 lb ai/A + Basagran, 0.5 lb ai/A POST; and 9) weedy check. Herbicide treatments were applied with a CO_2-

backpack sprayer, delivering 20 GPA. Postemergence herbicides were applied to V3 soybean and 2- to 3-in Palmer amaranth. The test in Newport was established in a natural population of Palmer amaranth. Weed control and soybean injury were evaluated at 2 wk after PRE (WAT PRE), and at 2, 8, and 14 wk after POST (WAT POST). Tank mixes of Dual + Sencor, Linex + Dual, and Linex + Sencor controlled Palmer amaranth 91-94% at 2 WAT PRE. Control of Palmer amaranth was 98-100% with Linex + Sencor PRE fb Prefix or Flexstar and Dual + Sencor PRE fb Flexstar at 2 WAT POST, but decreased to 88-96% at 14 WAT POST. Season-long control (91-96%) of Palmer amaranth was achieved with Dual + Sencor PRE fb Flexstar POST and Linex + Sencor PRE fb Prefix. Crop injury was minimal (4% at most) at 2 WAT PRE with Linex + Sencor PRE treatment. In Fayetteville, Palmer amaranth, morningglory, hemp sesbania, and prickly sida were broadcast-seeded. All treatments controlled Palmer amaranth 94-100% at 3 WAT PRE and at 1, 2, and 4 WAT POST. Morningglory was controlled ($\geq$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 $\geq$90%. Soybean injury at 1 WAT POST was highest with Prefix (50%), followed by Flexstar (30-35%) treatments; however, the crop recovered fully at 4 WAT POST. Each plant produced 50-70 pods on average, with 50-70 g seed weight. The highest grain yield (3033 kg/ha) was obtained in plants treated with Linex + Sencor PRE fb Flexstar POST. All other herbicide treatments, except Linex + Dual PRE fb Blazer + Basagran, had similar grain yield (2443-2917 kg/ha) as the treatment with the highest yield. Weed control programs for edamame should include Linex or Dual Magnum or in combination with Sencor PRE followed by Flexstar or Prefix or Blazer + Basagran POST.

Rainfastness of Selected Insecticides Used For Control of Tarnished Plant Bug in Arkansas Cotton.
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The tarnished plant bug, *Lygus lineolaris,* (TPB) has become the most destructive pest in cotton. Multiple insecticide applications are often required to achieve control of this pest, making it very expensive to control. This problem is made worse with the situation of “pop up” rain events that often occur in the Midsouth that can cause wash off of insecticide applications that may occur at any time after the application is made. Also, many growers that have overhead irrigation need to irrigate their crop as soon as possible behind applications. Labels do not provide adequate information on rainfastness, or the amount of time that is needed after an application before a rainfall event or overhead irrigation event can take place for the insecticide to still provide acceptable control. Studies were conducted in both the field and greenhouse to evaluate the rainfastness of selected insecticides currently recommended for control of TPB in Arkansas and the Midsouth. Treatments included an untreated check, Centric 2.5 oz/a, Acephate 1lb ai/a, Bidrin 8 oz/a, Transform 1.5 oz/a. In the greenhouse study, one inch of rainfall was simulated with overhead boom irrigation at 0, 1, 3, 6, 12, and 24 hours after application, as well as no rain for comparison. The three uppermost leaves were removed and placed in separate petri dishes, each with three plant bug nymphs. Mortality was checked at 24 and 48 hours after infestation. Field trials were conducted similarly using lateral irrigation to simulate rain. Sleeve cages were used with 5 nymphs per cage and 6 cages per treatment. Mortality was checked 48 hours after infestation. Greenhouse results indicated that all treatments showed a loss of control when rain occurred prior to 12 hours after insecticide application. The effectiveness of Bidrin dropped from 100% mortality with no rain to as low as 43% when rain occurred 0, 1, and 3 after application; a rain event 6 h after application had no impact on mortality compared to no rain. Acephate and Centric dropped from 100% with no rain to 0% effectiveness when rain occurred 0 and 1 hours after application, with 33% to 67% effectiveness at 3 and 6 hours respectively.. Transform lost all effectiveness when rain occurred at 0 and 1 hour after application, but regained 63% effectiveness at 3 hours after application compared to no rain. Field studies showed that all treatments resulted in a loss of control at all rain event timings from 0 to 24 hours after application with the exception of Bidrin which gave control at 12 hours after application. This data will assist growers in making key decisions about whether or not to re-spray if rain occurs after an insecticide application is made.

Evaluation of Conventional and Hybrid Rice (*Oryza sativa* L.) Recovery Potential from PRE-applied Clomazone Injury.

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Clomazone, an isoxazolidinone herbicide, is effectively used for preemergence (PRE) grass control in rice. However, use of clomazone on light-textured soils can cause severe rice injury in the form of foliar bleaching. Recommended seeding rates for hybrid rice (6 seed/ft of row) are one-fourth those for conventional rice (24 seed/ft of row); hence, the ability to recover from early-season clomazone injury and establish a dense crop canopy may differ between conventional and hybrid rice. Therefore, a field trial was conducted at Stuttgart (silt loam soil), AR, in 2012 to determine the potential of conventional and hybrid rice to recover from PRE-applied clomazone injury as a function of seeding rate. Clearfield 152, the conventional variety, and Clearfield XL 745, a hybrid, were planted at 1/3 and 1 times (X) their respective recommended seeding rates. Clomazone is labeled for use in Arkansas rice at rate of 0.3 (medium-textured soils such as silt loams) to 0.6 lb ai/A (fine-textured soils). Clomazone was applied PRE at 0.3, 0.45, 0.6, and 0.75 lb/A. At 2 weeks after treatment (WAT), injury to both conventional and hybrid rice with clomazone at 0.75 lb/A (13 and 10%, respectively) was greater than clomazone applied at 0.3 (5 and 4%, respectively) and 0.45 lb/A (8 and 6%, respectively). However, both varieties recovered from injury over time and no foliar bleaching was observed at 2 wk after flooding (WAF). At 1 wk before flooding, canopy cover of conventional and hybrid rice was greater at the 1X (34 and 30%, respectively) compared to the 1/3X seeding rate (26 and 18%, respectively). At 2 WAT, the 1/3 and 1X seeding rates of conventional rice had greater stand count (55 and 145 plants/2 m row, respectively) than the corresponding seeding rates of hybrid rice (18 and 46 plants/ 2m row, respectively). Likewise, 1/3 and 1X seeding rates of conventional rice produced more tillers (139 and 205 tillers/2m row, respectively) than the corresponding seeding rates of hybrid rice (105 and 130 tillers/2m row, respectively). However, rice yield did not differ among treatments. Data suggest that, although clomazone caused early-season foliar bleaching to rice regardless of cultivar and seeding rate used, rice yield did not differ with rice variety or seeding rate.

Factors Contributing to Cotton Injury from Soil-Applied Herbicides.

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With the evolution of glyphosate-resistant weeds throughout the Midsouth, especially Palmer amaranth, many cotton growers are reverting to using soil-applied herbicides as part of an integrated weed management approach to controlling these weeds. Preemergence (PRE) herbicides, although often effective, can cause considerable injury to cotton; hence, some growers are reluctant to use these products. Agronomic and environmental factors that could potentially affect the tolerance of cotton to PRE-applied herbicides were evaluated to better understand the causes of injury and steps growers could take to minimize the risk of injury from soil-applied herbicides. Field experiments were conducted in 2012 to evaluate the influence of cotton seed size, planting depth, and seed vigor on cotton tolerance to various rates of PRE-applied herbicides. The first experiment in Fayetteville was designed as a randomized complete block with a factorial arrangement of five seed sizes by two rates (1X and 2X) of diuron with four replications. Cotton seed sizes ranged from 9.3 to 13.1 g/100 seed. The second experiment in Rohwer was organized as a split-split plot design with the main plot being planting depth (1.27 and 2.54 cm), the subplot being herbicide product (diuron, fomesafen, and fluometuron) at two application rates (1X and 2X), and seedling vigor (low and high) as the sub-sub plot factor, replicated four times. Both experiments were assessed for injury, plants per 2 m of row, and biomass. Smaller seed, generally less than 11.6 g/100ct, exhibited more injury and less biomass than that of the larger seed. The largest seed size averaged 10 g more biomass per m^2 than the smallest seed. Depth of seed had no significant effect on injury from diuron, fomesafen or fluometuron. Higher rates of fluometuron and diuron reduced biomass (grams per plant) than lower rates when applied at either .25 or 1”, but fomesafen applied to the .25” seed depth plots exhibited no difference in grams per plant. Additionally, fomesafen was the only herbicide that resulted in less biomass (grams per 2 m of row) with shallower planting depths, but fomesafen had no significant effect on biomass when applied at different rates. Higher rates of fluometuron and diuron did reduce biomass (grams per 2 m of row). Injury was increased when plots were applied with a 2X rate; however, fomesafen rate had no significant impact on cotton injury.

Performance of Sweet Sorghum at Different Planting Densities, Water Regimes, and N Levels.
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Sweet sorghum is one potential alternative biomass source for ethanol production. Expanded and successful production in Arkansas depends on optimization of crop management practices. Toward this goal, we studied the effects of plant population, water regime, and N level on sweet sorghum at SEREC, Rohwer, AR. Sweet sorghum 'Topper 76-6' was planted in May and harvested 21 d after 50% flowering in October, 2012. Five average plant densities (46800 = A, 57200 = B, 61400 = C, 88500 = D, and 150000 = E, plants/ha), two irrigation conditions (irrigated and non-irrigated) and two soil fertility levels (low and high) were tested, in four replications. Plants under the 'high' fertility regime received 168 kg N/ha in split applications; those under the 'low' fertility regime received 84 kg N/ha. Crop responses evaluated included stand count, plant height, stem diameter, shoot biomass production, and total solids content. The only response variable that was correlated with plant population was stem diameter. Sweet sorghum stem diameter declined significantly ($r = -0.61$) as plant population increased. Sweet sorghum height was affected only by irrigation treatments; wherein the non-irrigated plants were 2.5 m tall and irrigated plants were 2.9 m tall, averaged over N level and planting density. Plant population and N level had no effect on plant height. Fresh biomass production was affected only by N level; planting density and irrigation had no effect. Plants under high fertility produced 76.9 mt/ha biomass while those in low fertility produced 67.6 mt/ha biomass, averaged over planting density and irrigation treatment. This indicates a strong capability of sweet sorghum to adapt to different plant populations or drought conditions. None of the factors investigated altered the total solids content of sweet sorghum; therefore, the potential ethanol production will not be jeopardized by adjusting any of these production practices. Biomass production would then be the sole determinant for potential ethanol production. This experiment will be repeated to gauge year-to-year variability in crop performance under the conditions tested here.

Efficacy of Rice Seed Treatments at Selected Nitrogen Rates
Mallory Everett*

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 levels in particular, may contribute to this variability in performance. We conducted two trials at the Pine Tree Experiment Station in St. Francis County to examine the response of rice plants when exposed to different insecticide seed treatments and nitrogen rate combinations. Nitrogen was applied at 0, 45, 90, 135, and 180 pounds per acre to rice plots treated with insecticides. Insecticide seed treatments included clothianidin (NipsIt Inside®), thiamethoxam (CruiserMaxx™), and a non-treated control. Plant stand counts and plant heights were taken to evaluate plant vigor, and leaf scar counts and soil core samples were taken to evaluate control of rice water weevil (*Lissorhoptrus oryzophilus* Kuschel). NipsIt Inside averaged 3.71 larvae per core, CruiserMaxx averaged 4.80, and the non-treated control averaged 10.82. 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. Overall, the non-treated control averaged one more scar than either insecticide seed treatment, with less scarring observed as nitrogen rates increased. Plant samples were taken at mid-season and early heading to measure nitrogen uptake. No differences in uptake were observed between the insecticide seed treatments or the non-treated control. Preliminary results in these trials indicate that nitrogen has no effect on the efficacy of rice seed treatments, although further studies are needed to confirm these findings.

Control of Tarnished Plant Bug, *Lygus Lineolaris*, in Cotton with Transform in Arkansas, 2009-2012.
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In the last several years, the tarnished plant bug (TPB) has become increasingly difficult to control, requiring multiple applications and higher rates. Over the last four years, a new insecticide (sulfoxaflor) has been evaluated in several trials for control of this pest. All trials were located at the Lon Mann Cotton Research Station in Lee County, Arkansas. In 2009, sulfoxaflor was evaluated at several rates, .022 lbs ai/a, .034 lbs ai/a, .045 lbs ai/a and .067 lbs ai/a, with two applications. Assessments were taken from 3, 6, 14, 20 days after treatment (DAT). Results showed that sulfoxaflor (Transform) at the high rate (0.067 lbs ai/a) was the only treatment to reduce insect populations below threshold, 6 plant bugs per 10 row ft, after the first treatment. In 2010, Transform was evaluated as a tank mix with other selected compounds, Diamond 6 oz/a, Karate .04 lbs ai/a and Orthene .5 lbs/a. At 3 and 9 DAT the first application no treatments reduced numbers below threshold, although all treatments separated from the UTC. Control was not achieved until after the second application. Although 11 days after the second application Transform .045 lbs ai/a was still able to keep TPB numbers below threshold. In 2011 an efficacy trial was conducted evaluating Transform and several other insecticides, Diamond .039 lbs ai/a, Karate .04 lbs ai/a, Acephate .75 lbs/a and Bidrin .5 lbs ai/a, for control of the TPB. Results indicated that selected insecticides provided good initial control but Transform maintained control 15 days after treatment. In 2012, Transform at 1.5 oz/a was evaluated with one application followed by an application of other selected compounds. Although all treatments significantly reduced TPB numbers below the untreated check, treatments were unable to keep populations below economic threshold 10 DAT 2. Higher rates or multiple applications may need to be used to achieve control. The 2012 growing season was the first year Transform became available for Arkansas growers and will provide an excellent control option when compared to current standards.

Grass Control in Bermudagrass Hay Production
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Weedy annual and perennial grasses are a problem for bermudagrass (*Cynodon dactylon*) hay producers that farm in the Arkansas River Valley. Johnsongrass (*Sorghum halepense*), large crabgrass (*Digitaria sanguinalis*), broadleaf signalgrass (*Brachiaria platyphylla)*, sandbur (*Cenchrus echinatus*), barnyardrass (*Echinochloa crus-galli*) and knotroot foxtail (*Setaria geniculata*) cause reductions in forage quality, and increased problems in curing the hay crop. In addition weedy grasses reduce the visual quality which is very important to hay buyers.

Bermudagrass producers traditionally had limited options for grass control. However three products, imazapic, sulfosulfuron and nicosulfuron + metsulfuron received labels between 2002-2012, so demonstrations were conducted to evaluate various herbicides for grass control. The tests were conducted using a CO2 backpack sprayer, 15 gpa, 3 liter mix, plot size was 10’ x 30’, each treatment was replicated three times.

Sulfosulfuron at 1.0-1.3 oz per acre provides 95-100% control of johnsongrass with no crop injury. Imazapic at 4-6 oz per acre gave 95-100% control of crabgrass and johnsongrass. Imazapic at 4-6 oz provides 75-90% control of sandbur, knotroot foxtail and broadleaf signalgrass. Weed control on these grasses is very dependent on stage of growth. Imazapic does cause crop stunting for up to 30 days after treatment. Nicosulfuron + metsulfuron at 1.0-1.5 oz per acre resulted in 95-100% control of johnsongrass, and 80-90% control of barnyardgrass and broadleaf signalgrass if applications are made to seedling grasses. Nicosulfuron + metsulfuron at 1.0-1.5 oz per acre gave 70-80% control of sandbur and knotroot foxtail. Glyphosate applied at

6-8 oz/acre 7-10 days after hay harvest provides 95-100% of johnsongrass and crabgrass, and 75-90% control of barnyard grass, knotroot foxtail and signalgrass.

Can Malathion be Used with ALS-Inhibiting Herbicides in Clearfield® Rice for the Management of Herbicide-Resistant Weeds?

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Concern regarding evolution of non-target-site-based resistance (NTSR) that confers cross and multiple herbicide resistance in weeds has increased tremendously recently. In mixture with acetolactate synthase (ALS)-inhibiting herbicides, compounds inhibiting NTSR enzymes including cytochrome P450s (CYP), glutathione-*S*-transferases, or hydrolases have been shown to restore sensitivity in ALS-resistant weeds. However, the effect of NTSR enzyme inhibitors in mixture with ALS-inhibiting herbicides on conventional and target-site-based-resistant (TSR) Clearfield® rice needs to be evaluated. Studies were conducted in 2012 at Keiser and Stuttgart to determine the tolerance of conventional (Roy J) and Clearfield® (CL 152) rice to ALS-inhibiting herbicides in mixture with malathion (a known CYP inhibitor), and at Pine Tree and Stuttgart to evaluate control of red rice with ALS-inhibiting herbicides in mixture with malathion. Clearfield® rice injury at 28 d after treatment (DAT) with imazamox at 0.039 lb ai/A, penoxsulam at 0.036 lb ai/A, imazethapyr at 0.063 lb ai/A, and bispyribac-sodium at 0.032 lb ai/A alone or in mixture with malathion at 0.6 lb ai/A was $\leq$5%. In contrast, injury to conventional rice at 28 DAT from imazamox, penoxsulam, imazethapyr, and bispyribac-sodium applied in mixture with malathion (70 to 89%, 5 to 11%, 88 to 89%, and 10 to 46%, respectively) was greater than these herbicides applied alone (59 to 74%, 0 to 3%, 55 to 71%, and 2 to 13%, respectively). A similar trend was observed for yield reduction of Clearfield® and conventional rice with ALS-inhibiting herbicides alone and in mixture with malathion. Red rice control (ALS susceptible) with imazethapyr or imazamox was not improved by the addition of malathion to either of these herbicides due to the high level of control with each herbicide alone. Although improved control of ALS-susceptible red rice was not achieved, future research on other weeds, including metabolic based ALS-resistant barnyardgrass, is underway to determine if CYP inhibitors can be used as part of a resistance management program in Clearfield rice.

Effect of Irrigation or Rainfall Timing and Amount on the Activation of Soil Residual Herbicides.

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Soil residual herbicides play a key role in achieving a sustained and season-long weed control. The effectiveness, however, depends on the activation of the herbicide in a timely and efficient manner, prior to its loss in the system. In this regard, two important questions remain to be answered: 1) how long can a grower wait for rainfall/irrigation after applying a residual herbicide and 2) how much of irrigation/rainfall is sufficient (or too much) to activate them. To address these questions, experiments were conducted at the University of Arkansas, Fayetteville, in 2011. A pot experiment was conducted in the greenhouse to determine the loss in herbicide activity (a measure of Palmer amaranth control) in response to delay in activation. Seven soil residual herbicides (Reflex®, Dual Magnum II®, Direx®, Callisto®, Zidua®, Warrant®, and Cotoran®) were evaluated when the herbicides were activated at 0, 7, or 14 days after application (DAA). The pots were arranged following a factorial (two factors: herbicide option, activation timing) completely randomized design with four replications. Except for Reflex®, Dual Magnum II®, and Zidua®, weed control activity considerably declined when activation was delayed for a week or more and the loss of activity was the greatest at 14 DAA (the longest delay tested in the study). Among the herbicides evaluated, Cotoran® exhibited the greatest loss in activity at 14 DAA, with only 60% Palmer amaranth control, followed by Warrant® providing 86% control. Subsequently, a field experiment was conducted to understand the effect of irrigation/rainfall amount on the activation of a number of soil residual herbicides (a measure of Palmer amaranth control). Plots were arranged in a split-plot design, with irrigation volume (four levels: 0, 0.25, 0.5, 1, and 3 inches) as the main plot treatment and the residual herbicide option (seven levels: Caparol®, Cotoran®, Direx®, Dual Magnum II®, Warrant®, Reflex®, and Valor®) as the sub-plot. All the herbicides were activated immediately after application and there was a rain-free period of 17 days following the activation. Palmer amaranth control ratings at 19 days after activation showed that the maximum activities of all the herbicides tested were obtained with as low as 0.5 inches of irrigation. For Dual Magnum® and Valor®, 0.25 inches of irrigation was sufficient to achieve complete activation. Results also showed that overhead irrigation of 3 inches did not greatly influence the loss of herbicide through leaching. Both the studies demonstrate that immediate activation of residual herbicides with at least 0.5 inches of irrigation/rainfall will ensure the greatest weed control efficacy. Growers need to be mindful of specific characteristics of the herbicides influencing the longevity on the soil surface and irrigation water requirement and their interaction with the soil and environmental factors, for making informed management decisions that are appropriate for their fields.