ABSTRACTS RESEARCH CONFERENCE

VOLUME 15

Arkansas Crop Protection Association

November 28 – November 29, 2011
Clarion Inn
Fayetteville, Arkansas

Monday, November 28, 2011

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

MODERATOR: Jason Meier
Mohammad T. Bararpour – Student Contest Chair
Jeremy Bullington – Audio-Visual Coordinator

01:00 p.m. **Yield Loss Associated With Ear Feeders in Bt and Non-Bt Field Corn.** Glenn Studebaker, University of Arkansas Cooperative Extension Service, Little Rock, AR………………………..1

01:15 p.m. **Use of Residual Herbicides in Liberty Link Soybean for Control of Glyphosate-Resistant Palmer Amaranth.** D.B. Johnson*, J.K. Norsworthy, C.E. Starkey, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville; R.C. Scott, University of Arkansas, Little Rock; and J.F. Smith, Bayer Crop Science, Cabot, AR………………………....1

01:30 p.m. **Salvage Palmer Amaranth Control with Ignite.** Starkey, C. E*., J. K. Norsworthy, D. B. Johnson, A. Lewis, and P. Devkota, Department of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville, AR……………………………………………………1

01:45 p.m. **Soybean *(Glycine max L.)* Sensitivity to Drift Rates of Imazosulfruon**. Sandeep S. Rana*, Jason K. Norsworthy, Dennis B. Johnson, Pratap Devkota, and Robert C. Scott, Department of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville, AR……………...2

02:00 p.m. **Post Control Options for Glyphosate-Resistant Palmer Amaranth in Roundup Ready Corn.** P. Devkota*, J. K. Norsworthy, D. B. Johnson, C. Starkey, A. Lewis, and S. S. Rana; Department of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville, AR……………………………………………………………………………………3

02:15 p.m. **Management Practices for Maximizing Soybean Yield.** Ryan J. Van Roekel**, Larry C. Purcell, Department of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville, AR………………………………………………………………………...3

02:30 p.m. ***EPSPS* Overexpression Also Confers Resistance to Glyphosate in Italian Ryegrass (*Lolium perenne* ssp. *multiflorum*).** Reiofeli A. Salas*, Nilda R. Burgos, Department of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville, AR; Franck E. Dayan, Zhiqiang Pan, Susan B. Watson, USDA-ARS, Thad Cochran, Research Center, University, MS; Robert C. Scott, and James W. Dickson, Department of Crop, Soil and Environmental Sciences, University of Arkansas Extension, Lonoke, AR……………………………………………………………4

02:45 p.m. **Effects of Environment and Cultivar on Charcoal Rot Development in Soybeans.** Micah Doubledee*[1], John Rupe[1], Craig Rothrock[1], Sreekala Bajwa[2], Adele Steger[1], and Robert Holland[1.1]Department of Plant Pathology- University of Arkansas, Fayetteville, AR 72701, [2]Department of Biological & Agricultural Engineering- University of Arkansas, Fayetteville, AR 72701……………………………………………………………………………………4

03:00 p.m. **Efficacy of Glufosinate Tank Mixed with Dicamba, Tembotrione or 2,4-D Amine on Glyphosate-Resistant Palmer Amaranth.** George Botha*, Nilda R. Burgos, and Ed Allan L. Alcober, University of Arkansas, Fayetteville, AR……………………………………………….5

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

03:15 p.m. **Break**

03:30 p.m. **A Survey of Arkansas' Ryegrass Populations.** James W. Dickson*, Robert C. Scott, Nilda R. Burgos, and Brad M. Davis. University of Arkansas Cooperative Extension Service, Lonoke, AR…………6

03:45 p.m. **Comparison of Selected HPPD Herbicides in One and Two-Pass Programs.** Austin L. Lewis*, Dr. Jason K. Norsworthy…………6

04:00 p.m. **AnnAGNPS Model Simulation of Sediment and Nutrient Loss on a Cross County, Arkansas Watershed.** Rodney Wright**, Ron Bingner, Terry Griffin, and Jennifer L Bouldin, Environmental Sciences Graduate Program, Arkansas State University, State University, Arkansas…………...7

04:15 p.m. **Dark Green Color Index As a Method of Real-Time In-Season Corn Nitrogen Measurement and Fertilization.** Upton Siddons*, Larry Purcell, University of Arkansas, Fayetteville; and' Morteza Mozaffari, University of Arkansas Soil Testing and Research Laboratory, Marianna, AR…………...7

04:30 p.m. **Alternative Monitoring and Control Tactics for Rednecked Cane Borer, *Agrilus Ruficollis*, in Blackberries.** Soo-Hoon S. Kim*, Barbara Lewis, Donn T. Johnson, Department of Entomology, University of Arkansas, Fayetteville, AR…………..8

04:45 p.m. **Comparison of Residual Herbicides in a Liberty-Link Soybean Program** Zachary Hill, Kenneth Smith, Jeremy Bullington, Ryan Doherty, and Jason Meier, University of Arkansas, Division of Agriculture, Monticello, AR…………9

05:00 p.m. **ALS-Inhibiting Herbicide Resistance in Barnyardgrass.** Dilpreet S. Riar, Jason K. Norsworthy, Jason A. Bond, Mohammad T. Bararpour, M. J. Wilson and Robert C. Scott, Department Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR…………9

Tuesday, November 29, 2011

MODERATOR: Ryan Doherty

08:30 a.m. **Efficacy of Foliar Insecticides for Control of Heliothines in Conventional Cotton in Arkansas.** Jason Fortner*, Gus Lorenz, Nichole Taillon, Kyle Colwell, Andrew Plummer, Ben Thrash, University of Arkansas Division of Agriculture Entomology…………..10

08:45 a.m. **Efficacy of Selected Insecticides for Control of Corn Earworm in Soybeans.** Nichole Taillon*, Gus Lorenz, Jason Fortner, Kyle Colwell, Andrew Plummer, Ben Thrash. University of Arkansas Division of Agriculture Entomology…………10

09:00 a.m. **Control of Tarnished Plant Bug, Lygus *Lineolaris*, in Cotton with Transform in Arkansas, 2009-2011.** A. Plummer*, Gus Lorenz, Jason Fortner, Nichole Taillon, Kyle Colwell, Ben Thrash. University of Arkansas Division of Agriculture Entomology…………10

09:15 a.m. **Control of Tarnished Plant Bug with Tankmixes and Premix Insecticides.** Ben Thrash*, Gus Lorenz, Jason Fortner, Nichole Taillon, Kyle Colwell, Andrew Plummer. University of Arkansas Division of Agriculture Entomology…………10

09:30 a.m. **Effects of Simulated Threecornered Alfalfa Hopper (*Spissistilus festinus Say)* Injury on Soybean Yield.** Howard, J.E.*, D.S. Akin, D. Cook, S. Stewart, G. Lorenz, and R. Wiedenmann, Southeast Research and Extension Center, Monticello, AR……………………..11

09:45 a.m. **Molecular Detection of Seed Dormancy in Weedy Red Rice.** Te-Ming Tseng**, Nilda R. Burgos, Ed-Allan L. Alcober, and Vinod K. Shivrain; Department of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville, AR…………………………….11

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

10:15 a.m. **Effect of Seeding Rate on RiceTec Hybrid Rice Yield and Milling Quality.** Simpson, G.D. McNeely, V.M., and Hamm, C. E. RiceTec Inc., Jonesboro, AR……………………………….12

10:30 a.m. **Developing Site-Specific Nematode Management Strategies: A Case Study in Arkansas Cotton.** Terry Griffin, Division of Agriculture, University of Arkansas, Little Rock, AR. Terry Kirkpatrick, Division of Agriculture, University of Arkansas, Hope, AR. Scott Monfort , Clemson University, Clemson, SC. Zheng Liu, Division of Agriculture, University of Arkansas, Little Rock, AR……………………………………………………………………………..12

10:45 a.m. **Weed Control Programs in Grain Sorghum.** M. T. Bararpour, J. K. Norsworthy, D. B. Johnson, and C. Starkey. Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR…………………………………………………………………....13

11:00 a.m. **ZIDUA® Herbicide: The Newest Herbicide from BASF.** Cletus Youmans, John Harden, and Siyuan Tan, R&D North America, BASF Corp., RTP, NC……………………………………...14

11:15 a.m. **Simulation Modeling to Identify Best Management Practices for Herbicide Resistance Mitigation in Barnyardgrass.** Muthukumar V. Bagavathiannan, Jason K. Norsworthy, Kenneth L. Smith, Department of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville, AR; Paul Neve, Warwick-HRI, University of Warwick, Wellesbourne, United Kingdom……………………………………………………………………………………15

11:30 a.m. Presentation of Awards -

12:00 Noon **Adjourn**

Yield Loss Associated With Ear Feeders in Bt and Non-Bt Field Corn
Glenn Studebaker, University of Arkansas Division of Agriculture, Keiser, AR

Corn hybrids containing one or more Bt (*Bacillus thuringiensis*) proteins are commonly used in Arkansas to manage southwestern corn borer (*Diatraea grandiosella*). However, there has been increasing interest in the potential benefits of utilizing hybrids containing two or more Bt proteins to minimize ear feeder damage from both the corn earworm (*Heliocoverpa zea*) and the fall armyworm (*Spodoptera frugiperda*). A study was conducted to determine the yield loss associated with ear feeders in corn hybrids containing 1) no Bt, 2) a single Bt protein (Cry1F or Cry1Ab), 3) two Bt proteins (Cry1A.105 + Cry2Ab or Cry1Ab + Vip3A), 4) three Bt proteins (Cry1A.105 + Cry2Ab + Cry1F). Each hybrid had two treatment regimes; 1) untreated, 2) sprayed daily with insecticide during silking to eliminate ear feeder damage.

In all instances ear feeding damage was reduced in the sprayed plots across all hybrids with the exception of the hybrids containing the Vip3A protein. The hybrids containing the Vip3A protein had very little damage in the untreated plots. However, when yield was measured there was no significant yield increase with the sprayed treatments in any of the hybrids including those that contained no Bt protein. This data indicates that ear feeders do not significantly reduce yield in field corn under normal conditions.

Use of Residual Herbicides in Liberty Link Soybean for Control of Glyphosate-Resistant Palmer Amaranth
D.B. Johnson*, J.K. Norsworthy, C.E. Starkey, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville; R.C. Scott, University of Arkansas, Little Rock; and J.F. Smith, Bayer Crop Science, Cabot, AR.

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. Experiments were conducted in the summer of 2011 at the Northeast Research and Extension Center in Keiser, AR with the objective being to evaluate early- and late-season control of glyphosate-resistant Palmer amaranth with residual herbicides in glufosinate (Ignite 280)- based programs. Residual herbicides evaluated in these studies included: S-metolachlor (Dual II Magnum), flumioxazin (Valor), pyroxasulfone (Zidua), trifluarlin (Treflan), S-metolachlor + fomesafen (Prefix), chlorimuron + thifensulfuron + flumioxazin (Envive), and S-metolachlor + metribuzin (Boundary). All residual herbicides were applied at rates appropriate for a clay soil. Herbicide programs were single or sequential applications of Ignite applied alone or in combination with a residual herbicide, single or sequential applications of Ignite following a preplant incorporated (PPI) or preemergence (PRE) application of a residual herbicide, or Ignite applied alone or in combination with a residual herbicide following a PRE residual herbicide. Visual weed control and crop injury ratings were taken weekly throughout the growing season. Crop injury was minimal. Programs that consisted of a residual herbicide applied PRE or postemergence (POST) in combination with Ignite provided more consistent control of glyphosate-resistant Palmer amaranth (≥ 92%) than Ignite applied alone (≤ 87%). However, programs consisting of Treflan applied PPI followed by (fb) Ignite were not as effective (86%), due to the lack of sufficient incorporation on the clay soil. Therefore, effective residual herbicides must be applied both PRE and POST in combination with Ignite to provide consistent Palmer amaranth control.

Salvage Palmer Amaranth Control with Ignite
Clay Starkey, J. K. Norsworthy, D. B. Johnson, and P. Devkota, Department of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville, AR

Glyphosate-resistant (GR) Palmer amaranth (*Amaranthus palmeri*) is a serious problem for Arkansas producers. Postemergence control of Palmer amaranth is difficult if the weed is also resistant to *acetolactate* *synthase*-inhibiting herbicides. Two experiments were conducted to evaluate control options for large Palmer amaranth in a field infested with a GR-Palmer amaranth biotype on the University of Arkansas experiment station in Fayetteville, AR. The first was to compare various use rates of Ignite and Roundup WeatherMax alone and tank-mixed with Laudis or Balance Flexx. The 11 herbicide combinations were applied at four different weed sizes (2-3, 6-10, 12-18, and 20-24 inches) for a 4x11 factorial. The second experiment compared high rates of Ignite (36 and 43 oz/acre) to Flexstar GT (4.5 pints/acre) for postemergence Palmer amaranth control. Five different weed sizes (6, 12, 18, 24, and 30") were treated with the three herbicides to provide a 3x5 factorial design that was rated 2-4 weeks after treatment. In the first experiment, combinations of Ignite and Laudis effectively controlled (>90%) Palmer amaranth at the 6-8 inch timing. No herbicide combination effectively controlled Palmer amaranth larger than 8 inches. In the second experiment, high rates of Ignite and Flexstar GT provided effective control of six-inch Palmer amaranth. When Palmer amaranth reached 12 inches, Flexstar GT provided significantly less control than both rates of Ignite. When Palmer amaranth was 18 inches or larger, no herbicide provided adequate control.

Soybean (*Glycine max* L.) Sensitivity to Drift Rates of Imazosulfuron

Sandeep S. Rana*, Jason K. Norsworhty, Dennis B. Johnson, Pratap Devkota, and Robert C. Scott, Department of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville, AR.

In the southern U.S., soybean is prone to drift of herbicides from rice fields since the two crops are often grown in close proximity. Therefore, a field trial was conducted at University of Arkansas Agricultural Research and Extension Station, Fayetteville, Arkansas to determine the sensitivity of soybean (cv. AG 4703) to drift rates of imazosulfuron. Imazosulfuron, a sulfonylurea herbicide, was recently labeled for use in Arkansas rice at a maximum use rate of 0.3 lb ai/A. Soybean was treated at the VC, V2, V6, and R2 growth stages with 1/256, 1/128, 1/64, 1/32, 1/16, 1/8, and 1/4 times (X) the maximum labeled rate of imazosulfuron. Soybean was injured regardless of herbicide rate or application timing. Injury to soybean plants from imazosulfuron was in the form of stunting and purple veins. At 3 wk after treatment, imazosulfuron at 0.075 lb/A (1/4X rate) caused 96, 86, 70, and 65% injury when applied at the VC, V2, V6 ,and R2 growth stages, respectively. There was no overall significant correlation between crop injury and yield at the end of growing season because soybean recovered from imazosulfuron injury over time, especially the earlier applications. At 13 weeks after VC growth stage, injury from the 1/4X rate of imazosulfuron applied at the VC, V2, and V6 growth stages of soybean was 17, 21, and 67%, respectively. However, soybean recovery at the R2 growth stage occurred only for the lowest four (1/256, 1/128, 1/64, and 1/32X) application rates. Imazosulfuron applied at 1/4X rate resulted in significant delays in days to maturity and reduced yield compared to the untreated check. Imazosulfuron applied at 0.075 lb/A to soybean delayed maturity by 9, 10, 13, and 14 d and reduced yield by 40, 49, 74, and 89% at the VC, V2, V6, and R2 growth stages, respectively. Results of this research indicate that imazosulfuron can severely injure soybean regardless of the growth stage at which drift occurs; however, soybean injured by imazosulfuron at early growth stages (VC and V2) have a better chance of recovery compared to later growth stages (V6 and R2).

POST Control Options for Glyphosate-Resistant Palmer Amaranth in Roundup Ready Corn

P. Devkota*, J. K. Norsworthy, D. B. Johnson, C. Sterky, A. Lewis, S. S. Rana; Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

There is serious concern with the glyphosate-resistant Palmer amaranth and its effective management in Roundup Ready crops. Roundup Ready corn technology is very popular in U.S. for higher yield; however, the glyphosate-resistant Palmer amaranth is a serious threat for profitable harvest. Therefore, it is necessary to evaluate herbicide programs for effective control of glyphosate-resistant Palmer amaranth in roundup ready corn. A Field experiment was conducted in Agricultural Research Station, at Marianna, AR, in summer 2011.

Different herbicides combinations were evaluated for glyphosate-resistant Palmer amaranth control in roundup ready corn. Herbicide programs consisted of: 1) Roundup PowerMax at 32 fl oz/A+Aatrex at 2 qt/A; 2) Roundup PowerMax at 32 fl oz/A + Degree Xtra at 3 qt/A; 3) Roundup PowerMax at 32 fl oz/A + Degree Xtra at 3.7 qt/A; 4) Roundup PowerMax at 32 fl oz/A + Degree Xtra at 3 qt/A + Callisto at 2 fl oz/A; 5) Roundup PowerMax at 32 fl oz/A + Warrant at 3 pt/A + Callisto at 3 fl oz/A; 6) Roundup PowerMax at 32 fl oz/A + Aatrex at 2 qt/A qt/A + Callisto at 3 fl oz/A; 7) Halex GT at 3.6 pt/A; 8) Halex GT at 3.6 pt/A + Aatrex at 2 qt/A; 9) Roundup PowerMax at 32 fl oz/A + Aatrex at 2 qt/A + Warrant at 3 pt/A ; and 10) Roundup PowerMax at 32 fl oz/A + Aatrex at 2 qt/A + Warrant at 3 pt/A + Callisto at 2 fl oz/A. The experiment was a randomized complete block design with four replications. Treatments were applied over the top of corn, at V_3-stage corn when the Palmer amaranth were 2 to 5" tall, with CO_2-pressurized backpack sprayer calibrated to deliver 15 GPA. Visual ratings were taken for corn necrosis, chlorosis, and stunting 1, 2, 3, 4, and 6-wk after treatment (WAT) to evaluate overall crop injury. Likewise, Palmer amaranth control was recorded for the similar dates. At the end of the season, corn was harvested and total yield was recorded. The corn injury in terms of necrosis, chlosrosis, and stunting were <10% at 1 WAT; with the lesser injury in later ratings. For the Palmer amaranth control, the herbicides programs consisting of: Roundup PowerMax with Degree Xtra plus Callisto; Roundup PowerMax with Aatrex and Warrant; Halex GT with Aatrex; and Roundup PowerMax with Aatrex plus Warrant plus Callisto provided the effective control (≥98%) at 6 WAT. Total corn yields in bu/A were also similar (≥ 171 bu/A) from the above mentioned four herbicide programs. In conclusion, Roundup PowerMax when applied tank mix with Degree Xtra, Callisto, Aatrex and Warrant can be an effective POST control options for glyphosate-resistant Palmer amaranth in Roundup Ready corn.

Management Practices for Maximizing Soybean Yield.

Ryan J. Van Roekel**, Larry C. Purcell, Department of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville, AR.

The highest average United States soybean (*Glycine max* (L.) Merr.) yield is 2956 kg ha^{-1} and occurred in 2009. However, research in New Jersey by Dr. Roy Flannery reported a maximum yield of 7911 kg ha^{-1} in 1983 and a 5-yr average irrigated yield of 6921 kg ha^{-1}, much above the national average yield. Dr. Flannery's yields were generally accepted to be near the maximum yield of soybean until 2006 when the Mr. Kip Cullers won the Missouri Soybean Association yield contest with 9339 kg ha^{-1}. Mr. Cullers again won the contest in 2007 with 10,388 kg ha^{-1} and in 2010 with 10,791 kg ha^{-1}.

Research was undertaken at the University of Arkansas to characterize Mr. Cullers' soybean crop and to replicate those yields by eliminating all biotic and abiotic stresses while simultaneously examining a few unique management practices. In 2011, crop growth and development were closely monitored and yield estimates were taken on Mr. Cullers' farm in southwest Missouri. In Fayetteville during 2011, maximum yield research examined 14 varieties and 9 individual management practices for crop growth characteristics and yield. Stresses were attempted to be eliminated though deep tillage, soil nutrient amendments in addition to poultry litter, frequent overhead irrigation, and insect management at first observation. Management practices for maximum yield included early planting, 46-cm row spacing, in-season fertigation, and preventative fungicides. Unfortunately, intense heat during seed fill in 2011 resulted in the highest replicated yield being 7145 kg ha^{-1} at Mr. Cullers' farm and 6195 kg ha^{-1} in Fayetteville.

Although these yields were less than anticipated, several points became clear which will continue to be evaluated. First, there were large differences among varieties in these maximum yield environments and the varieties that performed well at Mr. Cullers' farm were not necessarily the best varieties at Fayetteville. Second, the individual seed and post-emergence treatments evaluated did not significantly increase yield compared with the controls in 2011. Lastly, maximizing soybean yield depends greatly on the specific growing environment, often which is largely beyond the producer's control.

EPSPS **Overexpression also Confers Resistance to Glyphosate in Italian Ryegrass (*Lolium perenne* ssp. *multiflorum*)**

Reiofeli A. Salas*, Nilda R. Burgos, Dept. of Crop, Soils and Environmental Science, University of Arkansas, Fayetteville, AR; Franck E. Dayan, Zhiqiang Pan, Susan B. Watson, USDA-ARS, Thad Cochran Research Center, University, MS; Robert C. Scott and James W. Dickson, University of Arkansas Extension, Lonoke, AR.

Sustainability of glyphosate in weed management systems is being threatened by the evolution of glyphosate–resistant weeds. Evolved resistance to glyphosate in Italian ryegrass has been reported in Desha County, Arkansas in 2009. Glyphosate-resistant weeds usually exhibit either target site mutation or reduced translocation; however, *EPSPS* gene amplification and vacuole sequestration are recently reported. This research was conducted to determine the resistance mechanism to glyphosate in Des03 Italian ryegrass population. Susceptible and resistant plants from Des03 population were analyzed for *EPSPS* gene sequence, EPSPS enzyme activity, and *EPSPS* gene copy number. Dose-response bioassay on the susceptible and resistant plants was also conducted to establish their individual glyphosate resistance level and relate these to their EPSPS enzyme activity and *EPSPS* gene copy number. *EPSPS* gene sequence did not show any mutation that has been associated previously with resistance to glyphosate, nor any mutation that is present only in the resistant plants. Resistant plants had six-fold increase in basal EPSPS enzyme activity relative to the susceptible plants; however, the amounts of glyphosate needed to reduce the EPSPS activity by 50% (I_{50}) for susceptible and resistant plants were similar indicating that resistance is not due to insensitive EPSPS enzyme. Relative genomic *EPSPS* copy numbers ranged from 0.9 to 9.1 for susceptible plants, whereas relative copy numbers for resistant plants ranged from 2.6 to 25.1. High level of resistance to glyphosate was associated with increase in *EPSPS* genomic copy number and EPSPS enzyme activity in this population. Therefore, resistance to glyphosate in Des03 population is due to increased EPSPS enzyme activity and amplification of the *EPSPS* gene. The occurrence of gene amplification was first reported in Palmer amaranth and now is also observed in Italian ryegrass. It is likely that this mechanism may occur in other weed species. Weed populations are evolving ways to survive glyphosate application which increases the threat to glyphosate use sustainability.

Effects of Environment and Cultivar on Charcoal Rot Development on Soybeans

Micah Doubledee[1], John Rupe[1], Craig Rothrock[1], Sreekala Bajwa[2], Adele Steger[1],
Robert Holland[1], [1]Department of Plant Pathology- University of Arkansas, Fayetteville, AR 72701,
[2]Departmentof Biological & Agricultural Engineering- University of Arkansas, Fayetteville, AR 72701

Charcoal rot of soybean, caused by the soilborne fungus *Macrophomina phaseolina* (Tassi) Goid, is a disease associated with high soil temperature and low soil moisture (6). Above-ground symptoms, which can be difficult to distinguish from drought symptoms, include low vigor, dead leaves that remain attached to the plant, early senescence and yield loss (6). Irrigation limits damage, but does not prevent colonization of the tissue (3). No soybean line is immune to *M. phaseolina*, but a few lines may have moderate resistance (4, 5). The objectives of this research were to 1) separate the effects of cultivar and drought on the development of charcoal rot and 2) determine the efficacy of non-destructive techniques to measure disease development during the season. In 2008 and 2009, soybean cultivars, DT97-4290 (4, 5) and Delta Pineland 4546 (moderately resistant), LS980358 (susceptible) (4), and R01-581F (drought tolerant) (2) were grown in microplots. Treatments included presence or absence of *M. phaseolina* and water-stressed and non-stressed in a factorial randomized complete block design experiment with five replications. Soil moisture and temperature, and rainfall were monitored. Root colonization and plant growth was assessed at growth stages V2/V3 and V4/V5.

Stomatal conductance was measured with a porometer. Canopy temperature was measured with an infrared sensor and used to calculate Crop Water Stress Index (CWSI) (1). Yield, root/stem disease severity, plant height stem discoloration and *M. phaseolina* colonization were determined at harvest. When differences between treatments occurred, plants in infested plots had lower stomatal conductance and higher CWSI than those in non-infested plots. In 2009, infested LS980358 and R01-581F plants had 38 % and 49 % lower yields, respectively, than non-infested plants, whereas DT97-4290 and Delta Pineland 4546 did not differ significantly. The results from this study show that infection by *M. phaseolina* affects soybeans at all stages and that some cultivars are very sensitive to infection.

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2. Chen, P., C. A. King, T. Ishibashi, T. R. Sinclair, C. H. Sneller, and L. C. Purcell. 2007. Registration of Soybean Germplasm Lines R01-416F and R01-581F for Improved Yield and Nitrogen Fixation under Drought Stress [electronic resource]. *Journal of plant registrations* 1 (2):166-167.
3. Kendig, S. R., J. C. Rupe, and H. D. Scott. 2000. Effect of irrigation and soil water stress on densities of *Macrophomina phaseolina* in soil and roots of two soybean cultivars. *Plant Disease* 84 (8):895-900.
4. Mengistu, A., J. D. Ray, J. R. Smith, and R. L. Paris. 2007. Charcoal rot disease assessment of soybean genotypes using a colony-forming unit index. *Crop Science* 47 (6):2453-2461.
5. Paris, R. L., J. R. Smith, J. M. Tyler, and A. Mengistu. 2006. Registration of Soybean Germplasm Line DT97-4290 with Moderate Resistance to Charcoal Rot. *Crop science* 46 (5): 2324-2325.
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Efficacy of Glufosinate Tank Mixed with Dicamba, Tembotrione or 2,4-D Amine on Glyphosate-Resistant Palmer Amaranth

George Botha*, Nilda R. Burgos, and Ed Allan L. Alcober. University of Arkansas, Fayetteville, AR

Applying herbicides in a tank mixture could help provide greater weed control not usually achieved by individual herbicides and delay resistance to herbicides due to the use of different modes of action. However, efficacy can be compromised if incompatible herbicides are mixed. A greenhouse study was conducted to evaluate the efficacy of tembotrione, dicamba or 2,4-D amine tank mixed with glufosinate for the control of glyphosate-resistant Palmer amaranth accession with high tolerance to glufosinate. The 36 treatments comprised of nontreated control; combination of glufosinate and tembotrione or 2,4-D amine at 0.25, 0.50, and 1.0 times the labeled dose of each herbicide; or glufosinate mixed with 1.0 and 2.0 times the labeled dose of dicamba. The labeled doses of glufosinate, tembotrione, 2,4-D amine and dicamba were 0.73, 0.08, 1.12 and 0.56 kg ai ha^{-1}, respectively. Herbicide treatments were applied in a spray chamber delivering 187 L. Injury was visually evaluated 21 DAT. When applied separately at labeled doses, glufosinate controlled Palmer amaranth better (97%) than did tembotrione (93%) and 2,4-D amine (94%) or the 2.0X dose of dicamba (95%). Applying the labeled dose of dicamba was not different from doubling the rate on Palmer amaranth control. The addition of tembotrione, 2,4-D amine or dicamba increased the efficacy of 0.25X or 0.5X doses of glufosinate on Palmer amaranth from 60 and 90%, respectively to between 98 and 100% control at 21 DAT. Glufosinate applied at the labeled dose was as effective in controlling Palmer amaranth as when applied in combination with any dose of tembotrione, 2,4-D amine or dicamba, providing 97% control of Palmer amaranth. Tank mixing with 0.25X or 0.5X dose of tembotrione, however, antagonized the activity of the 1X dose of glufosinate, reducing Palmer amaranth control from 97% when applied alone to 82 or 77 % control, respectively when mixed with reduced doses of tembotrione. This research showed that 100% control of Palmer amaranth with high tolerance to glufosinate is possible under greenhouse conditions by combining glufosinate with 2,4-D amine or dicamba. The results in the field might be different. Addition of reduced rates of tembotrione to glufosinate, however, resulted in decreased efficacy of glufosinate on Palmer amaranth.

A Survey of Arkansas' Ryegrass Populations.
James W. Dickson*, Robert C. Scott, Nilda Burgos, and Brad M. Davis. University of Arkansas Cooperative Extension Service, Lonoke, AR

In the spring of 2009, a comprehensive sampling of Italian ryegrass (*Lolium perenne* ssp. m*ultiflorum*) populations in Arkansas was begun. Ryegrass samples from field sites were collected from a maximum 40 ft^2 area at a given location. Field history and global positioning system (GPS) coordinates were recorded for most samples. A total of 300 samples from 21 counties in Arkansas have been obtained from various sources, including commercially available ryegrass sources. Some of the population sites were randomly sampled, while other sites were harvested following herbicide failures. All samples were grown in a greenhouse near Lonoke, AR and treated with Roundup WeatherMAX (glyphosate) at 22 oz/A, Hoelon (diclofop) at 43 oz/A plus crop oil concentrate at 1% v/v, Axial XL (pinoxaden) at 16.4 oz/A, and PowerFlex (pyroxsulam) at 3.5 oz/A plus crop oil concentrate at 1% v/v. All treatments were applied to 3- to 4-leaf ryegrass. Twenty-seven of the samples received were reported to have survived a glyphosate application in the field in the spring of 2009. These 27 samples were treated with Roundup WeatherMAX at 22 oz/A and 44 oz/A applied to 3- to 4-leaf and 3- to 4-tiller ryegrass. These samples were also treated with Hoelon, Axial, and PowerFlex as described above. To date, 202 samples have been screened. Of these samples, 45 are resistant to glyphosate, 192 are resistant to diclofop, 23 are resistant to pinoxaden, and 126 are resistant to pyroxsulam.

Comparison of Weed Control Programs Using Selected HPPD-inhibiting Herbicides in Corn (*Zea mays*)
Austin L. Lewis*, J.K. Norsworthy, D.B. Johnson, C. Starkey, K.L. Smith

A field study was conducted in Keiser, AR, to evaluate selected hydroxyphenylpyruvate dioxygenase (HPPD)-inhibiting herbicides for weed control in corn. The study was set up as a randomized complete block design (RCBD) with a factorial arrangement of HPPD herbicides (Balance Flexx, Callisto, Capreno, Impact, and Laudis) and a tank-mix partner (none, Aatrex, and Dual II Magnum). Treatments were replicated four times and the individual plot sizes were four rows by 30 ft. Herbicides were applied at the recommended field rate for a clay soil. Adjuvants were applied according to the product label. The weed species evaluated were broadleaf signalgrass (*Urochloa platyphylla*), Palmer amaranth (*Amaranthus palmeri*), and pitted morningglory (*Ipomoea lacunosa*). Weed control was evaluated at 3 and 9 weeks after treatment and again immediately prior to crop harvest (17 weeks after treatment). Season-long control ($\geq$97%) of Palmer amaranth was provided by Laudis, Balance Flexx, or Capreno in combination with Aatrex. Broadleaf signalgrass was ($\geq$97%) controlled by Capreno alone and with Capreno plus Dual II Magnum. Pitted morningglory was controlled ($\leq$70%) by Laudis plus Dual II Magnum, or Balance Flexx or Callisto in combination with Aatrex. In regards to yield, only the mean effect of a tank-mix partner was significant. The addition of Dual II Magnum or Aatrex to the HPPD-inhibiting herbicides resulted in greater yields compared to just HPPD herbicides alone. On average, the addition of Dual II Magnum or Aatrex improved yields 25 to 26 bu/A.

AnnAGNPS Model Simulation of Sediment and Nutrient Loss on a Cross County, Arkansas Watershed
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Nonpoint source (NPS) pollutants in the Mississippi River Basin (MRB) include nutrients such as nitrogen (N) and phosphorus (P) from in-crop applications or livestock operations, and turbidity from construction, silviculture, and tillage operations. Farmland, the main contributor to NPS pollution, comprises about 56% of the MRB drainage area. The current emphasis on corn as a feedstock by the biofuels industry is concerning because of the potential environmental consequences. Corn is one of the most nutrient demanding crops, requiring three times the applied N of cotton on clay soils and infinitely more than soybeans which does not require any applied N. Nitrogen runoff from additional corn acres in the MRB may exacerbate the already high nutrient loads carried by the Mississippi River and contribute to other downstream externalities.

This study uses the Annualized Agricultural Non-Point Source Pollution Model (AnnAGNPS) to analyze differences in water quality due to increased corn production. The primary objective of this investigation is to determine the change in levels of sediment, N, and P loading with an increase in corn acres on a portion of the St. Francis River Watershed in Cross County, Arkansas. Cropping scenarios included a historical scenario (2003-2007 average harvested acres for the NASS Northeast Arkansas District), a 100 percent planting of each Delta crop, and post-ethanol mandates acreage outlook. A second objective is to analyze if best management practices (BMPs) can offset or possibly improve the current river nutrient loads in spite of the potential increased allocation of farmland to corn production. BMPs included in the study are no-tillage, cover crops, reducing fertilizer applications by 25 percent, and the removal of highly erodible land areas from production.

Results indicate that N contributions to the MRB from the watershed with 100 percent of the cropland planted to corn may be 28 percent greater than N loss from the same area planted to the historical crop acreage for the study area. Sediment and phosphorus losses remain fairly constant across cropping choices. All BMPs reduced nutrient loss, but sediment and nutrient contributions to the watershed were significantly lowered to a level below the historical crop rotations by combining BMPs. Corn and cotton crops planted on 100 percent of the acreage created the largest influxes of N and P into the stream system. Results from this study help quantify the potential change in runoff water quality and identify BMP recommendations to reduce the sediment, N, and P load to the MRB from the proposed shift in cropping patterns.

Dark Green Color Index as a Method of Real-time In-season Corn Nitrogen Measurement and Fertilization
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Corn (*Zea mays* L.) requires higher rates of nitrogen fertilizer than any other major U.S. crop partly because N fertilizers are subject to loss through leaching, denitrification, and volatilization. Because of this, corn may suffer from inadequate nitrogen fertilization or producers may over-apply nitrogen to compensate for early-season nitrogen losses. Typically, producers will rely on yield goal estimates to determine in-season nitrogen applications, a rule-of-thumb technique based on historical yields. Though useful, the yield goal method fails to account for native soil-N fertility and environmental variations within a growing season that can affect N availability and crop N status. Thus, a timely, accurate, and precise method for measuring in-season corn N status is needed to allow producers to keep nitrogen use efficiency high within a growing season.

Using appropriate software, hue, saturation, and brightness values of digital images can be combined in a dark green color index (DGCI) which is closely associated with leaf nitrogen concentration. Previous research has found that digital-image analysis can be used to determine the nitrogen status of corn leaves at tasseling. Our objective was to develop tools to allow farmers to make informed decisions regarding mid-season nitrogen rate applications. Our objectives were: (1) to develop quantitative relationships among yield, corn leaf nitrogen concentration, and DGCI measurements taken in the mid-vegetative stages of growth development; and (2) to determine the amount of nitrogen to apply to recover yield based upon DGCI measurements on 6-leaf corn (V6).

Commercial corn hybrids with 120 day maturity ratings were planted at four locations in Arkansas in fields treated with three different preplant nitrogen fertilizer rates (0, 84, and 168 kg N ha^{-1}). At the V6 development stage, subplots were measured for DGCI, SPAD, and leaf nitrogen concentration, then treated with one of seven additional nitrogen fertilizer rates (0, 14, 28, 70, 112, 168, 224 kg N ha^{-1}). Leaf nitrogen concentration, SPAD, and DGCI measurements were also taken at the tasseling stage. Leaf nitrogen concentrations, DGCI, and SPAD were found to be closely associated. Crops with varying early-season N deficiencies demonstrated a non-linear, quadratic response to V6 N applications. The three emergence N application rates for each location across both years gave us 24 early-season N deficiencies or sufficiencies from which we could study yield response to subsequent N applications. By developing equations to describe this yield response, we were able to determine the amount of N to apply to recover 90 or 95% of the crop's potential yield. Combining the responses of yield to V6 N application amounts with concurrent mid-season DGCI measurements allowed for the development of calibration equations. These calibrations equations allow corrective, mid-season N applications to be made based on an observed DGCI value, which will, in turn, allow for the recovery of 90 or 95% of the crop's yield potential.

Alternative Monitoring and Control Tactics for Rednecked Cane Borer, *Agrilus ruficollis*, in Blackberries.

Soo-Hoon S. Kim*, Barbara Lewis, Donn T. Johnson, Department of Entomology, University of Arkansas, Fayetteville, AR.

Blackberry production in the eastern US faces an insect pest that threatens nearly all the 7,100 tons of fruit produced annually from 2,500 acres of blackberries in the eastern North America. The rednecked cane borer has been shown to affect nearly 72% of blackberry canes and predisposes galled canes to winter injury. Control of this pest has relied upon hand removal of galled canes or applications of imidacloprid. Experiments were conducted to determine if alternative monitoring and control tactics are available against the rednecked cane borer. Alternative monitoring tactics consisted of testing cane and leaf color mimicked traps. Traps consisting of primocane (leaf and cane), floricane (leaf and cane), yellow, purple, and control colors were placed in two locations to test for attractiveness of the trap. Efficacy testing of several insecticides was tested to determine if other chemistries will control this pest besides imidacloprid. Results from the trapping experiment showed a significantly higher number of borers trapped on the primocane and floricane colored traps when compared to the control ($P < 0.05$). Results from the efficacy testing demonstrated that imidacloprid and JMS stylet oil had significantly less galls on blackberry plants when compared to the control. Further research is needed to determine the appropriate color and shape traps to effectively trap the pest. With JMS stylet oil showing some promise as an alternative to imidacloprid, larger scale tests should be conducted to see if effectiveness is still achieved.

Comparison of Residual Herbicides in a Liberty-Link Soybean Programs

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Six weed species have been confirmed resistant to glyphosate in Arkansas. Of these, Palmer amaranth is one of the most troublesome in cotton and soybean production. Tolerance of Liberty Link® soybean to glufosinate is an important tool for the control of Palmer amaranth *(Amaranthus palmeri)*; however, multiple modes of action are needed to provide optimum control of Palmer amaranth and provide resistance management. Herbicides with soil-residual properties have been shown to improve control and provide resistance management for Palmer amaranth. Studies were initiated to compare glyphosate-resistant Palmer amaranth control using soil-residual herbicides in a Liberty-Link herbicide program.

Three studies were conducted in a randomized complete block design with four replications at the Southeast Research and Extension Center near Rohwer, AR in 2010 and 2011. All applications were applied at 12 GPA with a CO_2 propelled sprayer. Study 1 was established to evaluate length of residual control provided by various soil applied herbicides applied preemergence. Comparisons were made between Valor SX, Sharpen, Reflex, Dual Magnum, Prefix, Fierce, Authority MTZ, and Boundary applied at normal use rates for silt loam soil. All treatments provided ≥ 90% control 36 DAT with no differences between herbicides, except for Valor SX (2 oz/a) in 2010. Twenty-nine days later, control with Valor SX (2 oz/a) and Sharpen (2 oz/a) continued to decrease below 90%, but control of Palmer amaranth with Fierce (3.5 oz/a), Reflex (24 oz/a), Dual Magnum (16 oz/a), Prefix (32 oz/a), Authority MTZ (10 oz/a), and Boundary (32 oz/a) remained above 90%. Study 2 includes Zidua (2.5 oz/a), Dual II Magnum (16 oz/a), Valor SX (2 oz/a), Prefix (32 oz/a), Fierce (3 oz/a), and Authority MTZ (12 oz/a), plus tankmixes of Sharpen (1 oz/a) and Valor SX (2 oz/a) with Zidua all applied preemergence. All treatments provided 100% control of Palmer amaranth 21, 42, and 55 DAT, with the exception of Valor SX (95%). When incorporating these residual herbicides into a Liberty-Link program (Study 3), tankmixes of Ignite 280 (22 oz/a) plus Dual Magnum, Prefix, or Flexstar applied postemergence at 16 oz/a following Prefix (32 oz/a), Valor SX (2 oz/a), and Canopy (4 oz/a) applied preemergence provided less than 95% control at 20 DAT, and by 31 DAT; there was a 8 to 23% decrease in control of Palmer amaranth from all treatment combinations with the exception of Fierce (3 oz/a) followed by Ignite 280 (22 oz/a) plus Prefix (16 oz/a) and Canopy (4 oz/a) followed by Ignite 280 (22 oz/a) plus Dual Magnum (16 oz/a).

Although there are differences in Palmer amaranth control provided by various soil applied herbicides when used alone, escaped weeds can be controlled when glufosinate is used postemergence in a Liberty-Link herbicide program.

ALS-Inhibiting Herbicide Resistance in Barnyardgrass.

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Barnyardgrass is the most important weed of rice in Arkansas. Recently, putative acetolactate synthase (ALS) -resistant barnyardgrass biotypes have been collected from Arkansas (AR1 and AR2) and Mississippi (MS1). A study was conducted to confirm resistance, characterize response to other ALS herbicides, and determine the resistance mechanism of these barnyardgrass biotypes. Difference in control was observed when these biotypes along with a known susceptible biotype were screened in the greenhouse with field rate applications of Beyond (imazamox), Newpath (imazethapyr), Grasp (penoxsulam), and Regiment (bispyribac-sodium) at 4 (0.062 lb ai/A), 4 (0.031 lb ai/A), 2 (0.031 lb ai/A), and 0.53 (0.033 lb ai/A) oz product/A, respectively. Control of AR1, AR2, and MS1 was 57, 6, and 83%, respectively, with Newpath; 59, 6, and 86%, respectively, with Beyond; 26, 51 and 22%, respectively, with Grasp; and 15, 98, and 16%, respectively, with Regiment. In contrast, control of the susceptible biotype was ≥98% with each herbicide. Dose response studies revealed that AR1, AR2, and MS1 biotypes were >94-, >94-, and 2.6-times, respectively, more resistant to

Beyond; >15-, 8.0-, and 1.8-times, respectively, more resistant to Grasp; and 21-, 0.89-, and 11-times, respectively, more resistant to Regiment compared to susceptible biotypes based on lethal dose to kill 50% of plants (LD_{50}). Addition of Prentox (malathion) at 23 oz/A (0.89 lb ai/A) to Grasp reduced dry weight of all resistant biotypes (40 to 96%) at 21days after treatment (DAT) compared to Grasp applied alone. However, addition of Prentox to Beyond did not reduce dry weight of resistant biotypes 21 DAT. Although, addition of Prentox to Regiment increased mortality of resistant biotypes, it did not reduce dry weight significantly. Malathion inhibits the activity of cytochrome P450 monooxygenase, an enzyme known to metabolize various herbicides. Reduction in dry weight after addition of malathion confirms that cytochrome P450 monooxygenase is imparting resistance to Grasp; nevertheless, some additional mechanism is involved in imparting resistance to Beyond.

Efficacy of Foliar Insecticides for Control of Heliothines in Conventional Cotton in Arkansas.
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Department of Entomology, Lonoke, AR

The efficacy of selected insecticides were evaluated for the control of Heliothines (bollworm and bud worm) on Conventional cotton in 2010 and 2011. New insecticides such as flubendiamide (Belt) and Chlorantraniliprole (Prevathon) appear to provide very effective control of these pests compared to the older standards.

Efficacy of Selected Insecticides for Control of Corn Earworm in Soybeans
Nichole Taillon, Gus Lorenz, Jason Fortner, Kyle Colwell, Andrew Plummer, Ben Thrash

Corn earworm, *Helicoverpa zea* (Bodie), is the most destructive insect pest of soybean in Arkansas. Selected insecticides were evaluated for control of corn earworm in three trials. Our studies have indicated several new insecticides may provide very good control compared to the standard insecticides currently used for controlling this pest. Results of this test, and the potential impact for growers, will be discussed.

Control of Tarnished Plant Bug, Lygus *lineolaris,* in Cotton with Transform in Arkansas, 2009-2011.
A. Plummer, G. M. Lorenz III, K. Colwell, N. Taillon, J. Fortner, B. Thrash. Department of Entomology, Lonoke, AR

Transform (sulfoxafor) a new insecticide, was evaluated across several trials over three years for control of tarnished plant bug in cotton. Results indicate that Transform provides excellent control of plant bugs compared to the current standards.

Control of Tarnished Plant Bug with Tankmixes and Premix Insecticides
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Tarnished plant bug in cotton has become increasingly difficult to control in the Midsouth. Recent studies have shown that single product applications are no longer effective for achieving adequate control under heavy infestations. Mixing insecticides is an effective way to increase control. Studies conducted to evaluate these insecticide mixes for control of plant bugs indicated increased control compared to several single product insecticides.

Effects of Simulated Threecornered Alfalfa Hopper (*Spissistilus festinus* Say) Injury on Soybean Yield
Howard J. E.*, D.S. Akin, D.R. Cook, S.D. Stewart, G.M. Lorenz, and R.N. Wiedenmann

The increase in value of soybeans over the past several years has resulted in questions concerning threecornered alfalfa hopper (3CAH) injury and the subsequent effect that injury may have on soybean yield. Previous research has suggested that soybean can respond in several ways to early season feeding by 3CAH. One observed response is that plants can continue to grow and mature normally after main stem girdling, only to break at the girdle site once plants achieve notable size. To investigate the impact feeding-induced breakage/lodging may have on soybean yield, research was conducted at 3 locations (Rohwer, AR, Stoneville, MS, and Jackson, TN) from 2008-2011. Hand-shears were used to cut the soybean main stem 2 inches above the soil surface to simulate late season plant breakage caused by early season girdling by 3CAH. Injury levels were simulated at 0, 10, 20, 30, 40 and 50% of plant stand, and were applied when the majority of the plants reached the selected reproductive stage. Three separate trials were conducted with injury applied at R1/R2, R3, and R5. Yield data were pooled across all locations within each growth stage, and analyzed using PROC MIXED (SAS 9.2).

When breakage occurred during R1/R2, significant yield loss was not apparent until ≥40% simulated breakage. This is likely due to the strong compensation potential of soybean—particularly as that compensation pertains to loss of plant stand. However, when simulated breakage occurred during R3 and R5 growth stages, significant yield reduction occurred at ≥30% injury level. Therefore, "full season" (e.g., early-planted) soybeans may be less susceptible to yield loss when breaking/lodging occurs during earlier reproductive stages. These results also suggest if ≥40% of a given plant stand suffers breakage/lodging, yield loss will likely occur regardless of reproductive stage. Preliminary research conducted in 2010 suggests late-planted soybean may be even more sensitive to breakage/lodging than full-season soybeans. However, more research investigating yield effects of main stem breakage on late planted soybean is needed and will be conducted in 2012.

Molecular detection of seed dormancy in weedy red rice
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Seed dormancy is a trait that allows weedy red rice (*Oryza sativa* L.) to persist in rice production systems. Weedy and wild relatives of rice exhibit high levels of dormancy. This high degree of dormancy allows red rice to escape weed management tactics and increases the potential for flowering synchronization, and therefore gene flow, between weedy and cultivated rice. Understanding the genetic controls of dormancy could help find means to circumvent this weedy trait for better red rice management. The use of molecular markers has made it possible to analyze complex traits such as seed dormancy. The objective of this study was to test microsatellite markers reported to be highly associated with seed dormancy and, to investigate their association with red rice hull types. Thirteen simple sequence repeat (SSR) markers, distributed across 4 chromosomes were used. Four populations were included: dormant blackhull, dormant strawhull, non-dormant blackhull, and non-dormant strawhull. A total of 90 alleles with a mean value of 6.9 alleles per locus were detected. All 13 markers were polymorphic but only 5 were able to distinguish between dormant and non-dormant plant types. Among the five markers, RM118, located on chromosome 4, was able to distinguish dormant strawhull red rice, while RM180, located on chromosome 7 and, RM28595, RM28603, and RM28621, located on chromosome 12, were able to distinguish dormant blackhull red rice. These markers associated with the dormant accessions may be unique, and would be good candidates for follow-up studies on the manipulation of dormancy gene expression in red rice. In addition, the genomic regions linked to the five dormancy markers can be used in breeding programs to introduce pre-harvest sprouting resistance in cereal crops.

Effect of Seeding Rate on RiceTec Hybrid Rice Yield and Milling Quality.

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Field studies have been conducted from 2004 to 2011 in Arkansas, Louisiana, Mississippi, Texas, and Missouri in multiple locations using RiceTec commercial rice hybrid seed. The purpose of these tests has been to observe the effect of seeding rate on emergence and resulting plant populations on yield and milling yield of RiceTec hybrid rice in an on farm setting. In every test RiceTec hybrid rice seed was compared side by side with locally recommended varieties. Seeding rate treatments of 200,000, 400,000, 600,000, and 800,000 seeds per acre were directly compared using a randomized strip plot design or randomized complete block design depending on the local field conditions. RiceTec hybrid genotypes included in the tests were XL723, CLEARFIELD XL729, and CLEARFIELD XL745. Variety checks were CL161, CL151, WELLS, and CHENIERE depending on the location and year. In each location tests were harvested using a 'Wintersteiger Delta plot combine' with 'Harvest Master' digital plot weigh system. Grain samples were collected at harvest and milled immediately after air drying. In individual location tests and in combined analysis over locations and years grain yield and milling yields from seeding rates from 400,000 seeds per acre to 600,000 seeds per acre were not significantly different . To achieve an acceptable rice plant stand the theme should be good seed to soil contact of the correct seeding rate. The top risk factors are: Improper Planting Date, Poor Seedbed Preparation, Poor Planter Adjustment / Maintenance, and Poor Surface drainage. If these risks are avoided the probability of acceptable stand establishment will be greatly increased. Independent of seeding rate USDA standard grain quality grades are routinely achieved commercially using RiceTec hybrid rice seed if the common risk factors that reduce rice milling yield are avoided. The most common issue with rice grade and milling scores are: 'fissuring', 'rewetting' or 'checking'. 'Rice fissuring' has been documented through the years as rice that has dried below a certain moisture level in the field then rewetted by rainfall dew or humidity forming micro-fissures within the kernel which reduce the kernel strength leading to breakage when the rice grain is milled using commercial friction methods. Questions have been raised for years around what affect if any the large amount of tillers hybrids produce has on milling. Results from side by side field tests indictate that the reduced seeding rates and corresponding increased tillering of RiceTec hybrids does not affect milling yields. Actions that minimize risk of rice checking are timely harvest, proper combine adjustment, well managed storage and drying after harvest. In conclusion individual location tests and in combined analysis grain yield and milling yields from seeding rates from 400,000 seeds per acre to 600,000 seeds per acre were not significantly different. Even at plant populations below 3 plants per square foot RiceTec hybrid rice seed offers significant economic advantage over commercial varieties.

Developing Site-Specific Nematode Management Strategies: A Case Study in Arkansas Cotton

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Nematode infestations tend to be spatially clustered within agricultural fields. Each year about 10% of all U.S. cotton production is lost to nematodes (Blasingame and Patel, 2005; Koenning et al., 1999) and yield losses in individual fields may reach 50%. Nematode control is primarily dependent on the application of nematicides (Koenning et al., 2004). Given the high cost of nematicides and their potential negative environmental effect, site-specific nematode management provides the opportunity for producers to maximize profit while maintaining acceptable yield and reducing potential for pollution. This strategy relies on applying nematicides at a single or at different rates across fields only in locations where they are needed. The objective of this research is to determine the spatial effect of the nematode species, nematode population density, and soil texture on the yield of cotton using on-farm field-scale data. Based on the results, we can identify and delineate zones that provide higher spatial stability relative to yield response to nematicide application to improve efficiency in site-specific nematicide application.

On-farm experiments were conducted from 2001 to 2004 in a 6.07 ha production field in southeastern Arkansas. The field was subdivided into 512 plots (32 plots wide × 16 plots long). Each plot was approximately 0.012 ha consisting of four 30.5-m long rows (30.5 × 3.9 m). The geographic location of each plot was determined with a differential global position system (GPS) receiver. The nematicide was applied 2 weeks prior to planting at different rates across the entire field area to ensure that there were differences in nematode population densities across the field. All plots were sampled each year prior to nematicide application (Ppre), at the time of planting (to represent the initial population after fumigation (Pi)), at peak bloom (Pm) and at harvest (Pf).

Site-specific crop yield data, as with most other agronomic data obtained at high resolutions are expected to be spatially structured, i.e. autocorrelated and heteroscedastic, which brings the validity of the independence assumption into question. Failing to account for spatial autocorrelation may result in inefficient parameter estimates that bias the test statistics. In this case study, nematodes (including *Meloidogyne incognita* and *Rotylenchulus reniformis)* population density, cotton yield and soil texture data were subjected to exploratory spatial data analysis (ESDA) using GeoDa 1.0.1.

Preliminary results indicated significant spatial autocorrelation existed in the whole field in 2001 and 2003 for cotton yield, and significant clustering of yield (especially for low-low cold spots) in each year. Local Indicators of Spatial Association (LISA) indicated that there is clustering of *Meloidogyne incognita* population from 2001 to 2003, and the population patch contracted from 2002 and hit a significant reduction in 2004. Tests indicated there are very weak autocorrelation and clustering for *Rotylenchulus reniformis* population. Soil texture (sand fraction) is shown to have a significant clustering dispersion. Spatial autoregressive error model, spatial autoregressive lag model and spatial Durbin model were used to explicitly model spatial dependence in the cotton yield, nematode population density, and the soil texture. R 2.13.2 was used to perform the estimation. The best fit model with respect to theoretical rationale was discussed. Spatial Durbin model may be the best fit model due to capturing the spillover effect from nematode population density, soil texture and also crop yield itself.

Weed Control Programs in Grain Sorghum.

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Grain sorghum (*Sorghum bicolor*) is an important feed crop grown in Arkansas. A field study was conducted in 2011 at the Agricultural Experiment Station, Pine Tree, AR, to evaluate new experimental and present herbicides and tank-mix combinations for weed control in grain sorghum. The plot area was tilled in both fall and spring and fertilized with 200 lb of NPK (0-21-32) prior to planting (May) and 300 lb of N on June. The experiment was established in a natural weed population of Palmer amaranth (*Amaranthus palmeri*), prickly sida (*Sida spinosa*), broadleaf signalgrass (*Urochloa platyphylla*), pitted morningglory (*Ipomoea lacunosa*) and barnyardgrass (*Echinochloa crus-galli*). The experimental design was a randomized complete block with 18 treatments and four replications. Treatments were as follows: 1) Dual II Magnum (*S*-metolachlor) at 16 oz/A; 2) Zidua (pyroxasulfone) at 2.24 oz/A; 3 and 4) Bicep II Magnum (atrazine/metolachlor) at 1.6 and 2.1 qt/A; 5) Integrity (saflufenacil/dimethenamid) at 13 oz/A; 6) Sharpen (saflufenacil) at 3 oz/A; 7) Guardsman Max (dimethenamid/atrazine) at 96 oz/A; 8) Aatrex (atrazine) at 2 qt/A; and 9) Aatrex + Zidua, all applied preemergence (PRE); 10) Aatrex; 11) Yukon (halosulfuron/dicamba) at 6 oz/A + Agri-Dex (1%); 12) Paramount (quinclorac) at 8 oz/A + Agri-Dex; 13) Peak (prosulfuron) at 0.75 oz/A + Induce (0.25%); 14) Aatrex + Yukon + Agri-Dex; 15) Aatrex + Paramount + Agri-Dex; 16) Aatrex + Peak + Induce applied postemergence (POST) at V2-V4 stage of grain sorghum; 17) Dual II Magnum (PRE) followed by (fb) Aatrex POST at V2-V4; and 18) weedy-check.

Zidua caused the greatest injury at 46% (reduced to 0% by the end of season) and 56% (reduced to 0%) 3 weeks after treatment when applied PRE alone and in a tank-mix combination with Aatrex, respectively. Palmer amaranth control was >90% from all herbicide applications except for Sharpen (PRE) at 0%, Paramount at 39%, and Peak at 79%. Pitted morningglory and prickly sida control were >85% from all herbicide applications except for Sharpen. All PRE herbicide applications provided >90% control of broadleaf signalgrass and barnyardgrass except Sharpen and Aatrex. Of the POST-applied herbicides, only Aatrex + Paramount provided >90% control of barnyardgrass and broadleaf signalgrass. The application of Dual II Magnum PRE fb Aatrex POST provided excellent (99 to 100%) control of all weeds.

Palmer amaranth, pitted morningglory, prickly sida, broadleaf signalgrass, and barnyardgrass interference reduced grain sorghum yield 65% compared to the standard treatment (Dual II Magnum PRE fb Aatrex POST). The three best herbicide treatments in terms of grain sorghum tolerance, yield, and weed control were Integrity (PRE), Guardsman Max (PRE), and Dual II Magnum (PRE) fb Aatrex (POST). These treatments yielded 2,946, 2,858, and 3,189 lb/A of grain sorghum, respectively.

ZIDUA® Herbicide: The Newest Herbicide from BASF.

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As of November 7, 2011, Zidua® herbicide (pyroxasulfone), tested under codes KIH-485, BAS 9446H and BAS 820H, was not registered or available for sale in the U.S., but Zidua® herbicide could be granted registration in the U.S. for the 2012 use season. Information contained in this presentation is intended for educational purposes and is not intended to promote the sale of the product. Any sale of this product after registration is obtained shall be solely on the basis of the EPA approved product label, and any claims regarding product safety and efficacy shall be addressed solely by the label. Zidua® herbicide is a registered trademark of BASF. Pyroxasulfone is patented and manufactured by Kumiai Chemical of Japan.

Zidua inhibits the growth of germinating weeds by primarily being absorbed by the shoot and secondarily by the roots of weed seedlings. This Isoxazoline compound represents a new class of herbicide chemistry. It's mode of action is inhibition of "Very Long Chain Fatty Acids" (WSSA Group 15, HRAC K3). While not a new mode of action, Zidua represents a significant improvement within this important mode of action, delivering higher unit activity and spectrum of control.

Field trials by scientists around the world have demonstrated that Zidua provides broad-spectrum control of key grass and broadleaf weeds preemergence, in major crops including soybeans, corn and wheat. Zidua's long-lasting residual control provides application flexibility from fall through early preplant to early postemergence. Zidua also has shown control of weeds resistant to glyphosate as well as ALS- and ACCase-inhibiting herbicides, and therefore, will be an important tool for resistance management. Primary target weeds in winter wheat are Italian/annual ryegrass (Lolium multiflorum), Phalaris spp., and annual bluegrass (Poa annua).

Zidua is currently being tested as an 85% wettable dispersible granule. The targeted rate range will depend on soil texture, application timing, mixing partner and weed spectrum present. The current Zidua 85WDG rate ranges are for soybeans: 1.5 to 3.5 oz/ac, for corn: 1.5 to 3.5 oz/ac, and for winter or spring wheat: 1 to 2 oz/ac. Although there are specific mixing partners for individual crops, Zidua tankmixes might include PURSUIT® herbicide, metribuzin, SHARPEN® herbicide, or atrazine, to mention a few.

Simulation Modeling to Identify Best Management Practices for Herbicide Resistance Mitigation in Barnyardgrass.

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The intensive use of herbicides for weed control has resulted in the evolution of herbicide resistance in weed communities. Herbicide resistance in weeds has been one the most important production issues for major field crops in the southern U.S. Barnyardgrass is the sixth most important herbicide-resistant weed worldwide and is a problematic weed in rice, cotton, and soybean production systems of the Mississippi Delta region. While barnyardgrass resistance to propanil, quinclorac, and clomazone has already confirmed in Arkansas rice, further resistance to acetolactate synthase (ALS) inhibitors in rice production and to glyphosate in cotton production has been anticipated, given the intensity of use of these herbicides and insufficient herbicide/crop rotation in these systems. In the Mississippi Delta region, cotton is mostly grown as a monocrop and the vast majority of the acreage comprises glyphosate-resistant cotton. Rice is usually rotated with soybean, although the acreage under continuous rice production has been increasing with the availability of imidazolinone-resistant rice cultivars. Thus, it is only a matter of time before resistance to these herbicides is commonplace. Mathematical models have been developed to simulate the evolution of resistance to the above herbicides in barnyardgrass and to identify suitable strategies for the mitigation of resistance. Several herbicide programs were tested in combination with suitable non-chemical approaches for each production system. Results suggest that herbicide resistance could be delayed dramatically if growers practice pro-active strategies prior to the evolution of resistance; pro-active measures are efficient and economical over the long-run compared with the re-active approach. The presentation focuses on key strategies for resistance mitigation in each production system.