ABSTRACTS RESEARCH CONFERENCE

VOLUME 11

Arkansas Crop Protection Association

November 26 and 27, 2007
Clarion Inn
Fayetteville, Arkansas

Monday, November 26, 2007
10:00 a.m. Business Meeting
12:00 noon Registration

MODERATOR: Dr. Nilda Burgos

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

Tuesday, November 27, 2007

MODERATOR: Dr. Scott Akin

12:00 noon Lunch Break

MODERATOR: Dr. Jason Norsworthy

03:00 p.m. Presentation of Awards – M. T. Barapour

03:30 p.m. Adjourn

Comparison of Wheat Herbicides for Control of Arkansas Diclofop-Resistant Italian Ryegrass.

Mohammad T. Bararpour and Lawrence R. Oliver. Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Resistance in Italian ryegrass (*Lolium perenne var. multiflorum*) is an economically important example of herbicide resistance in world agriculture, and Hoelon (diclofop)-resistant ryegrass is the number one weed problem in Arkansas wheat. Field studies were conducted from 2001 through 2007 at Fayetteville, to evaluate the efficacy of herbicides available to Arkansas producers for controlling diclofop-resistant ryegrass. The plot area contained a uniform, natural infestation (+/- 30 plants/ft^2) of dicofop-resistant Italian ryegrass. The number of treatments varied over years (15 to 46 combinations of herbicides, application timings, herbicide rates, and herbicide tank-mixtures) depending on current labels and new herbicides. Italian ryegrass control and wheat injury and yield were evaluated. Data from 2001 through 2004 and data from 2004 through 2006 were analyzed separately, because of treatment differences between the two data sets. Data from 2007 were analyzed alone because of frost and stripe rust (*Puccinia striiformis*) damage.

2001 through 2004. Finesse (chlorsulfuron/metsulfuron) at 0.023 lb ai/A preemergence (PRE) followed by (fb) Osprey (mesosulfuron) at 0.043 lb ai/A + Destiny (adjuvant at 1%) at 4-leaf to 2-tiller ryegrass provided excellent control (96%), and wheat yield was highest (59 bu/A). However, Sencor (metribuzin, 0.25 lb ai/A) at 2- to 3- leaf wheat fb Sencor at 2- to 3-tiller wheat; Axiom (flufenacet/metribuzin, 0.425 lb ai/A) at 1- to 2-leaf wheat; Osprey at 2- to 3-leaf wheat; and Osprey at 4-leaf to 2-tiller ryegrass provided equivalent Italian ryegrass control (89 to 96%) and wheat yield (52 to 59 bu/A).

2004 through 2006. The four best treatments were Finesse PRE fb Osprey at 0.0134 lb/A + Destiny at 3- to 4-leaf ryegrass; Sencor at 2- to 3- leaf wheat fb Sencor at 3- to 4-leaf ryegrass; Finesse (0.023 lb ai/A) PRE; and Axiom at 1- to 2-leaf wheat. These treatments controlled 92, 94, 89, and 89% Italian ryegrass and provided 56, 53, 48, and 48 bu/A wheat yield, respectively.

2007. Axiom at 1- to 2-leaf wheat; Prowl H2O (pendimethalin, 2 lb ai/A) at spike fb Osprey (0.0134 lb/A) + Destiny at 3- to 4-leaf ryegrass; Sencor at 2- to 3-leaf wheat fb Osprey + Destiny at 1- to 2-tiller ryegrass; Osprey + Destiny at 1- to 2-tiller ryegrass fb Osprey + Destiny at 4-leaf to 2-tiller ryegrass; Finesse (0.012 lb/A) PRE fb Osprey + Destiny at 4-leaf to 2-tiller ryegrass; and Sencor at 2- to 3-leaf wheat fb Sencor at 2- to 3-tiller wheat gave 97, 93, 95, 93, 93, and 85% control of Italian ryegrass, respectively. Yields were low (30 bu/A) because of frost and rust damage.

The natural infestation of Arkansas diclofop-resistant Italian ryegrass interference reduced wheat yield an average of 72% over the 6 years. In conclusion, Finesse, Axiom, Osprey, and Sencor can be used to control diclofop-resistant Italian ryegrass and prevent associated wheat yield reduction.

Comparison of Selected Irrigation Methods and Water Use for RiceTec Hybrid Rice Production in Poinsett County Arkansas.

Greg Simpson*, Van McNeely*, Mason Wallace*, Derrol Grymes, and Kurt Johns* , RiceTec inc. Harrisburg, Arkansas

Field studies were conducted in 2006 and 2007 in Poinsett County, Arkansas at the RiceTec Arkansas Business Center near Harrisburg, Arkansas, and at the Gary Sitzer Farm near Weiner, Arkansas to compare water use for selected irrigation methods and RiceTec rice hybrids and locally recommended rice cultivars. The 2006 experiment at the Arkansas Business Center compared water use and grain yield in RiceTec hybrids CLEARFIELD® XL729, CLEARFIELD® XL730, and CLEARFIELD® XL8 and the cultivar CL161 using irrigation methods called ' Intermittent Flood' and 'Standard Permanent Flood'. The experiment at the Gary Sitzer Farm was a comparison of water use and grain yield in RiceTec hybrids XL723 and XP729 and cultivars Wells and Cybonnet using irrigation methods called 'Standard Permanent Flood', Intermittent Flood', and 'Furrow Irrigation'. The 2007 experiment at the RiceTec Arkansas Business Center was a comparison of water use and grain yield in RiceTec hybrids CLEARFIELD® XL729, CLEARFIELD® XL730, CLEARFIELD® XP745, CLEARFIELD® XP746, XL723, and XP744, and the cultivars CL161, CL171, Wells, and Cybonnet using irrigation methods called 'Standard Permanent Flood', 'Intermittent Flood', 'Furrow Irrigation @ 3 day intervals' and 'Furrow Irrigation @ 5 day intervals. An experiment conducted at the RiceTec research farm near Alvin,Texas was a comparison of water use and grain yield for RiceTec hybrids CLEARFIELD® XL729, CLEARFIELD® XL730, CLEARFIELD® XP745, CLEARFIELD® XP746, XL723, XP744 and cultivars CL161, Cocodrie, and Trenasse using irrigation methods called Intermittent Flood, and 'Standard Permanent Flood'. In all experiments water use was significantly reduced by irrigation methods 'Intermittent Flood', and 'Furrow Irrigation'. In both years 'Intermittent Flood' significantly reduced water use without reducing grain yield. In all experiments RiceTec hybrids had less grain yield reduction associated with reduced water use than recommended cultivars. In both years 'Furrow Irrigation' significantly reduced water use, but with a significant reduction in grain yield. New cultural challenges arise from growing rice without flood irrigation in the areas of weed control, disease management, and nitrogen use efficiency. 2007 furrow irrigation comparisons at 3 day and 5 day intervals both had significant yield reduction compared to flood irrigation treatments. Furrow irrigation at 3 day intervals did not yield significantly different from furrow irrigation at 5 day intervals.

Efficacy of Endigo ZC a New Insecticide for Cotton and Soybeans in Arkansas, 2007.

Kyle Colwell, Gus Lorenz III, Craig Shelton, Heather Wilf, Robert Goodson, Eric Howard, Steven Stone, Chad Norton, Ben Von Kanel, University of Arkansas Cooperative Extension Service, Little Rock, AR

Increasing concerns with plant bug control in cotton and extremely high stink bug populations in soybeans leave Arkansas growers looking for efficacious insecticides. Endigo ZC is a new premix of 1.18 pounds of Thiamethoxam and 0.88 pounds of Lambda-Cyhalothrin per gallon. Efficacy trials were conducted in Arkansas during the 2007 growing season in order to determine efficacy of Endigo ZC. Three cotton trials and two soybean trials were conducted in 2007 to determine the efficacy of this premix compared to standards. Hopefully compounds such as this will relieve the overuse of current standards and reduce the insecticide resistance issues.

Seasonal Sampling, Cultivar Susceptibility, and Effects of Compost Tea on Grape phylloxera, *Daktulosphaira vitifoliae* (Fitch) in the Ozarks.

Sandra Sleezer, Donn T. Johnson and Barbara Lewis, Department of Entomology, University of Arkansas, Fayetteville, AR

Grape phylloxera is native to the southeastern United States but most published studies have been conducted in California or other parts of the world where it was introduced. This pest can cause crop reduction due to root and foliar feeding, but more importantly cause vine death through secondary fungal pathogens entering root-feeding wounds. Recently, growers in the Ozark region have planted European and hybrid grape cultivars that are susceptible to grape phylloxera. The three objectives were: to describe the life cycle by determining the overwintering sites, seasonal changes in crawler activity on vines, if root crawlers emerge from soil and if crawlers disperse via air; to compare survival and fecundity of grape phylloxera on roots of the predominant European and hybrid cultivars of grapes grown in Arkansas and Missouri; and to determine the effects of high fungal biomass compost tea on suppressing grape phylloxera and grape root pathogenic fungi. Weekly counts of phylloxera crawlers were made from sticky tape traps placed on canes and trunk, soil emergence sticky traps, and aerial sticky traps. By knowing the relative susceptibility of cultivars to root phylloxera we can better determine the need for using a rootstock or other management technique. Compost tea was added to the soil of potted grape vines to observe the effects on root fungal pathogens and root phylloxera. New control tactics are sought after to minimize root phylloxera populations and/or prevent root pathogenic fungi to allow vines to be grown on their own roots.

Clearfield® Rice Response to Low Doses of Glyphosate as Influenced by Imazethapyr Rate and Timing.

Jason R. Meier*, and Kenneth L. Smith; University of Arkansas Division of Agriculture, Monticello, AR. and Robert C. Scott; University of Arkansas Division of Agriculture, Little Rock, AR.

The imazethapyr tolerant (Clearfield®) rice system has been readily adopted by Arkansas farmers as a tool to help manage red rice infestations. Unfortunately, glyphosate drift onto rice continues to be a problem in Arkansas. It has been proposed that glyphosate drift immediately before or after imazethapyr applications may enhance crop response to either of the herbicides. A greenhouse study was conducted in 2007 to examine Clearfield® rice response to imazethapyr and low rates of glyphosate when applied sequentially at 0, 1, 3, 7, and 14 days. CL-161 was hand-seeded into pots 10.2 cm square and 12.7 cm tall and allowed to reach the 4-5 leaf growth stage before treatments were initiated. Glyphosate (Roundup WeatherMax®) was applied at 0, 45, and 90 g ae ha^{-1} at 0, 1, 3, 7, and 14 d prior to applying imazethapyr (Newpath®) at 0, 105, or 210 g ai ha^{-1}. Imazethapyr was also applied at the above rates 0, 1, 3, 7, and 14 days prior to receiving glyphosate at 0, 45, or 90 g ae ha^{-1} to determine any predisposition of plants to either herbicide. Plant height (cm) and chlorophyll content (SPAD) was measured 7, 14, and 21 d after the final applications, then plants were cut at the soil surface, dried, and dry weight (g) recorded.

Glyphosate at all application timings resulted in plant height reduction and reduced dry weight, but this reduction was not influenced by imazethapyr rate or timing. SPAD readings showed no consistent treatment influences on chlorophyll at any application interval. From this trial there is no evidence that imazethapyr applications will predispose CL-161 to greater injury from glyphosate or that glyphosate will predispose CL-161 to injury from imazethapyr. However, it is uncertain how a hybrid Clearfield® cultivar or a conventional Clearfield® cultivar with less tolerance to imazethapyr than CL-161 will respond to a combination of these herbicides.

Control of Palmer Amaranth in Cotton When Glyphosate No Longer Works
R. C. Doherty, K. L. Smith, D. O. Stephenson, L. R. Oliver, J. A. Bullington, J. R. Meier; University of Arkansas, Monticello, AR.

Palmer amaranth is a common and very troublesome weed in cotton fields throughout the southern U. S. It has been effectively controlled with glyphosate in Roundup Ready® cotton; however, glyphosate-tolerant Palmer amaranth is present in 11 counties in AR. The ability of these plants to tolerate high rates of glyphosate has caused major problems and requires a different weed control system. The objective of this research was to evaluate the efficacy of preplant and preemergence residual herbicides for control of glyphosate-tolerant Palmer amaranth in Arkansas cotton.

In 2006 and 2007, duplicate experiments were established in Rohwer, AR, on the Southeast Research and Extension Center in a Hebert silt loam soil and in Keiser, AR, on the Northeast Research and Extension Center in a Sharkey clay soil. The trials were arranged in a randomized complete block design with four replications. Parameters evaluated were visual ratings of Palmer amaranth control, visual ratings of cotton injury, and cotton yield. Herbicides used in this experiment were Reflex at 0.187 and 0.25 lb ai/acre, Valor at 0.063 lb ai/acre, Cotoran at 1 lb ai/acre, Caporal at 1 lb ai/acre, Direx at 0.5 lb ai/acre, and Prowl H2O at 1 lb ai/acre.

In 2006, cotton injury was noted with Reflex applied 14 and 0 days preplant (DPP) at 0.25 lb ai/acre, Reflex applied 7 and 0 DPP at 0.187 lb ai/acre, Valor, Cotoran, and Caporal applied 0 DPP, and Prowl H2O applied 21 and 0 DPP at Rohwer and only with Valor 0 DPP at Keiser. Cotton yield was affected only by Valor applied 0 DPP, which caused death of the cotton at the Rohwer location. Forty-five days after emergence (DAE) at Rohwer, Reflex at 0.25 lb ai/acre and Prowl H2O applied 14 DPP provided 98% control of Palmer amaranth, while Valor applied 21 DPP provided 99% control. Valor applied 14 and 7 DPP and Direx applied 0 DPP provided 100% control, while Cotoran and Caporal applied 14 DPP provided 96 and 83% control, respectively. Twenty-four DAE at Keiser, Reflex applied 21 and 14 DPP at 0.25 lb ai/acre and Valor applied 21, 14, and 7 DPP provided 99% control, while Reflex applied 14 DPP at 0.187 lb ai/acre, Cotoran applied 21 DPP, Caporal applied 14 DPP, Direx applied 14 DPP and Prowl H2O applied 21 DPP provided 97, 95, 97, 98, and 94% control respectively.

In 2007, cotton injury was not noted with any treatment at Rohwer, while Valor applied 21, 14, 7, and 0 DPP caused injury at Keiser. Twenty-nine DAE at Rohwer, Reflex at 0.25 lb ai/acre applied 21, 7 and 0 DPP provided 92, 97, and 91% control of Palmer amaranth, while Reflex at 0.187 lb ai/acre applied 14 and 7 DPP provided 90 and 93% control. Direx applied 0 DPP provided 93% control of Palmer amaranth. Twentyone DAE at Keiser, Valor applied 21, 14, and 7 DPP provided 95, 96, and 92% control of Palmer amaranth respectively, while Reflex at 0.187 lb ai/acre applied 7 DPP provided 88% control. Residual herbicides applied preplant and preemergence did provide excellent control of glyphosate-tolerant Palmer amaranth in Arkansas cotton.

Phenyl Isothiocyanate as a Methyl Bromide Alternative for Weed Control in Tomato.

S.K. Bangarwa, J.K. Norsworthy, and G.A. Griffith, Department of Crop, Soils, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Methyl bromide is widely used for weed in plasticulture tomato production system. With the impending ban of methyl bromide in the United States, a suitable alternative that provides effective weed control without injuring tomato is urgently needed. Field experiments were conducted at Clemson, SC in 2006 and at Fayetteville, AR in 2007 to determine if phenyl isothiocyanate (phenyl ITC) would supply effective weed control without injuring tomato, using low density polyethylene (LDPE) and Virtual Impermeable Film (VIF) mulches. The experiments were organized as a randomized complete block design using 2 by 6 factorial treatment arrangement, and replicated four times. The treatment factors included 2 mulch types and 6 rates of phenyl ITC. A standard rate of methyl bromide plus chloropicrin was included for comparison. Phenyl ITC was applied to the soil and immediately incorporated using a roto-tiller. Raised beds were prepared after ITC incorporation and covered with LDPE or VIF mulch. Tomato transplants were transplanted three weeks after applying the plastic mulch. Crop injury and weed control were visually rated every other week. Marketable fruit were harvested throughout the season and graded according to USDA standards. Higher crop injury was observed in 2006 than in 2007. The difference was due to the time of punching holes in the mulch prior to transplanting, which was 0 hour in 2006 and 48 hours in 2007. Unacceptable injury was observed in tomato plants at the highest phenyl ITC rate of 1514 kg/ha. Phenyl ITC at 757 kg/ha provided tomato fruit yield equal to the standard methyl bromide treatment in both years with minimal injury. On average, phenyl ITC at 757 kg/ha provided effective control of purple and yellow nutsedge (>80%), Palmer amaranth (90%), and grass species (86%) up to 4 weeks after transplanting. Overall, VIF film improved yellow nutsedge suppression. This research shows that the combination of phenyl ITC at 757 kg/ha beneath a VIF mulch provides weed control and tomato fruit yield comparable to methyl bromide.

Performance of Selected Insecticides for Control of Tarnished Plant Bug in Southeast Arkansas

B. Chase Milligan[1], D. S. Akin[1], G. M. Lorenz[2], and G. E. Studebaker[3], [1]University of Arkansas, Cooperative Extension Service, Monticello, AR, [2]University of Arkansas, Cooperative Extension Service, Lonoke, AR, [3]University of Arkansas, Cooperative Extension Service, Keiser, AR

Field trials were conducted in 2007 at the Southeast Research and Extension Center (SEREC, Rohwer) to evaluate effectiveness of single chemistry as well as tank mix control options for the tarnished plant bug, *Lygus lineolaris* (TPB). All treatments were applied to post-bloom cotton.

Tank mixes of a neonicotinoid (imidacloprid, Trimax Pro®) with novaluron (Diamond®), cyfluthrin (Baythroid®), and dicrotophos (Bidrin®) as well as a tank mix of cyhalothrin (Karate®) with acephate and a premix of cyhalothrin + thiamethoxam (i.e., Endigo®) were evaluated in the first trial. Cyfluthrin, acephate, and dicrotophos were included as stand alone treatments. At 4 and 7 days after treatment (DAT), all treatments except imidacloprid alone and those containing cyfluthrin provided adequate control of TPB compared to the untreated check.

In a second trial, treatments containing single chemistries were evaluated for TPB control including flonicamid (Carbine®), thiamethoxam (Centric®), cyhalothrin (Prolex®), oxamyl (Vydate®), dicrotophos (Bidrin®), imidacloprid (Trimax Pro®), acephate, and dimethoate. A premix of gamma-cyhalothrin + chlorpyrifos (i.e., Cobalt®) was also included. A significant reduction in TPB numbers was observed across all treatments at 4 DAT. At 7 DAT, the same trend was observed in all treatments except the lower rate of gamma-cyhalothrin + chlorpyrifos.

One-Shot Weed Control Programs in Corn.

Greg J. Sivils, Lawrence R. Oliver, and Kenneth L. Smith. Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

As corn acreage increases throughout the United States, alternative herbicide methods are being implemented to reduce input costs. The objective of this study is to assess one-shot herbicide programs (only one herbicide application in the season) in corn for effective season-long weed control. Twenty-six treatments were evaluated at three locations, Fayetteville, Keiser, and Rohwer, AR. The experimental design was a randomized complete block with four replications. Both soil and foliar-applied herbicides were evaluated, either alone or in tank mixtures. The plots were overseeded prior to planting with pitted morningglory (Ipomoea lacunosa), entireleaf morningglory (Ipomoea herderacea var. integriuscula), velvetleaf (Abutilon theophrasti), broadleaf signalgrass (Urochloa platyphylla), Palmer amaranth (Amaranthus palmeri), and prickly sida (Sida spinosa). Plots were rated at 1, 2, 4, 6, and 8 weeks after application and at harvest for weed control by species and corn injury. Corn yield was obtained at maturity. Data were pooled for Fayetteville and Keiser. The Rohwer experiment had inadequate weed pressure and was not included in the analysis.

Atrazine (Aatrex) applied at 2 lb ai/A preemergence was used as the standard treatment, since atrazine is the most commonly used herbicide in corn. Corn treated with atrazine yielded 210 bu/A, which was comparable to yield of the weed-free check of 216 bu/A. Glyphosate (Roundup OriginalMax) at 0.77 lb ae/A plus atrazine 1.5 lb/A + COC (Agri-dex) 1% v/v applied at 1-to 3-inch weed growth represented the highest numerical yield at 234 bu/A with total weed control of 98%. Treatments, such as atrazine + S-metolachlor + mesotrione, (Lumax and Lexar with different formulations), flufenacet + isoxafutole (Radius), or rimsulfuron (Resolve), that included glyphosate in the tank mixture had equal weed control and corn yield. Mesotrione (Callisto) 0.1875 lb ai/A applied preemergence, was the next highest treatment with a yield of 231 bu/A and weed control of 96%. The herbicide treatment with the lowest yield and weed control was

topramezone (Impact) 0.016 lb ai/A tank mixed with methylated seed oil (MSO) 1% v/v and ammonium sulfate (AMS) at 1.28 lb ai/A applied at 2-to 4-inch weed growth. This treatment yielded 162 bu/A and had 68% weed control. Isoxaflutole (Balance Pro) at 0.07 lb ai/A tank mixed with flufenacet (Define) at 0.64 lb ai/A also showed poor results as a preemergence herbicide, with 189 bu/A corn yield and 75% weed control. For the less effective treatments, pitted and entireleaf morningglories were the most difficult species to control, especially late in the growing season.
All treatments outperformed the untreated check, which yielded only 123 bu/A. Statistically twelve treatments had no significant difference in yield when compared to the highest yielding treatment. Glyphosate, both alone and in tank mixtures, provided high yields and excellent weed control. Herbicides tank mixed with atrazine also provided equivalent yield and weed control. After one summer of research, the recommended herbicide program would be a tank mixture of any of the herbicides tested plus atrazine, glyphosate, or both when applied by 2-to 4-inch weed growth

Profitable Systems for Ultra-Early Soybean Production.
Franklin H. Lyons IV, Lawrence R. Oliver, Larry C. Purcell, and Michael P. Popp. Departments of Crop, Soil, and Environmental Sciences and Agricultural Economics, University of Arkansas, Fayetteville, AR.

Rising input cost for soybean production is a major constraint for Arkansas producers; thus, lowering fuel, seed, and herbicide cost can influence a producer’s profit margin. Conventional soybean varieties can reduce cost by avoiding technology fees associated with Roundup Ready varieties, and early-maturing varieties can reduce irrigation cost. Planting any of these varieties at high populations can also reduce herbicide cost due to earlier canopy closure. The objective of this research was to determine the influence of soybean maturity group (MG), plant density, and herbicide program on soybean yield. All production methods will be subjected to economic analysis to discover the most profitable method of producing ultra-early soybean.

Experiments were conducted at Keiser, Pine Tree, and Fayetteville, AR, in 2006 and 2007. The planting dates ranged from May 16 to May 22. The experimental design was a split-split plot with four replications. Main plots were maturity group, MG II (AG2203), MG III (S31-V3), and MG IV (AG4801). Subplots were a factorial arrangement of planting density, 75,000, 125,000, and 200,000 seed/A, and herbicide program, which consisted of a conventional program and two Roundup Ready programs. The conventional program was S-metolachlor plus metribuzin applied preemergence at the recommended rates for soil texture followed by fomesafen plus sethoxydim applied at V4. The Roundup Ready programs were glyphosate (Roundup WeatherMax) applied at 0.75 lb ae/A at the V3 and V6 stages and glyphosate applied at 0.375 lb/A at the V2 stage and again whenever control reached less than 80% on a particular treatment. Soybean density, growth stage, and light interception were recorded throughout the growing season. Weed size and density measurements were recorded prior to each herbicide application, and weed control ratings were taken throughout the season. Soybean yield was obtained for a final economic analysis.

Fayetteville and Keiser results could not be pooled over years, and Pine Tree data were too variable due to lack of rainfall for herbicide activation (data not presented). A significant interaction of year by location by cultivar was noted for yield. The 2007 growing season was better than the 2006. Fayetteville had higher yield for all cultivars than Keiser, with the greatest difference being MG II soybean (58 vs 29 bu/A). MG IV responded the best among varieties with 65 vs 58 bu/A at Fayetteville and Kesier, respectively. MG III and IV gave equivalent yield except at Keiser, which yielded 62 bu/A for MG IV and 45 bu/A for MG III. The main effects of cultivar and density showed that yield was greater at the 200,000 seed/A planting rate than at 125,000, and 75,000 seed/A, and herbicide program did not influence yield potential.

At each location, entireleaf *(Ipomoea hederacea var. integriuscula*) and pitted (*Ipomoea lacunosa*) morningglory species were controlled better at the high planting density than the low planting density. Herbicide program had no effect on soybean yield; however, the conventional program did not control entireleaf morningglory late into the season. The lack of adequate late-season morningglory control was more prevalent for the MG II soybean than the other varieties. Both Roundup Ready programs provided good control of both morningglory species (>90%), but the full-rate Roundup program did provide slightly higher control.

Based on this research, the best treatment (economically) for high-yielding ultra-early soybean production would be MG III or IV soybean grown at 200,000 seed/A with a Roundup Ready herbicide program.

Evaluation of Polymer-Coated Urea as an Alternative to Preflood Urea for Delayed-Flood Rice.

Bobby R. Golden, Nathan A. Slaton, Russell E. Delong, and Richard J. Norman.

Nitrogen fertilization of rice (*Oryza sativa* L.) in the direct-seeded, delayed-flood production system relies heavily on aerial application of N-fertilizer. The ability to apply N-fertilizer with ground equipment before seeding would benefit rice producers by reducing N-application costs. The research objective was to compare the effects of preplant application of polymer-coated urea fertilizers with the standard practice of preflood urea fertilizer application on growth and yield of rice in the delayed-flood production system.

In 2007, experiments were established on Calhoun, Dewitt, and Hilleman silt loams. Three polymer-coated urea fertilizers (ESN, 44% N; Polyon 41, 41%N, and Polyon 42, 42% N; Agrium Inc., Calgary, AB, Canada) were broadcast at total-N rates ranging from 30 to 150 lbs N ac^{-1} immediately before drill seeding ‘Francis’ rice at 100 lbs seed ac^{-1}. Before flooding at the 5-leaf stage, urea was applied at the same total-N rates as the polymer-coated fertilizers. Total, aboveground N uptake was determined near the panicle differentiation (PD) stage and at early heading (HDG) for treatments receiving 120 lbs N ac^{-1}. Grain yield was determined by harvesting the middle four rows of each plot. Each experiment was arranged as a randomized complete block design with a 4 (N source) x 5 (total N rate) factorial treatment arrangement plus two unfertilized controls (0 lbs N ac^{-1}). Grain yields were initially regressed on N-rate allowing for both linear and quadratic terms with coefficients depending on N-source and site-year. Non-significant model terms were removed sequentially and the model was refit until a satisfactory model was obtained. Differences among all remaining coefficients, which varied by N source, site-year, or both were determined using single degree of freedom contrasts. Mean separations were performed for N uptake data by Fisher's Protected Least Significant Difference method.

Nitrogen uptake at PD was affected only by the main effects of site and N source with total-N uptake, averaged across sites, following a decreasing order of urea > ESN = P42 μ P41 > control. Rice grain yield increased non-linearly across N rates with all N source and site combinations sharing a common quadratic coefficient, all N sources within a site sharing a common linear coefficient, and each N source x site combination having a unique intercept that was different than zero. For rice grown on the Dewitt and Calhoun soils the intercepts for urea applied preflood were greater than for polymer coated urea sources applied preplant indicating that rice receiving urea produced greater yields for each N rate. For the Hillemann soil, intercepts among N sources were similar. Preplant applied polymer-coated urea sources produced yields similar to urea applied preflood at one site, but when all sites were considered polymer-coated urea fertilizers required higher total N rates to produce similar yields as the standard method of urea. The polymer coated urea fertilizers evaluated appear to release N too rapidly (ESN) or slowly (P41 and P42) for rice grown in the delayed-flood production system.

Potassium Deficiency Influences Rice Growth and Yield.

E. T. Maschmann, N. A. Slaton, R. E. Delong, P. H. Micheri, B. R. Golden. Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Potassium deficiency of rice (*Oryza sativa* L.) has become an increasing problem over the last 20 years due in part to inadequate fertilization programs and increasing crop yields. Knowledge of the influence of K deficiency on rice yield components such as number of spikelets per panicle and percentage filled spikelets would be useful information for management of K-deficient rice. The research objectives were to determine the effect of K-fertilizer rate on rice grain yield, whole-plant K concentrations at panicle differentiation (PD) and early heading (EH), and selected yield components of rice grown on K-deficient and sufficient soils.

Experiments were conducted on K-deficient soils at the Pine Tree Branch Station (PTBS) on two Calhoun silt loams in 2007 and a Henry silt loam in Poinsett County in 2004. One additional study was established on a K-sufficient Dewitt silt loam at the Rice Research and Extension Center (RREC). Muriate potash fertilizer was applied at rates ranging from 0 to160 lbs K/acre at all sites. Whole-aboveground plant samples were collected at PD and EH for determination of tissue K concentrations. At maturity, panicles were collected from plots receiving 0, 80 and 160 lbs K_2O/acre and assayed for total spikelet number and percentage of filled spikelets. Grain yield was determined by harvesting the middle rows of each plot. For statistical analysis, site-year data were grouped by the soil-K sufficiency status (deficient or sufficient) and interpreted at the 0.10 significance level.

Soil-test K ranged from 54-74 ppm at the three K-deficient sites and 150 ppm at the K-sufficient site. As expected, K-fertilizer rate had no influence on grain yield (176 bu/acre), whole-plant K concentration at EH (2.03% K), spikelet number/panicle (151), and percent blank spikelets (11%) of rice grown in K-sufficient soil. In K-deficient soils rice receiving no K-fertilizer contained deficient whole-plant K concentrations at PD (1.14-1.33% K) and EH (0.78-1.00% K) which increased as K rate increased. Averaged across K-deficient sites, grain yields of rice receiving no K fertilizer (155-186 bu/acre) were increased significantly by 13-17% from application of 80 to 160 lbs K_2O/acre with maximum numerical yields (188-206 bu/acre) produced by the greatest applied K rate. Panicle assays, averaged across K-deficient sites, showed that total spikelet number increased significantly (156 vs 169-175 spikelets /panicle) and percent blank spikelets decreased (24% vs 20-22%/panicle) when 80 and 160 lbs K_2O/acre were applied. These data suggest that yield loss from K-deficiency is partially attributed to a reduction in spikelet number/panicle plus an increase in blank spikelets/panicle. Because spikelet number per panicle is set by PD, application of K fertilizer to K-deficient rice after PD may aid in reducing disease incidence and severity and/or reduce blanking, but is likely too late for production of maximum yield potential.

Rice Cultivar Response to Low Glyphosate Rates as Influenced by Growth Stage.
Mason Wallace, Van McNeely, Marshall Sigsby, and Steven Gann

The utilization of glyphosate tolerant crops has resulted in the off target drift of glyphosate. Numerous instances of suspected glyphosate drift occurred over the years on many rice fields. An experiment was conducted in 2007 to investigate the response of three cultivars to reduced rates of glyphosate. CL161, CLEARFIELD® XL8, and CLEARFIELD® XL730 were chosen to be used in the experiment with glyphosate applied at 2 leaf, 4 leaf, and panicle initiation +14 days. Glyphosate rates used were: 0, 3.2 oz/A (0.1 lb ai/A), and 6.4 oz/A (0.2 lb ai/A). A 9.6 oz/A (0.3 lb ai/A) rate were also used at the 4 leaf timing. Plant injury, 50% heading delay, and yield were evaluated. Applications of glyphosate at 0.1 lb ai/A at the two leaf timing resulted in no visible injury symptoms or yield loss on any cultivar. The four leaf application timing at 0.1 lb ai/A resulted in visible plant injury in all cultivars but no significant yield decrease in any cultivar. Heading was delayed on average 5 days with CL161 and CLXL729 and 10 days with CLXL730 with the 0.1 lb ai/A rate. The four leaf application at 0.2 lb ai/A resulted in substantial plant injury in all cultivars and heading delays of at least 14 days. Yield significantly declined in all cultivars except CLXL730. The 0.3 lb ai/A rate resulted in substantial plant loss and yield loss in all cultivars and delayed heading 21 days. Glyphosate applied at 0.1 lb ai/A at PI+14 days significantly affected the yield of all cultivars except CLXL730. Heading was delayed on CLXL730 and CLXL729 14 days and only 2 days on CL161. The 0.2 lb ai/A rate at PI+14 days resulted in significant yield loss in all cultivars and an average heading delay of 21 days. Plant injury symptoms at the PI+14 timing included reduced length of rice panicles, parrot beaked grains, and new rice tillers splitting off from lower rice nodes. CLXL730 showed the most tolerance to glyphosate and yield loss.

Response of Three Wheat Cultivars to Low Rates of Glyphosate and Glufosminate.
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A study was conducted to assess the injury caused by low rates of glufosinate and glyphosate on wheat. The experiment was conducted near Lonoke, AR in 2006-2007. AGS 2000, Agro Coker Berretta, and Delta King 9410 wheat varieties were grown using conventional tillage practices. Herbicide treatments consisted of glyphosate applied at 0 lb ae/A, 0.05 lb ae/A, and 0.1 lb ae/A. Glufosinate was applied at 0 lb ai/a, 0.025 lb ai/A, and 0.05 lb ai/A. These represent 0x, 1/10x, and 1/20x rates, respectively. Treatments were applied at the 3-4 lf, ¼ inch panicle initiation (PI), and boot stages using Roundup Weathermax® (glyphosate) and Ignite280® (glufosinate). Applications were made using a pressurized CO_2 backpack sprayer with a four-nozzle boom delivering a spray volume of 10 gallons per acre. The study design was a randomized complete block with four replications. Visual injury, canopy heights (cm) (taken at boot and heading), heading dates, and maturity dates were recorded for all treatments. Yields were obtained using a small plot combine and adjusted to 12.5% moisture.

Visual injury from the 3-4 lf timing for both glyphosate and glufosinate ranged from 0% to 7% with few statistical differences. At the ¼ inch PI timing, AGS 2000 was injured from 20-48% at the 0.1 lb ae/A glyphosate rate, while injury of Delta King 9410 and Berretta was generally 20% less up to 3 weeks after treatment (WAT). Glufosinate applied at 0.05 lb ai/A caused the most visual injury when applied at boot (2WAT) with injury ranging from 20-40% nercrosis across varieties. Glufosinate injury consisted of nercotic leaf burn as far as the herbicide penetrated the canopy on the plant. By comparison glyphosate caused 10-15% less visual injury at the boot timings than glufosinate.

Canopy height was reduced by 0.1 lb ae/A of glyphosate on AGS 2000 and Delta King 9410 when applied at ¼ PI timing. Glufosinate did not reduce canopy height at any timing when measured at boot. Canopy height was not affected by either herbicide when applied at 3-4 lf at any rate when measured at heading. Canopy height was reduced up to 28 cm when glyphosate was applied at ¼ PI and boot at both rates. Glufosinate (0.025 lb ai/A) reduced canopy height of AGS 2000 up to 6 cm when applied at ¼ PI at and Berretta by 6 cm when applied at 0.05 lb ai/A. Glufosinate applied at boot reduced canopy height of AGS 2000 at both 0.05 lb ai/A and 0.025 lb ai/A and Delta King 9410 when applied at 0.05 lb ai/A by about 9 cm. In general, glyphosate decreased canopy heights more than glufosinate.

Flag leaf length was not affected by either herbicide when applied at the 3-4lf timing. Glyphosate reduced flag leaf length by 10 cm when applied at ¼ PI at both rates. Glufosinate (0.05 lb ai/A) reduced flag leaf length by 2 cm when applied at ¼ PI on AGS 2000. When glufosinate was applied at boot at 0.025 lb ai/A a reduction in flag leaf length on AGS 2000 was also documented, however other varieties were not affected.

Glufosinate applied at 0.05 lb ai/A reduced the yield of DK 9410 when applied at the 3-4 lf timing by 10 bu/A. All other treatments did not affect wheat yields when applied at this timing. Glyphosate at 0.10 lb ae/A significantly reduced yield of all varieties by 10 to 20 bu/A when applied at either the ¼ inch PI or boot timings. However, glufosinate 0.05 lb ai/A reduced yields of all three varieties when applied at boot from 10 to 16 bu/A. Germination of harvested grain was not affected by either glyphosate or glufosinate at any timing or rate.

Resistance Mechanism in an Arkansas Palmer Amaranth (*Amaranthus palmeri*) Population.

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Over-reliance on glyphosate for weed control in glyphosate-resistant crops has resulted in the development of glyphosate-resistant species worldwide as well as in Arkansas. Glyphosate-resistant Palmer amaranth was documented in Missisippi County, AR, in June 2005, with the resistant biotype having an LD_{50} of 2.517 lb ae/A glyphosate, which was 79- to 115-fold greater than susceptible biotypes. In spring of 2007, another glyphosate-resistant Palmer amaranth biotype was found in Lincoln County, AR, near Grady. The Lincoln County biotype was treated twice with Roundup WEATHERMAX® at 22 oz/A (0.78 lb ae/A glyphosate) followed by Roundup Weathermax at 44 oz/A (1.56 lb/A glyphosate) followed by Roundup WEATHERMAX at 128 oz/A (4.5 lb/A glyphosate), with each application occurring at a weekly interval. Survivors were collected and placed in a greenhouse in Monticello, AR, and seeds were collected at maturity. In a subsequent greenhouse trial, all six-leaf progeny from the Lincoln County population survived 44 oz/A of Roundup WEATHERMAX. As a result of lower variability in response to glyphosate of the Lincoln County compared with the Mississippi County population, further research was initiated on determining the resistance mechanism of the Lincoln County biotype. Studies have been initiated to evaluate glyphosate absorption and translocation using ^{14}C-glyphosate and to determine whether shikimic acid accumulates in the resistant biotype. Glyphosate-resistant and -susceptible biotypes were used in both experiments. Results from these laboratory experiments will be presented.

Green June Beetle Attraction to Lures and Susceptibility to Insecticides

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Green June beetle, *Cotinis nitida* (L.) is native to the eastern half of the United States from Nebraska to Connecticut and south to Texas and Florida. Adults in search of food are attracted to odors released by fermenting fruit. Adults aggregate and feed on sweet sap of oaks and maples and cause feeding damage to ripening and over-ripe fruits, ears of corn, figs, and tomato. Adults oviposit in soil that is heavily mulched or has additions of manure or decomposing vegetation. The immature stage is a white grub that tunnels at night at the soil surface feeding on humus or manure in soil. This tunneling causes bare spots of dying plants in organic fertilizer-enriched pastures, lawns and golf courses. The goal is to develop an attract-and-kill tactic to prevent fruit damage by green June beetle adults and lower grub densities in turf. The objectives of this study include: comparing attractiveness of several odor blends to green June beetles and conducting insecticide efficacy bioassays on green June beetle adults in the laboratory.

Lure Attractiveness. In Purdy, MO we set out modified Japanese beetle traps that funneled green June beetle adults into a clear 3-gal. plastic box. Traps were hung at 3’ height in transect parallel to but 100 ft out from a Seyval grape block infested with green June beetles. The traps baited with either 91% isopropyl alcohol or Mix-M captured 1,069 and 1,090 beetles, respectively, which were significantly greater counts than the 691 beetles attracted to the traps baited with 50% isopropyl alcohol.

Fruit Dip. Each glass jar contained ten green June beetle adults allowed to feed for 72 hrs on ten insecticide-dipped grapes (four replicates). The synthetic insecticides and respective percent mortality in parentheses were: Fenpropathrin, Danitol 2.4 EC (100%); Thiamethoxam, Actara 25WG (85); Acetamiprid, Assail 30SG (85); Carbaryl, Garden Tech Sevin Concentrate Bug Killer (45.7). The OMRI approved organic insecticides and respective percent mortalities in parentheses were: *Bt* subsp. *tenebrionis*, Colorado Potato Beetle Beater (45); Rotenone plus Pyrethrin, Bonide Products (40); Azadirachtin, Aza-Direct (35); and Pyrethrin plus Piperonyl butoxide, Houseplant & Garden Insect Spray (22.5).

Beetle Dip. Ten green June adults were dipped in one of six insecticide dilutions, 2X, 1X (field rate), 0.5X, 0.25X, 0.125X and 0.06X. Ten dipped beetles were placed in each glass jar and fed untreated grapes for 48 hrs (4 replicates). The 1X labeled field rate doses were: 471 ppm Danitol 2.4EC; 5867 ppm Garden Tech Sevin Concentrate Bug Killer 22.5%; and 103 ppm Actara 25WG. The lethal concentrations killing 95% (LC_{95}) in ppm for each insecticide were: Danitol = 123.8 (0.26X field rate); Carbaryl = 2717.0 (0.46X field rate); and Actara = 385.1 (3.7X field rate). Carbaryl worked better when beetles were dipped in insecticide (95% kill with half the field rate) compared to killing 45.7% when feeding on dipped fruit.

Bermudagrass Forage Yield and Ammonia Volatilization as Affected by Nitrogen Fertilization.

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Bermudagrass [*Cynodon dactylon* (L. Pers.)] forages managed for hay production requires significant levels of nitrogen (N) to produce high yields. Restrictions on poultry litter application, decreasing availability of NH_4NO_3, and the increasing cost of inorganic fertilizers demand researchers and growers seek alternative N sources and fertilization strategies that maintain soil productivity and minimize N losses. Our research objectives were to i) compare bermudagrass yields receiving a range of N rates from four N sources and ii) determine levels of NH_3 volatilization from four N sources.

An experiment was conducted during the summers of 2006 and 2007 on a Captina silt loam on an established stand of common bermudagrass. Pelleted poultry litter (PPL, ~4.0% total N) and three inorganic-N fertilizers including NH_4NO_3, urea, and urea treated with Agrotain (urease inhibitor) were applied at season-total rates of 0, 90, 180, 270, 360, and 450 lbs N/acre. Nitrogen was applied in two (90 lbs N/acre) or three (>90 lbs N/acre) split applications at greenup in early May and after each hay harvest with the exception of the final harvest. A second experiment measuring NH_3 volatilization from N fertilizers was initiated in May 2007 within the field study. Clear Plexiglas chambers were driven 4 inches into the ground and the equivalent of 120 lbs N/acre/application of PPL, urea, urea+Agrotain, and NH_4NO_3 was applied inside each chamber. Two foam sorbers saturated with a 0.73 *M* H_3PO_4-33% glycerin solution were placed inside each chamber to trap volatilized NH_3-N. Sorbers were changed 3, 6, 9, 12, and 15 d after fertilization and extracted with a 2 *M* KCl solution and analyzed for total N.

Season total bermudagrass yields in 2006 were not affected significantly (p>0.10) by the N source x N rate interaction. Bermudagrass receiving PPL or inorganic-N fertilizer produced significantly greater season-total yields than the unfertilized control, which yielded 3,560 lbs/acre. Bermudagrass receiving the inorganic-N fertilizers produced similar yields that were greater than yields produced with PPL. Yields increased gradually as N rate increased with the greatest yield (7679 lbs/acre) produced by application of 450 lbs N/acre. In 2007, forage yield was affected significantly by the N source x N rate interaction. In general, forage yields increased as N rate increased with the highest N rate producing the greatest yield and, among N sources, yields decreased in the order of NH_4NO_3 (10718 lbs/acre) > urea (10005 lbs/acre)= urea+Agrotain (9994 lbs/acre) > PPL (9331 lbs/acre) > control (4660 lbs/acre). The two years of data shows that urea produced yields similar to or 7% lower than NH_4NO_3 and PPL produced 87-88% of the total yield as compared with inorganic-N fertilizers. The urease inhibitor showed no significant benefits for increasing forage yield under the climatic conditions of 2006 or 2007. However, the NH_3 volatilization study showed urea+Agrotain lost 3% of the applied N after 15 d compared with 14% for urea alone. Nitrogen loss was 0.5% for NH_4NO_3 and 1% for PPL after 15 d. Most of the NH_3 loss occurred in the first 3 to 5 d after application. Despite greater NH_3-N losses from urea, yield data shows that bermudagrass yields are generally similar when fertilized with urea or NH_4NO_3.

Resistance of Winter Wheat to Fusarium Head Blight and Mycotoxin Accumulation.

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Fusarium head blight (FHB) is a fungal disease of wheat caused by several *Fusarium* species. In the U.S., the most important species is *Fusarium graminearum*. In addition to yield losses, *F. graminearum* produces several mycotoxins that pose health hazards to humans and animals that ingest products made from contaminated grain. The most prevalent mycotoxins produced by *F. graminearum* are deoxynivalenol (DON) and nivalenol (NIV). Strains that produce mainly DON (DON chemotypes) predominate in the U.S. However, strains that produce mainly NIV (NIV chemotypes) were found recently in Louisiana and Arkansas, and NIV is ten times more toxic to humans than DON. Developing resistant wheat cultivars is perceived to be the effective means of managing FHB and reducing levels of mycotoxins. The presence of both DON and NIV chemotypes in the Midsouth necessitates having resistance to both chemotypes in wheat cultivars adapted to this region. The objective of this study was to determine if wheat lines selected for resistance to FHB caused by DON chemotypes also have resistance to the NIV chemotype and to mycotoxin accumulation in the grain.

A susceptible check and 15 resistant wheat lines were grown in the greenhouse. Heads were inoculated at flowering with two DON and two NIV chemotypes. Inoculum was injected into one floret of each head, and plants were misted for 72 hours to promote infection. The number of infected florets per head was counted 21 days after inoculation, and the percentage of infected florets (%IF) was calculated. Heads were harvested at maturity and threshed by hand to retain all of the rachis tissue and grain. Ground grain and rachis samples were analyzed for DON and NIV concentrations using GC/MS. The statistical model was a full factorial with 16 lines, two DON chemotypes, two NIV chemotypes, and three replications (pots) with three to eight heads per pot. Analysis of %IF was based on three experiments, and analyses of toxin concentrations were based on two experiments.

Both DON chemotypes and both NIV chemotypes produced similar results, indicating that data could be analyzed on a chemotype basis. Line × chemotype interactions were significant for toxin concentration in grain and in rachis tissue. However, for each line, the NIV concentration was always less than the DON concentration, indicating that the interactions were due only to the magnitude of the differences between DON and NIV concentrations. The line × chemotype interaction for percentage of infected florets was not significant, indicating that lines ranked similarly for both chemotypes. All wheat lines expressed greater resistance to the NIV chemotype than to the DON chemotype. Lines ARGE97-1033-10-2 and VA04W-433 had the lowest concentrations of toxins in grain and rachis tissue and were among the most resistant lines as measured by %IF. Both lines have the cultivar 'Freedom' in their pedigree, which may have contributed genes for resistance.

The results of this study indicate that high levels of resistance to FHB and mycotoxin accumulation exist in advanced breeding lines. Furthermore, selecting lines for resistance to the DON chemotype also is effective for selecting resistance to the NIV chemotype. These lines will be evaluated under high FHB pressure from DON chemotypes in the field to determine the ranking of lines for resistance under more natural conditions.

Physiological Characteristics of ALS-resistant Bidens Subalternans.

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Beggarticks (Bidens subalternans), a member of the Asteraceae family, is an annual weed that originated in tropical America. It has become an important weed occurring in soybean fields in Brazil. Herbicides that target the enzyme acetolactate synthase (ALS) are among the most used in the world. They are efficient at low-use rates, have a broad-spectrum weed control and low mammalian toxicity. Since 1996, beggarticks plants resistant to ALS inhibitors have been detected in soybean fields in Brazil. There, some fields have been sprayed with these herbicides within at least 10 consecutive years. The objectives of this research were to quantify levels of beggarticks resistance to ALS inhibitors, examine cross-resistance patterns using ALS enzyme assay and to compare growth rates and fitness between resistant and susceptible biotypes. Seeds of resistant plants were collected from soybean fields in Goias, Brazil. The susceptible seeds were collected from a field that has never been sprayed with ALS herbicides, in Rio Grande do Sul, Brazil. Dose response curves to ALS inhibitors were generated by in vivo enzyme assays with three replications and two runs. The herbicides tested included chlorimuron, imazethapyr, and cloransulam. Growth rate experiment was conducted in pots placed outside with one plant per pot and four replications, with data collected at weekly harvests up to the flower initiation stage of each biotype. A set of plants were grown to full maturity where weight of 100 seeds was recorded. At the whole plant level, the resistant biotype can tolerate a dose higher than 160 g ai/ha chlorimuron, which is equivalent to eight times the commercial rate of this herbicide. Data showed that the resistant biotype was cross resistant to chlorimuron, imazethapyr and cloransulam. The susceptible biotype flowered two weeks earlier and produced less biomass at flowering time than the resistant biotype. However, there was no difference in growth rates and biomass production between susceptible and resistant biotypes for up to 45 days after emergence. The weight of seeds did not show difference between resistant and susceptible biotypes. Evaluation of seed viability and dormancy will be conducted. Thus far, data showed that the resistant biotype is equally fit as the susceptible one and that the herbicide resistance mechanism(s) did not cause any physiological penalty.

The New Transgenics: Will They Be Cost Effective for Arkansas Cotton Growers?
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With the development of transgenic cotton cultivars producers have been given more options for pest control. The control of tobacco budworm and cotton bollworm has always been costly for Arkansas producers. Before the introduction of Bollgard cotton cultivars in 1996, the tobacco budworm was the most economically damaging pest of cotton production. The endotoxins expressed by Bollgard cotton cultivars are highly effective for budworm control, but only provide suppression of cotton bollworm. Bollgard II and WideStrike express two endotoxins to provide increased control of bollworm and other caterpillar pests. This study examines the costs and returns associated with pest management systems using transgenic and non-transgenic cultivars in an effort to identify the most economical alternative. The value of these technologies to producers depends not only on the cost savings in pest management, but also the gross revenues from the sale of the crop produced. This study compared the efficacy and economics of Bollgard, Bollgard II, WideStrike and a conventional cotton cultivar when produced under grower conditions. This study also identifies the potential for improved and more economical means for the control of cotton bollworm and tobacco budworm using these transgenic cultivars. Improved use of this technology and determining the fit for Arkansas producers will help to improve their competitive position in the world cotton market.

Comparative Responses of Early-maturing and Late-maturing Soybean Cultivars to an Irrigation Gradient.
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Drought stress reduces late-maturing soybean yields in Arkansas and the Mid-southern USA, and early-maturing soybean cultivars require less irrigation than late-maturing soybean cultivars but have similar yields. It is not known, however, how early-maturing soybean cultivars will respond to suboptimal irrigation compared with late-maturing soybean cultivars.

We hypothesized that early-maturing soybean cultivars will decrease yield more than late-maturing soybean cultivars when drought occurs. A field study was conducted at Fayetteville, AR to evaluate the yield response of early-maturing soybean cultivars to seven irrigation treatments, from full irrigation to no irrigation, and to compare the results of early-maturing cultivars with late-maturing cultivars. We used two soybean cultivars from each of the maturity groups (MG) I, II, III, IV and V. Genotypes and MGs were used as covariates and yield was regressed as a function of irrigation plus rainfall from emergence to beginning R6.

There was no significant difference between cultivars within a MG in yield response to amount of water received (irrigation plus rainfall), but MGs differed significantly. Under well-watered conditions, AG2802 (MGII) and S31-V3 (MGIII) produced similar yields as MGIV cultivars but they required 18% and 20% less irrigation, respectively. Yields of MG I, II, III, and IV all decreased linearly as total amount of irrigation plus rainfall from emergence to beginning R6 decreased. The slope of the regression equation between yield and irrigation plus rainfall tended to become less steep as the MG increased. These results demonstrate that yield of early-maturing cultivars is decreased more than late-maturing cultivars when the total amount of water received by the crop is decreased by similar amounts.

Radiation Use Efficiency of Soybean Genotypes That Differ in Wilting Under Drought.

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Water availability is the number one limiting factor in crop yield world wide. In Arkansas, dryland soybean yields are substantially lower compared to irrigated yields. By improving soybean performance under drought conditions, producers could expect increased profits.

One trait that is thought to confer drought tolerance is delayed wilting. In field experiments, when most genotypes are wilted due to drought, a few plant introductions have been observed to have little or no wilting for several days. We hypothesized that soybean genotypes which express delayed wilting have, under well-watered conditions, lower stomatal conductance. This hypothesis predicts that if stomatal conductance is depressed in slow wilting genotypes, photosynthesis will be decreased, and soil moisture will be conserved, thereby allowing these genotypes to function for an extended period of time during the onset of drought.

To test this hypothesis, we evaluated 10 different genotypes that differ in wilting. The experimental design was a randomized complete block with six replications. Plots were planted in 19-cm rows at a seeding rate of 60 seeds m^{-2}. Plots were irrigated by overhead sprinklers when soil moisture deficits reached 30 mm. Light interception (LI) data were collected biweekly from emergence until 100% LI was reached. Four biomass (BM) samples of $2m^2$ were harvested at 12, 25, 43, and 63 days after planting. Radiation use efficiency (RUE) is a long-term measure of photosynthesis, expressed as gBM MJ^{-1} of radiation intercepted, and was used to evaluate possible differences in photosynthesis among genotypes. Estimates of RUE were made by two methods: 1.) determining the increase in BM between harvests per unit of solar radiation intercepted, and 2.) by regressing BM for the four harvests against the cumulative amount of radiation intercepted. Leaf conductance measurements were made eight times during the growing season.

Our results show that slow wilting genotypes have lower radiation use efficiency than do fast wilting genotypes. The RUE of the fastest wilting genotype was 0.61 gBM MJ^{-1}, while the RUE of the slowest wilting genotype was 0.46 gBM MJ^{-1}. The other eight genotypes segregated similarly for wilting and RUE. Estimates of RUE taken between harvests 4 and 1 agreed well with the full regression method, thus, suggesting we may be able to use a simplified, less labor-intensive method for determining RUE. Among the 10 genotypes, there were no significant differences in leaf conductance.

Although we did not observe differences in stomatal conductance among genotypes, those genotypes with delayed wilting had substantially lower RUE than those genotypes that wilted quickly. The inability to detect differences in stomatal conductance could be due to variability in environmental conditions and/or because obtaining conductance measurements for an entire canopy is difficult given the measurement is taken during a relative short time on an individual leaf. The information gained from this experiment will aid in the design of future experiments that will continue focus on investigating the agronomic importance and physiological mechanisms controlling the delayed wilting trait.

Importance of Combined Control of Thrips and Nematodes in Arkansas Cotton.
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Studies to determine the impact of thrips and nematodes on cotton were performed during the 2007 cotton growing season in Lonoke and Monroe counties Arkansas. Natural infestations of thrips and nematodes were studied at each location, although nematode species differed between locations. Root-knot nematode (*Meliodogyne incognita*) was the dominant nematode species in Lonoke County, while the reniform nematode (*Rotylenchulus reniformis*) was dominant in Monroe County. Tobacco thrips (*Frankliniella fusca*) was the dominant thrips species at both locations. Plots were established where only thrips were controlled, only nematodes were controlled, both were controlled and neither were managed. In the thrips-controlled treatments, seed was treated with Gaucho Grande™ (imidacloprid) and Bidrin™ (dicrotophos) was applied to foliage when thrips were present. In the nematode-controlled treatments the fumigant nematicide Telone™ (*1*, 3-dichloropropene) was applied two weeks prior to planting. Thrips populations, nematode numbers and plant monitoring parameters were recorded to measure the independent and combined effects of these pests on cotton. Independently, thrips and nematodes altered cotton growth and yield relative to plots where these pests were not managed. The combined impact of these two pest appears to be additive, but additional analyses are required to determine if a synergistic interaction occurred between thrips and nematodes.

Mutations in the Acetolactate Synthase Gene of Imazethapyr-tolerant Red Rice.
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Red rice accessions from Lonoke and Randolph counties in Arkansas have been found tolerant to the commercial rate of imazethapyr, the herbicide used to control red rice in Clearfield^{TM} rice. The two red rice accessions, Lon-3 and Ran-4, were tolerant to imazethapyr in greenhouse screenings and bioassays and were among the 136 accessions collected from different geographical regions in Arkansas. Full-length amplification of the acetolactate synthase (ALS) gene in these accessions revealed a coding sequence of 1935 bp. ALS gene sequences were generated from three replications of four red rice accessions that were either tolerant or susceptible to imazethapyr. Analyses of the nucleotide sequence alignments revealed six base polymorphisms in tolerant red rice relative to 'Bengal' rice. Three of the base changes resulted in amino acid substitutions. One amino acid substitution, Gly^{654}Glu, involves a residue required for imazethapyr-binding to the ALS, which is a mutation in one of the parent lines used in developing imazethapyr-resistant rice. The other substitution, Val^{669}Met, implies conformational changes in the ALS structure which enhances binding of thiamine diphosphate, an ALS cofactor, and consequently stabilizes the enzyme. These amino acid substitutions unique to tolerant red rice accessions existing in locations that have not been planted to Clearfield^{TM} rice support the hypothesis that herbicide-resistant populations can evolve in the presence of intensive herbicide selection pressure, stressing the need for an integrated management of red rice in Clearfield^{TM} rice production systems for this technology to be sustainable.

Effect of Plant and Environmental Factors on ALS-resistant Gene Transfer from Clearfield^{TM} Rice to Red Rice.
Vinod K. Shivrain**, Nilda R. Burgos, Marites A. Sales, Kenneth L. Smith, David R. Gealy, and Howard L. Black, University of Arkansas, Fayetteville, AR.

Imazethapyr-resistant gene from Clearfield^{TM} (CL) rice varieties transfers through pollen flow to red rice (*Oryza sativa* L.), a noxious weed in rice production in southern states. Factors which affect gene transfer rate include, but are not limited to, plant and environmental factors. Thus, we aimed to determine the impact of red rice biotypes, CL cultivars, and planting and flowering times of red rice and CL cultivars on the rate of gene transfer.

Field experiments were conducted at the Rice Research Extension Center, Stuttgart; Southeast Research and Extension Center, Rowher; and Vegetable sub-station, Kibler, AR from 2005 to 2007. Experimental design was a split-split plot with 3-4 replications. Treatment factors were: planting date (main plot with 4 treatments: early April to late May at 2-week intervals); CL cultivar (subplot with 2 treatments: CL161 and CL hybrid); and red rice biotype (sub-subplot with 12 treatments: 7 strawhull, 3 blackhull, and 2 brownhull). Red rice was planted in the middle row and flanked by four CL161/CL hybrid rice on each side. Emergence, flowering, and plant height of red rice and CL rice were recorded. Red rice seed was harvested at maturity and a sub-sample of 100 g was planted in the field in subsequent years. Red rice seedlings were sprayed twice with imazethapyr at 0.14 kg ai/ha. Red rice plants which survived imazethapyr applications were counted. Leaf tissues from survivors were collected for DNA analysis to confirm outcrossing. Furthermore, in the summer of 2007, manual crosses were performed between the 12 red rice accessions and CL161 to determine their compatibility, using three biological replicates of each accession.

In all plantings, there was overlap in flowering (> 50%) between both cultivars and at least six red rice accessions. Interactions between planting date by CL cultivar and planting date by red rice accession were significant ($p< 0.05$) for outcrossing rate. The outcrossing rate in different red rice accessions varied from 0 to 0.7% in different planting dates. In general, outcrossing was highest with brownhull red rice followed by blackhull and strawhull, and occurred at the first planting date. Outcrossing rate differed between red rice accessions at the same planting date due to differences in their flowering time. Averaged over planting dates, the outcrossing rate between CL hybrid and red rice accessions was 0.3% compared with 0.06% in CL161. In experiments related to compatibility, brownhull, blackhull, and strawhull had 91, 78, and 71% seed set, respectively. Between red rice accessions, seed set ranged from 49 to 100%. Field and greenhouse experiments provide evidence for higher outcrossing between brownhull biotypes and CL cultivars. Among red rice biotypes, brownhull infests the least acreage in Arkansas but the rapid evolution of red rice types necessitates measures to counter their proliferation in CL rice production systems.

Evaluation of Selected Insecticides for Control of Various Stink Bug Species – 2007

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Two late-season efficacy trials were conducted in 2007 to determine the effectiveness of selected insecticides for control of various species of stink bugs. Trial 1 was conducted in late August near Dermott, AR. Data were collected at 4 and 7 days after treatment (DAT). All insecticides provided adequate control of green and southern green stink bugs compared to the untreated check (UTC) for both evaluation timings. All insecticides provided control of the brown stink bug compared to the UTC with the exception of Centric @ 1.83 oz/A at 7DAT. Trial 2 was conducted near Hamburg, AR in early October and to date, has only been evaluated once (4DAT) due to prolonged inclement weather. Most insecticides provided adequate control of green, southern green, brown, and redbanded stink bug species.

Reaction of Current Soybean Cultivars in Arkansas to *Bean Pod Mottle Virus* (BPMV)

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One of the important soybean viral diseases causing reduction of seed yield and quality in soybean is Bean pod mottle virus (BPMV). The objective of this research was to evaluate reaction of Arkansas soybean cultivars to BPMV and to identify and classify cultivars with resistance/tolerance to this virus. Three-hundred and three current

Arkansas soybean cultivars were inoculated with two BPMV isolates, K- Ha1 representing the mild isolate (subgroup II) and K-Ho1 representing severe reassortment isolate (I/II). All cultivars were inoculated by the mechanical method. For detection of the virus, two serological tests (the Tissue Blotting and ELISA) were used. The results showed no cultivar with complete resistance to BPMV, but there was a range of tolerance to the virus among the cultivars. ELISA confirmed presence of BPMV in high and low tolerance cultivars. Tolerance to the virus is associated with less plant height and biomass reduction; therefore, based on 20, 25-45, 45-60, and 60% of plant height reduction and 25, 25-50, 50-75, and 75% plant biomass reduction cultivars were classified in four groups: high, moderate, low, and very low tolerance, respectively.

Management of Japanese Beetle Larvae Using Entomopathogenic Nematodes and Cultural Practices in Northwest Arkansas.

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The Japanese beetle (Popillia japonica) has been an established pest in the northern and Midwestern US for many years, but it is a relatively new pest in Arkansas. Little has been studied on its biology in southern states of the US. Environmental conditions (temperature and precipitation), turf varieties, and soil types in Northwest Arkansas differ from the areas where most Japanese beetle research has been conducted. Furthermore, little work has been done on young Japanese beetle larvae. We investigated the effects of five species of entomopathogenic nematodes and six species of turfgrass on survival of early-instar Japanese beetles. Preliminary results indicate that certain turfgrasses appeared to provide a more suitable habitat for first instars; and nematodes are able to infect first instars, suggesting their potential as biological control agents against young Japanese beetle larvae.

Efficacy of Alternative Herbicides for Ryegrass Control in Wheat

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With the repeated application of diclofop in winter wheat fields, herbicide resistance has been documented across the state of Arkansas. New herbicides have become available in wheat in recent years and these were assessed in the study for possible alternatives to commonly used herbicide programs. Research was conducted in suspected diclofop resistant ryegrass field located in Lee County, Arkansas to evaluate the efficacy of herbicides for ryegrass control in wheat. Fourteen treatments were used including a nontreated check. Seven treatments were applied in the fall at 2-3 leaf ryegrass including diclofop, fluazifop + fenoxaprop, pinoxaden, clethodim, imazamox, flucarbazone-sodium, and mesosulfuron. The selective grass herbicides clethodim and fluazifop + fenoxaprop), not labeled for application on wheat, were included as reference treatments for verifying possible cross-resistance. Five follow up treatments were applied in the spring at 2 tiller ryegrass including pinoxaden and mesosulfuron. Four treatments were applied in the fall at 1-2 leaf wheat and included flufenacet + metribuzin and pendimethalin. Fall applied herbicide caused 0-91% wheat injury. Clethodim, fluazifop + fenoxaprop and imazamox caused 91, 88, and 82% damage respectively. Diclofop, pinoxaden, flucarbazone-sodium, and mesosulfuron caused less than 6% crop injury. Spring applied herbicides caused 0% wheat injury. Treatments of diclofop conrolled ryegrass at 41% while mesosulfuron provide better ryegrass control at 64%. Pinoxaden provided slightly less ryegrass control at 62%. There is suspected herbicide resistance problem in this wheat field. Wheat yields from the recently commercialized herbicides in wheat ranged from 54.90-59.66 kg/ha. A greenhouse study is on going at this time to determine herbicide resistance to the herbicides diclofop and pinoxaden.

Confirmation and Management of Glyphosate-Resistant Giant Ragweed in Arkansas.

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The response of giant ragweed to a commercial formulation of glyphosate (Roundup WEATHERMAX®) was evaluated in Greene County, AR, under field conditions in 2005. Additionally, the effectiveness of alternative postemergence-applied herbicides for controlling the putative-resistant biotype was evaluated. In the first field experiment, glyphosate was applied as a single application to 15- and 30-cm tall giant ragweed at 0.43, 0.87, 1.30, 1.73, and 3.48 kg ae/ha. Additional treatments included glyphosate applied to 15-cm tall giant ragweed at 0.87 and 1.73 kg/ha followed by a subsequent application at the same rate at 3 weeks after the initial treatment. In the second field experiment, herbicides applied to 15-cm tall giant ragweed included: glyphosate at 0.87 kg/ha, chlorimuron at 0.008 kg/ha, acifluorfen at 0.42 kg/ha, imazaquin at 0.091 kg/ha, fomesafen at 0.263 kg/ha, fluiclorac-pentyl at 0.045 kg/ha, chloramsulam-methyl at 0.024 kg/ha, carfentrazone at 0.018 kg/ha, and bentazon at 0.84 kg/ha. Fomesafen at 0.329 kg/ha, flumiclorac-pentyl at 0.06 kg/ha, carfentrazone at 0.026 kg/ha, and bentazon at 1.12 kg/ha were applied to 30-cm tall giant ragweed. All other herbicides were applied to 30-cm tall giant ragweed at the same rate applied at the earlier stage. An adjuvant was added to each herbicide. A nontreated control was included in both studies, and control was visually rated at 3 weeks after the 30-cm application.

Giant ragweed control increased with glyphosate rate at both application timings. At 3 weeks after the later application, the 1X rate of glyphosate (0.87 kg/ha) provided only 11% control, regardless of application timing. Overall, glyphosate was more effective in controlling 15-cm than 30-cm tall plants. For instance, glyphosate rate at 3.48 kg/ha (4X rate) provided 96% control at the earlier timing compared with only 56% control following the later application. Sequential glyphosate applications at 0.87 kg/ha resulted in 90% control. In the second experiment, all herbicide treatments provided <60% control regardless of application timing, except for chloramsulam-methyl and fomesafen applied at the 15 cm height. Control of 15-cm tall giant ragweed was 64% with chloramsulam-methyl and 86% with fomesafen.

The Greene County giant ragweed accession and additional accessions from Mississippi County and Jefferson County were screened for resistance to glyphosate in the fall of 2006. Susceptible accessions from Lonoke and Washington County were used for comparison. A glyphosate rate titration experiment was conducted twice in the greenhouse on 4- to 6-leaf (10- to 12-cm tall) giant ragweed seedlings. Seedlings were treated with 8 rates of glyphosate (MON 78623) ranging from 0.035 to 2.24 kg/ha plus 0.25% v/v nonionic surfactant. Plant death was recorded 28 days after treatment. The lethal dose needed to kill 50% of each population (LD_{50}) was determined. The LD_{50} values for the susceptible biotypes were 0.164 and 0.335 kg/ha glyphosate for Lonoke and Washington County, respectively. The Mississippi, Greene, and Jefferson County accessions had an LD_{50} of 0.680, 0.765, and 1.180 kg/ha glyphosate, respectively. The Jefferson County accession was 7.2 times more tolerant to glyphosate than the Lonoke County accession, indicating the evolution of glyphosate-resistant giant ragweed in Arkansas. Additional research is underway to determine control measures for progeny from the greenhouse experiment as well as sensitivity of the subsequent generation to glyphosate.

The Use of Seed Treatments in Rice to Control Grape Colaspis and Rice Water Weevils in Arkansas, 2007.

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Durable (Field) Resistance Provides Primary Rice Blast Control In Arkansas Rice Production.

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Rice (*Oryza sativa* L.) is a critical commodity in the Arkansas agricultural economy. A sustained period of historic per-acre rice production was realized for Arkansas during years 2001 through 2006. Modern cultivars grown during this period possessed a very high yield potential packaged with multiple desirable agronomic characteristics. Control of rice blast, incited by *Magnaporthe grisea* Cav., using flood-induced field resistance was a key component of the agronomic package.

Although cultivars with the efficacious *Pi-ta* gene and other R-genes were available, blast susceptible cultivars were planted to more than 80% of Arkansas production acres during 2001–2006. In the absence of effective R-genes, producers relied upon cultivar field resistance for blast control. On the whole, cultivars utilized during 2001–2006 were susceptible to panicle blast when growing in drought stressed blast field nurseries and were rated as being moderately susceptible (MS) to very susceptible (VS) to rice blast. These susceptible cultivars typically exhibit a high degree of flood-induced blast field resistance in disease test plots and in production fields, especially when growers were careful about field selection, irrigation schedules and other cultural practices. Field resistance, adversely impacted by improper cultural practices, may have been supplemented with fungicides when cultivars were badly mismanaged.

Flood-induced blast field resistance occurs with depletion of root zone dissolved oxygen (DO) to establish anaerobic conditions. The anaerobic environment defines availability and form of nutrients associated with blast susceptibility, influences production of hormones mediating disease resistance mechanisms, and induces morphological modifications which facilitate oxygen transport to the roots and restricts pathogen growth. Flood-induced blast field resistance is cumulative with duration and depth of flood and in many susceptible cultivars is comparable to that expressed by major R-genes. To date, some degree of flood-induced field resistance has been detected in all flooded rice cultivars inoculated with a virulent race of *M. grisea*.

Historically, field resistant cultivars such as Starbonnet and Cypress have performed exceptionally well in Arkansas. The very durable Starbonnet was planted to 42 to 65 % of Arkansas production from 1969 through 1984. Cypress was planted to 15 to 39 % of Arkansas rice production during 1994 through 2000. In inoculated greenhouse tests, Starbonnet and Cypress were susceptible to common blast races occurring in Arkansas during the years they were being grown. However, blast was rarely observed in either cultivar unless production fields were significantly drought stressed.