ABSTRACTS RESEARCH CONFERENCE

VOLUME 7

Arkansas Crop Protection Association

December 1 and 2, 2003
Clarion Inn
Fayetteville, Arkansas

PROGRAM

Monday, December 1, 2003

10:00 Board Meeting (Conference Suite)

12:00 Registration

MODERATOR: Dr. Bob Scott, Extension Weed Specialist, University of Arkansas Cooperative Extension Service. LOCATION: Terraces 2 and 3.

01:00 **A Twenty Year Review of the Rice Research Verification Program.** Jeff W. Branson and Charles Wilson, Department of Crop, Soil, and Environmental Science, University of Arkansas Cooperative Extension Service, Stuttgart, AR. 6

01:15 **Trends in Arkansas Soybean Production.** Chris Tingle, University of Arkansas Cooperative Extension Service, Little Rock, AR. 6

01:30** **Comparison of Soybean Burndown Programs.** Jason L. Alford, Lawrence R. Oliver, and Dickie Edmund. Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville and DuPont, Little Rock, AR. 6

01:45** **Distribution of *Helicoverpa zea* Across a Southeastern Arkansas Farming Community.** Clint Allen, R. G. Luttrell, and Marvin Wall, Department of Entomology, University of Arkansas, Fayetteville, AR. 7

02:00 **Field Evaluation of Pentia and Mepex.** Bill Robertson, Sunny Wilkerson, Susan Mathews, Mitch Crow and Mike Hamilton. University of Arkansas Cooperative Extension Service, Little Rock, AR. 8

02:15 **Nature's Defoliators: Are Armyworms Beneficial Insects in Wheat??** Tim Kring, Gus Lorenz, Don Johnson, Department of Entomology, University of Arkansas, Fayetteville, AR. 8

02:30* **How Far Could Clearfield® Pollen Move?** Vinod K. Shivrain, Nilda R. Burgos, Satyendra N. Rajguru, Oscar C. Sparks, Merle M. Anders, and Karen A.K. Moldenhauer, Department of Crop, Soil, Environmental Sciences, University of Arkansas, Fayetteville, AR. 9

02:45* **Soybean Response to Boron Fertilization in Arkansas.** J.R. Ross, N.A. Slaton, R.E. DeLong, M. Mozaffari, and L. Espinoza, University of Arkansas, Fayetteville, AR. 9

03:00 **Break**

MODERATOR: Dr. Ron Talbert, Weed Scientist, Department of Crop, Soil and Environmental Sciences, Univ. of AR, Fayetteville. LOCATION: Terraces 2 and 3.

03:15 **Beyond Herbicide Post Emergence for Red Rice Control in Clearfield Rice.** Sam Atwell, Greg Stapleton, Alvin Rhodes, Brad Guice and Clete Youmans BASF Corp., Michigan City, MS. 10

03:30** **Influence of Glyphosate on Seed Production of Barnyardgrass (*Echinochloa crus-galli*), Pitted Morningglory (*Ipomoea lacunosa*), and Sicklepod (*Senna obtusifolia*).** Eric R. Walker and Lawrence R. Oliver, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 10

03:45** **Competitiveness of Rice Cultivars, Wells, CL161, and XL8 at Reduced Seeding Rates**. Brian V. Ottis, Sunny S. Malik, and Ronald E. Talbert, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 11

04:00** **Comparison of Chlorimuron, Fomesafen, and Glyphosate for Control of Arkansas Pitted Morningglory (*Ipomoea lacunosa*) Accessions.** Daniel O. Stephenson, IV and Lawrence R. Oliver. Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 12

04:15 **Infection of Grain Sorghum, Corn and Selected Weed Species by Zonate Leaf Spot (*Gloeocercospora sorghi*).** Mohammad T. Bararpour, David O. TeBeest, and Lawrence R. Oliver. Crop, Soil, and Environmental Sciences and Plant Pathology Departments, University of Arkansas, Fayetteville, AR. 13

04:30* **Interactions Between Virus-Induced Signaling Pathway and the JA-Mediated Herbivore-Defense System.** Juan Mayta, Keneth Korth and Jorge Ayala, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 14

04:45* **The Use of Directional Radar for Tracking Pentatomidae.** Greg O'Neal, Jeremy Greene, Chuck Capps, and Randy Luttrell, University of Arkansas, Monticello, AR and Fayetteville, AR. 14

05:00** **Characterization of OSLti6, A Small Family of Stress-related Rice Genes Encoding Low Molecular Weight Membrane Proteins.** M. M. Morsy and B.G. de los Reyes, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 15

05:15** **Response of Palmer Amaranth (*Amaranthus palmeri*) Accessions to Postemergence Herbicide Applications.** Jason A. Bond and Lawrence R. Oliver. Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 15

05:30 **Adjourn (Dinner on Your Own)**

Tuesday, December 2, 2003

MODERATOR: Nilda Burgos, Weed Scientist, Crop, Soil and Environmental Sciences Department, University of Arkansas, Fayetteville, AR. LOCATION: Terraces 2 and 3.

08:00	**The Future of Crop Protection from My Perspective.** Dr. Ford Baldwin, Professor Emeritus, Retired, University of Arkansas. 16
08:15	**Evaluation of Site-Specific Applications of Harvest Aid Materials in Northeast Arkansas Cotton.** Amanda McFall, T.G. Teague, David Wildy, Bill Robertson, Dale Wells & D.M. Danforth, Ark. State Univ; Univ. Ark. Ag Exp Station/Ark. State Univ., Wildy Farms, Univ. of Ark. Coop. Ext. Serv., Cotton Services, Inc., Univ. of Ark. Dept. of Agri. Econ.& Ag Business; Jonesboro, Leachville, Little Rock, Monette, and Fayetteville, AR 16
08:30*	**Utilizing Late-Season Glyphosate Applications to Reduce Weed Seed Rain.** Chad E. Brewer, Lawrence R. Oliver, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR. 17
08:45*	**Effects of Conservation Tillage on Runoff Water Quality in the Arkansas Delta.** T.W. Harper, T.C. Daniel, M.M. Anders, N.A. Slaton, University of Arkansas, Fayetteville, AR. 18
09:00**	**Weed Control and Heliothine Management in Transgenic Cotton.** O.C. Sparks, J.L. Barrentine, N.R. Burgos, and M.R. McClelland, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR 18
09:15**	**Role of Varietal Resistance to Soybean Cyst Nematode in the Development of Sudden Death Syndrome of Soybean in Field Microplots.** S.L. Giammaria and J.C. Rupe, University of Arkansas, Fayetteville, AR. 19
09:30**	**Effect of Diphenylether Herbicides on Light Interception and Yield of Short-season Soybean in the Midsouth.** Jeff Edwards and Larry Purcell, University of Arkansas, Fayetteville, AR. 19
09:45	**Break**
10:00*	**Does a Landscape Determine the Fate of Its Trees? Predicting Red Oak Borer Outbreaks Using Geographic Information Systems.** Leah Lucio and F.M. Stephen, University of Arkansas, Entomology, Fayetteville, AR, and C. Fred Limp, University of Arkansas, Center for Advanced Spatial Technologies, Fayetteville, AR 20
10:15*	**Herbicide Efficacy as Affected by Yellow Nutsedge Growth Stage.** Frank E. Groves, Kenneth L. Smith, University of Arkansas, Southeast Research and Extension Center, Monticello, AR. 20

10:30* **Recovery Efficiency of Nitrogen in Fresh and Pelletized Poultry Litter in Rice.** B. R. Golden, N. A. Slaton, K. R. Byre, R. J. Norman, and R. E. DeLong. Cooperative Extension Service, University of Arkansas, Fayetteville, AR. 21

10:45* **Broadleaf Weed Control With Carfentrazone Tank Mixtures in Rice.** A.T.Ellis, Ronald E. Talbert. Department of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville, AR. 21

11:00 **An Economic Comparison of Transgenic and Non-transgenic Cotton Production Systems in Arkansas.** Kelly Bryant, Jeremy Greene, Chris Tingle, Glenn Studebaker, Fred Bourland, Chuck Capps, Frank Groves, University of Arkansas Division of Agriculture, Bob Nichols and Jeanne Reeves, Cotton Incorporated. 22

11:15* **Herbicide Evaluation in Snap Beans.** Mayank S. Malik, Ronald E. Talbert, **and** Brian V. Ottis, Department of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville, AR. 22

11:30* **Seasonal Patterns of *Helicoverpa zea* and *Heliothis virescens* Trap Captures in Mississippi County Arkansas.** Bryce Blackman, R. G. Luttrell, Tina Gray Teague, Department of Entomology, University of Arkansas, Fayetteville, AR, College of Agriculture, Arkansas State University, Jonesboro, AR, and Dale Wells, Wildy Farms, Manila, AR. 23

11:45 **Response Of Four Rice Cultivars To Simulated Hail Injury At Seedling Growth Stages.** Charles E. Wilson, Jr., Donna L. Frizzell, Richard J. Norman, and Nathan A. Slaton, Rice Research and Extension Center, University of Arkansas, Stuttgart, AR. 24

12:00 **Break for Lunch**

MODERATOR: Dr. Randy Luttrell, Department of Entomology, University of Arkansas, Fayetteville AR. LOCATION: Terraces 2 and 3.

01:00 Commercial/Noncommercial Pesticide Applicator Recertification – Ples Spradley. Terrace 4.

01:00 **Comparison of Fruit Retention Under Moderate to Heavy Lepidopteran Pressure in Bollgard vs. Bollgard II Cottons.** Zachary W. Shappley, Larry W. Ganann, Robert F. Montgomery and C. Ronald Akin, Monsanto Company, St. Louis, MO. 24

01:15 **Resistance to Bt in Arkansas Populations of Corn Earworm and Tobacco Budworm.** R. G. Luttrell and Ibrahim Ali, Department of Entomology, University of Arkansas, Fayetteville, AR. 24

01:30	**Preventative Applications of Insecticide to Row Crops: Marketing vs IPM.** Gus Lorenz, University of Arkansas Cooperative Extension Service, Little Rock, AR. 25
01:45	**Insecticide Performance Evaluations for Control of Tarnished Plant Bug, *Lygus lineolaris* 2003.** Charles Capps and Jeremy Greene, University of Arkansas, Monticello, AR, Gus Lorenz, Patrick Smith, and Don Johnson, University of Arkansas, Little Rock, AR, and Glenn Studebaker, University of Arkansas, Keiser, AR. 25
02:00	**Update on Roundup-Resistant Horseweed in Arkansas.** Ron E. Talbert, M. R. McClelland, Ken L. Smith, Jim L. Barrentine, and Susan G. Matthews, Department of Crop, Soil, and Environmental Sciences, Fayetteville, AR and University of Arkansas Extension Service, Monticello and Blytheville, AR. 26
02:15	**Rice Grain Yields and Disease Levels as Affected by Nitrogen Fertilization Strategy** Nathan A. Slaton[1], Rick D. Cartwright[2], Richard J. Norman[1], and Russell E. DeLong[1], [1]Department of Crop, Soil and Environmental Sciences, Fayetteville, AR and [2]University of Arkansas Cooperative Extension Service, Little Rock, AR. 27
02:30	**Thrips Control in Arkansas Comparing Temik, Seed Treatments and Foliar Insecticides.** Glenn Studebaker, Assistant Professor, Extension Entomologist, University of Arkansas, Little Rock, AR. 28
02:45	**Late Season Spraying of Cotton for Plant Bugs....When Is It a Waste of Money?** Tina Gray Teague, College of Agriculture, Arkansas State University, Jonesboro, AR. 28
03:00	**Evaluation of Osprey for Control of Annual Ryegrass in Winter Wheat.** Keith W.Vodrazka, Alan Hopkins, Shane Hand, Bayer CropScience, RTP, NC. 28
03:15	**Scholarship Recipients** **Graduate Paper Awards**
03:30	**ADJOURN**

* Denotes MS
** Denotes Ph.D.

A Twenty Year Review of the Rice Research Verification Program.

Jeff W. Branson and Charles Wilson, Department of Crop, Soil, and Environmental Science, University of Arkansas Cooperative Extension Service, Stuttgart, AR.

In 1983, the Cooperative Extension Service initiated the Rice Research Verification Program (RRVP). The program is an interdisciplinary program that stresses intensive management and integrated pest management to maximize returns. The overall goal is to verify that crop management according to University of Arkansas recommendations can result in increased profitability.

The objectives of the program are: (1) To conduct on-farm field trials to verify research based recommendations. (2) To aid researchers in identifying areas of production that require further study. (3) To improve or refine existing recommendations which contribute to more profitable production. (4) Incorporate data from RRVP into Extension educational programs at the county and state level. Since 1983 the RRVP has been conducted on 210 commercial rice fields in every rice-producing county in Arkansas. Trials have been conducted on 12,083 acres with an average field size of 58 acres. The Arkansas average rice yield over the last 20 years is 123 bushels/acre while the RRVP average is 139 bushels/acre. In 2003 the RRVP recorded the highest yields in the history of the program with an average of 174 bu/acre while production costs are equal to or less than the state average. The trends in yields, management decisions, and profit will be evaluated.

Trends in Arkansas Soybean Production.

Chris Tingle, University of Arkansas Cooperative Extension Service, Little Rock, AR.

Soybean production in Arkansas has seen many changes in the past 10 years. One of the most notable changes is the increase in irrigated cropland. In 1993, Arkansas produced 1.2 million acres of irrigated soybeans and increased to 1.8 million in 2002. During this same time the average irrigated soybean yield has increased from 32 bu/a to 37 bu/a. However, this is no comparison to the impact of Roundup Ready soybeans. Since its introduction in 1995, Roundup Ready soybeans have revolutionized soybean production in Arkansas. According to the 1995 Arkansas Soybean Performance Tests, only 5 entries included this new technology. This number increased to 157 entries in 2002. It is estimated that Arkansas soybean producers planted 2.4 million acres of Roundup Ready soybeans in 2003 or 84% of the planted acreage. This rapid adoption leaves little doubt to the future implications of this technology.

Comparison of Soybean Burndown Programs.

Jason L. Alford, Lawrence R. Oliver, and Dickie Edmund. Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville and DuPont, Little Rock, AR.

Agricultural production methods are moving towards a complete no-till production system, which relies on the continuous use of non-selective herbicides for weed control. The negatives of a no-till production method are the risk of resistance, as well as, multiple periods of weed emergence during seasons with adequate rainfall.

An experiment was conducted at the Northeast Research and Extension Center in Keiser, AR, to evaluate the benefit of tank-mixing residual herbicides with a burndown application. Armor 53K3RR soybeans were planted June 1, 2003. Applications were made using a backpack or sequential plot sprayer. Treatments were replicated three times in a randomized complete block design. An untreated check was included for rating comparisons. Preplant treatments

(PPL) applied 2 weeks prior to planting included Canopy XL (sulfentrazone + chlorimuron) (1.9 and 1.17 oz/A) + Roundup WeatherMax (glyphosate), Canopy XL + Harmony GT XP (thifensulfuron) + Roundup WeatherMax, Harmony GT XP + Roundup WeatherMax, Gramoxone Max (paraquat), Gramoxone Max + Sencor (metribuzin), Roundup WeatherMax, and Roundup WeatherMax + Valor (flumioxazin). All treatments were followed by Roundup WeatherMax as needed (< 70% control). Data recorded were visual evaluations of soybean injury and control of plains coreopsis (*Coreopsis tinctoria*), pitted morningglory (*Ipomoea lacunosa*), barnyardgrass (*Echinochloa crus-galli*), hemp sesbania (*sesbania exaltata*), and prairie cupgrass (*Eriochloa contracta*).

At 5 weeks after burndown treatments were applied, all PPL treatments resulted in > 90% control of plains coreopsis, except Gramoxone Max + Sencor and Roundup WeatherMax + Valor. Only Canopy XL at 1.9 oz/A + Roundup WeatherMax had > 90% control of pitted morningglory. Canopy XL (both rates) + Roundup WeatherMax and Roundup WeatherMax + Valor had > 90% control of barnyardgrass. Hemp sesbania was controlled > 88% by all treatments except Gramoxone Max, Harmony GT XP + Roundup WeatherMax, and Roundup WeatherMax. Prairie cupgrass was controlled > 90% by Canopy XL (1.9 oz/A) + Roundup WeatherMax and Canopy XL + Harmony GT XP + Roundup WeatherMax. Treatments of Canopy XL + Harmony GT XP + Roundup WeatherMax, Harmony GT XP + Roundup WeatherMax, Roundup WeatherMax, and Gramoxone Max all required two postemergence treatments of Roundup WeatherMax to maintain effective weed control, where as all other treatments only required one application to remove weeds that escaped PPL applications. All yields differed from the untreated check and yields of the Gramoxone Max treatment were less than all other treatments.

Distribution of *Helicoverpa zea* Across a Southeastern Arkansas Farming Community.
Clint Allen, R. G. Luttrell, and Marvin Wall, Department of Entomology, University of Arkansas, Fayetteville, AR.

The polyphagous nature of the corn earworm, *Helicoverpa zea*, causes it to be an economically important pest of multiple crops. It is considered a pest of at least four crops in southeastern Arkansas including corn, cotton, sorghum, and soybeans. The corn earworm, also known as the cotton bollworm or soybean podworm, prefers to lay eggs on its host plants during the flowering or reproductive stage of plant development.

During 2002 and 2003, field observations and pheromone trap captures were examined to determine the temporal and spatial distribution of *H. zea* in six different crops in southeastern AR. Drop cloth and visual samples were taken in conventional cotton, Bt cotton, early and late soybeans, corn, and sorghum. High populations were observed in June and July in corn during both years. Measurable populations were observed on late soybeans during the bloom stage. Pheromone traps located adjacent to corn collected higher numbers of moths in early season captures, while those located near late soybeans collected slightly higher numbers later in the season. In general, crop type had little influence on the number of moths collected in pheromone traps, and the polyphagous insect appears to be widely distributed across the agricultural landscape.

In a collaborative study, forewings of moths from pheromone traps were removed and analyzed for carbon content. This procedure identifies whether a C3 plant, which includes mostly broadleaf plants, or a C4 plant, which includes mostly grasses, was fed upon when the insect was a larva. Most of the carbon analysis studies show that the majority of moths were produced on C4 plants in June and July of 2002, 62% and 95% respectively. During August, half of the moths analyzed fed on C3 plants as larvae. In September, only 11% of moths collected fed upon C3 plants as larvae. Moths collected near the various crop types showed little difference with respect to the number containing C3 or C4 carbon in their wings. Studies are being continued with 2003 pheromone trap captures, which followed numerical trends observed in 2002. In addition to carbon analysis, a procedure for gossypol detection in moths is being refined to estimate the number of moths from larvae fed on cotton.

Field Evaluation of Pentia and Mepex.

Bill Robertson, Sunny Wilkerson, Susan Mathews, Mitch Crow and Mike Hamilton, University of Arkansas Cooperative Extension Service, Little Rock, AR.

Plant growth regulators (PGRs) have been an integral part of cotton production for the last 20 years. Mepiquat chloride, introduced by BASF as Pix in the late 1970s, is the most widely used in season PGR in cotton. Its use is to primarily reduce plant height. As a result of height reduction, often times enhanced earliness as well as yield improvements are observed. Mepiquat pentaborate, introduced by BASF as Pentia in 2003, is the next generation PGR. Pentia is different chemistry from mepiquat chloride and has a much faster rate of uptake which has helped made this compound more active. The objective of this study was to compare Pentia and mepiquat chloride (Mepex – Griffin) use at the same rate and timing of application at multiple locations. Five studies were established in 2003 to evaluate these products utilizing producer or consultant based timings and rates. Height control, lint yield, fiber quality, and economic comparisons between PGRs will be discussed in the presentation.

Nature's Defoliators: Are Armyworms Beneficial Insects in Wheat??

Tim Kring, Gus Lorenz, Don Johnson, Department of Entomology, University of Arkansas, Fayetteville, AR.

The true armyworm is a considered a significant pest of wheat across much of the US. In severe infestations, armyworm completely defoliates large portions of entire wheat fields. Based on concepts originally proposed by Art Mueller, former entomologist at the University of Arkansas, research was conducted to evaluate the impact of defoliation on wheat production in Arkansas. Artificial defoliation tests were conducted in the field, and large-field demonstration tests were established during natural armyworm outbreaks. These studies consistently demonstrated that wheat tolerates complete defoliation at the time late-stage armyworm infests the wheat during the spring (late milk stage of wheat development, Zadock stage 7.7). Large scale field tests (40 acre blocks) showed no consistent or significant benefit derived from a single insecticide application, even though the application effectively reduced or eliminated armyworm defoliation. Some have suggested that a 4.7 bu/acre yield increase (not statistically significant) observed in our tests warrants an 'insurance' insecticide treatment of the crop to reduce armyworm densities and eliminate defoliation. Does the 5.5 bu/acre yield <u>increase</u> observed in armyworm-defoliated fields in the same tests (also not statistically significant) warrant a less-expensive 'insurance' chemical defoliation treatment of the crop? Should we encourage late-season armyworms to defoliate wheat intentionally? The answer to both of these questions is "No!".

How Far Could Clearfield® Pollen Move?

Vinod K. Shivrain, Nilda R. Burgos, Satyendra N. Rajguru, Oscar C. Sparks, Merle M. Anders, and Karen A.K. Moldenhauer, Department of Crop, Soil, Environmental Sciences, University of Arkansas, Fayetteville, AR.

Red rice (O. *Sativa* L.) is a problematic weed in rice growing areas of southern U.S. New herbicide-resistant cultivars now offer excellent options for red rice control. This technology also accentuates the risk of gene flow, which can result in the transfer of herbicide resistance to red rice and thus, render the herbicide ineffective. This study was conducted at the Rice Research and Extension Center, Stuttgart, AR in 2002 and 2003. Two experiments were planted in April and May to determine the extent of natural outcrossing between Clearfield® (CL) rice and Stuttgart strawhull red rice, and its effect on the weediness of red rice. CL 161 and CL 121 were planted in circles, 10 m in diameter, at 112 kg/ha seeding rate. Natural red rice population was maintained at 20 to 30 plants per m^2 in the outer circles, 20 m in diameter. There was synchronization in flowering between red rice and CL cultivars. After seed set in 2002, CL rice was removed from the inner circles and red rice was allowed to shatter. The field was left undisturbed during the winter and in 2003, red rice plants that emerged in the outer circles were treated with three applications of imazethapyr. Eighty-five red rice plants from the April planting and 109 plants from May planting survived these applications. Survivors were located from 0.0 m to 5.0 m from the pollen source. As an initial test for cross-pollination between Clearfield® and red rice, we tested the above-mentioned individuals using SSR (Simple Sequence Repeat) primers. We utilized primer RM 180 because it amplifies a DNA fragment that is polymorphic between rice and red rice. We compared DNA fingerprints of red rice that survived imazethapyr applications to those of CL 121 and CL 161. Plants that tested positive as hybrids were further tested using a gene-specific primer and morphologically characterized. Hybridization test using SSR primer showed 67% of red rice survivors from May planting were hybrids. These plants were morphologically identical to F_1 plants from reciprocal crosses of CL rice and red rice. Testing of red rice survivors from the April planting and the gene-specific assay are on-going. At this point, we can say that pollen from herbicide-resistant rice can move up to 5 m from the pollen source.

Soybean Response to Boron Fertilization in Arkansas.

J.R. Ross, N.A. Slaton, R.E. DeLong, M. Mozaffari, and L. Espinoza, University of Arkansas, Fayetteville, AR.

Boron deficiency of soybean [*Glycine max* (L.) Merr.)] has been diagnosed in a number of northeast Arkansas soybean fields since 2001. Tentative B fertilization recommendations have been provided to growers in northeast Arkansas, but these recommendations are based on suggestions from other soybean-producing states. The objectives of this project were to evaluate the effects of B application time and rate on soybean yield and tissue B concentration to develop research-based B fertilization recommendations for soybean in Arkansas.

Studies to evaluate soybean response to B fertilizer applied at various times and rates were conducted in 2002 and 2003 at the Pine Tree Branch Station (PTBS) and at three growers fields (Hall, Covington, and Moery fields) in 2003. Each experiment was arranged as a randomized complete block, split-plot design where B rate was the main plot factor and application time was the subplot factor. Each treatment was replicated six times. Boron was applied near the V3 stage and R2 soybean development stages at 0, 0.28, 0.56, 1.12, and 2.24 kg B ha^{-1} with a backpack sprayer. Before B application at the R2 stage, whole soybean plants and trifoliate leaves were collected from each plot receiving B at the V3 stage. Tissues were dried, weighed, ground, digested, and analyzed for B. Grain yields were measured at maturity and adjusted to 13% moisture content for statistical analysis. Locations were analyzed separately. The Fishers Protected Least Significant Difference (LSD) procedure ($p = 0.05$) was used to compare treatment means when appropriate.

Boron deficiency symptoms were not observed at the PTBS in 2002 or 2003. Trifoliate leave B concentrations and soybean yields were not affected by B rate, application time, or their interaction in 2002. Tissue analysis for the 2003 studies is not yet complete.

At the Hall site in 2003, severe B deficiency symptoms and growth differences among B rates applied at the V3 stage were observed during vegetative growth. The mean plant height (P <0.0001)) and number of nodes ($P = 0.0002$) were significantly different among B rates (applied at V3) at the V10 stage. Plant height increased from 28 cm for 0 and 0.25 kg B ha^{-1} to 48 cm for 1.12 or 2.24 kg B ha^{-1}. The mean whole-plant weights were not significantly different (P = 0.1208), but showed trends similar to plant height. The mean plant heights and weights at R2 were similar among B rates at the other three sites in 2003. By maturity, B deficiency symptoms were observed at all three grower field sites. Growth measurements suggest that application of 1.12 kg B ha^{-1} is required to maximize soybean growth on B-deficient soils. Although yield data is not yet available from the four 2003 studies, based on the presence or absence of B deficiency symptoms significant yield increases from B fertilization are expected at the three grower fields sites, but not at the PTBS.

Beyond Herbicide Post Emergence for Red Rice Control in Clearfield Rice.

Sam Atwell, Greg Stapleton, Alvin Rhodes, Brad Guice and Clete Youmans BASF Corp., Michigan City, MS.

The NEWPATH CLEARFIELD Rice System has proven to be very effective in controlling red rice in Clearfield Rice. Occasionally there are a few red rice plants escaping the two Newpath treatments, these escapes having potential for out crossing. An additional postemergence red rice treatment is needed to control these escapes to further reduce outcrossing.

BEYOND herbicide was tested on CL 161 rice for tolerance and red rice control. Five drilled seeded trials were established in AR, LA, and TX. Beyond was applied postemergence at 4, 6, 8, and 12 oz formulated product per acre at six CL rice growth stages from one leaf to anthesis.

CL 161 rice responses to Beyond herbicide 30 DAT were no stunting, no stand reduction and no discoloration. There was very slight discoloration at some rates at some locations prior to 30DAT. At the early tillering stage, Beyond at 4oz / acre was not as effective controlling red rice as greater Beyond rates. From the late tillering to green ring stage, very effective red rice control was obtained with all Beyond rates. At the boot stage, red rice control varied between locations, some locations having excellent red rice control while other locations resulted in only fair control. There were no differences in red rice control between Beyond rates at all locations. Red rice control was poor at all locations when the red rice was in the late boot to flowering stage.

Influence of Glyphosate on Seed Production of Barnyardgrass (*Echinochloa crus-galli*), Pitted Morningglory (*Ipomoea lacunosa*), and Sicklepod (*Senna obtusifolia*).

Eric R. Walker and Lawrence R. Oliver, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

A field study was conducted in 2000-2002 to evaluate the effects of glyphosate applications on barnyardgrass (*Echinochloa crus-galli*), pitted morningglory (*Ipomoea lacunosa*), and sicklepod (*Senna obtusifolia*) at weed flowering. The experimental design was a split plot with a factorial treatment arrangement and four replications. The main plot was weed species and the subplot was application rate by timing. Plots were 6.6 ft long and each plot was surrounded by a 6.6-ft border to maintain plot integrity. Herbicide treatments included glyphosate (Roundup UltraMAX™) at 0, 0.094, 0.188, 0.375, and 0.75 lb ae/acre applied either once at first weed flower or sequentially beginning at weed flowering, then every 10 days until the maturation of the weed species. Barnyardgrass received 4, 4, and 5 sequential glyphosate applications in 2000, 2001, and 2002, respectively. Pitted morningglory received 5, 6, and 5 sequential glyphosate applications in 2000, 2001, and 2002, respectively. In 2000, 2001, and 2002, sicklepod received 5, 7, and 5 sequential glyphosate applications, respectively. Biomass and seed production were obtained from a 2-ft sample from the center of each plot. Single or sequential glyphosate applications of 0.375 or 0.75 lb/acre reduced biomass of barnyardgrass, pitted morningglory, and sicklepod. In addition, sequential 0.188 lb/acre glyphosate applications reduced pitted morningglory biomass and single or sequential applications of 0.188 lb/acre reduced sicklepod biomass. Single glyphosate applications of 0.375 or 0.75 lb/acre or sequential glyphosate applications of 0.188, 0.375, or 0.75 lb/acre decreased seed production in all three species. Greatest seed reduction in barnyardgrass occurred in response to a single glyphosate application of 0.75 lb/acre or sequential glyphosate applications of 0.375 or 0.75 lb/acre, resulting in a 95% seed reduction. Pitted morningglory seed production was reduced 98% by a single application or sequential applications of 0.375 or 0.75 lb/acre glyphosate. A single application of 0.375 or 0.75 lb/acre glyphosate or sequential applications of 0.188, 0.375, or 0.75 lb/acre glyphosate reduced sicklepod seed production by 97%. These results demonstrate that glyphosate applied at flowering will effectively reduce seed production of barnyardgrass, pitted morningglory, and sicklepod.

Competitiveness of Rice Cultivars, Wells, CL161, and XL8 at Reduced Seeding Rates.
Brian V. Ottis, Sunny S. Malik, and Ronald E. Talbert, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

New rice cultivars have been released that have yield potential greater than 200 bu/A. However, in order to achieve high yields it is important to have the proper fertility, seeding rate, and weed control. It is not well understood how these new, high-yielding cultivars respond to varying weed control levels. The most recent research established barnyardgrass threshold levels of 0.5 to 1.0 plants/ft^2 using older cultivars.

Studies were established in 2002 and 2003 at the Rice Research and Extension Center at Stuttgart, AR, to evaluate the innate competitive abilities of three new rice cultivars at reduced seeding rates. Representatives from each of the three classes of long grain rice were selected. ‘Wells’ represented conventional long grain rice, ‘CL161’ represented semi-dwarf, imidazolinone-tolerant rice, and ‘XL8’ represented hybrid, long-grain rice. A randomized complete block design with four replications was used. Treatments were arranged in a factorial arrangement, with factors consisting of three rice cultivars, four plant populations (5, 10, 20, and 40 plant/ft^2) and four levels of weed control (25, 50, 75, and 100%). Planting rates for each cultivar were established based on seed counts of the respective rice cultivars, and ranged between 3 and 25 seed/row ft.

Weed control was managed with timely herbicide applications in an effort to achieve the above control levels. Plant populations were verified by stand counts after rice emergence.

Harvest index, panicles/ft row, and combine yield from each plot were also collected. Ground cover was also evaluated within 100% control plots to determine canopy closure using a digital camera as another factor of competitive ability. Grain yield was measured and adjusted to 12% moisture prior to analysis. Statistical analysis was done using the PROC REG function in SAS.

Preliminary analysis has shown that Wells and CL161 tend to yield better at higher seeding rates, while XL8 yields better at lower seeding rates. CL161 and XL8 appear to achieve canopy closure slightly faster than Wells, but this does not correlate to yield differences.

Comparison of Chlorimuron, Fomesafen, and Glyphosate for Control of Arkansas Pitted Morningglory (*Ipomoea lacunosa*) Accessions.

Daniel O. Stephenson, IV and Lawrence R. Oliver, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Research was conducted in 2000, 2001, and 2002 at the Arkansas Agriculture Research and Extension Center in Fayetteville to determine if variability in the efficacy of chlorimuron, fomesafen, and glyphosate exists among Arkansas pitted morningglory accessions. Indigenous, multiple-plant pitted morningglory accessions were collected throughout Arkansas. Sixteen accessions were randomly selected from 13 Arkansas counties for this presentation. Crittenden, Cross, Desha, Hempstead, Lonoke, Miller, Mississippi, Poinsett, Pope, and St. Francis counties were represented by one accession each, and Conway, Lafayette, and Washington counties with two accessions each.

A randomized complete block experimental design with accession as the main plot parameter and herbicide as the subplot parameter was used. Original seed samples were planted in 1-m long rows on raised beds each year. Each main plot consisted of four raised beds (subplot) representing chlorimuron, fomesafen, glyphosate, and a nontreated check. Each bed was thinned to 6 plants m^{-1} 4 days after emergence. Chlorimuron, fomesafen, and glyphosate were applied at 0.008, 0.35, and 1.0 lb ai $acre^{-1}$, respectively, postemergence over-the-top, to 10 to 20 cm tall pitted morningglory. Data collected included visual percent injury ratings recorded weekly for 3 weeks after application (0 = no injury and 100 = plant death) and treated and nontreated plant dry weight biomass presented as a percent of the nontreated check. Environmental conditions and plant size at application were similar at herbicide application each year. Means were separated by Fisher’s Protected Least Significant Difference test at the 0.05 significance level. Only 1 week after treatment (WAT) ratings and dry weight biomass are presented for fomesafen and 2 and 3 WAT ratings and dry weight biomass are presented for chlorimuron and glyphosate.

One WAT, fomesafen applications injured all accessions 83 to 93%. Variation in fomesafen efficacy was detected within Washington County (84 and 91%) and between the four Northwest Arkansas counties, Mississippi (83%) , Poinsett (88%), Cross (91%), and Crittenden (88%) 1 WAT. Dry weights of accessions treated with fomesafen ranged from 27 to 54% of the nontreated check. Mississippi and St. Francis County accessions were injured 88 and 95% 2 WAT, respectively, with little to no differences in other accessions 2 and 3 WAT by chlorimuron. Glyphosate injury ratings were 72 to 84% and 84 to 89% 2 and 3 WAT, respectively. Glyphosate injured the Cross County accessions more than the Desha and Mississippi County accessions 2 and 3 WAT. Glyphosate injured all other accessions similarly. Overall, chlorimuron injured all accessions greater than glyphosate 2 and 3 WAT. However, averaged over all accessions, both chlorimuron and glyphosate reduced pitted morningglory biomass equally.

Infection of Grain Sorghum, Corn, and Selected Weed Species by Zonate Leaf Spot (*Gloeocercospora sorghi*).

Mohammad T. Bararpour, David O. TeBeest, and Lawrence R. Oliver. Crop, Soil, and Environmental Sciences and Plant Pathology Departments, University of Arkansas, Fayetteville, AR.

Zonate leaf spot (*Gloeocercospora sorghi),* is common throughout the grain sorghum (*Sorghum bicolor*) producing areas often occurring in high rainfall years or periods of high rainfall. As acreage of grain sorghum increases in Arkansas, the occurrence of the disease has become more prevalent. Four separate greenhouse studies were conducted at the University of Arkansas at Fayetteville, to determine the severity of zonate leaf spot on ten grain sorghum hybrids, four corn (*Zea mays*) hybrids, and on selected grasses including shattercane (*Sorghum bicolor*), johnsongrass (*Sorghum halepense*), large crabgrass (*Digitaria sangunalis*), barnyardgrass (*Echinochloa crus-galli*), goosegrass (*Eleusine indica*), broadleaf signalgrass (*Brachiaria platyphylla*), fall panicum (*Panicum dichotomiflorum*), giant foxtail (*Setaria faberi*), red rice (*Oryza sativa*), and ryegrass (*Lolium sp.*). Four-week-old seedlings of each species were sprayed with an aqueous suspension of spores from a strain of the fungus from johnsongrass and all plants were placed in a dew chamber at 24 C for 24 hours. The amount of disease was rated from 1 (lesion size 1 to 2 mm) to 10 (lesion size >10 mm or death of infected tissue). Species that were not infected by the fungus were rated as zero.

Two days after inoculation, symptoms of zonate leaf spot infection on grain sorghum appeared as 2-mm non-diagnostic purple lesions on the leaves. The disease progress on grain sorghum leaves was rapid and was rated as 5 (lesion 5-6 mm in size), and 10 within 8, and 23 days after inoculation. At this stage, the lesions were brownish in color and linear in pattern. Infection of johnsongrass by zonate leaf spot was similar to the increase of disease on grain sorghum with ratings of 1, 5.9, 8.3, and 9.7, in 2, 8, 14, and 23 days after inoculation, respectively. Symptoms of infection were not observed on large crabgrass, barnyardgrass, goosegrass, giant foxtail, red rice, ryegrass, fall panicum or broadleaf signalgrass. Symptoms of infection developed most rapidly on shattercane. Inoculation of shattercane resulted in visible lesions within a day after inoculation and disease ratings of 3.5 and 10 after only 2 and 8 days inoculation, respectively.

All ten grain sorghum hybrids tested were susceptible. Hybrid FFR-322 was the most resistant hybrid tested with an average disease rating of 4. The other hybrids responses to zonate leaf spot was 6, 7, 8, and 9.3 for Dekalb-5190; Southern State-800, Terral-99317, and Triumph-461; Asgrow-571, Triumph-82G, and Terral-9421; and Golden Acre-444E, respectively. Pioneer-83G66 was the most susceptible hybrid with a rating of 10 to this isolate of zonate leaf spot. Symptoms of zonate leaf spot infection were not observed on corn cultivars tested.

The results suggest that while all grain sorghum hybrids are susceptible to zonate leaf spot, considerable differences existed in the disease severity of the hybrids tested. Zonate leaf spot infection on shattercane was most severe compared to any other species tested (shattercane> sorghum> johnsongrass). Since corn appears to be immune to this isolate of zonate leaf spot , it may be possible to use this isolate as a mycoherbicide to control shattercane or johnsongrass in corn.

Interactions Between Virus-Induced Signaling Pathway and the JA-Mediated Herbivore-Defense System. Juan Mayta, Keneth Korth and Jorge Ayala, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

The best-studied induced defensive pathways in plants are systemic acquired resistance (SAR) and induced insect resistance (IR). SAR is characterized by protection against pathogens, and by its dependence on salicylic acid (SA); IR is characterized by protection against insects and its dependence on jasmonic acid (JA). Additionally, indirect defense mechanisms in plants, such as the release of volatile compounds following herbivory are also dependant on JA. Pathogens such as viruses can induce SA-mediated SAR, whereas chewing insects such as beetles initiate JA-mediated wound responses. When an insect herbivore serves as a virus vector, the potential for JA- and SA-pathway interaction is enhanced because the plant has to deal with both the insect and pathogen. It has been reported that Mexican bean beetles (*Epilachna varivestis*) prefer to feed on excised leaf tissue from virus-infected beans (*Phaseolus vulgaris* L. cv. 'Black Valentine') compared to uninfected tissue. A hypothesis to explain this beetle feeding preference is the antagonism between a virus-induced signaling pathway and the JA-mediated herbivore-defense system. To gain a better understanding of this virus-insect-plant interaction, feeding preference tests with Mexican bean beetle were conducted on beans infected with *bean pod mottle virus*, *southern bean mosaic virus*, and a combination of both; additionally, the test was done on plants treated with JA and benzothiadiazole (BTH), an SA mimic that induces SAR. Mock-inoculated and water-sprayed plants were used as controls. The test was conducted using leaf disks 6.15 cm^2, and whole plants, over a 19-hour period. Volatiles released after herbivory were collected and analyzed by gas chromatography (GC). Lower quantities of volatile compounds were released from virus-infected plants suggesting that this might not be a cause for attraction of Mexican bean beetles to virus-infected plants. Feeding preference tests confirm that Mexican bean beetles prefer to feed on virus-infected beans than uninfected. Beans infected with SBMV, BPMV, and both viruses combined, were more damaged compared to the control. Additionally, beans treated with BTH were the most damaged, and JA-treated beans had the least damage. Results demonstrate antagonism between JA- and SA-mediated defensive pathways. This pathway interaction serve to the advantage of both the insect vector because plant defenses are weakened, and the virus, because its vector prefers to consume infected tissue.

The Use of Directional Radar for Tracking Pentatomidae.
Greg O'Neal, Jeremy Greene, Chuck Capps, and Randy Luttrell, University of Arkansas, Monticello, AR and Fayetteville, AR.

Movement, host preference, and spatial distribution of stink bugs (Hemiptera: Pentatomidae) in a complex agricultural landscape were addressed with innovative research using directional radar. Although reflector tags increased the body weight of adults of *Acrosternum hilare* and *Euschistus servus* by 9-10%, we recorded flights of tagged insects up to 600 feet. Mortality of tagged insects was reduced from >75% initially to <30% by the end of the season. Stink bugs without reflector tags were recovered less (3%) than insects with reflector tags (67%), suggesting that the radar tracking method was more effective in recovering marked/tagged stink bugs and/or that movement and behavior of tagged insects was limited and negatively modified, facilitating their relocation. Although questions still remain to be answered concerning the effects of the radar reflector tag on bug behavior and movement, this continued research should help broaden our knowledge of the basic biology of stink bugs and likely lead to more efficient detection methods and management options for stink bugs important in agriculture.

Characterization of OSLti6, A Small Family of Stress-related Rice Genes Encoding Low Molecular Weight Membrane Proteins.

M. M. Morsy and B. G. de los Reyes, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Low temperature stress is a major limiting factor in rice production. One of the most sensitive stages is early seedling development. Two closely related genes, *OsLti6a* and *OsLti6b*, were isolated from developing seedlings of the chilling tolerant japonica cultivar CT6748 (P1560247). These genes are closely related to the *Arabidopsis* rare cold-inducible (RCI2) and barley low temperature-inducible (*blti*101) genes. Northern blot and RT-PCR analyses showed that level of transcripts corresponding to both *OsLti6a* and *OsLti6b* were elevated in response to low temperature, dehydration, salt and exogenous application of abscisic acid (ABA). Both genes were rapidly induced by low temperature and exogenous application of ABA, while induction of gene expression due to dehydration and salt stresses occurred at much slower phase. Cultivar comparison of expression profiles showed that induction due to low temperature, ABA, and dehydration occurred earlier in tolerant (CT6748) than in intolerant (INIAP12) cultivar. The 6.0 kDa OSLTI proteins are highly hydrophobic with two possible membrane-spanning domains. Western blot data indicated that the proteins accumulate in the membrane but not in soluble protein fraction of seedlings grown under cold stress. Positive correlation between genotypic differences in cold hardiness as measured by electrolyte leakage and *OsLti* expression suggests that these proteins have possible roles in the maintenance of membrane stability during low temperature and osmotic stress conditions.

Response of Palmer Amaranth (*Amaranthus palmeri*) Accessions to Postemergence Herbicide Applications.

Jason A. Bond and Lawrence R. Oliver. Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Palmer amaranth is a tremendous hindrance to crop production in the southern United States. Because reports on control levels with different herbicides often conflict, better control strategies to minimize the competitive effects of Palmer amaranth need to be developed. Experiments were conducted in Fayetteville from 2001 to 2003 to determine whether Palmer amaranth accessions from different areas of the southern United States vary in response to applications of glyphosate. Similar experiments were conducted in 2002 and 2003 with fomesafen and pyrithiobac. Seeds were collected from 54 Palmer amaranth accessions in ten states across the indigenous range of the species. Each accession was assigned to one of nine regions based on geographic area of origin with emphasis placed on crop producing areas of Arkansas. Five regions were identified as West (six samples from west Texas and New Mexico), Midwest (six samples from Kansas), North-central (six samples from Missouri and west Tennessee), Midsouth (six samples from east Texas, Louisiana, and Mississippi), and Southeast (six samples from South Carolina and Alabama). The remaining four regions were contained within the boundaries of Arkansas with six samples taken from each quadrant of the state.

For each herbicide (glyphosate, fomesafen, and pyrithiobac) in each year, the experimental design was a randomized complete block with four replications. Fomesafen (0.42 kg ai/ha) and pyrithiobac (0.07 kg ai/ha) were applied to 15-cm tall Palmer amaranth with 12 to 15 leaves. Glyphosate (0.84 kg ae/ha) was applied when weeds reached 60 cm. Non-treated check rows were included for comparison adjacent to treated rows for all accessions in each experiment. Data collected included visual control ratings at 7, 14, and 21 days after treatment

(DAT) and plant biomass following the last visual rating. Data were analyzed with geographic regions and accessions within each region treated as fixed effects and years treated as a random effect.

Palmer amaranth control for glyphosate was greater than 99% 21 DAT for all accessions tested. Biomass was reduced at least 95% for all accessions following treatment with glyphosate compared with non-treated controls for the respective accessions. Control with fomesafen was equivalent and at least 96% for all accessions. Biomass was reduced at least 94% for all accessions following fomesafen application. Palmer amaranth control with pyrithiobac was inconsistent within each of the nine geographic regions. Control differences varied from 24 to 70% within each region 21 DAT. Averaged across accessions in each region, Palmer amaranth control with pyrithiobac ranged from 27 to 81% 21 DAT. Highest control was observed for accessions from the West region and lowest control was observed for accessions from the northwest quadrant of Arkansas. Biomass reductions following pyrithiobac application reflected visual control data. Palmer amaranth biomass was reduced 84% for accessions from the West region and 33% for accessions from northwest Arkansas.

Variation in control of Palmer amaranth accessions from across the United States was observed for pyrithiobac, but not glyphosate or fomesafen, based on visual weed control and biomass reductions. Palmer amaranth accessions responded differently to pyrithiobac, but differences could not be credited to accession origin or production practices in different regions of the country.

The Future of Crop Protection from My Perspective.

Dr. Ford Baldwin, Professor Emeritus, Retired, University of Arkansas.

Evaluation of Site-Specific Applications of Harvest Aid Materials in Northeast Arkansas Cotton .

Amanda McFall, T.G. Teague, David Wildy, Bill Robertson, Dale Wells & D.M. Danforth, Ark. State Univ; Univ. Ark. Ag Exp Station/Ark. State Univ., Wildy Farms, Univ. of Ark. Coop. Ext. Serv., Cotton Services, Inc., Univ. of Ark. Dept. of Agri. Econ.& Ag Business; Jonesboro, Leachville, Little Rock, Monette, and Fayetteville, AR

Midsouth cotton producers routinely apply harvest aid chemicals in the fall to their crops to defoliate plants, promote boll opening and reduce regrowth. Blanket applications of these products across a field may be at rates *too low* for rank cotton and *too high* for senesced plants. This is especially true for variable fields with a mixed assortment of soil types and/or prominent irrigation patterns. Newly available application and spatial technologies may provide producers with the ability to make *just right* applications in these variable fields. GPS controlled sprayers are now commercially available that allow producers to make spatially variable chemical applications based on prescription maps generated using remotely sensed imagery of the crop. Cotton producers are interested in this new technology, but they have many questions related to system efficacy, profitability, reliability, and ease-of-use. We attempted to answer some of these questions in a 2003 field study where we compared variable rate technology and standard defoliation techniques.

The experiment was performed in a 155 acre field located on Wildy Farms in Northeast Arkansas near Leachville. The three harvest aid treatments were **(1)** the grower's standard practice (two separate blanket applications of a combination of defoliant (Def) and boll opener (Prep)), **(2)** two separate variable rate applications of the grower standard, and **(3)** a single variable rate application of defoliant/boll opener (GinStar, Prep and Finish). Spray volumes ranged from 10 to 20 gpa depending on crop biomass classification. Plots were 30 rows wide across a ½ mile field, and treatments were replicated 9 times. Prescriptions for variable rate application were generated by InTime Inc. (Cleveland, MS; http://www.gointime.com) using imagery obtained in mid-September and based on 7 crop biomass classifications created using their system. Prior to application, plants were monitored to compare crop information from remote sensing to actual plant measurements. Imagery obtained in early July was used to define 3 crop production zones based on InTime's crop biomass classification. Plants in these zones were sampled from the time of first flowers through physiological cutout (mean nodes above white flower = 5) using the COTMAN crop monitoring system and standard insect scouting procedures. Square and boll retention, plant height, sympodial production along with insect injury symptoms were recorded. At 7 and then 14 days after defoliant applications, measurements including % open bolls, % defoliation, and regrowth observations were recorded. End-of-season plant mapping using COTMAP also was performed in each management zone. Yield was determined using hand harvesting in management zones and using a 6-row picker equipped with a yield monitor across treatment plots. Data from plant mapping, insect scouting, defoliation observations, yield and lint quality assessments as well as variable costs for each treatment will be discussed in the presentation.

Utilizing Late-Season Glyphosate Applications to Reduce Weed Seed Rain.

Chad E. Brewer, Lawrence R. Oliver, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Spurred anoda (*Anoda cristata*), entireleaf morningglory (*Ipomoea hederacea* var. *integriuscula*) and hemp sesbania (*Sesbania exaltata*) have previously shown natural partial tolerances to glyphosate. Upon survival, these weeds may proliferate in an agricultural system that bases weed control on a glyphosate application, by replenishing the soil seedbank with their offspring. Therefore, it is imperative to eliminate or reduce the production of weed seeds.

A field study was established in 2002 to examine the potential use of glyphosate in reducing seed production of the aforementioned weed species. Glyphosate (Roundup Ultra Max™) rates included 0.5, 1.0 and 2.0 lb ai /A applied at 3, 6, and 9 weeks after emergence (WAE) to create the herbicide treatments. All treatments were compared against an untreated control. The experiment was a factorial within a randomized complete block design. Data included a weed harvest index (seed weight/ total biomass), biomass accumulated per plant, percent stand reduction, and number of seed produced per plant. All data were subjected to an analysis of variance using the PROC GLM function in SAS.

Significant differences in harvest index, biomass accumulation, and number of seed produced were associated with glyphosate application across all species when compared to the control. Percent stand reduction was significantly affected by glyphosate rate and timing of application in spurred anoda and entireleaf morningglory. However, there were no differences in hemp sesbania stand reduction. .

Glyphosate applications made to weeds in the latter portion of the growing season can reduce the number of seed produced, therefore, limiting the amount of weed seed rain that replenishes the soil seedbank.

Effects of Conservation Tillage on Runoff Water Quality in the Arkansas Delta.

T.W. Harper, T.C. Daniel, M.M. Anders, N.A. Slaton, University of Arkansas, Fayetteville, AR.

Intense rainstorms on bare, tilled agricultural lands produce surface water runoff that carries high sediment and phosphorous (P) loads to nearby lakes and streams. The objective of this study was to determine the effects of two tillage practices (no-till and conventional till) on sediment load, turbidity, runoff volume, and runoff concentrations of dissolved P, bio-available P, and total P. Rainfall simulations were conducted at the Rice Research and Extension Center in May of 2003 on a Typic Natrudalfs under rice (*Oryza sativa* L.)-rice, rice-soybean (*Glycine max* L.) and rice-corn (*Zea mays* L.) rotations. Runoff volumes per plot averaged 74.5 L (or 67% of applied water) for conventional till and 80.8 L (or 72% of applied water) for no-till. Sediment concentrations were 0.4 g L^{-1} for no-till and 4.3 g L^{-1} for conventional till giving a total sediment load of 32.3 g/plot for no-till and 320.4g/plot for conventional till systems. Turbidity of the runoff samples averaged 70.3 and 1232.9 NTUs for no-till and conventional till plots, respectively, with no-till producing higher concentrations of runoff dissolved P (0.56 mg L^{-1}) than the tilled (0.03 mg L^{-1}) systems. These results suggest that even though runoff volumes were higher on these soils under no-till, these systems produced ten times less erosion and 17 times less turbidity than the till systems.

Weed Control and Heliothine Management in Transgenic Cotton.

O.C. Sparks, J.L. Barrentine, N.R. Burgos, and M.R. McClelland, Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Studies were conducted in Marianna and Rohwer, AR from 2000 - 2002 to evaluate weed control and heliothine management in transgenic cotton. In 2000, Palmer amaranth was controlled at least 95% with glyphosate (RR) or conventional (CONV) herbicide systems. This control was better than that from bromoxynil (BXN) systems in the two locations. Over a three-year period there was a trend for CONV herbicide systems to provide better early-season control of pitted morningglory than systems that used glyphosate. In 2001 and 2002 Preemergence (PRE)+RR and RR systems controlled Palmer amaranth better than CONV or BXN systems. There were lower numbers of reproductive Palmer amaranth at the end of the season in PRE+RR and RR systems as compared to CONV and BXN systems. Regarding heliothine management, there were no significant differences in yield between standard and no insecticide applications for cultivars treated with CONV herbicides in 2000 and 2001, probably due to low populations and late infestations of heliothine species. We did, however, see a trend for a cultivar response in which DP 451BR under CONV, RR, or PRE + RR herbicide systems was one of the higher yielding cultivars over both years and locations. Although there was no yield difference to be attributed to heliothine control we observed higher fruit retention in cultivars expressing the B.t. endotoxin. Reductions in seed cotton yield were correlated more to Palmer Amaranth density than heliothine numbers. Increases in seed soil bank density of Palmer amaranth over the following years may have increased the number of Palmer amaranth escapes from PRE herbicide treatments. This could have caused some of the decline in herbicide efficacy with time. Cotton cultivars with both glyphosate-resistance and B.t. endotoxin consistently showed trends of higher yields over the three-year period as compared to cotton cultivars with glyphosate-resistance or B.t. endotoxin alone.

Role of Varietal Resistance to Soybean Cyst Nematode in the Development of Sudden Death Syndrome of Soybean in Field Microplots.
S.L. Giammaria and J.C. Rupe, University of Arkansas, Fayetteville, AR.

Sudden death syndrome (SDS) of soybean is a soilborne fungal disease caused by *Fusarium virguliforme* (syn. *Fusarium solani* f.sp. *glycines*). *Heterodera glycines*, the soybean cyst nematode (SCN), has often been associated with SDS in the field. Although the presence of the SCN is not necessary for disease occurrence, previous studies have shown that co-inoculation with SCN and the SDS pathogen resulted in more rapid and severe disease development. To determine the effect of cultivar resistance to one or both of these pathogens, a 2-years microplot study was conducted at the University of Arkansas in Fayetteville, AR. Four cultivars -Pioneer 9594, resistant to SDS and susceptible to SCN, Asgrow 5603, resistant to SCN and susceptible to SDS, Hartwig, resistant to both pathogens, and Essex susceptible to both pathogens-, were inoculated with the fungus, the nematode, both pathogens, or not inoculated. Percentage of symptomatic leaf area was assessed twice a week after flowering. SDS ratings were highest for Essex followed by Pioneer 9594 and then Asgrow 5603. With Essex and Pioneer 9594, the SCN-susceptible cultivars, SDS was much greater in the co-inoculated plots than the plots inoculated with the fungus alone. In Asgrow 5603, the SCN-resistant cultivar, co-inoculation only slightly enhanced SDS development. No disease developed in Hartwig in any of the treatments. These results indicate that the field reaction to SDS in cultivars susceptible to SCN may change depending on the virulence of the race of SCN present in the field. Also, they suggest that the varietal resistance to SCN may be important in predicting the performance of soybean cultivars, especially in fields where both pathogens occur simultaneously.

Effect of Diphenylether Herbicides on Light Interception and Yield of Short-season Soybean in the Midsouth.
Jeff Edwards and Larry Purcell, University of Arkansas, Fayetteville, AR.

Recent literature has shown that short-season soybean requires less irrigation but has yield potential similar to full-season soybean in the Midsouth. Short-season cultivars, however, have a compressed window for light interception, and rapid canopy closure is critical to optimizing yield. Diphenylether herbicides typically result in necrosis of leaf tissue and, therefore, could delay canopy closure and reduce light interception. The objective of this study was to determine if diphenylether herbicides could be applied to short-season soybean without adversely affecting light interception or yield. Irrigated field studies were conducted in 2001, 2002, and 2003 at Fayetteville, Arkansas. Factors evaluated in the study included soybean maturity (MG 0 and II), seeding density (50 or 100 seed m^{-2}), application timing (reproductive and vegetative), and herbicide treatment (acifluorfen and lactofen). Treatment with 0.2 kg ha^{-1} lactofen reduced seed size in 2001, but differences in yield were nonsignificant. In 2002 herbicide treatment resulted in smaller seed size as compared to untreated soybean, regardless of soybean maturity. All herbicide treatments in 2002 reduced cumulative intercepted PAR in MG 0 soybean, and 0.2 kg ha^{-1} lactofen reduced cumulative intercepted PAR in MG II soybean. In 2003 soybean seeded at 100 seed m^{-2} intercepted more PAR than soybean seeded at 50 seed m^{-2}, regardless of soybean maturity or herbicide treatment. Lactofen at 0.2 kg ha^{-1} reduced cumulative intercepted PAR of MG II soybean seeded at 50 seed m^{-2}. Overall, this study demonstrates that acifluorfen may reduce cumulative PAR interception of MG 0 soybean but can be safely applied to MG II soybean as long as seeding densities are high.

Does a Landscape Determine the Fate of Its Trees? Predicting Red Oak Borer Outbreaks Using Geographic Information Systems.

Leah Lucio and F.M. Stephen, University of Arkansas, Entomology, 319 Agriculture Building, Fayetteville, AR, and C. Fred Limp, University of Arkansas, Center for Advanced Spatial Technologies, Ozark Hall, Fayetteville, AR

The red oak borer, *Enaphalodes rufulus* (Haldeman) has been wreaking havoc on the forests in the Ozark Mountains of Arkansas, Missouri and Oklahoma in recent years. A model predicting when and to what extent certain areas of the forest will be affected is being created using several landscape attributes. These attributes were chosen for their importance to tree or stand health or for facilitation of insect movement. It is expected that certain variables will prove to be more important that others in determining the overall susceptibility of forest acreage to the insect.

Herbicide Efficacy as Affected by Yellow Nutsedge Growth Stage.

Frank E. Groves, Kenneth L. Smith, University of Arkansas, Southeast Research and Extension Center, Monticello, AR.

Studies were conducted in the greenhouse and field during 2001 and 2002 to investigate a possible correlation between plant growth stage and basipetal translocation of carbohydrates. Greenhouse studies were conducted in Fayetteville, utilizing a completely randomized design. Plants were either dissected into various tissues for sugar analysis by high-performance liquid chromatography (HPLC) and sugar analysis by enzyme-linked immunosorbent assay (ELISA), or chemically treated for herbicide efficacy. Plants selected for HPLC and ELISA analysis were separated and quantified. Sugars were expressed as μg/g fresh dry weight (FDW) and starch was expressed as percent concentration.

Sucrose content was greater than that of the hexoses among all plant parts. However, the three sugars followed the same general trends when sugar content (μg/g FDW) was evaluated relative to plant growth stage. The sucrose content of the primary tuber gradually increased until reaching a maximum (> 40 μg/g) at the fifth to sixth leaf stages. A sharp decrease to 10 μg/g FDW was observed at the seventh leaf stage and sucrose content remained low until the ninth leaf stage. The sucrose content of the new leaf was inversely related to sucrose content of the primary tuber. Sucrose content decreased sharply from 30 μg/g FDW to 22 μg/g FDW from the fifth to sixth leaf stages, respectively. Sucrose content of the new leaf increased gradually until reaching a maximum at the eighth leaf stage at > 35 μg/g FDW and declined thereafter. The greatest concentration of starch (>30%) was observed in the tuber. The starch content of the tuber was graphically represented by a bimodal curve, with peaks of 38% at the seventh and ninth leaf stages. The starch content of the new leaf was approximately 25%, except for a decrease to 16% at the sixth leaf stage.

In a spray chamber, plants were treated with glyphosate at 0.84 kg ae/ha or trifloxysulfuron at 0.019 kg ai/ha + 0.25% non-ionic surfactant (NIS). Glyphosate provided > 65% control at the two- to four-leaf stage. Control decreased to < 30% at the five- to seven-leaf stages and increased to > 85% at the eight- and nine-leaf stages. Trifloxysulfuron provided > 70% control for leaf stages five through seven. Control improved to > 85% for the eighth- and ninth-leaf stages. A trend was observed between plant growth stage, sugar translocation, and herbicide efficacy. During the 5- to 6-leaf stage, sucrose content was the highest and glyphosate injury was lowest. At the 8- and 9-leaf stage, sucrose content was lowest while glyphosate and trifloxysulfuron injury was the greatest.

Recovery Efficiency of Nitrogen in Fresh and Pelletized Poultry Litter in Rice.

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

The feasibility of transporting the excess litter from northwest to eastern Arkansas is partially dependent on its value as a fertilizer source. The objectives of this research project were to determine the N-fertilizer value of fresh and pelletized poultry litter applied preplant to soils used for the direct-seeded, delayed-flood rice (*Oryza sativa* L.) production system.

Studies were conducted at the Northeast Research and Extension Center (NEREC), at the Pine Tree Branch Station (PTBS), and at the Rice Research and Extension Center (RREC) in 2003. Fresh (4.2% total N at 21% moisture) and pelletized (4.1% total N at 11% moisture) litter were applied at five total N rates ranging from 34 to 269 kg N ha^{-1} and immediately incorporated before seeding. 'Wells' rice was drill seeded at each location. Before flooding at the 5-leaf stage, urea was applied at six N rates ranging from 0 to 168 kg N ha^{-1} at the PTBS and RREC and 0 to 280 kg N ha^{-1} at the NEREC to plots receiving no litter. Total, aboveground N uptake was determined near the panicle differentiation (PD) stage and at early heading (HDG). Grain yield, adjusted to 12% moisture content, was determined by harvesting the middle five rows of each plot. Each experiment was arranged as a randomized complete block, 3 (N source) % 5 (total N rate) factorial design and was compared to an untreated control. Each treatment was replicated four times. Each location was analyzed separately.

The N source % N rate interaction significantly affected total N uptake at both sampling times (i.e., PD and HDG) at all three locations. For each location when samples were taken at PD, total N uptake increased numerically as total N rate increased within each source, but significantly different total N uptakes generally occurred only within N rates for urea. By HDG, total N uptakes from fresh and pelletized litter applied at the two highest total N rates were generally significantly greater than the unfertilized control and similar to the lowest one or two rates of N applied as urea. Rice grain yields tended to parallel total N uptake at HDG for each location. Maximum grain yields (8136 to 10,462 kg ha^{-1}) were produced only by application of 100 kg urea-N ha^{-1} at the PTBS and RREC and 280 kg urea-N ha^{-1} at the NEREC. Litter source did not influence total N uptake by rice suggesting the mineralization of organic N was similar between pelletized and fresh litter. By HDG, only 8 to 26% of the total litter N content was recovered by rice, which was much lower than the N uptake efficiency from urea (50 to 87%). On average, preplant incorporated poultry litter applied at rates of 5,000 to 6,000 kg ha^{-1} resulted in similar rice N uptake and grain yield as about 100 kg urea ha^{-1} applied preflood.

Broadleaf Weed Control With Carfentrazone Tank Mixtures in Rice.

A.T.Ellis and R.E. Talbert. Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville, AR.

An experiment was conducted in 2003 to evaluate the performance of carfentrazone (Aim) tank mixed with various broadleaf herbicides. The experiment was conducted at Rice Research and Extension Center at Stuttgart, Arkansas on a Dewitt silt loam. The experimental design was a randomized complete block design with four replications. 'Francis' was the variety used in the experiment. Broadleaf weed species, hemp sesbania (*Sesbania exalta*), pitted morningglory (*Ipomoea lacunosa*) and northern jointvetch (*Aeschynomene virginica*) were sown in rows perpendicular to the drilled rice.

A blanket application of clomazone (Command) at 0.4 lb ai/A was applied to the entire study area. Carfentrazone at 0.025 lb /A + NIS 0.25% V/V was applied alone and with tank mixtures preflood (PREFLD) applications of bentazon + aciflurofen (Storm) at 0.25 lb /A, triclopyr (Grandstand) at 0.025 lb ai/A, bispyribac-sodium (Regiment) at 0.0375 lb /A, propanil (Stam) at 4 lb /A, halosulfuron (Permit) at 0.0375 lb /A. Carfentrazone was also in a tank mixture at 0.025 lb /A + NIS 0.25% V/V with 2,4-D amine (Savage) at 0.25 lb /A applied postflood (POSTFLD).

Greater than 98% control of hemp sesbania was achieved with all treatments except for carfentrazone + triclopyr (28%) and carfentrazone + bispyribac-sodium (46%). Pitted morningglory was controlled at 100% with all treatments. Northern jointvetch control was >80% with carfentrazone + 2,4-D amine, carfentrazone + halosulfuron and carfentrazone + bispyribac-sodium with Carfentrazone (22%), acifluorfen + bentazon (26%), triclopyr (32%), propanil (68%). No significant crop injury was observed.

An Economic Comparison of Transgenic and Non-transgenic Cotton Production Systems in Arkansas.

Kelly Bryant, Jeremy Greene, Chris Tingle, Glenn Studebaker, Fred Bourland, Chuck Capps, Frank Groves, University of Arkansas Division of Agriculture, Bob Nichols and Jeanne Reeves, Cotton Incorporated.

Cotton cultivars, consisting of conventional, Roundup Ready, BXN, *Bt*, and Roundup Ready/*Bt*, were planted at the Northeast Research and Extension Center (Keiser, AR) and the Southeast Branch Experiment Station (Rohwer, AR) in 2001, 2002 and 2003. All plots were managed to maximize yields while taking advantage of the genetic capabilities for each cultivar. The plots at Keiser were farmed no-till (without PPI herbicide or cultivations) while those at Rohwer were farmed using conventional tillage (with PPI herbicide and cultivations).

The results show a tendency for the highest yielding varieties to produce the greatest returns. However, in instances where yields are so close, costs become the determining factor in profitability. At Keiser, the Roundup Ready system was the cheapest in 2001 and 2002. This system is especially cost effective under no-till systems or cases where no PPI herbicide is used. At Rohwer, the Roundup Ready system was the cheapest in 2001 and 2003 while the conventional system was the cheapest in 2002.

The Bollgard system was not cost effective at either location in any year. However, high yields with some of the Bollgard cultivars made them economical. No clear indication of one cotton production system being more economical than another was observed.

Herbicide Evaluation in Snap Beans *(Phaseolus vulgaris)*.

Mayank S. Malik, Ronald E. Talbert, and Brian V. Ottis, Department of Crop, Soil and Environmental Sciences, University of Arkansas, Fayetteville, AR.

Snap Beans *(Phaseolus vulgaris)* are an important crop planted in the Ozark region. Herbicide performance trials are conducted annually and studies conducted in 2002 and 2003 in Fayetteville, AR are summarized. Treatments that provided adequate control of hophornbeam copperleaf, yellow nutsedge, goosegrass, Venice mallow, cutleaf groundcherry, fall panicum, common purslane, and easternblack nightshade were preemergence treatments of metolachlor at 0.6 lb/A, fomesafen at 0.25 lb/A, metolachlor + halosulfuron at 0.5 + 0.032 lb/A, flufenacet at 0.3 lb/A, postemergence treatments of fomesafen + bentazon at 0.2 + 0.5 lb/A, imazamox at 0.036 lb/A, imazamox + bentazon at 0.036 + 0.5 lb/A, imazamox + fomesafen + halosulfuron at 0.036 + 0.2 + 0.032 lb/A, halosulfuron + bentazon at 0.032 + 0.5 lb/A, halosulfuron + fomesafen at 0.032 + 0.2 lb/A, chloransulam at 0.016 lb/A. Dimethanamid at 0.5 and 1 lb/A PRE , imazethapyr at 0.036 lb/A PRE, acifluorfen at 0.025 and 0.5 lb/A provided less than adequate control of Venice mallow (30 and 55%) and yellow nutsedge (0, 33%). Fomesafen POST at 0.25 lb/A, and rimsulfuron + bentazon POST at 0.016 + 0.5 lb/A also provided less control of yellow nutsedge (70%) and hophornbeam copperleaf (70%). Excessive injury to snap beans was caused by rimsulfuron at 0.016 lb/A PRE and POST (33% and 91%), dimethanamid at 1 lb/A PRE (35%), acifluorfen at 1 lb/A POST (43%), tank mix applications of metolachlor + halosulfuron at 0.5 + 0.032 lb/A POST (30%), metolachlor + imazamox at 0.5 + 0.032 lb/A POST (43%), rimsulfuron + bentazon at 0.016 + 0.5 lb/A POST (70%) and crop yields were reduced. Another experiment was conducted to evaluate phytotoxicity of PRE and POST applications of halosulfuron and to assess carryover effects of halosulfuron on rotational planting of snap beans and cowpeas. There was poor control of cutleaf ground cherry from halosulfuron POST at 0.024, 0.036, and 0.048 lb/A. There was slight stunting from the POST treatments to snap beans replanted 40 days after POST application of halosulfuron. Southern peas were not injured.

Seasonal Patterns of *Helicoverpa zea* and *Heliothis virescens* Trap Captures in Mississippi County Arkansas.

Bryce Blackman, R. G. Luttrell, Department of Entomology, University of Arkansas, Fayetteville, AR, Tina Gray Teague, College of Agriculture, Arkansas State University, Jonesboro, AR, and Dale Wells, Wildy Farms, Manila, AR.

A comprehensive data set of pheromone trap captures of *Helicoverpa zea* and *Heliothis virescens* has been developed through long-term efforts of two agricultural crop consultants in Mississippi County, Arkansas. These data are routinely referenced during the crop-growing season in Northeast Arkansas because of the critical management decisions associated with the two pest species on conventional and Bt cotton. The more affordable pyrethroid insecticides are still highly effective against *H. zea*, but rather ineffective against *H. virescens*. Conversely, *H. virescens* is almost eliminated from Bt cotton while *H. zea* routinely requires sprays for effective control and crop protection.

The consistent collection of these data across Mississippi County over an 11-year period provides a unique opportunity to examine temporal and spatial patterns of *H. zea* and *H. virescens* distribution across this important cotton-growing region. Recent concerns for *H. virescens* populations following intensive early season sprays for boll weevil, *Anthonomus grandis grandis*, further stimulate interest in the historical significance of these data. The data also transcend the introduction of Bt and herbicide-resistant cottons.

The number of trap sites increased over the 11-year period with 14 trap sites in 2003. At each trap location, densities *of H. zea* and *H. virescens* males are monitored daily throughout June, July, and August. In 2003, traps were baited and monitored earlier than normal. Early season captures of *H. virescens* and concerns for continued high densities of *H. virescens* observed late in 2002 created some anxiety about potential insect problems with the 2003 crops. Growers and consultants were keenly aware of the potential for *H. virescens* populations in Mississippi County cotton in 2003.

Over the 11-year period, trap captures of *H. zea* averaged 40.2 moths/trap/night. Trap captures of *H. virescens* averaged 5.1 moths/trap/night. The highest average annual trap capture for *H. zea* was recorded in 1998 with 85.7 moths captured/trap/night. Trap captures of *H. zea* during 2002 and 2003 were less than the 11-year average at 24.2 and 18.2 moths/trap/night, respectively. During 10 of the 11 years, average trap captures for *H. zea* were numerically higher in the more northern regions of the study area as compared to the more southern regions.

Trap captures for *H. virescens* during 2002 and 2003 were slightly higher than the 11-year average with 12.9 and 7.6 moths captured/trap/night, respectively. Captures of *H.*

virescens moths over the 11-year period were evenly distributed with more *H. virescens* captured in 5 of the 11 years in the more northern regions. Interestingly, more were captured in the more northern regions over the past three years. A higher percentage of the total moth capture was *H. virescens* in 2002 (37.3%) and 2003 (29.4) than in previous years (average of 11.1% across 11-year period). Prior to 2002, the highest percentage of total trap captures recorded as *H. virescens* was 20.2% in 1993, the first year of the study.

Response Of Four Rice Cultivars To Simulated Hail Injury At Seedling Growth Stages.
Charles E. Wilson, Jr., Donna L. Frizzell, Richard J. Norman, and Nathan A. Slaton, Rice Research and Extension Center, University of Arkansas, Stuttgart, AR.

Hail injury at specific growth stages can cause significant yield loss. This usually occurs when the stems are injured or the plant is defoliated during the reproductive growth stage. However, recent questions have been raised concerning the effects of injury to rice at seedling growth stages. Therefore, the current study was conducted in 2001-2003 to evaluate the influence of simulated hail injury to rice at the seedling growth stage. Four varieties were planted in four row plots and defoliated at either the 2-3 leaf growth stage or the 4-5 leaf growth stage. Hail injury was simulated by removing 0, 33%, 66%, or 100 of the above ground material in each of the four rows. The dry matter removed was determined and stand counts were made 5-7 days after defoliation. Grain yields were determined at maturity. Grain yields were not significantly affected by defoliation at ground level at either 2 wk after emergence or 4 wk after emergence. Simulated hail injury at seedling growth stages in this study suggests that rice has the ability to recover without significant yield loss. Disruption of the growing point below ground level may negatively affect yields but more research is needed to determine the levels of potential yield loss.

Comparison of Fruit Retention Under Moderate to Heavy Lepidopteran Pressure in Bollgard vs. Bollgard II Cottons.
Zachary W. Shappley, Larry W. Ganann, Robert F. Montgomery and C. Ronald Akin, Monsanto Company, St. Louis, MO.

Resistance to Bt in Arkansas Populations of Corn Earworm and Tobacco Budworm.
R. G. Luttrell and Ibrahim Ali, Department of Entomology, University of Arkansas, Fayetteville, AR.

The genetic capacity of insects to evolve resistance to insecticidal proteins contained in *Bacillus thuringiensis* and expressed in transgenic crops has been widely recognized for more than a decade. Aggressive management strategies, including mandated refugia and desired high-dose expression, have been required by regulatory agencies in the U.S. in an effort to delay resistance and extend the useful life of the transgenic crops and commercial *B. thuringiensis* products used on a diversity of crops. Most of the conceptual basis for these management approaches is focused on the management of autosomal, recessively inherited traits associated with toxin binding. A critical assumption is that high dose expression will eliminate the heterozygote produced by rare resistant individuals mated to susceptibles from the refuge.

In 1992 and 1993 prior to the commercial release of Bt cotton and Bt corn, we conducted studies at Mississippi State University to establish base-line susceptibilities to Cry1Ac and Cry1Ab proteins expressed in the insecticidal plants. We measured wide variability in the response of populations of the corn earworm, *Helicoverpa zea*, collected across the U.S. Cotton

Belt. Less variability was observed in populations of the tobacco budworm, *Heliothis virescens*. Some population of *H. zea* and *H. virescens* had LD50s ~10-fold those of laboratory susceptible populations.

Ten years later, we resumed this work here in Arkansas. Although some experimental variability in the resistance measurements may be associated with different sources of insecticidal proteins used in the 2002 laboratory assays, we have attempted to standardize these differences by comparing all data to the response of laboratory susceptible strains. Average LC50s measured for Arkansas populations of *H. zea* and *H. virescens* were ~10 fold more resistant to Cry1Ac than the average of those measured in 1992 and 1993. Some populations of *H. zea* collected from transgenic crops had LC50s 70-fold those of a susceptible laboratory colony.

The more resistant field colonies were crossed with laboratory susceptible colonies, and progeny were backcrossed to the parent lines. LC50s measured for progeny of each cross suggested that the Cry1Ac resistance was inherited as a dominant trait with a strong maternal influence. Insects from some of the resistant colonies survived for 96 hours on expressing Bt cotton leaf tissue.

Additional collections were made in 2003 from Bt cotton and Bt corn fields in Southeast Arkansas. Higher LC50s tend to be associated with collections made from the transgenic crops, including some of the newer Bt cottons, and with collections made later in the year after several generations have been exposed to selection on Bt crops.

Preventative Applications of Insecticide to Row Crops: Marketing vs IPM.

Gus Lorenz, University of Arkansas Cooperative Extension Service, Little Rock, AR.

Insecticide Performance Evaluations for Control of Tarnished Plant Bug, *Lygus lineolaris* 2003.

Charles Capps and Jeremy Greene, University of Arkansas, Monticello, AR, Gus Lorenz, Patrick Smith, and Don Johnson, University of Arkansas, Little Rock, AR, and Glenn Studebaker, University of Arkansas, Keiser, AR.

Evaluations of new and existing insecticides for control of tarnished plant bug (TPB), *Lygus lineolaris*, in early-season and mid-to-late-season trials were conducted in 2003. In early-season trials, new chemistries such as novaluron (Diamond) and thiamethoxam (Centric), and newly-formulated compounds such as imidacloprid (Trimax), provided adequate control of TPB, as did existing compounds such as acephate (Orthene), dicrotophos (Bidrin), and oxamyl (Vydate). In mid-to-late-season trials, new compounds provided enhanced control of TPB when tank mixed with pyrethroids and organophosphates. Experimental compounds, new chemistries such as acetamiprid (Intruder) and Centric, and existing chemistries such as Vydate provided adequate control of TPB. A pyrethroid alone performed poorly in early-season trials reaffirming that pyrethroids should not be used early season for control of TPB.

Update on Roundup-Resistant Horseweed in Arkansas.

Ron E. Talbert[1], Marilyn R. McClelland[1], Ken L. Smith[2], Jim L. Barrentine[1], and Susan G. Matthews[3]. [1]Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville; [2]University of Arkansas Southeast Research and Extension Center, Monticello; [3]Arkansas Cooperative Extension Service, Blytheville, AR.

Roundup (glyphosate)-resistant horseweed (*Conyza canadensis*) was confirmed in Delaware in 2000 and in Tennessee in 2001. Tennessee weed scientist Dr. Bob Hayes predicted a spread outward from the original resistant population that would rapidly include areas of Arkansas. Indeed, in the first months of 2003, producers in Poinsett, Mississippi, and Craighead Counties reported that glyphosate failed to control horseweed in some fields. Arkansas weed scientists have begun a cooperative effort with Arkansas extension agents and producers, with support from the State Support Committee of Cotton Incorporated, to confirm and monitor the spread of glyphosate-resistant horseweed and to develop management programs for its control in cotton.

Suspected glyphosate-resistant plants were collected in May 2003 from three locations in Mississippi and Poinsett counties (Osceola, Lepanto, Pritchett Corner). Plants were transplanted into 4- or 6-inch plastic pots and tested for level of resistance in the greenhouse at Fayetteville. Susceptible plants were collected from a susceptible population at Fayetteville and were matched in size to those from the resistant populations. Glyphosate rates of 0, 0.375, 0.75, 1.5, 3, 6, and 12 lb ae/A were evaluated in six, single-plant replications from each location. In 2003, field experiments were conducted on a resistant horseweed population near Osceola and a susceptible population at Fayetteville to screen various herbicides for horseweed control.

The original Osceola population contained plants resistant to 3 lb/A glyphosate (74% control), a resistance factor of 4X, and control was complete with 6 and 12 lb/A. Plants that emerged and were collected and tested a few weeks later from that same population were susceptible to 6 lb/A (58% control), and 4 out of 6 plants showed some resistance to 12 lb/A (resistance factor = 16X). The Lepanto plants were also controlled with 6 and 12 lb/A, but had a resistance factor of 4X (contained plants resistant to 3 lb/A). The Pritchett Corner plants had a resistance factor of 16X, with control of only 59% from 12 lb/A 27 days after treatment (DAT). Susceptible plants were controlled 100% with glyphosate at 0.75 lb/A and 81% with 0.375 lb/A.

In the field screening test at Fayetteville (sprayed Jn. 13), treatments that gave greater than 90% horseweed control 42 DAT were: Gramoxone (alone or plus Direx), Buctril, Liberty, MSMA (alone or plus Direx), 2,4-D amine, Clarity, Roundup Weathermax, and Stinger. Control with Envoke, FirstRate, and Gramoxone plus Canopy was 87 to 89%. Control was poor with Staple, Blazer, Goal, Cobra, Reflex, Aim, Command, Valor, Caparol, Cotoran, and Direx. At Osceola (sprayed May 12), only Roundup Weathermax plus 2,4-D controlled horseweed more than 80% 22 DAT. Control with Gramoxone plus 2,4-D or Caparol was initially above 80% but declined by 22 DAT. Control with MSMA, Gramoxone plus Aim, Roundup Weathermax plus Aim or Staple, or Aim plus Staple was also poor by 22 DAT. Continued herbicide evaluation will include early and late spring preplant and early postemergence treatments in cotton, and resistance monitoring will continue.

Rice Grain Yields and Disease Levels as Affected by Nitrogen Fertilization Strategy.
Nathan A. Slaton[1], Rick D. Cartwright[2], Richard J. Norman[1], and Russell E. DeLong[1], [1]Department of Crop, Soil and Environmental Sciences, Fayetteville, AR and [2]University of Arkansas Cooperative Extension Service, Little Rock, AR.

Sheath blight, *Rhizoctonia solani* (Kuhn), and kernel smut, *Neovossia horrida* (*Tilletia barclayana*), are two of the most economically important diseases in the Midsouth rice (*Oryza sativa* L.) producing area of the USA. The use of excessive N fertilizer is believed to increase the incidence and severity of these and other diseases to rice, but the effect of specific N application rates and application strategies are not well defined. Two research projects were conducted to investigate the interaction between N fertilization strategies, across a range of total N rates, and sheath blight and kernel smut levels of rice in Arkansas.

Twenty treatments with all possible combinations of two N-fertilization strategies (single preflood and 2-way split), five N-fertilizer rates (0 to 250 kg N ha^{-1}), and two rates of azoxystrobin fungicide (0 and 0.22 kg ha^{-1}) applied at panicle differentiation were used to evaluate the effect of N fertilization on sheath blight relative lesion height (RLH) of 'Cocodrie' rice during a three-year period at the Rice Research and Extension Center (RREC) located near Stuttgart, AR. Application of azoxystrobin, averaged across all other treatment factors, produced a mean rice grain yield of 8740 kg ha^{-1}, which was 16% greater than treatments not receiving azoxystrobin fungicide. Early-season application of fungicide prevented disease development from 4 to 6 wk, but RLH increased with time when no fungicide was applied. Application of high preflood (PF) N-fertilizer rates increased the initial RLH during early reproductive growth, but had little effect on the RLH by heading. Although fungicide application suppressed RLH, it did not alter the N rates required to produce near maximum grain yields.

Nitrogen treatments, including four PF N rates (50 to 152 kg N ha^{-1}) and three midseason N rates (0 to 100 kg N ha^{-1}), were arranged in a factorial design and used to delineate the effects of N fertilizer rate and application timing on rice grain yield, kernel smut incidence (% smutted panicles), and kernel smut severity (% smutted grains) in five site-year-cultivar (Cocodrie or 'LaGrue') studies conducted during 2001 and 2002. Depending on the environment, disease incidence ranged from 2 to 93% and severity ranged from <0.1 to 4.8% among PF N rates. Preflood N rate had no significant effect on kernel smut incidence and severity for three environments receiving optimum-to-excessive N and a fourth environment receiving inadequate-to-optimum N. For the remaining environment that received optimum-to-excessive N, kernel smut incidence increased linearly (43 to 93%) and severity increased non-linearly (0.5 to 4.8%) as PF N rate increased. Midseason N rate, averaged across environments and PF N rates, did not affect severity, but caused a positive, linear increase for incidence.

These studies show that i) a wide range of preflood N rates can produce near maximum rice yields, ii) PF N rate has the greatest influence on rice yields and the greatest potential to influence early-season sheath blight levels and kernel smut incidence and severity at maturity, and iii) the PF N rate required to produce near maximum grain yields does not change in relation to fungicide use. Nitrogen fertilization strategies designed to produce near maximum grain yields tend to increase the potential for damaging levels of sheath blight and kernel smut, especially when environmental conditions are favorable for disease development.

Thrips Control in Arkansas Comparing Temik, Seed Treatments and Foliar Insecticides.
Glenn Studebaker, Assistant Professor, Extension Entomologist, University of Arkansas, Little Rock, AR.

Several rates of Temik 15G placed in-furrow at planting were compared with several seed treatments and with foliar applications if insecticides for their efficacy against early season thrips in cotton. The trial was conducted in small plots (4 rows x 45-feet) of PM1218 BG/RR cotton at the Northeast Research and Extension Center, Keiser, AR. Treatments were arranged in a randomized complete block design with 4 replications. Foliar treatments were applied at 2nd-true leaf stage with a backpack sprayer calibrated to deliver 10 gpa through 2 hollowcone nozzles per row. Thrips counts were made weekly after emergence by removing 5-plants per plot and counting the larval and adult thrips per sample. Counts were made up through 36 days after planting.

Thrips populations per 5 plants ranged from 13 to 32.8 in the untreated check. Temik and all seed treatment insecticides gave significant thrips control up through 23 days after planting. At 30 days after planting, control began to break down in all treatments except Temik at 3.5 lbs per acre. All treatments had broken down by 36 days after planting. There were no differences in efficacy between at-planting insecticide treatments. Intruder applied at 0.025 lb ai/acre did give significant control as a foliar application for thrips. Centric applied at 0.05 lb ai/acre did not give any control as a foliar application. Temik at 3.5 lbs per acre was the only treatment that had significantly higher yields than the untreated control, showing an increase of 110 lbs of lint per acre over the untreated control.

Late Season Spraying of Cotton for Plant Bugs....When Is It a Waste of Money?
Tina Gray Teague, College of Agriculture, Arkansas State University, Jonesboro, AR.

Evaluation of Osprey for Control of Annual Ryegrass in Winter Wheat.
Keith W.Vodrazka, Alan Hopkins, Shane Hand, Bayer CropScience, RTP, NC.