Midsouth Entomologist **5**:23-33
ISSN: 1936-6019
www.midsouthentomologist.org.msstate.edu

Abstracts of the 58th Annual Conference of the Mississippi Entomological Association, October 24–25, 2011

Poster Presentations

Native Siricid (Hymenoptera: Siricidae) Abundance in Various Forest Stand Types. K. Chase, K. Gandhi, J. Riggins

A study of native Siricid (Hymenoptera: Siricidae) abundance is currently being conducted in northeastern Mississippi in various forest stand types. The objective of this study is to better understand how dynamics of each stand type influence native Siricid abundance and how these factors could play a part in preventing the non-native Siricid *Sirex noctilio* from becoming an outbreak pest in the southeastern U.S.

The Mississippi Entomological Museum: A Regional Identification Center of the USDA-APHIS Supporting the Cooperative Agricultural Pest Survey. J. Seltzer, R. Brown, S. Lee, and D. Plotkin

During 2011 more than 2,000 samples of insects obtained in surveys by the Cooperative Agricultural Pest Surveys (CAPS) have been screened for exotic plant pests by personnel in the Mississippi Entomological Museum. An overview of Exotic Bark Beetle Surveys from 2009–2011 is presented. The history and relationship of the Regional Identification Center at Mississippi State University with USDA-APHIS and CAPS is reviewed.

Evaluating the Impact of Corn Earworm on Yield of Field Corn. J. Bibb, A. Catchot, D. Cook, F. Musser, S. Stewart, R. Leonard, and D. Buntin

Recently, field corn, *Zea mays L.,* new pyramided *Bacillus thuringiensis* (Bt) corn technologies have been introduced to the market. These technologies reduce kernel damage from ear feeding caterpillar pests, including corn earworm, *Helicoverpa zea* (Boddie), and fall armyworm, *Spodoptera frugiperda* (J.E. Smith). The first generation Bt traits in field corn demonstrated little corn earworm feeding on grain in ears. With broader spectrum cry proteins, higher cumulative protein levels, and improved expression throughout the plant, these new corn traits should provide an effective management tool against these pests. In addition, reduced kernel injury should also have a direct effect on physical grain quality and potentially yield protection. Thus, it is important to quantify the level of injury and yield impacts caused by ear feeding lepidopteran insect pests, specifically corn earworm. These results could provide significant new information and opportunities to improve IPM of field corn across the southern U.S.

These studies were conducted at four locations during 2011 that included R. R. Foil Plant Science Farm, Starkville, MS; Delta Research & Extension Center, Stoneville, MS; West Tennessee Experiment Station, Jackson, TN; and Macon Ridge Research Station, Winnsboro, LA. Plot size was 8 rows (row spacing) by 30 to 50 ft. Treatments included field corn hybrids expressing the Herculex 1, VT3, and VT Triple Pro

technologies. Treatments were arranged in a randomized complete block design with four replications. Multiple plantings were utilized at each location to increase the probability of encountering corn earworm infestations of different intensities.

Within each technology, foliar insecticide applications to manage corn earworm did not significantly improve grain yield. Numerical increases in yield ranged from 0.6% for VT Triple Pro to 8.2% for Herculex. Within each technology, the foliar insecticide applications significantly reduced numbers of damaged kernels. Reductions in kernel damage ranged from 65% for Herculex and VT Triple Pro to 70% for VT3.

Foliar insecticide applications to manage corn earworm did significantly improve test weight for the Herculex technology. For the VT3 and VT Triple Pro technologies, supplemental insecticide applications did not significantly affect test weight.

Across technologies, insecticide applications to manage corn earworm did not significantly improve yield. Insecticide applications significantly reduced kernel damage, and improved test weight.

No significant relationship between number of damaged kernels and grain yield was observed.

Population Dynamics of Rice Stink Bug (Hemiptera: Pentatomidae): The Role of Host Plants. G. Awuni, J. Gore, F. Musser, D. Cook, T. Allen, and W. Jones

The rice stink bug is an important late-season insect pest of rice in southern rice-producing states that can cause considerable yield loss. Rice stink bugs overwinter as adults, emerge in late April to early May, then feed and mate on graminacious winter hosts that have fruiting structures present. The relative abundance of rice stink bugs was monitored twice weekly from May–August 2011 on cultivated and uncultivated host plants using a 38-cm sweep net in Stoneville, Mississippi. By visual inspection, habitats with host plant densities of 70% or more along crop margins, roadsides, drainage ditches, pastures, and cultivated fields were sampled. Ten consecutive sweeps constituted a sample, with ten samples (100 sweeps) taken per habitat at a time.

The distribution and abundance of host plants impacted the local distribution and abundance of rice stink bugs. Adult rice stink bugs emerging from diapause in May and were found on wheat and Italian ryegrass. Peak densities of rice stink bug were observed in June when numerous grass species such as crabgrass, bahiagrass, dallisgrass, Johnsongrass, prairie cupgrass, junglerice, and barnyardgrass were in various fruiting stages. These hosts provided an ideal habitat for rice stink bug reproduction and population expansion prior to infesting rice. We conclude that early control measures on these grasses may reduce their reproduction and subsequent injury in rice.

Spread of the Invasive Hairy Crazy Ant, *Nylanderia pubens* (Hymenoptera: Formicidae) in the United States. J. MacGown and B. Layton

Nylanderia pubens (Forel), the hairy crazy ant, is an invasive species thought to be native to South America. It was first reported in the US from Florida in 1953, but did not show signs of being an invasive species until approximately 2000. Since then, it has been found in 20 counties in Florida, 18 counties in Texas, two parishes in Louisiana, and 2 counties in Mississippi. We first discovered populations in Hancock County, Mississippi in 2009, and we found populations at multiple localities in Jackson County in 2010. This species displays supercolony characteristics with extremely large populations. Workers do not sting and rarely bite, but large populations create serious nuisance problems. They often cause short circuits in electrical equipment and may reduce biodiversity of other insects, ground nesting birds, and other small animals. Due to their extraordinarily large populations, hairy crazy ants are difficult to control. They can be identified by their reddish-brown color; small size (2.0–2.3 mm); paired erect, elongate, thickened, reddish-

brown setae on the dorsum of body; pubescence on entire body; their large populations; and their rapid and erratic movement.

A Summary of 13 Years of Monitoring for Insecticide Resistance in the Tarnished Plant Bug in the Mississippi Delta. G. Snodgrass

Glass-vial bioassays along with spray-table and field tests were used to study resistance to insecticides commonly used to control the tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois), in cotton in the midsouth over a period of 14 years (1998–2011). Twenty to twenty-five populations were tested with each insecticide each year, and test populations were collected from locations in the Delta of Arkansas, Louisiana, and Mississippi. Populations were found on average to be resistant to pyrethroid insecticides in every year except 2011. No cause for the decline in resistance to pyrethroid insecticides observed in 2011 has been found. Resistance to acephate was detected in 2004 and was widespread by 2007. From 2007 through 2011, about 75% of the populations tested had high levels of resistance to acephate. Populations with acephate resistance were commonly found with cross resistance to other organophosphates and multiple resistance to pyrethroid and carbamate insecticides. Resistance to the neonicotinoid insecticides, thiamethoxam and imidacloprid, was found to be low and has changed very little from 2007–2011.

The Ant (Hymenoptera: Formicidae) Fauna of Cedar Glades and Barrens of the Central Basin of Tennessee. J. Hill

The Central Basin of Tennessee has the highest concentration of glade and barren habitats east of the Mississippi River. The ants may be the most thoroughly documented group of insects inhabiting the glades with two studies conducted in the late 1930s reporting ants found in cedar glades of the region. To compare the ant fauna of modern cedar glades with the lists produced in earlier studies and to document the ant fauna of barrens associated with the glades, a study was conducted from June 2010–April 2011. Twenty-six total species, including the hybrid imported fire ant, were sampled from both habitat types (19 species in cedar glades and 18 in the barrens), which included most of the species reported in the previous studies. Two new state records for Tennessee were documented. Ordination of the species lists from cedar glade and barren habitats indicates that the ant fauna of the two habitats are distinct from each other.

A Comparison of Alleles of Selected Microsatellite Markers in Two Imported Fire Ant Species and Their Hybrid. D. Cross, R. Garlapati, and M. Caprio

The hybrid imported fire ant, RIFA, *Solenopsis invicta x richteri*, is a reproductively viable hybrid of *Solenopsis invicta*, the red imported fire ant, RIFA, and *S. richteri*, the black imported fire ant, BIFA. In the U.S., HIFA occurs from mid Tennessee, south through the northern half of Mississippi and to the east through northern Alabama and northwestern Georgia. RIFA borders the HIFA range from its southwestern to the southeastern extent. BIFA is limited to a shrinking pocket in northeast MS and western Tennessee. Because of a gradient for degree of hybridization of most, if not all genes in HIFA's range, there is no single simple genetic assay for positive identification for pure BIFA or RIFA adjacent to or intermixed in this region. Consequently, GC/MS analysis of cuticular hydrocarbons and venom alkaloids of these ants has been the tool of choice for definitive determination of species/hybrid status. Polymorphic microsatellite repeat regions of DNA at five loci, were examined in 212 HIFA colonies (or queens [11]) from three Mississippi counties and one county in Alabama, and 141 RIFA colonies from three Mississippi counties and one county in Alabama. Four colonies of BIFA were sampled from two counties in Tennessee. Fragment analysis of four of the loci, sol11, sol42, sol49 and sol55, indicated marked

differences in the relative frequencies and, most notably, the complete absence of some of the alleles in the RIFA. This variability can be used as a powerful genetic assay aiding species identification and may be performed in a modestly equipped genetics laboratory.

Adverse Influence on Reproduction and Potential Fitness Cost in Survivors of Orthene-Treated Tarnished Plant Bug, *Lygus lineolaris*. Y. He, Y. Zhu, R. Luttrell

By using dose response to Orthene at 80 mg/L (LC_{50} of the laboratory susceptible colony), a relative resistant population (71% survival rate) of the tarnished plant bug, *Lygus lineolaris*, was located near Tillar, Arkansas. This population was used in this study to evaluate potential fitness cost in Orthene-resistant bugs. After the bugs were treated with Orthene at 240 mg/L for 2 days, approximately 38% of the bugs died. The survivors were transferred to an untreated fresh diet for investigating the mortality, fecundity, hatchability, survival rate from nymph to adult, population growth index, and relative fitness. Results showed increased adult mortality, lower fecundity, lower hatchability, lower population growth index (I), after being treated with Orthene. Our results suggest a potential fitness cost (the relative fitness value was 0.41) for the Orthene resistance development in the tarnished plant bug.

Fatty Acid Methyl Esters Profile of *Ambrosiella beaveri*, sp. nov. S. Woolfolk, W. Stone, D. Six

Xylosandrus mutilatus (camphor shot borer) is an Asian ambrosia beetle that has recently established in Mississippi, Texas, Alabama, and possibly Florida. This beetle, as other ambrosia beetles (Coleoptera: Curculionidae, Scolytinae), typically colonizes inner tissues of woody plants and is easily transported in logs from one area to another. In China, this beetle is a primary pest of chestnut and in the United States it attacks a wide range of plants such as *Acer rubrum, A. palmatum, Cornus florida, Pinus taeda,* and many others (1). *Xylosandrus mutilatus* carried fungi that are associated with its mycangia (specialized fungus-transporting structures). Recent studies showed that mycangia consistently yielded *Ambrosiella beaveri*, sp. nov., a fungus which was closely related to other *Ambrosiella* affiliated with *Ceratocystis* yet shown very distinctive morphological features (2, 3). Fatty acid methyl ester (FAME) analysis has been used to identify various microorganisms based on cellular fatty acid profiles. While morphological features and molecular analyses are the two most prominent identification methods, FAME analysis were utilized to distinguish a closely related microorganism, for example, to differentiate isolates of *Rhizoctonia solani* AG-4 from AG-7 (4). This study is to determine the cellular fatty acid components of *A. beaveri* isolated from *X. mutilatus*.

Adult female were collected from a privately owned hardwood forest in Winston Co., MS, from several vines. The *A. beaveri* fungi were isolated based on standard microbiological procedures and protocol described in Six *et al.* (2), and stored temporarily in an ultra freezer. Fungi were grown on Sabouraud dextrose agar for 2–5 days. Several fungal plugs were then transferred into Sabouraud dextrose broth in 125-ml flasks and placed on a shaker at 150 rpm, 28 °C. Following the incubation period (2–3 days), fungi were extracted according to MIDI (Microbial Identification System Inc.) protocol, and the cellular fatty acid profile was analyzed using Agilent® 6890 gas chromatograph and Sherlock® v.6 software.

The result of this study is preliminary (Table 1, Figure 1). By comparing the fatty acid profile against Sherlock® v.6 fungal database, *A. beaveri* showed similar fatty acid profile with *Pseudallescheria boydii* (similarity index, SIM = 0.522), *Geotrichum candidum* (SIM = 0.461), and *Phoma* spp. (SIM = 0.394). FAME analysis is commonly utilized to characterize bacteria and to a lesser degree yeasts (and fungi). However, a few studies (for example, 4) indicated that the method was successfully used for fungi, particularly to distinguish one strain from another, and it can complement characterization using morphological features (traditional identification method) and molecular analyses. The

Sherlock® software of MIDI has capability to generate a special microorganism library of our interest. Therefore, further comparison is necessary by comparing the profile of other *Ambrosiella* related species (*Ceratocystis, Rafaela*) to be able to determine whether fatty acid profiles can be useful tools to distinguish among closely related species or isolates or strains. With additional data, a special fungal library for *Ambrosiella*-related species can be created.

Table 1. Mean percentage of fatty acid methyl esters (FAME) extracted from *Ambrosiella beaveri*

FAME peak name (Figure 1)	Mean % content (*n* = 5)
16:1 Cis 9 (ω 7)	3.16
16:0	12.97
18:2 CIS 9,12 /18:0a	39.28
18:1 CIS 9 (ω 9)	41.52
18:0	3.07

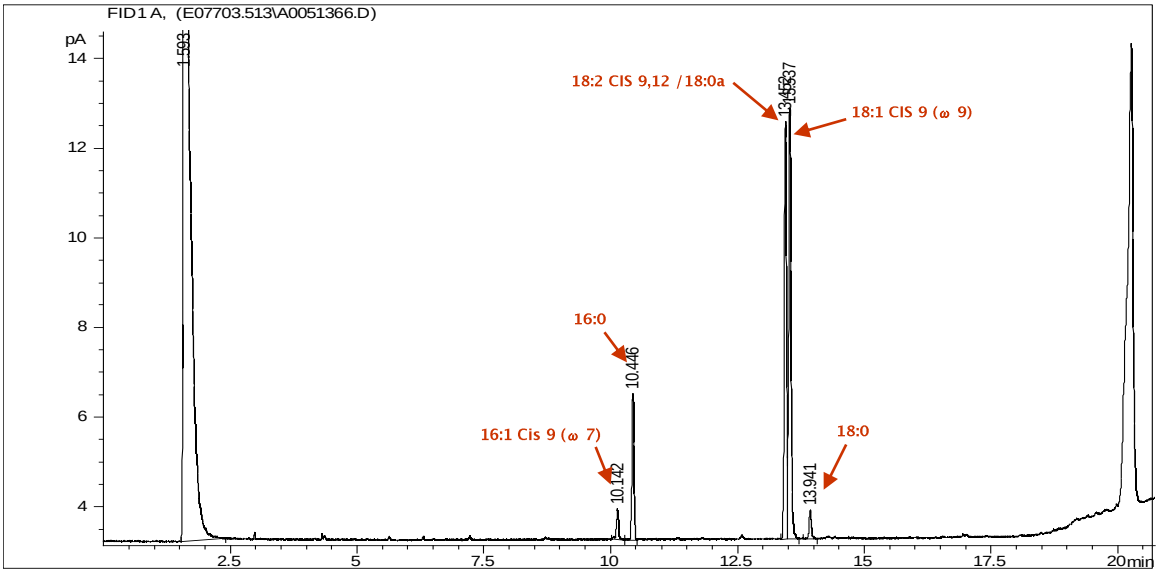

Figure 1. Cellular fatty acid profile of *Ambrosiella beaveri*

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Oral Presentations

Two-Spotted Spider Mite Dispersal in the Presence of Seed Treatments. W. Scott, A. Catchot, J. Gore, F. Musser, and D. Cook

An experiment was conducted to quantify two-spotted spider mite temporal and spatial distribution based on their damage in cotton. Significant differences in mite injury were found between distances from the point of infestation at the three rating dates. Additionally, significant differences in mite injury ratings were found between rating dates at the four distances away from the initial infestation point. In general, as distance from the point of infestation increased, two-spotted spider mite injury decreased and as time after infestation increased, spider mite injury increased.

Ecology and Disease Potential of the Black-Legged Deer Tick, *Ixodes scapularis*, in Mississippi. L. Goltz, A. Varela-Stokes, and J. Goddard

Ixodes scapularis Say is the primary vector of the agent of Lyme disease (*Borrelia burgdorferi*) in the eastern U.S. Studies of the seasonality of the immatures of this tick are lacking in the southern U.S. In an attempt to clarify the seasonality of larval and nymphal *I. scapularis* in Mississippi, ticks were collected weekly with a 1-m^2 corduroy drag cloth from two sites in Mississippi for an entire year (August 2010–July 2011). One site was located in extreme north Mississippi at Wall Doxey State Park in Holly Springs, and the other in north-central Mississippi at Noxubee National Wildlife Refuge in Starkville. Environmental data, consisting of temperature, sky condition, and relative humidity, were observed and recorded for each collection date and site. All ticks collected in the field were preserved in 95% ethanol and returned to the lab where they were counted, identified to species, and appropriately labeled. Both the environmental and temporal data are being analyzed with SAS and R statistical software. For screening for disease agents, adult *I. scapularis* were macerated and DNA extracted. DNA extracts were frozen for further analysis and are currently being tested for the presence of *Borrelia burgdorferi*, *Anaplasma phagocytophilum*, and *Babesia* ssp. using PCR methodology.

***Amblyomma maculatum* Host Bloodmeal Detection by Reverse Line-Blot.** G. Moraru, J. Goddard, A. Varela-Stokes

The Gulf Coast tick, *Amblyomma maculatum*, is the primary vector of *Rickettsia parkeri*, which was first reported to cause human disease in 2004. The natural history of this pathogen is not well understood, and because it is intertwined with that of its tick vector, it is important to understand the ecology of *A. maculatum* as well. Several vertebrates have been identified as hosts for this tick; detailed information, however, is not known. Reverse line-blotting hybridization (RLBH) is a technique that was first used to identify specific strains of bacteria. It has since been applied to several fields of research, including tick bloodmeal detection. The concept is to bind known oligonucleotide sequences to a Biodyne C membrane and test unknown samples with them. Bands should be seen on lanes of the membrane where there are samples that contain DNA of one (or more) of the oligonucleotide probes. This project aims to test adult *A. maculatum* collected from sites in Mississippi. Ticks are DNA extracted using illustra tissue and cells genomicPrep kit; these samples are then put through polymerase chain reaction (PCR) amplification targeting the mitochondrial 12S rRNA gene. PCR products are used for RLBH. Thus far, we have experienced some contamination problems with the blotting. This is a very sensitive technique, as the gene target of interest has a broad array of sources (one

example being human DNA). We are currently troubleshooting, trying different dilutions of probes or PCR products and possibly also attempting to PCR amplify a different gene.

Contribution of Corn Earworm, *Helicoverpa zea* (Boddie), to the Overall Population Reared on VT3 PRO Field Corn. B. Von Kanel, A. Catchot, F. Musser, J. Gore, R. Jackson, D. Cook, M. Caprio

A total of four Non-Bt and twenty Genuity VT3 PRO corn fields were surveyed across Mississippi to determine the landscape contribution of corn earworm to the overall population. Significantly more larvae were observed in Non-Bt corn compared to VT3 PRO. However, there is a substantial amount infesting VT3 PRO. This data represents the first step in determining whether larvae completing development on VT3 PRO field corn pose a higher risk for damaging dual-gene cotton.

Localization of Novel Rickettsiae in Gulf Coast Ticks, Vector of Human Rickettsiosis. F. Girao, J. Goddard, C. Paddock, A. Varela-Stokes

Gulf Coast ticks, *Amblyomma maculatum* Koch, are currently reported in most of the Southeastern United States. Recently the agent transmitted by *A. maculatum*, *Rickettsia parkeri,* was recognized causing human rickettsiosis similar to Rocky Mountain spotted fever. A novel spotted fever group rickettsia (SFGR), and potential endosymbiont, *Candidatus* Rickettsia andeanae was recently detected in *A. maculatum,* although this species is still poorly understood. In a previous study, we found 15% of Gulf coast ticks infected singly with *R. parkeri*, 1.4% ticks with *Ca.* R. andeanae only and an additional 1.9% ticks co-infected with both species, the first evidence of co-infection in *A. maculatum*. Identification of *Ca.* R. andeanae in singly and co-infected *A. maculatum* led us to investigate the biology of the novel SFGR. To our knowledge, no morphological study of *Ca.* R. andeanae has been performed. Transmission electron microscopy offers the ability to evaluate closely the internal structure of the tick and associated rickettsiae, including tissue tropism of the rickettsiae. In this study, we found evidence of rickettsiae in adult *A. maculatum* that were positive for the *Ca.* R. andeanae by PCR. Infected ticks contained rod-like bacteria of small size (approximately 0.3 × 0.9 µm), often with a halo zone (electron-lucent layer around the organism), and a trilaminar cell wall, all consistent with the morphology of SFGR. Two female ticks contained organisms suggestive of *Ca.* R. andeanae in tissues including granular salivary glands, foregut, connective tissue, Malpighian tubules, nerve trunks, and female reproductive tissue. Interestingly, rickettsia-like bacteria were less commonly observed in the two male ticks, but were still present in agranular salivary glands. Through our findings, we hope to contribute to the current understanding of this recently identified rickettsia in the Gulf Coast tick. Evidence of *Ca.* R. andeanae in tick feeding tissues emphasizes a need for host transmission studies to elucidate its pathogenicity.

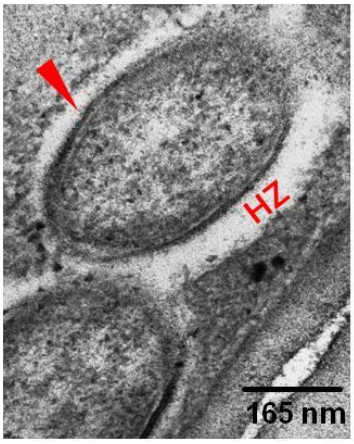

Figure: Transmission electron micrograph of *Candidatus* R. andeanae showing bacterium of ≈0.3 × 0.9 µm. Novel rickettsia was characterized by having an electron-lucent area, the “halo zone” (HZ), corresponding to the bacterial capsule and by having a trilaminar cell wall.

Impact of Rice Stink Bug, *Oebalus pugnax* (F.), (Hemiptera: Pentatomidae) on Grain Quality and Yield in Rice. G. Awuni, J. Gore, D. Cook, F. Musser, and A. Adams

The rice stink bug, *Oebalus pugnax* (F.), is an important pest of rice in Mississippi. It is a grass feeder but prefers rice during the heading stages. Rice stink bug feeding in rice results in direct and indirect yield losses. Feeding during the early stages of panicle development can cause reduced grain numbers and weight. Indirect yield losses result from feeding during the later stages of panicle development. Feeding during the milk through soft dough stages results in kernel discoloration and negatively affects milling quality.

The impact of rice stink bug infestation timing on yield and quality was determined using sleeve cages on individual rice panicles in 2010 and 2011 in Stoneville, Mississippi. Treatments included one or two adult rice stink bugs per panicle compared with caged uninfected panicles at bloom, milk, and soft dough stages. Twenty individual panicles per treatment were infested in a completely randomized design. At each panicle stage, individual panicles were caged for one week. Each panicle was harvested at the end of the season by hand. Individual grains from each panicle were categorized into undamaged, discolored, and blanks. The number and weight of each category was recorded.

Regardless of infestation level, rice stink bug damage was significant at bloom and milk stages. At the bloom stage, grain yield was significantly lower in panicles infested with one or two rice stink bugs compared to the uninfested cages. Significant yield losses were also observed at the milk and soft dough stages. Significant differences in discolored kernels were observed between the infested and uninfested panicles only during the milk stage. These results suggest that rice is susceptible to yield losses during all of the stages evaluated. Grain quality was negatively affected only during the milk stage as a result of rice stink bug feeding. Future research will focus on the interactions between rice stink bug and microorganisms on grain quality in rice.

Effects of Simulated Threecornered Alfalfa Hopper Injury to Soybean Yield. E. Howard, S. Akin, D. Cook, J. Gore, and S. Stewart

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

When breakage occurred during R1/R2, significant yield loss was not apparent until $\geq$40% simulated breakage. This is likely due to the strong compensation potential of soybean—particularly as that compensation pertains to loss of plant stand. However, when simulated breakage occurred during R3 and R5 growth stages, significant yield reduction occurred at $\geq$30% injury level. Therefore, "full season" (e.g., early-planted) soybeans may be less susceptible to yield loss when breaking/lodging occurs during earlier reproductive stages. These results also suggest if $\geq$40% of a given plant stand suffers breakage/lodging, yield loss will likely occur regardless of reproductive stage.

Preliminary research conducted in 2010 suggests late-planted soybean may be even more sensitive to breakage/lodging than full-season soybeans. However, more research investigating yield effects of main stem breakage on late planted soybean is needed and will be conducted in 2012.

Penetration of Termiticide Treatments into Gravel Used as a Construction Fill Material. C. Peterson

Five termiticidal solutions (Termidor, Premise, Talstar, Phantom, and Transport) were examined in packed columns in the laboratory to determine initial penetration. Each column had a layer of gravel (4 inches, 10 cm) and a lower layer (4 inches, 10 cm) of construction-grade fill soil, which is a common building practice in parts of the United States. The applied solution (at both the usual labeled rate and rates permitted by the label for application to gravel) penetrates the gravel sufficiently to treat the soil beneath, as the top soil layer beneath the gravel usually contained the highest concentrations of the active ingredient. It is hypothesized based on previous studies that the concentrations in the soil were sufficient to kill termites (Isoptera: Rhinotermitidae). The active ingredients were detected in the gravel, but usually in lower amounts than those found in the soil. The highest concentrations in the gravel were usually detected in the top 2.5 cm.

Impact of Time to Flood on the Efficacy of Insecticidal Seed Treatments in Rice. A. Adams, J. Gore, D. Cook, F. Musser, and G. Awuni

Recently insecticide seed treatments have been labeled for rice water weevil, *Lissorhoptrus oryzophilus* (Kuschel), control in the U.S. A series of experiments were conducted at the Delta Research and Extension Center in 2011 to determine the impact of agronomic practices on the efficacy of these insecticidal seed treatments in rice. Currently, thiamethoxam (Cruiser, Syngenta Crop Protection) and chlorantraniliprole (Dermacor, E.I. DuPont de Nemours) are registered for commercial rice production. Clothianidin (Nipsit, Valent Corporation) should be available in the near future. The objectives of these studies were to determine the impact of time from planting to permanent flood, and to determine the impact of flushes between planting and permanent flood on the efficacy of these seed treatments. For timing to permanent flood, plots were 2 × 5-m set as a factorial treatment arrangement with four replications. In order to minimize variability among plots, planting dates were spaced 2 weeks apart in order to establish the permanent flood on the same date. This allowed for a 4, 6, and 8 weeks after planting flood timing. Rice water weevil densities were determined by pulling two 10.2-cm cores per plot and counting the number of larvae. Time to permanent flood did not affect the efficacy of insecticidal seed treatments against rice water weevil. In the second trial, the impact of flushes with water on insecticide seed treatments was evaluated. Treatments included 0, 1, or 2 flushes prior to permanent flood. Flushing rice reduced the efficacy of insecticidal seed treatments and significant yield losses were observed from rice water weevil from the treatment that was flushed two times. During hot and dry years, multiple flushes with water may be needed on rice. In these situations, monitoring adult rice water weevil populations will be important to ensure effective control and minimize yield losses.

Utilization of Pollen to Examine Insect Foraging and Movement. C. Allen and G. Jones

The outer wall of a pollen grain is called the exine and protects the genetic material located inside the grain from desiccation and radiation. It is made up largely of a complex molecule called sporopollenin, which is durable and does not easily decay. The exine also exhibits specific patterns which are used to identify the plant of origin to the family, genus, and often species rank. Insects often become “contaminated” with pollen, either

internally or externally, during feeding activities on a particular plant. Due to their unique characteristics and their common association with insects, pollen grains have been utilized to examine foraging habits and movement of some insect species. Pollen grains found on some moths that were collected hundreds of kilometers from the nearest plant distribution have been used to indicate long-range migration. Also, the finding of pollen grains and the identification of the plants producing these grains in the gut of various insect species provide information on foraging habits. In a preliminary study, a process called “acetolysis” was used in an effort to recover pigweed pollen grains from tarnished plant bugs. Plant bugs were fed pigweed pollen in the laboratory and removed from the pigweed after three days of feeding and placed in a container with some water-saturated floral foam. The tarnished plant bugs were frozen at different time intervals after removal from the pigweed. Pigweed pollen was found in over 50% of the tarnished plant bug samples after four days of being removed from the pigweed.

Comparative Benefit of Bt Technologies in the MS Delta. R. Jackson, C. Allen, and R. Luttrell

The benefit of Bt technologies was evaluated at five locations across the Mississippi Delta by comparing commercial Bt (Bollgard II and WideStrike) and non-Bt (Roundup Ready Flex) cottons with regard to the need for supplemental heliothine control (lambda-cyhalothrin, chlorantraniliprole, or non-treated) and yields. Supplemental insecticide applications were made to each cotton variety when a larval threshold of 4% infested plants was met. Two locations did not require insecticide oversprays for heliothine control for any variety, even the non-Bt. Yields did not differ significantly among the various technologies at these two locations. For the other three locations, significant heliothine infestations triggered 2–8 applications of lambda-cyhalothrin and 1–3 applications of chlorantraniliprole in the non-Bt variety. Applications for the Bollgard II and WideStrike technologies ranged from 1 to 2 for lambda-cyhalothrin and chlorantraniliprole. Heliothine larval populations reached or exceeded threshold in all Bt technologies at these three sites. Yield increases were also observed for all technologies receiving applications of lambda-cyhalothrin or chlorantraniliprole at the locations receiving significant heliothine infestations. These results show that insecticidal transgenes are not always necessary in the Mississippi Delta for heliothine control. However, when significant populations occur, yields of Bt cottons, regardless of the technology, may be improved by insecticidal oversprays. Cost-benefit analyses will be conducted on these data to determine the economic benefit of these technologies with and without supplemental insecticide applications.

Acephate Resistance and Potential Mechanisms in the Tarnished Plant Bug. Y. Zhu

The tarnished plant bug is an economically important pest. Control of the insect mainly relies on chemical insecticides. Heavy selection pressure prompted resistance development in the target insect. This study was conducted to survey dose response to Orthene in different plant bug populations collected once a month from May to September in 2011 in Delta. Most of the field populations were collected from pigweeds around edges of cotton or soybean fields. Approximately 25 bugs were used as a replication and 3 replications were used for each population. For spraying treatment with Orthene, the bugs along with four green bean pods were placed in a plastic container (diameter [D] × height [H]: 10.5 × 7cm). A 7-cm (D) hole was cut at the bottom of the container and covered a fine mesh cloth. A 9-cm (D) hole was cut on the lid and covered with a fine net cloth (10 grids/cm). Orthene 90WP was dissolved in d-H_2O to a concentration of 80 mg/L, which is the LC_{50} value against the standard laboratory susceptible colony. Exactly 500 µl of Orthene solution was delivered into the container using a modified Potter Spray Tower. The sprayer was set at 7.5 psi and spray distance of 30.5 cm to ensure a uniform deposition of the Orthene mist on the inner surface of the

container, green beans, and bugs. Bioassay results showed that different populations had different susceptibilities. Survival rates ranged from 25 to 74% in May, 24 to 59% in June, 7 to 70% in July, 10 to 95% in August, and 10 to 81% in September. In addition to bioassays, esterase and glutathione S-transferase activities and gene regulation were examined. Analysis of 6,688 genes using microarray revealed 635 differentially expressed genes (≥2-fold) in resistant strain. Ninety-nine up-regulated and 134 down-regulated genes were annotated. Eleven esterase, four cytochrome P450, and one glutathione S-transferase genes were significantly up-regulated, and no such genes were down-regulated in the resistant insects.