Midsouth Entomologist **8**:49-63

ISSN: 1936-6019
www.midsouthentomologist.org.msstate.edu

Abstracts of the 61th Annual Conference of the Mississippi Entomological Association, October 20-21, 2014

Oral Presentations

Invasive Ants of the Southeastern United States. J. A. MacGown and R. L. Brown

The southeastern United States has a rich and diverse myrmecofauna with at least 330 species reported, 73 of which are alien to the region. The presence of such a large number of alien species can be attributed in part to the semi tropical climate and the high number of oceanic shipping ports in the region. A subset of these alien species are considered to be "invasive", meaning that their introduction causes or is likely to cause economic harm or harm to human health. These species often have large populations that are easily spread, and they may disrupt natural ecosystems. At least 30 of these species are considered invasive, or show strong potential of becoming invasive. Some of the more notable invasive ants in the region include the red imported fire ant, *Solenopsis invicta*; the black imported fire ant, S. richteri; the hybrid imported fire ant, S. invicta X richteri; Argentine ants, *Linepithema humile*; the tawny crazy ant, *Nylanderia fulva*; the Asian needle ant, *Brachyponera chinensis*; the dark rover ant, *Brachymyrmex patagonicus*; the long-legged crazy ant, *Paratrechina longicornis*; the trapjaw ant, *Odontomachus haematodus*; the big-headed ant, *Pheidole megacephala*; the little fire ant, *Wasmannia auropunctata*; and the ghost ant, *Tapinoma melanocephalum*. Here, we document the range and spread of some of the dominant invasive ants in the region.

Biological Rhythm of Polygalacturonase in *Lygus lineolaris*. D. Fleming, N. Krishnan, F. Musser

Polygalacturonase (PG) is an enzyme in the salivary glands of *Lygus* spp. that is used to break down plant pectins for easier plant tissue feeding and possibly in oviposition site preparation. Previous research has suggested that PG gene expression may change based on the current host of the insect as well as the sex of the insect. However, little is known about other factors that may be involved in PG gene expression regulation or PG enzyme activity. A study using quantitative real time-polymerase chain reaction (qRT-PCR) was used to measure expression levels of three PG genes (PG1, PG2, PG3) at six times of day and for both sexes. There was no interaction between time and sex for gene expression of any of the three PG genes. Time and sex were each significant ($p<0.05$) factors for gene expression of PG1 and PG2, while neither factor was significant for PG3. Activity of the PG enzyme was also measured. There was no significant interaction between sex and time and neither sex nor time were significant as main effects. The potential impacts of PG in IPM will be discussed.

Collections of immature *Amblyomma maculatum* Koch (Acari: Ixodidae) from Mississippi, U.S.A. J.S. Portugal and J. Goddard

Immatures of *Amblyomma maculatum* have historically been difficult to collect when not on an animal host, thus a definite seasonality of the immatures has never been determined. In this study, we made tick collections in two sites during 2012 – 2014. Site A (Oktibbeha County) in northern Mississippi, and Site B (Jackson County) in southern Mississippi, were sampled from September-May and October-May, respectively. Sampling was made from vegetation with a 1 m^2 weighted white corduroy drag cloth, dry ice traps, and also a novel method known as “swabbing.” A total of 157 ticks were collected, with 42.04% (n=65) of them being *A. maculatum*. Of these 65, only 20% (n=13) were immatures, with 18.46% (n=12) of them being nymphs, and one larva (1.54%) (collected by swabbing). To our knowledge, this is only the third time that larvae

of this species have been collected from vegetation in the United States. The larva is the first collected from Mississippi in November, and expands the known seasonality of this stage. Of the twelve nymphs collected, one was found during May, becoming the first known nymphal *A. maculatum* collected south of U.S. Route 84 in Mississippi during this month.

Metamorphoses no more: laurel wilt drives palamedes swallowtail decline. J. Formby, K. Oten and J. Riggins

This study sought to determine if laurel wilt disease-induced mortality of redbay (*Persea borbonia* (L.) Spreng.) has a negative effect on palamedes swallowtail abundance. Laurel wilt disease (LWD), a non-native insect-pathogen complex, has caused widespread mortality of redbay in the southeastern U.S. In many areas, mortality in mature redbay stands exceeds 90% within two years of initial LWD infestation. Redbay is the primary host of the palamedes swallowtail butterfly (*Papilio palamedes* Drury) and sudden LWD-induced morality of redbay may have an effect on palamedes abundance. Six ~400 meter (1/4 mile) transects were established in two LW-infested states; Mississippi and North Carolina. Three transects were establish for each treatment type (LW-infected and LW-uninfected stands) in each state. Each ~400 meter transect was walked at an average pace and butterflies within 15 meters of the observer were tallied. Weather conditions were recorded at the beginning of each transect. Transects have been completed in Mississippi and in North Carolina for 3 and 2 years, respectively. Data collection will continue for a minimum of 3 years in each state. Results from Mississippi indicate a significant ($p < .0001$) 7 fold decrease in palamedes abundance in infected stands. In North Carolina, palamedes abundance has significantly ($p < .0001$) decreased 4 fold in infected stands. These results indicate that LWD-induced mortality of redbay significantly decreases palamedes abundance. Therefore, extinction or long term decline of redbay may lead to a loss of the palamedes swallowtail throughout its range. These results indicate a need to focus conservation efforts to protect palamedes habitat. These results also indicate a need to monitor the LW-induced mortality of sassafras and its effect on the spicebush swallowtail (*Papilio troilus* L.), the state butterfly of Mississippi.

Black flies (Diptera: Simuliidae) occurring in Mississippi. T.M. Nations and J. Goddard

Black flies are second to mosquitoes as being a notorious blood-feeding pest. In many parts of the world, black flies are a serious problem and transmit various diseases such as onchocerciasis (human) and leucocytozoonosis (animal). Black fly outbreaks were common in Mississippi during the first half of the 20th century, but ended for unknow reasons. This study is part of a broader project on black flies as pests of people and animals in Mississippi . This study examines all historical records of black fly species in this state. Specimens used in the analysis were housed in the Mississippi Entomological Museum at Mississippi State University, with almost all specimen identifications confirmed by Dr. Peter Adler at Clemson University. Our work, thus far, has revealed 25 species occurring in Mississippi (most of the diversity was from larval specimens). The two main adult biting species in Mississippi are *S. meridionale* and *C. pecuraurm*. Geographic distribution and seasonality of Mississippi black fly species will be presented and discussed.

Evaluating Green Stink Bug Damage on Edamame Soybean. B.C. Thrash, G.M. Lorenz, N. Taillon, A. Plummer, M. Chaney, D. Clarkson, M. Everett, and L. Orellana

Edamame soybeans are a new crop to Arkansas and existing thresholds for conventional soybeans will likely not apply to this crop. A major pest of conventional soybeans in Arkansas is the green stink bug and it will likely be an important pest of edamame. Trials were conducted by caging green stink bugs on edamame soybean at densities of 0, 0.55, 1.64, or 3.28 stink bug adults per row meter for 7 days. Pods were hand harvested for yield and average pod weights were calculated. Pods were also stained to detect the

presence of stink bug salivary sheaths, relating this to damage. No differences were found in yield, average pod weight or damage when compared to stink bug densities although numerical differences were observed. These data will provide insight on how to better design future stink bug threshold studies.

Residual Efficacy and Systemic Nature of the Diamide Insecticides. A. Adams, J. Gore, A.Catchot, D. Cook, F. Musser, and T. Irby

Soybean production ranks as the third most valuable agricultural commodity in Mississippi. The increased value of soybean production has led to the adoption of new agronomic practices to increase production value. The diamide insecticides Belt and Prevathon have played a critical role in soybean production over the recent years. These chemistries provide excellent residual control of lepidopteran insect pests and have been used widely over the past three years. Prevathon is known to move up the plant when applied as a seed treatment in rice production or through drip irrigation in vegetable production; however, it was not known to move up the plant when applied as a foliar application.

In order to determine the systemic nature and longevity of Prevathon, bioassays were conducted in the summer of 2013 and 2014 at Mississippi State University in Mississippi State, MS.

Leaf material was collected from field plots located on the Mississippi State University North Farm in Mississippi State, MS. Treatments were applied on 28 August 2013 and 5 August 2014. Plants were flagged at the uppermost node in order to ensure that only new leaf material was collected for bioassays. Plots were irrigated on 29 August 2013 to encourage new growth.

Ten upper most newly emerged trifoliates were pulled per plot to determine systemic efficacy of insecticides out to 32 and 31 days after treatment for 2013 and 2014, respectively. For a positive control and to determine residual non systemic activity leaves were pulled from lower in the canopy on leaf material that was present at the time of application 25 and 32 DAT 2013 and 10-31 DAT, 2014. Two 1st instar corn earworm *Helicoverpa zea* (Boddie) larvae were placed on leaf material per dish for a total of 80 larvae per treatment. Mortality was evaluated three days after exposure (DAE). Larvae were deemed dead when they were unable to right themselves after being flipped onto its dorsal side.

At 25 DAT Belt and Prevathon provided similar levels of control of *H. zea* over that of the non-treated in leaves pulled from the lower canopy. Prevathon moved into the new growth of the plant providing significantly more effective control out to 32 DAT in both the newly emerged leaves and the lower canopy leaves over Belt and the non-treated. Belt did not move into the new growth but did provide significantly better control over the non-treated out to 32 DAT in 2013. During the summer of 2014 only Prevathon was examined and results were similar to those observed in 2013.

Impact of Nitrogen Rate on Tarnished Plant Bug (*Lygus lineolaris*) Populations and Control. C.A. Samples, D.M. Dodds, J. Gore, B.R. Golden, A.L. Catchot, J.J. Varco, J.D. Copeland, T.H. Dixon, and D. Z. Reynolds

Tarnished plant bugs have become the key insect pest in Mississippi cotton production, particularly in the Mississippi Delta. In 2011, over 573,000 acres were infested with tarnished plant bugs resulting in 86,240 bales lost with an average cost per acre in the delta region of $97.02. In 2012, 442,000 acres were infested and 80,243 bales were lost with an average cost per acre in the delta region of $79.80. Over the last 10 years a large increase in number of applications for tarnished plant bugs in the Delta compared to the hills region of Mississippi have been observed.

Tarnished plant bugs are drawn to rank, lush cotton; which could be an effect of excessive nitrogen. Nitrogen is a key component in maximizing the yield of cotton. As stated, excessive nitrogen application rates can cause an increase in plant height, increased vegetative growth, and delayed maturity. Previous research has been conducted on insecticide efficacy on tarnished plant bugs as well as evaluating the effect of planting date and cultivar maturity effect on control. However, little to no data exists on the effect of nitrogen application rate on tarnished plant bug infestation and control. Therefore, the objective of this study was to determine the effect nitrogen application rate has on tarnished plant bug infestation, cotton growth, and yield. Experiments were conducted in 2012 and 2013 at the Delta Research and Extension Center located in Stoneville, Mississippi. Plots receiving 80 pounds of nitrogen per acre increased profit compared to all other nitrogen application rates and resulted in the least financial risk (based on a risk analysis) when compared to plots receiving ≥120 pounds of nitrogen per acre.

Seasonal Occurrence of Mid-South Pests of Soybeans. N. Bateman, A. Catchot, J. Gore, F. Musser, D. Cook, and T. Irby.

Over the past decade growers in Mississippi have moved away from the traditional early soybean production system, consisting of maturity group 3 and 4 soybeans, which allowed the grower the opportunity to avoid potential late season damage from Lepidopteron pest. In 2004 over 65% of soybeans planted in Mississippi were planted before April 25, in 2012 it was less than 40%. With growers planting more maturity group 5 soybeans with spread out planting dates, the benefits of the early soybean production system have diminished. To see how planting date and maturity group effects Lepidopteron pest in Mississippi, a study was conducted at the North Farm in Starkville, Mississippi, as well as the Delta Research and Extension Center in Stoneville, Mississippi. The study consisted of two maturity groups, group 4 and group 5 soybeans, that were planted over 7 different planting dates at both locations. Surveys were taken weekly from the plots using a standard 15 inch diameter sweep net. The goal of this study was to show the benefit of early planted early maturing soybeans to avoid late season damage from Lepidopteron pest

A maturity group 4 and 5 soybean where used over 7 different planting dates, in both the hills and delta regions of Mississippi, to show the impact of Lepidopteron pest throughout the season. Weekly surveys were taken to see when soybeans are most vulnerable to caterpillar pest.

Value of Neonicotinoids in Mid-South Row Crop Systems. J. North, A. Catchot, J. Gore, D. Cook, D. Dodds, and F. Musser

Neonicotinoids have recently come under public scrutiny for their potential link to the decline in honey bee populations. Over the last decade the neonicotinoid class of chemistry has gained widespread popularity among farmers because of its low mammalian toxicity and high degree of efficacy against piercing sucking insect pest. Neonics are used as seed treatments in nearly every field crop grown in the Midsouthern region and also used as foliar treatments in many of these same crops. Although widely adopted, the full economic benefit to producer has not been fully evaluated. This paper will address potential benefits of seed treatments and foliar use strategies of neonicotinoids in cotton, soybeans, and grain sorghum.

Management Strategies for Tarnished Plant Bug (*Lygus lineolaris)* in the Mid-South Cotton Belt. S. Graham, A. Catchot, J. Gore, D. Cook, D. Dodds, and F. Musser.

The tarnished plant bug, *Lygus lineolaris* [Palisot de Beauvios], is the most important pest of cotton in the Mid-South. While early season feeding can delay plant maturity and cause deformed plants, most economic damage is caused by feeding from first square

(flower bud) to early bloom. During this time, it is a direct pest feeding on squares, flowers, and fruit. Numerous insecticide applications are needed to control this pest annually. Recent research has shown that multiple agronomic management practices such as planting date, leaf pubescence, and nitrogen rate can impact tarnished plant bug management. The objective of this research was to combine multiple best management practices to determine if we can reduce the reliance on chemical insecticides to manage this pest.

Populations of Foraging Honey Bees in Midsouth Crops. A. Whalen, A. Catchot, S. Stewart, G. Lorenz, J. Gore, D. Cook, F. Musser, and J. Harris

In recent years there has been a global decline in populations of both native and managed pollinators. Pesticides are considered to serve some role in these declines. A study was conducted to see when and at what densities honey bees forage agronomic crops in the Midsouth. Fields of corn, cotton, and soybeans were visually sampled for foraging honeybees across Arkansas, Mississippi, and Tennessee. Honey bees were observed at three time intervals and at four distances into each field. Significantly more honey bees were observed in soybeans than in corn and cotton. The mid-day time interval had the significantly most number of honey bees per acre observed. More honey bees were observed in the morning time interval than the evening time interval. Based on these data, insecticide applications should be made in the evenings when honey bees are less active in crop fields. This allows for the most time for the residual activity of insecticides to diminish before foraging honey bee numbers increase in the morning and maximize in the middle of the day.

Susceptibility of Tobacco Thrips, Frankliniella Fusca, to the Neonicotinoid Class of Insecticides in the Mid-Southern Region. C. Darnell, A. Catchot, F. Musser, J. Gore, and D. Cook.

This paper will address reduced insecticidal efficacy of imidacloprid, thiamethoxam, and clothianidin against tobacco thrips,*Frankliniella fusca* (Hinds), in the Mid-Southern Region. Over the past several years tobacco thrips have become an increasing problem throughout the cotton cropping systems in the South. Thrips can cause a delay in maturity and cause a reduction in yield if not controlled. If infestations are severe, thrips can cause a loss of apical dominance or even kill plants. Currently, seed treatments are the primary means of controlling tobacco thrips in cotton. It is critical to understand the potential levels of resistance currently established in populations throughout the southern region of the U.S.

Dose-response bioassays with the three commonly used neonicotinoid insecticides were performed on field-collected adult female tobacco thrips during May and June, 2014. Populations were collected from agricultural regions in Mississippi from wild hosts as well as from insecticide-treated crops. Results suggest that crop host was not an important factor in determining survival to neonicotinoids, but agricultural region was. Thrips collected from the Mississippi River Delta region were less susceptible to all three neonicotinoids than populations collected from the Northeastern part of Mississippi. When compared to a laboratory colony, field colonies were similarly susceptible to imidacloprid, but less susceptible to thiamethoxam. Further research is planned to confirm findings and to explore the mechanisms that are responsible for resistance to these insecticides.

Wing Patterns of Moths are Dependent on Wing Venation in Primitive Lepidoptera and Trichoptera. S. Schachat, and R. Brown.

Wing patterning in the order Lepidoptera (butterflies and moths) is a subject of great biological, social, and economic importance. These patterns serve essential biological functions in predator avoidance and sexual signaling; they inspire the general public to learn about the natural world, often turning Lepidoptera into conservation symbols; and

they are important characters for species recognition, allowing us to identify invasive species and other pests. Two models predict the location of forewing pattern elements in all moths based on wing venation, but until now, neither model had been tested in the most basal family of moths, Micropterigidae. When the complete suite of primitive lepidopteran wing venation is taken into account, wing veins separate forewing pattern elements (fascia) from non-patterned (interfascial) areas in all wing locations but one. The "missing" vein that would allow prediction of the entire forewing pattern is present in certain caddisflies; because caddisflies (Trichoptera) form the sister-group to Lepidoptera, it is possible that this vein was also present in the common ancestor of moths and caddisflies. Constraints on color pattern exerted by "missing" venation have long been known to occur in Lepidoptera, so the present finding extends this fascinating phenomenon back to the common ancestor of all moths and butterflies.

Distribution of Heliothines in Cotton/Soybean Landscapes. T. D. Dill, A. Catchot, J. Gore, D. Cook and M. Caprio.

Recently, cotton acres as a whole throughout the Mid-South and Southeast regions of the U.S. have declined substantially. This is due in part to an increase in prices and acreage of corn and soybean. Recent inflation in the price of soybeans is indicative of the growing demand and importance of the commodity. Additionally, the pest status of bollworm, *Helicoverpa zea* (Boddie), has increased in soybean. As a result, there is growing interest from producers and industry to have commercial access to transgenic soybean varieties that express the Bt toxins to help assist management against lepidopteran pests. One issue arising is that presently soybeans are assumed to be a key host in the natural refuge concept used for Bt cotton. *Bacillus thuringiensis* has been a tremendous asset in cotton and corn production, but the potential for resistance development by multiple insect species is a concern. Research is needed to determine if the introduction of Bt soybeans into the U.S. will present an unacceptable risk to the sustainability of other crops. This project will examine the contribution of soybean to the susceptible heliothine populations in the natural refuge system, the potential of delayed in-season emergence of *H. zea* from field corn, effects of soil moisture on emergence and pupal duration, fitness of adult *H. zea* from Bt and non-Bt corn, and modeling factors for resistance management.

An experiment was conducted to quantify the bollworm and budworm plant host preference between soybean and cotton based on oviposition. Paired male and female adults were released in 20 ft. x 20 ft. screen cages placed over three rows of cotton and three rows of soybean when both crops were at peak bloom. Three days after infestation, plants from five foot of row were removed and visually sampled for number of eggs present and location of eggs deposited on plants.

Histology of Lepidoptera: an analysis of stain performance on Lepidoptera wings and genitalia. C. Jaeger

A well-stained dissection is invaluable when preserving insect genitalia or whole body mounts. Any specimen for which considerable time and labor has been expended is worth preparing in such a manner that it retains its utility beyond a few months or years. A perfect dissection can easily be ruined if it isn't visible due to improper staining; this limits taxonomic utility. Understanding basic histological techniques is essential for the display of insect tissue; mounting media turns colour as it ages, staining can fade, and an over-stained sample can distort what we see. I explored the effectiveness of several commonly used stains, including Eosin Y, Acid Fuchsin, Orange G, Chlorozol Black, Saffranin, Mercurochrome, and Rose Bengal. Additionally, the amount of time required for staining was investigated. Ultimately, preliminary results showed that acidified Eosin Y and Mercurochrome were most effective whilst also staining in the least amount of time, 30 minutes.

Evaluating Threecornered Alfalfa Hopper, *Spissistilus festinus,* As a Pest in Mississippi Soybeans. J. Ramsey, A. Catchot, F. Musser, J. Gore, D. Cook, and T. Irby

The threecornered alfalfa hopper is a pest of soybeans during the vegetative and reproductive stages of soybeans. Primary damage from this pest is stem girdling. During the vegetative stage they feed on the main stem and during the reproductive stage they move to the upper part of the plant to feed. Early season feeding can be economic, but many fields are planted with treated seeds, which provide some protection. Most foliar applications targeting threecornered alfalfa hoppers occur during later reproductive growth stages. Previous research has shown that the former treatment threshold of 1 TCAH/sweep was too low. In 2012 the threshold was raised to 2 TCAH/sweep. No yield losses in recent research have been reported from TCAH feeding during reproductive stages, so this threshold may still be conservative. Experiments were conducted during 2012 and 2013 in Starkville and DREC to test higher densities of TCAH and to estimate sweep net sampling efficiency for threecornered alfalfa hopper adults in soybeans. For the sweep net efficiency, field cages (20' x 20') were erected in field once soybeans reached R3 growth stage. Cages were infested with 0-6 TCAH adults/row ft. (0-900/cage). One sample was taken each day from each cage for four consecutive days, with 20 sweeps per cage. For the threshold research, smaller field cages (6' x 6') were infested with 60 TCAH adults/row ft or left uninfested during R3-R4 stages. Cages were maintained for 2 weeks and then removed and fields were sprayed. Yield was measured at harvest.

Effect of Tarnished Plant Bug on Yield and Maturity of Cotton During the Flowering Period. W. Wood, J. Gore, A. Catchot, D. Cook, D. Dodds and J. Krutz

The tarnished plant bug, Lygus lineolaris (Palisot de Beauvois), is a major pest of cotton in the Mid-South. Insecticides are the main form of control for this pest, and numerous applications are required during a growing season to control the tarnished plant bug. Little information exists about when to terminate insecticide applications targeting tarnished plant bugs in cotton. Numerous sprays with tank mixtures of high rates of organophosphates and pyrethroids are made late in the season to protect a small percentage of the overall yield. Experiments were conducted at the Mississippi State University Delta Research and Extension Center to determine the impact of tarnished plant bug infestation timings on cotton yields. Two separate planting dates were utilized to determine the weeks of flowering that tarnished plant bugs can cause significant yield losses. There was not a significant planting date by treatment interaction, so the data were combined across planting dates. The first four weeks of flowering were the most critical for tarnished plant bug control and this is when the greatest yield losses occurred. Also, when no insecticide applications were made after the fourth week of flowering, no significant yield loss was observed. To minimize yield losses caused by tarnished plant bugs, thresholds should strictly be adhered to during the early flowering period.

The Impact of Corn Earworm on Grain Sorghum Yield. C. Dobbins, J. Gore, A. Catchot, D. Cook, F. Musser, and B. Olivi

The corn earworm, *Helicoverpa zea* (Boddie), is an important insect pest of grain sorghum in Mississippi. Recently, concerns were raised about the validity of the current action threshold of one larva per panicle for this pest. To address this concern, an experiment was conducted in Stoneville, MS utilizing artificial infestations with second instar corn earworms. Larvae were infested at seven densities ranging from 0.17 to 6 larvae per panicle and compared to an uninfested control. Additionally, infestations were done at two plant densities. Plant density did not have an impact on feeding injury or yield losses caused from corn earworm. Significant yield reductions compared to the uninfested control were observed for infestation densities of 0.5 or more larvae per panicle. These preliminary results suggest that the current threshold may be too high. The experiment was repeated in 2014 but data have not been analyzed.

Evaluation of Pre Herbicide and Seed Treatment on Thrips Infestation in Cotton. D. Copeland, D. Dodds, A. Catchot, J. Gore, D. Wilson, D. Reynolds, C. Samples and D. Denton

Since 2011, foliar treatments for thrips infestations in cotton have increased to nearly two applications per acre on 75% of total acres treated with an insecticidal seed treatment. Additionally, glyphosate-resistant Palmer amaranth has become problematic for Mississippi producers. As a result, the use of preemergence herbicides has increased dramatically since 2008. From 2008 to 2012 the number of cotton bales lost due to thrips damage increased from 152 bales lost in 2008 to 5,057 bales lost in 2012. In cotton, both thrips damage and PRE herbicides can interfere with emergence. Previous research on thiamethoxam and imidacloprid, have both to be effective in controlling thrips in cotton. Given the increased use of PRE herbicides in Mississippi cotton production, it has been suggested that PRE herbicides may be contributing to the increase in thrips populations over the past several growing seasons. Therefore, the goal of this research was to evaluate the use of PRE herbicides and seed treatments on thrips populations and observe how each of these coincide with cotton development and yield.

Estimating the Critical Level of Kernel Damage to Impact Field Corn Yield. B. Olivi, D. Cook, J. Gore, A. Catchot, F. Musser, and C. Dobbins.

The first generation *Bacillus thuringiensis* (Bt) traits in field corn, YieldGard® and Herculex®, demonstrated minimal activity against corn earworm feeding on grain in ears. However, the newer transgenic Bt corn hybrids express Genuity® and VT Triple Pro®, Genuity® and SmartStax®, and Agrisure Viptera® traits with significant efficacy against corn earworm infesting corn ears. Preliminary evaluations have demonstrated that these traits are effective at reducing ear damage from corn earworm, however yield responses have been variable. Studies were initiated during 2013 using simulated damage methods to determine the critical level of kernel damage required to impact corn yield. Individual ears were assigned randomly to the simulated damaged treatments which included 0, 10, 20, 40, 60, or 100 kernels. A minimum of 20 ears were used for each treatment. Damage treatments were imposed at milk stage to avoid interference with pollination. The first kernels from the tip that would mature were estimated on each ear. The number of kernels to be damaged began at that point and proceeded toward the base of the ear. Kernels were damaged manually with a sharp object or finger nail. After damage was imposed, each ear was surface sterilized with 95% ethanol and covered with a corn ear pollination bag to minimize fungal growth. Each ear was hand harvested and shelled individually into 4 sections based upon length, with section 1 representing the ear tip. The mean grain weight, number of kernels, and weight of individual kernels was determined for each ear section. Preliminary data for the 2013 trials were subjected to linear regression using (SAS Institute 2010). During 2013, a significant relationship between kernel damage and yield was observed. Preliminary analysis of the 2013 data indicated a significant relationship between kernel damage and yield. Based on the regression equation, for every kernel damaged (ca. 0.15g) of grain yield was lost. Additional studies are planned for 2014.

Beneficial Beetles for Bioinformatics. M. L. Allen

Coleomegilla maculata (Coleoptera: Coccinellidae) is a common generalist predator found throughout much of North America. The species is ecologically important and has become a useful subject of genetic research. It is easy to find outdoors, seasonally, and laboratory maintenance Standard Operating Procedures (SOP) have been established at the National Biological Control Laboratory in Stoneville, MS. The Allen laboratory has selected for a 7X inbred a strain through isofemale selection. During the course of the selection process, some interesting phenotypes were also selected. The established strains: Yellow Eyes and Elytra (Ye), Gold, and 10-Spot will described and presented visually. Experimental results demonstrating efficacy of *C. maculata* for spider mite

remediation will be shown. Progress toward differential transcriptome analysis will also discussed.

A Brief Overview of Current Relationships of Geography, Statistics, and Taxonomy with the Classical Integrated Control Concept. J. L. Willers, and G. F. Backoulou

A classic paper on the integrated control concept appeared in the later part of the 1950's, led by Vernon Stern, Ray Smith, Robert van den Bosch, and Kenneth Hagen. Numerous concepts and definitions were formulated at that time. In this presentation, a short philosophical summary will be presented to illustrate how technological advances that did not exist in the 1950's, but now exist in the present time provide opportunities to think differently, act differently, and explore new challenges from different perspectives. There are many new technologies that could be discussed. However, these three categories are examined: (1) Geography through the use of Geographic Information Systems (GIS) and digital remote sensing (RS), (2) statistics, in reference to techniques first developed in the 1970's and 1990's, such as count model regression methods and GIS-based statistics as found in FRAGSTATS and (3) classical taxonomy and sampling methods as linked to GIS, RS, and these novel statistical techniques. The purpose of the presentation is review concepts of the classic integrated control concept from the 1950's, demonstrate how newer technologies fit well with classical integrated control, and encourage discussion among the listeners of all disciplines to solve current and future problems promptly and through better research methods.

Poster presentations

Emergence of *Helicoverpa zea* (Boddie) from Corn in Mississippi. T. Dill, A.Catchot, J. Gore, F. Musser, D. Cook, and M. Caprio.

Recently, cotton acres as a whole throughout the Mid-South and Southeast regions of the U.S. have declined substantially. This is due in part to an increase in prices and acreage of corn and soybean. Recent inflation in the price of soybeans is indicative of the growing demand and importance of the commodity. Additionally, the pest status of bollworm, *Helicoverpa zea* (Boddie), has increased in soybean. As a result, there is growing interest from producers and industry to have commercial access to transgenic soybean varieties that express the Bt toxins to help assist management against lepidopteran pests. One issue arising is that presently soybeans are assumed to be a key host in the natural refuge concept used for Bt cotton. *Bacillus thuringiensis* has been a tremendous asset in cotton and corn production, but the potential for resistance development by multiple insect species is a concern. Research is needed to determine if the introduction of Bt soybeans into the U.S. will present an unacceptable risk to the sustainability of other crops. This project will examine the contribution of soybean to the susceptible heliothine populations in the natural refuge system, the potential of delayed in-season emergence of *H. zea* from field corn, effects of soil moisture on emergence and pupal duration, fitness of adult *H. zea* from Bt and non-Bt corn, and modeling factors for resistance management.

An experiment was conducted to quantify the bollworm and budworm plant host preference between soybean and cotton based on oviposition. Paired male and female adults were released in 20 ft. x 20 ft. screen cages placed over three rows of cotton and three rows of soybean when both crops were at peak bloom. Three days after infestation, plants from five foot of row were removed and visually sampled for number of eggs present and location of eggs deposited on plants.

Dopaminergic regulation of circadian locomotor activity and resistance to oxidative stress in *Drosophila melanogaster*. M. Hanna, A. Bednářová , K. Rakshit, and N. Krishnan

Dopamine (DA) is the sole neuroactive catecholamine in *Drosophila melanogaster* which regulates locomotor behavior along with various physiological and developmental functions. We monitored the impact of mutations in three key genes in DA regulation on circadian locomotor behavior and resistance to oxidative stress (OS) in *D. melanogaster*. *Catecholamines up* (*Catsup*) - a negative regulator of DA production acts on tyrosine hydroxylase (TH)-a rate limiting enzyme for DA synthesis. *Pale* (*ple*) encodes TH and *Punch* (*Pu*) encodes GTP cyclohydrolase (GTPCH) important for synthesis of tetrahydrobiopterin (BH_4) necessary for TH activity. A mutant in the vesicular monoamine transporter (VMAT) a key transporter which helps in transport and packaging of DA in the vesicles of the DA neurons was also studied. Male flies of all mutants with isogenized controls (6-8 days old) were used to study circadian locomotor activity rhythms, longevity as well as resistance to OS induced by both hydrogen peroxide and Paraquat. In general, most mutant flies exhibited rhythmic circadian locomotor activity. *Catsup* mutants were however significantly more hyperactive compared to *ple*, *Pu* and VMAT mutants. When DA synthesis pathway was affected, life span was impacted along with a differential response in antioxidant systems in response to OS. Taken together, we hypothesize that DA could have a significant role in regulation of response to OS independent of the circadian system. Further studies on the downstream targets of DA with special reference to OS will help clarify the precise molecular mechanism of DA function in organismal homeostasis.

Ornamentation in Hard Ticks (Acari: Ixodidae): Possible Biological Significance and Potential Medical & Veterinary Applications. S. Schachat and J. Goddard.

Many hard ticks (family Ixodidae) are vectors of disease agents in Mississippi and around the world; these ticks transmit pathogens that are of both medical and veterinary concern. To combat these vectors, we must better understand their biology. Many hard ticks have ornamentation on their scutum, and ticks in different genera have strikingly similar ornamentation patterns. In North America the patterns usually consist of broad beige or dull white stripes against a dark brown background, but some tropical ticks are more brightly colored. Here, three common functions of animal coloration (aposematism, camouflage, and sexual advertising) are considered in relation to ixodid ornamentation, and additional steps for hypothesis testing are outlined. Insights into the biology of other arachnid taxa are considered and potential medical and veterinary applications of the present findings are discussed.

Impact of Threecornered Alfalfa Hopper, *Spissistilus festinus*, Feeding in Seedling Cotton. J. Ramsey, A. Catchot, F. Musser, D. Gore, and D. Cook

The threecornered alfalfa hopper, *Spissistilus festinus*, is primarily a pest of soybeans. In the past few years damage from threecornered alfalfa hoppers in cotton has become a concern in some areas. In the past, damage was usually limited to field borders, but recently damage seems to be spread out across entire field areas where they are present. Cotton plants that have been injured from threecornered alfalfa hoppers will have a stunted appearance, leaf veins will become dark red, and the leaves will either be red or orange. There will also be a girdle or knot on the main stem, usually below the cotyledons. Injury from threecornered alfalfa hoppers can cause cotton plants to bend over and break or kill the plant outright, unlike soybean plants that are injured early from threecornered alfalfa hoppers. Soybeans are more prone to lodging later in the year, but if the plant does not lodge usually they produce normal yields. The yield response of damaged but surviving cotton plants is unknown, and was the objective of this research. A problem with threecornered alfalfa hoppers is they are difficult to scout for when cotton is small and usually damage is found long after the damage was done. Currently there is no published threshold in cotton. Treatments based on plant stand become apparent too late to be practical, so an early season threshold based on insect numbers or plant

damage is needed. The focus of this research is to determine the impact threecornered alfalfa hoppers have on yield in cotton.

Comparison of LC50s for *Lygus lineolaris* from the Delta and Hills Regions of Mississippi. D. Fleming, N. Krishnan, and F. Musser

Lygus lineolaris is a major pest of cotton in the Mississippi Delta region, but is not as damaging to cotton in the Hills region. Insecticide resistance to several classes of insecticides have been documented in the Delta region and may help explain the reason for the severity of *L. lineolaris* injury to cotton in the Delta. An experiment was conducted to compare LC50s of Permethrin, Imidacloprid, and Acephate for *L. lineolaris* from these regions. Insects were collected from wild hosts and reared to F1 generation 4th instar nymphs. Nymphs were exposed to insecticide in glass vial bioassays and LC50s were determined using Proc Probit in SAS. Overall results indicated that region had no effect on LC50 levels for any insecticide ($p<0.05$). However, one colony from the Delta had a three to four fold higher LC50 level for both Permethrin and Acephate. Implications of insecticide resistance and landscape factors that could lead to insecticide resistance and impact the severity of *L. lineolaris* injury to cotton are discussed.

The Limited Distribution of Mississippi Southern Dogface Butterflies, *Zerene cesonia*, to Black belt Prairies. J. Schwab and B. Counterman

The Black belt Prairie runs from Tennessee to Alabama and is characterized by its black, fertile, alkaline soils. Due to agriculture, urban development, erosion, and forest encroachment over 99% of the black belt prairies have been lost since the late 1800's. The remaining remnant prairie patches experience a range of management and protection due to the number of diverse native flora and fauna, some of which are prairie specific species. *Dalea purpurea* and *Dalea candida* are two such plant species that are diagnostic of a prairie remnant patch. In the Southern Dogface butterfly, *Zerene cesonia*, we have observed a preference for *Dalea* as a host plant. This preference could then limit the distribution of *Z. cesonia* to prairie remnant patches. To test this hypothesis, as well as to test if prairie management strategies can affect the distribution *Z. cesonia,* surveys for all sulfur butterfly species were conducted. Over the course of five weeks nine Mississippi grassland sites were surveyed. Three sites were unmanaged prairies that contained *Dalea*, three were grasslands with no *Dalea* and three were fire managed prairie sites that contained *Dalea.* All sites were sampled for average number of *Dalea*, as well as the soil pH and Area of usable habitat were also calculated. Principle Component analysis as well as ANOVA analysis relieved a significant relationship between the presence of *Dalea* and the presence of *Z. cesonia*. With sites that contained the highest average number of *Dalea* had the largest density of *Z. cesonia.* No *Z. cesonia* individuals were found in grasslands that completely lacked *Dalea*. There was no significant relationship between fire management and *Z. cesonia* density. While all other sulfur species showed only a significant relationship with the size of the grassland and were present in all nine sites. Surveys also showed *Z.cesonia* to be nonspecific pollinators for native prairie species. The goal of this study was to establish the multitrophic relationships between the flora and fauna of the highly threatened black belt system.

A Review of the Seasonality and Distribution of Immature *Amblyomma maculatum* Koch in Mississippi, U.S.A. J.S. Portugal and J. Goddard

The Gulf Coast tick (*Amblyomma maculatum* Koch), a known vector of medical and veterinary concern, is well established in Mississippi. Although seasonality and distribution patterns of this species of adults are somewhat understood, those of immatures (larvae and nymphs) are not. In this study, a review of literature was paired with unpublished data to identify trends in immature *A. maculatum* activity. Compiled

data showed dates ranging from 1920-2014, consisting of 2,368 total specimens of *A. maculatum* collected in Mississippi. Of those, 2,295 (96.92%) were adults: only 27 (1.14%) were nymphs and 46 (1.94%) were larvae. Only 4 larval collections were recorded (one each in June and November and two in October). Seventeen nymphal collections were recorded with peaks in March and August, roughly corresponding to bi-modal distribution observed in larval records. This bi-modal distribution suggests the possibility that there may be two batches of GCT's per year, or that immatures go through a stage of inactivity during periods of both winter and summer months. As expected, nymphs were collected in southern portions of Mississippi earliest, but unexpectedly, adults were collected earlier further north. With one minor exception (single collection from Emu) all host species matched those already established in literature for immature GCT's.

Results from the Regional Identification Center of the USDA-APHIS (Raleigh Hub) for the 2014 Wood Boring Beetle Surveys, Including New County Records. J. Seltzer, T. Schiefer, and R. Brown

The Mississippi Entomological Museum (MEM) has served as a Screening and Identification Center for the USDA-APHIS (Raleigh Hub) for eight years. This service has allowed the state and federal programs an efficient and timely way to have their samples processed, with a targeted turn around time of three weeks. During the 2014 trapping year, samples were received from Alabama, Kentucky, Mississippi, Tennessee, and Georgia. These samples include Lindgren Funnel trap samples run for exotic wood borers/bark beetles and *Sirex* Woodwasps, pheromone traps for a wide range of Lepidopteran pests, and purple prism traps for Emerald Ash Borer. 4278 samples were received for screening and identification between January 1, 2013 and October 17, 2014.

Exotic Wood Borer/Bark Beetle Surveys totaled 3357 samples, and were comprised of the following target trapping: 19 Emerald Ash Borer, 41 *Sirex* Woodwasp, 95 Walnut Twig Borer (WTB), and the remaining 3202 were Lindgren funnels bated with lures. Lure types used included: WTB, monochamol, alpha-pinene, *Ips*, pitcha, lineatin, *Playpus quercivorus*, spruce blend with geranyl acetol, pine shoot beetle, *Megaplaytypus mutates*, and *Typographus*. Changes in the number of specimens screened appear to have been largely affected by the shift in lure types used. This year, lures for Platypodidae species were used and number of platypodid specimens screened increased (Figures 1 and 2). Increases in the number of specimens screened increases the chance of exotic specimens being identified during the screening process. This year a total of 832 positive specimens were identified from 64 samples. This year most positive samples were from previously recorded counties, however two samples from Alabama were positive for *Ambrosiodmus minor* (Stebbing) (Figures 3 and 5) and one sample for *A. lewisi* (Blandford) (Figures 4 and 5) were new county records. Dallas and Calhoun county smaples were positive for *A. minor* and Coffee County was positive for *A. lewisi*. Additionally, Kentucky had one new county record for Daviess County, this sample was positive for *Scolytus schevyrewi*.

Susceptibility of Lepidopteran Pests to the Diamide Insecticides. A. Adams, J. Gore, A. Catchot, D. Cook, and F. Musser.

Bioassays were conducted on both insecticide-susceptible laboratory strains and colonies derived from field populations of *Helicoverpa zea* (corn earworm), *Spodoptera exigua* (beet armyworm) and *S. frugiperda* (fall armyworm) reared at the Delta Research and Extension Center in Stoneville, MS in 2013 and Clay Lyle Entomology building in 2014 to determine baseline susceptibility levels to flubendiamide using larval weight as criterion to determine mortality. All bioassays on field populations were conducted within 2 generations on neonate larvae (<12 h old).

Insect mortality was evaluated 7 d after exposure by recording the weight of each individual larvae. Bioassay data were analyzed by entering total number of larvae by the number dead based on weight ranging from 1 mg – 10 mg using probit analysis in SAS version 9.3 to determine the best fit. Fiducial limits that did not overlap were considered significantly different. Data was corrected for control mortality using Abbot's formula.

The LC 50 values for *H. zea* colonies at 10 mg ranged from 0.016 – 0.024 ppm and LC90 values ranged from 0.021 – 0.033 ppm. The LC 50 values for *S. exigua* colonies at 10 mg ranged from 0.012 – 0.017 ppm and LC90 values ranged from 0.017 – 0.022 ppm .The LC 50 values for *S. frugiperda* colonies at 8 mg ranged from 0.032 – 0.042 ppm and LC90 values ranged from 0.045 – 0.056 ppm.

These data suggest that the criterion for rating mortality is appropriate for concentration-mortality bioassays with the diamide chemistry. This information will be used as a reference for future resistance monitoring with the diamides.

The Grasshopper Fauna of Southeastern Grasslands and a Revision of the *Melanoplus scudderi* (Orthoptera: Acrididae) species group. J.G. Hill.

Natural grasslands historically covered a significant portion of the southeastern United States. These grasslands contribute significantly to the biodiversity of the region with many endemic or rare species inhabiting them. Grasshoppers are important components of temperate grassland ecosystems, but no comprehensive review of the grasshopper fauna of southeastern grasslands had previously been conducted. Here a review of the regional fauna was conducted. In total, 211 grasshopper species have been documented in the Southeast, with 111 species (53%) being endemic to natural grasslands. Of particular note, 74 species (34% of the regional fauna) are endemic to the longleaf pine ecosystem. Many of the non-endemic grasshopper species inhabiting grasslands in the region are disjunct from larger populations west of the Mississippi River, presenting interesting biogeographic distributions. Moreover, the faunal distinctiveness these grasslands is supported by a cluster analysis of grasshopper community composition from several types of grasslands in the region. One of the most striking examples of evolutionary divergence in the region comes from the *Melanoplus scudderi* species group. The revision presented here describes 21 new species and establishes the *Melanoplus carnegiei* group, all of which are associated with grasslands in the Southeast along with hypothetical and a hypothetical evolutionary history of the group is conferred.

Comparison of degree-day accumulation models for predicting spring reproductive populations of *Lygus lineolaris* (Palisot de Beauvois). K. A. Parys and G. Snodgrass

Tarnished plant bugs, *Lygus lineolaris* (Palisot de Beauvois), are a major pest of cotton throughout Mississippi and the midsouth region. Adult *L. lineolaris* diapause and overwinter utilizing leaf litter and winter host plants. Degree day accumulation models were evaluated using six biofixes, four lower temperature thresholds, and 13 years of data to predict the appearance of two phenological events (first instar nymphs and adults). Determining seasonal and temporal patterns of *L. lineolaris* contribute to further understanding this pest¹s population dynamics, and have broad implications for pest management programs.

A Novel Design for a Mechanical Aspirator Targeting Ant-sized Insects. D. C. Cross.

Mouth aspiration of certain insects can often be difficult given that the collector may become sensitized to insect allergens or the insect may produce volatile compounds

when agitated. Mechanical aspirators are available but generally are expensive and may be limiting in application. Using an inexpensive bilge blower fan as the nucleus, we designed and fabricated a low-cost field aspirator that is well suited for collecting medium to small ants and like-sized insects. The new configuration compares favorably to a commercially available unit for air flow and allows the collection of fast moving ants on multiple substrates. The tawny crazy ant, *Nylanderia fulva*, (Hymenoptera: Formicidae), has proven particularly difficult to mouth aspirate given its abundant chemical defenses. This species, well established in FL, and TX, can now be found in a patchwork distribution in all the contiguous coastal states in between. A project requiring large numbers of *N. fulva* served as motivation for producing our device. Our newly designed aspirator increases the catch rate and comfort level of the author during collections of tawny crazy ants as compared to that experienced when using a standard mouth aspirator.

Evaluation of *Beauveria bassiana* Spores Compatibility with a Sprayable Bioplastic Formulation to Control the Tarnished Plant Bug. M. Portilla, H.K. Abbas, C. Accinelli

An initial trial was conducted in the laboratory to evaluate the compatibility of a single concentration of spores ($6x10^9$ conidia/ml) of *Beauveria bassiana* NI8 Delta strain with a novel sprayable starch-based bioplastic formulation prepared with increasing percentage of bioplastic (0.25, 0.50, 0.75 and 1%) to control the tarnished plant bug (TPB) (*Lygus lineolaris*). Bioplastic concentrations (treatments) were compared with a 0.04% solution of Tween-80 control and water control. Bioassay was carried out using SOLO cups with solid diet (Portilla et al., 2011). Aliquots of 6 ml of a solution of 0.5 g of harvested spore powder in 50 ml of 0.04% Tween-80 water solution and concentrations of bioplastic ($6x10^9$ conidia/ml) were used to inoculate TPB adults. Spray from each treatment covered a circular area of 14.1 inches in diameter in which the group of insects was placed. After application, adults were released into an insect observation cage (BioQuip 1466A) to let them dry. The sprayed insects were placed individually into a SOLO cup with solid diet. Adults were examined daily for mortality. Dead insects were kept in the same cup and were daily checked for sporulation of the fungus inside the dead insect body. Adults of TPB were held for 10 days in an environmental room at 27ºC, 65% RH, and 12 hr: 12 h (light: dark) photoperiod.. No differences in TPB mortality were found three days after treatment, neither was there any mortality found in the water control (mortality < 0.5%). As expected, high mortality was observed 5 days after *B. bassiana* application where TPB mortality was 80 and 76, for 1% bioplastic and 0.04% Tween-80, respectively. Mortality continued to rise over 10 days. Although the bioplastic formulation promoted fungal sporulation, no significant differences were found between 1% bioplastic and 0.04% Tween-80. Ten days after spraying, sporulation was approximately 95% for both bioplastic and Tween-80.

Survey of Spiders on the Sam D. Hamilton Noxubee National Wildlife Refuge. B. Lyle and J. Guyton.

Over a two year period, we have identified spider species collected on the refuge using a variety of techniques. Our principal method has been the use of pitfall traps that have been placed in rural areas of the refuge as well as closer to areas that are frequently traveled by visitors. We have also utilized nocturnal collecting with spotlights and mercury vapor lights. Sweep netting has been carried out in dense grassy areas, and in the forests we used beat sheets to sample spiders from branches and foliage. The spiders taken to the lab have been keyed out using the most up-to-date keys available. Experts have been contacted to confirm identifications on species where the identity is uncertain. Specimens are being mailed to specialists and identification confirmation is pending. Over the first two years of the project, we have identified just over 60 species of spiders from the refuge, and are continuing to work collecting and identifying. The project will continue over several years, and results are reported to the refuge manager yearly.