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Oral Presentations

Pursuit of the Parumapertus Agent: A Long Lost Tick-borne Rickettsia. J. Goddard, R. M. Goddard and C. Paddock

During the 1950's, an unidentified spotted fever group (SFG) rickettsial organism was reported twice from ticks removed from jackrabbits near Dugway Proving Ground in western Utah. Unfortunately, all samples and isolates were subsequently lost. In July 2013, the authors set out on a quest to find, isolate, and name this unidentified rickettsia in hopes that it might help clarify the ecology of SFG rickettsiae in North America. With appropriate IACUC approval, the authors traveled to western Utah, collected jackrabbits, and examined them for ticks. Seventy-eight adult *Dermacentor parumapertus* ticks were removed from 8 adult *Lepus californicus* in western Utah. For comparison, 13 *D. parumapertus* (found on 4 jackrabbits) were received for analysis from a wildlife biologist in Black Gap Wildlife Management Area, Texas. Preliminary results of tick analysis and rickettsia isolation attempts will be presented and discussed.

Effects of Termites on Wood Decay and Microbial Communities in Flooded and Unflooded Forests. M. D. Ulyshen, S. V. Diel

This study sought to determine how subterranean termites (Isoptera: *Rhinotermitidae: Reticulitermes* spp.) and seasonal flooding affect wood decay and microbial communities. Twenty transects were established in northeastern Mississippi, evenly divided between flooded and unflooded hardwood/pine forests. Two hundred 0.5 m loblolly pine logs were cut from freshly felled trees. One caged log (i.e., to exclude termites) and one uncaged log were placed at five locations in each transect. One pair of logs was collected from each transect every six months over ~31 months. Wood specific gravity was compared between caged and uncaged logs and between flooded and unflooded forests. In addition, 12 wooden stakes were driven into the ground in each transect to compare termite activity between forest types. The stakes were collected after 3, 6 or 12 months to compare termite presence or absence between flooded and unflooded forests. Finally, culturing methods and terminal restriction fragment length polymorphism (T-RFLP) were used to determine how bacterial and fungal communities were affected by termites and flooding after 24 months. Approximately 20.5% and 13.7% of specific gravity loss after 31 months was attributable to insect activity in flooded and unflooded forests, respectively. Subterranean termites were 5-6 times more active below-ground in unflooded forests compared to flooded forests based on wooden monitoring stakes. They were also more active above-ground in unflooded forests but these differences were smaller and not statistically significant. Although seasonal flooding clearly reduced termite activity, it can be concluded from an insignificant interaction between forest type and exclusion treatment that reduced decay rates in seasonally flooded forests were due largely to suppressed microbial activity at those locations. Termites significantly increased the abundance and richness of bacteria. Furthermore, both termites and seasonal flooding significantly altered the composition of bacterial and fungal communities.

Saliva of *Lygus lineolaris* Digests Double Stranded Ribonucleic Acids. M. L. Allen

Pesticides based on double stranded ribonucleic acids have been a recent focus of scientific research. Not all insects are sensitive to double stranded RNA (dsRNA) gene knockdown effects. In my laboratory, knockdown experiments relied on microinjection of dsRNA into the hemocoel of the tarnished plant bug, *Lygus lineolaris*. Subsequent experiments delivering dsRNA to insects by feeding were repeatedly unsuccessful in demonstrating knockdown, and a hypothesis was formulated that the dsRNA was digested and degraded by the insect prior to contact with the insect cells. Exposure of dsRNA to insect saliva, insect salivary glands, and insect hemolymph was compared with commercial RNAase III. The saliva of *L. lineolaris* was found to rapidly digest double stranded RNA. Journal of Insect Physiology, 58:391-396, M. L. Allen and W. B. Walker III 2012.

Are plant trichomes harmful to predatory insects and mites? E. W. Riddick, A. M. Simmons

Plants may use epidermal hairs (trichomes) to defend themselves from attack by herbivores. Predatory arthropods may serve as biocontrol agents against herbivores. Whether or not plant trichomes work in concert with predators is undocumented in many cases. We reviewed the peer-reviewed literature to determine if trichome-bearing plants have neutral, harmful or beneficial effects on predatory insects and mites. We used database resources at the USDA, National Agricultural Library to conduct this review of the literature. We found more than 60 published records that dealt with interactions between plant trichomes and predators. The evidence indicates that plant trichomes have more harmful than beneficial effects on the life history of many predators. Most harmful effects involve negative alterations to development, oviposition, foraging and predation potential. In worst cases, predators are trapped in glandular exudates or on hooked tips of non-glandular trichomes. Entrapped predators eventually die from desiccation or starvation. Plants with high trichome density (with or without associated glands) appear to cause the most harm to predators foraging for prey. When developing and testing cultivars with increased trichome-based resistance to herbivory, we should determine if these technologies are compatible with predators.

Dr. George H. Bradley and the Southern Buffalo Gnat in Mississippi and Arkansas. K. T. Edwards, J. Goddard

Dr. George Hirst Bradley (1893-1993) was head of the Entomology Division, Office of Malaria Control, Public Health Service, and a veteran public health service officer for the Center for Disease Control during World War II. He later became Chief Entomologist with the CDC in Atlanta.

He obtained his BS in biology and his PhD in medical entomology from Cornell in 1916 and 1949, respectively. Dr. Bradley was past president of the National Malaria Society, a U.S. Delegate to the Eighth International Congress on Entomology at Stockholm, Sweden in 1948 and a U.S. delegate to the First Inter-American Congress of Tropical Medicine and Hygiene in Havana, Cuba, in 1953. Dr. Bradley was a veteran of World War I and a member of the American Legion. The first and only Dr. Thomas J. Headlee Memorial Award was given to George H. Bradley by the American Mosquito Control Association in 1968.

In the Mississippi Entomological Museum (MEM), Mississippi State University, we discovered numerous stacks of type-written manuscripts authored during the 1930s by Dr. George H. Bradley, some including original photographs. Dr. Bradley served as Associate Entomologist for the Division of Insects Affecting Man and Animals, Bureau of Entomology and Plant Quarantine, USDA in the 1930s. During that time he made an

extensive study of the buffalo gnat, *Eusimulium pecuarum* Riley, in Mississippi and Arkansas. He published at least two papers on this work, both in 1935: Other than those two publications, short summaries of his research appear in the USDA, Insect Survey Bulletin Archives from 1928 to 1937, but most of these manuscripts remain unpublished and represent an enormous body of research conducted by Dr. Bradley. We have compiled them into a cohesive unit in order to capture the historical perspective and economic impact of the Southern Buffalo Gnat in the south at that time, including loss of over 500 mules in Arkansas in 1932. These papers also document the various methods used to try to control these insects, which at times were useless and at other times, cruel. Soon, we hope to make these papers open to the public and interested scientists.

Development Time and Survival of Delta and Hills Populations of Tarnished Plant Bug (*Lygus lineolaris*) on Various Diets. D. Fleming and F. Musser

Lygus lineolaris is a major crop pest, especially of cotton, in the mid-south agricultural region of the United States. Economic data indicates that *L. lineolaris* is more damaging to cotton in the Delta region than in the Hills region of Mississippi. Previous research has shown that biological differences exist between the Delta and Hills populations of *L. lineolaris* reared on cotton and artificial diet. This study was conducted to determine if the previous differences seen could be repeated and if differences could be seen on a larger array of food types. Comparisons were made of development time and survival of *L. lineolaris* reared on artificial diet, broccoli, cotton, corn, green bean, and pigweed. There was no interaction of Region*Food type effect of region for any of the developmental or survival variables measured. Food type had a significant effect on all variables measured.

Efficacy and Longevity of Diamide Insecticides in Mississippi Soybean Production. A. Adams, J. Gore, A. Catchot, D. Cook, F. Musser

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 in 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.

To determine the systemic nature and longevity of Prevathon and Belt, bioassays were conducted in the summer of 2013 at Mississippi State University. Leaf material was collected from field plots located on the Mississippi State University North Farm. Treatments were applied on 28 August 2013 and 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 at 11, 18, 25 and 32 days after treatment (DAT). 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. Two 1st instar corn earworm, *Helicoverpa zea* (Boddie), larvae were placed on leaf material in each 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 their 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.

Cold Tolerance of the Redbay Ambrosia Beetle (*Xyleborus glabratus*) - Implications for Invasion Potential in North America. J. P. Formby, N. Krishnan, and J. Riggins

The redbay ambrosia beetle, *Xyleborus glabratus* Eichoff, (Coleoptera: Curculionidae: Scolytinae) is an invasive pest of North America trees and shrubs in the family Lauraceae. The beetle vectors the fungal pathogen, *Raffaelea lauricola*, the causative agent of laurel wilt disease (LWD). To date, the disease has killed millions of native redbay (*Persea borbonia*) trees. Laurel wilt disease has recently moved out of redbay and into sassafras (*Sassafras albidum*), which ranges throughout the eastern U.S. and into southern Ontario, Canada. Widespread sassafras mortality could have profound ecological consequences; furthermore, there are several other laurel species that share similar distribution. Regrettably, insecticides have been ineffective against *X. glabratus* and mortality due to low temperatures may be the only realistic factor limiting northern range expansion. To begin to understand the limiting temperatures and the North American invasion potential of *X. glabratus*, the supercooling point (SCP) was experimentally determined on field-collected and artificially cold hardened specimens. Supercooling point is an important physiological reference point for cold tolerance studies and could provide useful insights into the invasive potential of *X. glabratus*. Field-collected beetles were trapped in symptomatic redbay stands using Lindgren funnel traps baited with manuka oil lures. Testing was performed June through August 2011. Specimens obtained for cold hardening were reared from symptomatic redbay bolts and cold hardened at a thermo-photoperiod of 7 ºC:2 ºC for 31 days. Field-collected and cold hardened *X. glabratus* supercooled to a mean (±SE) temperature of -21.7ºC ±0.5ºC and -23.9ºC ±0.4ºC, respectively. A significant negative trend in the SCPs of field-collected beetles occurred over the summer testing period. Artificial cold hardening significantly lowered the SCPs compared to field-collected beetle SCPs. Biometrics of *X. glabratus* (size, weight, and size x weight interaction) had no effect on the mean supercooling SCPs of either field-collected or artificially cold hardened beetles. Based on the mean SCPs*, X. glabratus* and LWD could theoretically impact Lauraceae throughout North America. However, subsequent studies of long-term durations to low temperatures on *X. glabratus* have shown mortality at higher temperatures. Using artificially cold hardened *X. glabratus* ~90% mortality was observed at a thermoperiod of -10ºC for 10 hours. The results of the combined studies indicate that *X. glabratus* has high thermal plasticity. This may allow *X. glabratus* to spread throughout much of eastern North America; however, the beetle may be limited by low temperatures from exploiting all of Lauraceae throughout this range.

The Effects of Simulated Corn Earworm Damage in Soybean. B. Adams, A. Catchot, D. Cook, J. Gore, and F. Musser

In order to evaluate damage and compensation levels of newer indeterminate soybean varieties to corn earworm damage, a simulated experiment was performed. A maturity group four indeterminate variety was planted at two locations in Mississippi and received 0, 50, or 100% pod removal at four growth stages: R2, R3, R4, and R5. It was found that simulated corn earworm damage caused significant maturity delays from the untreated control expressed as percentage of dropped leaves 137 DAP as early as R3 at 100% removal and all removal levels of the R4 and R5 treatments. We also observed a significant maturity delay expressed as a percentage of green stems present per plot from the untreated control for both removal levels of the R5 treatment. Significant yield loss was observed for each level of removal beyond the untreated control. Some growth stages and removal levels appeared to compensate for fruit loss through increased pod load and increased seed count; however it wasn't always reflected in the yield. This

indicates that seed size and seed weight were likely more important factors in yield contribution.

Predictive Value of Gravid Trapping and Testing of Female *Culex quinquefasciatus* Mosquitoes for West Nile Virus in Mississippi. W. C. Varnado and J. Goddard

Mississippi consistently ranks in the top 5 states of West Nile Virus cases per 100,000 population and there was a large WNV outbreak last year (2012) in Mississippi with 247 human cases and 5 deaths, so WNV surveillance and control methods are definitely warranted. This study evaluated the efficacy and predictive value of setting gravid traps for mosquitoes in selected sites in Mississippi and testing specimens collected for the presence of WNV. This practice is premised upon the idea that WNV shows up in mosquito populations weeks before human cases occur, giving mosquito control personnel ample time to conduct intensive mosquito control in affected areas. Results of this three-year study will be presented and discussed.

Case of Enteric Myiasis Caused by Larvae of the Soldier Fly, *Hermetia illucens*. K. Hoppens, J. Goddard, K. Lynn

Myiasis is the term used to describe invasion of human or animal tissues by fly larvae. Here we present a case of a seven year old female Caucasian from north Mississippi who experienced coughing, nasal congestion, nausea, and vomiting for about two days. En route to the clinic, the girl vomited and the mother observed a live worm-like creature in the vomit. She collected the specimen and presented it to her healthcare provider upon arrival at the clinic. The patient was treated symptomatically for the wheezing with albuterol sulfate 0.083% and Pulmicort 0.5 mg/ml. The larva was sent to Mississippi State University where it was identified as *Hermetia illucens* by both the senior author and a second expert in entomology. The origin of this accidental myiasis case is unknown, but the mom reported that her daughter had eaten plums or muscadines 24 hours prior to vomiting. *Hermetia illucens* eggs or larvae may have been present on the fruit when the patient ate them. It is reasonable to assume that the enteric myiasis may have caused the nausea and upset stomach in this patient. Her wheezing and nasal congestion were most likely unrelated to the myiasis. This report documents a bona fide case of enteric myiasis caused by *Hermetia illucens*.

Impact of Tarnished Plant Bug, *Lygus* lineolaris (Palisot de Beauvois), on Yield and Maturity of Cotton. W. Wood, J. Gore, A. Catchot, C. Dobbins, B. Olivi

The tarnished plant bug, Lygus lineolaris (Palisot de Beauvois), has become the primary pest of Midsouth cotton over the past decade. Numerous foliar insecticide applications have to be made during the growing season to suppress the tarnished plant bug and to protect cotton from extensive yield loss caused by this pest. New methods of control are needed to conserve grower's money, improve yields, and lower the amount of insecticide resistance that is occurring in tarnished plant bug populations. Experiments were conducted at the Mississippi State University Delta Research and Extension Center, located in Stoneville, Mississippi, to determine the impact of tarnished plant bug infestation on yield and maturity of cotton. Weeks within the flowering stage from two separate planting dates were tested to determine the critical period when cotton is most susceptible to damage from the tarnished plant bug. Results from these trials will be discussed.

Arthropod Contributions to Fine Woody Debris Decay in a Warm Temperate Forest. A. M. Stoklosa, M. D. Ulyshen, Z. Fan

Decomposition of plant debris is an important but incompletely understood process. This is especially true for fine woody debris (i.e. material less than 10cm in diameter) that has been largely neglected in decay research relative to leaf litter and coarse woody debris (Harmon et al. 1995, Müller-Using and Bartsch 2009). The decay process relies heavily on microbial activity and environmental conditions, but the influence of arthropods remains relatively unclear (Harmon et al. 1986, Rayner and Boddy 1988). In this ongoing study, mesh bags are being used to exclude arthropods from small diameter Chinese tallow (*Triadica sebifera* L. Small) twigs in a mature mixed pine/hardwood forest in northeastern Mississippi, USA. The study consists of two mesh sizes (300µm and 1000µm) and a no-mesh treatment, with three size classes of Chinese tallow twigs collected every 4 months over a 2-yr period. Preliminary findings at four months show an overall mass loss of 7% with no significant differences between treatments with respect to mass loss or moisture content. Past studies employing the use of mesh bags have rarely addressed the potential for mesh bags to affect decay beyond the exclusion of insects, i.e., by affecting substrate moisture or other physical conditions likely to impact microbial activity (Kampichler and Bruckner 2009). We are testing a novel method aimed at addressing this concern.

Impacts and Species Composition of Thrips on Seedling Cotton in the Mid-South. J. North, A. Catchot, J. Gore

The effect of preventive, insecticidal/nematicidal seed treatments on thrips species composition is reported as part of a regional cotton project that was initiated in 2009. The treatments were Aeris or Avicta seed treatments, Temik applied in furrow and an untreated control. Thrips species varied greatly among the 17 locations, which included 2010 Beltwide Cotton Conferences, New Orleans, Louisiana, and January 4-7, 2010 906 trials within Arkansas, Georgia, Louisiana, Mississippi, Missouri, North Carolina, South Carolina, Texas, and Virginia. *Frankliniella fusca* (Hinds), tobacco thrips, was identified from fifteen locations; *Thrips tabaci* Lindeman, onion thrips, was found at 6 locations; *F. occidentalis* (Pergande), western flower thrips, and *Neohydatothrips variabilis* (Beach), soybean thrips, were found at 11 locations; and *F. tritici* (Fitch), flower thrips, was identified from 13 locations. Tobacco thrips was the dominant species at all locations except four. The overall distribution of thrips species relative to preventative insecticides appears not to differ greatly among treatments, although tobacco thrips ranged higher in numbers throughout the untreated checks than in the seed treatments and Temik treated plots. This indicates more species may be less susceptible to the insecticides than tobacco thrips.

The Pest Status of Three-cornered Alfalfa Hopper in Mississippi Soybean. J. Ramsey, A. Catchot, D. Cook, J. Gore

Three-cornered alfalfa hopper is a common pest of soybeans. Previous research has shown that the former treatment threshold of 1 TCAH/sweep is too low, but it is still unknown what the higher threshold should be. Currently the threshold is 2 TCAH/sweep. Three-cornered alfalfa hoppers can be found on soybean from seedling emergence until physiological maturity. Early season feeding on vegetative soybeans can be economic, but many fields are planted with treated seed which provides some protection from early season feeding. Most foliar applications targeting TCAH occur during later reproductive stages. From 2007 to 2011, an average of 22% of soybean acreage in MS was sprayed for TCAH. However, in research trials, we have not been able to document any yield loss from TCAH feeding during reproductive stages. It is expected that the number of

insecticide applications targeting TCAH will decrease as a result of this research and the insecticides applied will be used more effectively.

Impact of Planting Date and Maturity Group on the Occurrence of Lepidopteran Pests in Mississippi Soybean. N. Bateman, A. Catchot, J. Gore, D. Cook

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 R. R. Foil Research 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.

Attempts to Feed Larval Ticks, *Amblyomma maculatum* Koch and *A. americanum* (L.) (Acari: Ixodidae) on Two Arthropod Hosts. J. S. Portugal, J. Goddard

Ticks have been occasionally reported from arthropods such as beetles, flies, and bees. This study evaluated whether two tick species, *Amblyomma maculatum* and *A. americanum* (L.), can feed on two common insects, the European honey bee (*Apis mellifera*) and the house cricket (*Acheta domesticus*) whose distributions overlap that of the ticks. Approximately 25 larval ticks were placed inside clear plastic tubes containing one of the test insects and the observations were made every 24 hours until 72 hours when the tube was frozen and the insect then examined microscopically for attached ticks. This procedure was repeated 3 times with both crickets and honeybees for each of the two tick species. No ticks were seen actually attached to the crickets or honeybees at any of the observational periods. However, in a few cases, ticks gave an appearance of being sequestered or attached, although penetration with the mouthparts could not be verified. Sixteen ticks (*A. americanum*) exposed to the crickets appeared slightly larger than other (unexposed) ticks from the colony, however after washing and closer examination of the gut contents, no evidence of feeding could be found. Further investigation should be undertaken to explore the possibility of ticks utilizing invertebrates as hosts.

Drift and Deposition of Neonicotinoid Contaminated Seed Lubricants on Wild Flowers. A. Whalen, A. Catchot, J. Gore, G. Lorenz, S. Stewart, D. Cook, F. Musser, and J. Harris

Populations of honey bees have declined worldwide in recent years. One suspected cause is the widespread use of pesticides in agriculture, specifically neonicotinoid seed treatments. When treated seeds are planted using a vacuum controlled planter, talc or graphite is mixed with the seed to serve as a lubricant and to help the seeds properly flow through the system. The exhaust fan operating this vacuum system blows these seed lubricants as well as minute pieces of seed treatment into the environment where it may interact with foraging honey bees by settling on flowering vegetation. To access these risks, an experiment was conducted to determine at what concentrations neonicotinoid containing seed lubricant exhaust settles on marigold flowers. Talc, graphite, and a new experimental fluidity powder were tested using two different rates of clothianidin, 0.5

mg/seed and 1.25 mg/seed. Marigold flowers were set downwind at distances of 0, 5, 20, 50, and 100 m away from a planter planting corn treated with the two different seed treatment rates. One marigold pot was set at 20 m upwind of the planter to serve as a negative control. Flowers from the marigold plants were sampled and tested for clothianidin using liquid chromatography/mass spectrometry.

Factors That Impact Headworm Management in Grain Sorghum. C. Dobbins, J. Gore, A. Catchot, D. Cook, B. Olivi

There are several key insect pests that target the heads of grain sorghum. These insects include the sorghum midge, the bollworm *Helicoverpa zea* (Boddie), the fall armyworm *Spodoptera frugiperda*, and the sorghum webworm *Nola sorghiella*. The sorghum midge causes damage to individual seed resulting in shriveled, discolored seed coats. Female midges lay eggs during the early bloom stages and do not cause any damage to the plant. Larvae hatch out and begin feeding on the individual seed causing a loss of yield if left untreated. Threshold for sorghum midge is one adult per head. Bollworms, fall armyworms, and sorghum webworms together are known as the headworm complex in grain sorghum. Bollworms and fall armyworms can both cause damage to the whorl before bloom and can also cause damage to the head after bloom. These larvae feed on individual seed and can cause significant yield loss if left untreated. Threshold is one per head for each species and 75 to 100% infestation in the whorl. Sorghum webworms also cause damage to individual seed resulting in yield loss. It takes a lot more sorghum webworms to cause a loss in yield. Threshold is 5-6 larvae per head. There were two planting dates in this experiment and plots were set up in a randomized block design. An automatic midge application was made at 25% bloom. Plots were sampled until worm populations reached threshold. Once threshold was reached another application was made. Samples were collected until plants reached the late dough stage. Data was collected to determine the impact of midge applications on headworms and the residual activity that diamides had on worm populations.

Residual Efficacy of Chlorantraniliprole and Flubendiamide against Fall Armyworm in Field Corn. B. Olivi, D. Cook, F. Musser, C. Dobbins, J. Gore

Spodoptera frugiperda (J.E. Smith), are major defoliators of field corn in the southern U.S. They primarily feed within the whorl of field corn, but can also feed during the reproductive stages and impact yield. Experiments were conducted at the Delta Research and Extension Center in Stoneville, MS to determine the residual efficacy of chlorantraniliprole and flubendiamide against fall armyworms in field corn. Selected insecticides were sprayed at different growth stages of field corn. Fall armyworms (1st instar), were infested artificially in field corn tissue samples. Samples ranged from non-treated, treated with chlorantraniliprole, and treated with flubendiamide. Samples were rated for mortality 48 hours after infestation, and results will be presented in this presentation.

Distribution of *Helicoverpa zea* (Boddie) and *Heliothis virescens* (F) in Cotton/Soybean Landscapes. T. D. Dill, A. Catchot, J. Gore, F. Musser, M. Caprio

In recent years cotton acres have declined substantially in the Midsouth while corn and soybean acres have expanded. As a result, there is increased interest from producers and industry in the Midsouth to have commercial access to transgenic soybean varieties that express the Bt-toxins to assist management of lepidopteran pests. Currently, soybeans are valued as an influential component to the natural refuge concept in producing susceptible individuals to the *H. zea* and *H. virescens* population. Further research must be generated to understand the possible influence of Bt-soybeans to the natural refuge system in place for cotton.

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, five foot of row were removed and visually sampled for number of eggs present and location of eggs deposited on plants. Differences were observed in oviposition on crop hosts and between species.

Poster Presentations

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

In recent years cotton acres have declined substantially in the Mid-South while corn and soybean acres have expanded. As a result, there is increased interest from producers and industry in the Mid-South to have commercial access to transgenic soybean varieties that express the Bt-toxins to assist management of lepidopteran pests. The bollworm, *Helicoverpa zea* (Boddie), can be found in the majority of corn acres across Mississippi in early to mid-season. Late generations of the bollworm will develop on non-corn crop hosts such as cotton, soybeans, sorghum, peanuts, and wild plant hosts after the corn has senesced. Late generations could potentially develop on Bt-crops and develop resistance evolution to Bt-proteins. It will be important to evaluate the adult emergence of H. zea from corn.

An experiment was conducted at the Delta Research and Extension Center in Stoneville, MS to evaluate pupal duration and the effects of water on adult emergence of *Helicoverpa zea*. Non-Bt corn was planted late to attract heavy populations of H. zea. A natural infestation of H. zea larvae were established in the ears and a screen cage was placed over the 0.125 acre cage to prevent further oviposition. When larvae have left the ears and pupated in the soil, the corn plants were cut by hand at the soil surface and removed from the cages. Additionally, regular sprays with Gramoxone were made to ensure that there was no living plant material that could support the development of late developing larvae. A black light trap was placed in each cage to collect moths emerging from the soil. The trap was checked daily and the numbers of moths were recorded along with soil moisture.

Impact of Leaf Pubescence and Irrigation on Tarnished Plant Bug in Cotton. W. Wood, J. Gore, D. Cook, J. Krutz, A. Catchot

The tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois), is the most important insect pest of cotton in the Midsouth. Foliar insecticide applications are the main form of control for the tarnished plant bug, and multiple treatments must be made during the growing season to keep the pest suppressed. Cost of these insecticide applications have increased throughout the past years, with the average per acre cost of control during the growing season being slightly over 100 dollars. Improved cultural control practices are needed to protect cotton and conserve grower's money. Experiments were conducted at the Mississippi State University Delta Research and Extension Center, to determine the impact of leaf pubescence and irrigation methods on populations of tarnished plant bug and their injury. A smooth leaf variety, semi-smooth leaf variety, and a pilose variety were planted to determine the effects of leaf pubescence on the tarnished plant bug. Tarnished plant bug populations were sampled once a week in all plots. Before first flower, 25 sweeps using a standard 38 cm diameter sweep net was used to determine population numbers, and after first flower two drop cloth samples were taken per plot using a 0.76 m black drop cloth. Node above white flower counts and square retention

were also taken weekly for all plots. The pilose variety received the highest amount of tarnished plant bug pressure, yet, it still retained the highest number of squares and had the highest yield. A separate experiment utilized irrigation timings to determine if there was an effect on tarnished plant bug control. Irrigation was initiated at early squaring, first flower, and peak flower, with all timings containing weekly, threshold or un-sprayed plots. Prior to first flower, 25 sweeps using a standard 38 cm diameter sweep net was used to determine population numbers, and after first flower two drop cloth samples were taken per plot using a 0.76 m black drop cloth. These samples were taken twice a week. Plant height, node above white flower counts, and square retention were conducted once a week. It was found that tarnished plant bugs will still infest dryland cotton in the same numbers as irrigated cotton, and by delaying irrigation it is possible to reduce the number of insecticide applications that are needed to control the tarnished plant bug.

The Effect of Circadian Rhythm on the Polygalacturonase Gene Expression of the Tarnished Plant Bug, *Lygus lineolaris.* D. Fleming, N. Krishnan, F. Musser

Polygalacturonase (PG) is an enzyme found in the salivary glands of *Lygus lineolaris* and is used to breakdown plant pectins during feeding. The factors involved in the expression of the PG gene is not well understood, and previous data (unpublished) has shown a high level of variation in PG gene expression. This experiment was conducted to determine if circadian rhythm had an influence on PG gene expression in *L. lineolaris*. Adult *L. lineolaris* from a colony fed artificial diet at the Mississippi State University Insect Rearing center were used in this experiment. Polygalacturonase gene expression of the PG1, PG2, and PG3 genes was measured for both males and females at the times of 9am, 1pm, 5pm, 9pm, 1am, and 5am. The results indicated that there was no interaction between sex and time for any of the three genes. Both time and sex were significant factors for PG1 and PG2, however they were not found to be significant for PG3.

Methodology for Running Diet Incorporated Dose-Mortality Bioassays with the Diamides. A. Adams, J. Gore, A. Catchot, D. Cook, F. Musser

Recently the diamides, a new class of insecticides, has been introduced for Lepidopteran control in Mississippi. These insecticides are used on a large scale in Mississippi soybean production under the trade names of Belt and Prevathon. These insecticides act on the ryanodine receptors in muscle cells. In contrast, most insecticides targeting caterpillars act on the nervous system. Historically, the criteria for determining mortality were based on flipping the larvae on its dorsal surface and failure to right itself was considered dead. With the diamides larvae become severely stunted while still maintaining locomotive function. The difference in larval size made it difficult in determining mortality because larvae that weighed >1 mg functioned as well as larvae weighing <100 mg. In order to develop new criteria for mortality, larval weights were recorded and analyzed using Probit Analysis in SAS to find the larval weight that best determines mortality.

Notes and New Distributional Records of Invasive Ants in the Southeastern United States. J. A. MacGown, H. Richter, R. Brown

As a result of increased world trade, alien species are now regularly introduced into new regions. In the United States, ants have proven to be among the most successful of these species to establish populations. The Southeast has been especially susceptible to introduced ant species becoming established with at least 75 alien species known to occur in the region. Based on large population levels, difficulty to control and overall negative impacts to natural ecosystems, mankind, and agricultural systems, several of these alien species are considered to be invasive. The economic impact of these invasive species can be measured in the billions of dollars spent annually. With global warming

becoming a reality, invasive species and other alien species of ants are spreading farther northward than early models predicted. In addition to the well-known invasive species *Solenopsis invicta* (red imported fire ants) and *Linepithema humile* (Argentine ants), several lesser known invasives including *Nylanderia fulva, Brachymyrmex patagonicus, Pseudomyrmex gracilis, Hypoponera punctatissima*, and *Pachycondyla chinensis* have shown marked spread in the region during recent years. Here, we give a brief overview of some of these less well-known invasive ants and their distributions in the southeastern United States.

Results from the Regional Identification Center of the USDA-APHIS (Eastern Region) for the 2013 Wood Boring Beetle Surveys, Including New County Records. J. Seltzer, T. Schiefer, R. Brown

Since 2009 the Mississippi Entomological Museum (MEM) has served as a Screening and Identification Center for the USDA-APHIS Eastern Region. Currently the Screening Center supports Cooperative Agricultural Pest Surveys in Mississippi, Alabama, Kentucky and Tennessee for exotic wood borers/bark beetles, *Sirex* woodwasps, and a wide range of Lepidoptera pests. A total of 3963 samples were received for screening and identification between January 1, 2013 and October 1, 2013. Each year the Screening Center has seen an increase in the number of samples submitted for screening and the number of positive samples identified. Last year 32 positive specimens were identified from 20 samples, compared to a total of 132 positive specimens from 67 samples this year. The increase in positive samples can be partially attributed to the spread of *Ambrosiodmus minor* in Alabama into an additional twelve counties this year: Autauga, Bullock, Coffee, Covington, Dale, Escambia, Henry, Lowndes, Madison, Mobile, Pike, and Russell were recorded. The expansion of *Xyleborinus octiesdentatus* (Murayama) in Mississippi into the following new counties has also accounted for this increase: Stone, George, and Greene.

Using our Natural Resources to Control Mosquitoes: The Louisiana Native Plant Initiative. W. Dees, A. Richard, J. Dupre, S. McMicken, O. Christian, C. Richmond, J. Hightower, J. Woolman

The objective of the Louisiana Native Plant Initiative is to study native plants from Louisiana ecosystems with the purpose of conserving vanishing natural resources and providing for the development of a native plant seed industry that will supply plant materials for restoration, re-vegetation efforts, roadside plantings and the ornamental plant industry. To this end, the Biomedical Entomology Research Laboratory at McNeese State University is investigating the effect of these plants on medically important arthropods (e.g., mosquitoes, biting/nuisance flies and fire ants) to determine if native plant components and/or derivatives (e.g.,extracts) alter arthropod behavior and development. Information obtained from these investigations may lead to innovative area-wide (landscape) pest management methodologies as well as novel personal protective measures against biting arthropods. Current studies focus on the effect of botanical components on mosquito behavior and development. We evaluated the effect of plant extracts (hexane, acetone and methanol) of Rattlesnake Master, *Eryngium yuccifolium*, Cluster Bushmint, *Hyptis alata*, and Wooly Rose Mallow, *Hibiscus lasiocarpus*, and freshly-cut plant parts of *E. yuccifolium*, Coreopsis*, Coreopsis lanceolata*, American Beautyberry, *Callicarpa americana*, and Slender Mountain Mint, *Pycnanthemum tenuifolium*, on female *Aedes aegypti* mosquitoes. We observed up to 85% mortality in adult mosquitoes after 24 h exposure to freshly-cut flowers of *E. yuccifolium*, and 57% mortality after 24 h exposure to methanolic extracts of *E. yuccifolium* buds. After 7 days (168 h), we observed 96% mortality in mosquitoes exposed to hexane extracts of *Hyptis alata* stems and 93% mortality in mosquitoes exposed to methanolic extracts of *E.*

yuccifolium buds, respectively. Supported in part by NRCS Chenier Plain Sustainability Initiative Collaboration and Louisiana Mosquito Control Association.

Mosquito Oviposition Response to Botanical Extracts. W. Dees, J. Dupre, A. Richard, O. Christian, S. McMicken, C. Richmond, J. Hightower, J. Woolman

We evaluated the effect of plant extracts on ovipositing *Aedes aegypti* mosquitoes. Choice bioassays were conducted in screened cages containing plastic cups lined with seed/germination paper on which eggs were deposited. The cups contained hexane, acetone and methanolic botanical extracts in distilled water. Extracts consisted of the following plant parts: (1) Cluster Bushmint, *Hyptis alata* (stems and roots), (2) Wooly Rose Mallow, *Hibiscus lasiocarpus* (stems and roots), and (3) Rattlesnake Master, *Eryngium yuccifolium* (buds, stems and roots). The bioassay was conducted for 24 h. After 24 h, the seed paper in each cup was removed and the eggs on each seed paper were counted. The oviposition activity index (OAI) for each extract was calculated. Only the hexane extracts of *E. yuccifolium* buds and roots and the acetone extract of *E. yuccifolium* stems repelled ovipositing mosquitoes. Hexane extracts of *E. yuccifolium* stems slightly attracted ovipositing mosquitoes. Methanolic extracts of *Hyptis alata* roots and *E. yuccifolium* stems and roots also were slightly attractive. All extracts of *Hibiscus lasiocarpus* roots showed the greatest attraction to ovipositing mosquitoes (OAI range: (+) 0.32-0.41 on a scale of (+) 1 (attraction) to (-) 1 (repellency)). Supported in part by NRCS Chenier Plain Sustainability Initiative Collaboration and Louisiana Mosquito Control Association.

The Effect of Plant Parts from Seven Plant Families on the Yellow Fever Mosquito, *Aedes aegypti*. W. Dees, J. Theriot, J. Byrne, K. Leonards, A. Richard, J. Dupre, C. Ardizzone, T. Estrada, O. Christian, C. Richmond, J. Hightower, A. Daugereaux, S. Mopper, J. Woolman

We evaluated the effect of freshly-cut berries, flowers (petals), buds, leaves, stems, and seeds from seven plant families on female *Aedes aegypti* mosquitoes. Plant families included: Lythraceae, Apiaceae, Asteraceae, Lamiaceae, Verbenaceae, Apocynaceae, and Malvaceae. Standard plastic Petri dishes were used to hold mosquitoes and cut plant parts from 16 plant species. We recorded percent mortality at 24 and 48 h. Three tests per plant part using ten mosquitoes per test were conducted. A 10% sucrose solution served as a food source for mosquitoes during the Petri dish tests. Mosquitoes exposed to fresh-cut flowers (petals), buds, leaves, stems, and seeds from Asteraceae, Apiaceae, and Lamiaceae exhibited over 50% mortality when compared with the controls. These families are in the plant subgroup known as Asterids, a large subgroup of the flowering plants. Genera of interest include: *Chrysanthemum* (*Chrysanthemum* spp. – e.g., Spider Mum), *Eryngium* (e.g., *Eryngium* yuccifolium – Rattlesnake Master), *Eupatorium* (e.g., *Eupatorium capillifolium* – Dog Fennel), *Rudbeckia* (e.g., *Rudbeckia texana* – Texas Cone Flower), *Monarda* (e.g., *Monarda fistulosa* – Bee Balm), and *Pycnanthemum* (e.g., *Pycnanthemum muticum* – Blue Mountain Mint and *P. tenuifolium* – Slender Mountain Mint). Mosquitoes exposed to different parts of a chrysanthemum plant (flowers, buds, leaves and stems) exhibited 100% mortality in 24 h. Mosquitoes exposed to cut buds of *Pycnanthemum muticum, P. tenuifolium*, and *Monarda fistulosa* exhibited 100% mortality in 24 h. Several species are native to Louisiana and some are considered ethnobotanicals. Supported in part by NRCS Chenier Plain Sustainability Initiative Collaboration and Louisiana Mosquito Control Association.

Comparison of the Genitalia from Northern and Southern Populations of *Neonympha mitchellii* (French), including *N. francisci* (Pearson and Kral). J. Seltzer, J. Hill

The Mitchell's satyr, *Neonympha mitchellii mitchellii* (French), often cited as one of the rarest butterflies in North America, (Parshall and Kral 1989, Michigan DNR 2011, US Fish and Wildlife Service 2011) was first described from southern Michigan (French 1889) with additional populations in Indiana and extirpated populations in Ohio, New Jersey and Maryland. Parshall and Kral (1989) described another subspecies, *N. mitchellii francisci*, from US Department of Defense lands in Fort Bragg, North Carolina. Between 2000 and 2003 additional populations of *N. mitchellii* were discovered in Alabama and Mississippi. While these populations are protected under the Endangered Species Act, their taxonomic status and relationship to the Northern populations have not been fully addressed. Differences in their flight periods, behavior, and plasticity in optimal habitat suggest that the southern populations might represent a new subspecies. However, initial DNA testing by C. Hamm (2011), indicates that the southern populations do not separate out from the northern populations, and thus remain taxonomically unresolved. As part of an effort to resolve the taxonomic status of the southern populations, comparisons between the genitalia of these populations are presented.