SERA-IEG3 2008 ANNUAL REPORT FOR ALABAMA

Henry Fadamiro

PROGRAM MANAGEMENT:

The mission of the Alabama Integrated Pest Management (IPM) program is to facilitate implementation of economically and environmentally sound IPM practices in traditional and non-traditional agriculture in Alabama. The program is a diverse and interdisciplinary effort driven by stakeholder needs and enhanced by collaboration between IPM specialists and other stakeholders. Alabama currently has active IPM programs in the following key commodity areas/settings: agronomic/row crops (e.g., grain crops, soybeans, and peanuts), cotton, fruit and vegetable crops (e.g., citrus, peaches, tomato, cruciferous crops, and organic vegetable production), fire ants, and school/community IPM. We have active applied research programs and have established a team of extension/research IPM specialists with expertise from across all pest disciplines in most of these areas. A large portion of Alabama's Smith Lever 3(d) formula funds has traditionally been used to support specialist/faculty salaries working on IPM of some of the above commodity areas. General IPM-related activities in Alabama include evaluation and training of clientele, stakeholders and extension agents on IPM tactics, and applied research. Survey programs are active in most areas to detect introduced and exotic pests. The Plant Diagnostic Laboratory at Auburn University (AU) also provides IPM-related service by providing plant pest diagnosis. Alabama has also set aside a portion of its Smith-Lever 3(d) funds for the Alabama IPM Competitive Minigrant Program to provide small (seed) grants for IPM education, extension, demonstration, and implementation projects in the state. The Alabama IPM program is managed by the state's IPM coordinator (Dr. Henry Fadamiro) with inputs from the Alabama IPM Advisory Board (note that the program pays only the 3-month summer salary of the IPM coordinator annually).

PROGRAM DELIVERY:

The Alabama IPM Program funded 10 IPM minigrant projects for total of ~$22,000 during the 2007 funding cycle (March 1, 2008 – February 29, 2009). Funded projects covered different pest organisms (i.e. diseases, insects and weeds) and commodity areas/settings. A list of funded projects is available online at www.alabamaipm.com. Examples include: i) Hydroponic strawberry production utilizing the Hydro-Stacker vertical growing system; ii) Weed Identification and Management Techniques for Alabama Forage Producers; iii) On-Farm Cotton Pest Management Evaluation of the New Insecticide, Fungicide and Nematacide Seed Treatments; iv) Evaluation of Peach Fruit Bagging as an Alternative Pest Management Practice in Home Orchards; v) Central West Alabama / Black Belt Fruit and Vegetable IPM Training Program; and vi) Fruit Pest Monitoring and Management.

The IPM coordinator continues to maintain the Alabama IPM website, which was established in November 2005. This website is available at http://www.aces.edu/anr/ipm/ OR www.alabamaipm.com. The website contains information on program objectives, activities, personnel, IPM information on various commodity areas in Alabama, IPM-related news, links to Alabama IPM publications and crop profiles, as well as links to the Southern Region IPM Center, IPM programs for other southern states, and relevant federal and state websites.

One major pest-related event in 2008 was the detection of the Asian citrus psyllid *(Diaphorina citri*) in the fall of 2008 on Satsuma citrus at several locations in Baldwin County, South Alabama. The Asian citrus psyllid (ACP) was first found in Florida in 1998 and has also been recently discovered in Louisiana, Texas, Georgia, Mississippi, South Carolina, and California. ACP is the most efficient vector of citrus greening disease bacterium, *Candidatus Liberobacter asiaticum*. Citrus greening (also called Huanglongbing) is one of the most serious diseases of citrus causing reduced production and eventual tree death. So far, none of the ACP-infested citrus trees and insect samples collected in Alabama have tested positive for greening. Nonetheless, the entire state of Alabama (and most other Gulf Coast states) has been placed under quarantine by the USDA-APHIS-PPQ. The disease and vector complex currently poses a major threat to the budding Alabama Satsuma citrus industry and has the potential to significantly impact citrus production in the Gulf Coast. In September 2008, the Alabama IPM Coordinator established a working group for Citrus Greening/Vector in the state. The group was charged with formulating and coordinating a game plan for managing the pest/disease complex in Alabama, including quarantine, education, pest surveys, research, and management strategies. Since that time, the group has organized (in conjunction with the Alabama Department of Agriculture & Industries) several meetings and workshops to educate the public on citrus greening and train growers on the identification, biology, sampling and management of the vector. In addition, several pest identification and educational materials were developed and distributed to growers and extension agents. Other activities related to citrus greening include media/press releases. Other programs with significant accomplishments during 2008 include Fruit & Vegetable IPM, School IPM, and Fire ant IPM programs. Implementation of IPM programs for key commodities in Alabama has allowed farmers to protect their crops with practices and materials that pose minimal health and environmental risks. Fewer pesticides are being applied in several crops and farmers are now using reduced-risk pesticides.

In response to the RFA for the 2009 Extension IPM Coordination program (EIPM), the Alabama IPM program submitted a coordination proposal in January 2009. The two Alabama's 1890 land grants (Alabama A & M University and Tuskegee University) were collaborators on the proposal. The following six emphasis areas were proposed: i) Agronomic Crops; ii) High Value/High Input Crops; iii) IPM in Schools; iv) IPM in Housing; v) Diagnostic Facilities; and vi) Wide Area Pest Monitoring. We recently received notification from the USDA that the proposal was recommended for funding but the budget was reduced by almost 50%. Several of the emphasis areas (in particular High Value/High Input Crops which included cotton) received severe budget cuts, while two areas (Diagnostic Facilities and Wide Area Pest Monitoring) did not receive any funding. In summary, the total recommended funding was less than the amount of the Smith Lever 3(d) formula funds typically awarded annually to Alabama in the past.

PROGRAM INVOLVEMENT:

The Alabama IPM Coordinator continues to work cooperatively with local research and extension staff and other stakeholders and with the SRIPMC to set IPM priorities for Alabama and to coordinate and promote existing and new IPM programs in the state. The program continues to collaborate with several other related programs in the state including the Plant Pest Diagnostic Laboratory, Alabama Cooperative Extension System, and the Alabama Fire Ant Management Program, Alabama's School IPM Coordinator, IR-4 Coordinator, SARE Coordinator, Organic Agriculture Coordinator, and Pesticide Safety Education Program Coordinator. The Alabama IPM coordinator served in 2008 as Chairperson of the Southern Region IPM Center Advisory Council and on the center's Steering Committee. He is also currently serving as SERA 3 Chairperson.

ADMINISTRATIVE SUPPORT:

Administratively, the Alabama IPM program was supported by the Directors of the Alabama Cooperative Extension System (ACES) and the chairman of the Entomology and Plant Pathology Department at Auburn University. However, no accounting or secretarial staff are assigned specifically to the program, making day-to-day coordination of the program and management of the IPM account a major part of the IPM Coordinator's activities.

SERA-IEG3 2008 ANNUAL REPORT FOR FLORIDA

Norm Leppla

PROGRAM MANAGEMENT: IPM Florida has been in place since 2001 and has had a full-time IPM Coordinator since its inception. The full-time Associate IPM Coordinator for the past three years transferred to another program when S-L 3(d) funding ended on September 30, 2008. Total annual 3(d) funding was about $178,000 and the state added the coordinator's salary. The program shared control of the 3(d) funds with the Associate Dean for Extension and at least 45% of the funds were used for mini-grants. The IPM Florida program is being maintained at a lower level than in the past but still encompasses agriculture, communities and natural areas. Extramural funding was sought to support IPM Florida and it's cooperators: "University of Florida IPM program," "Maximizing the effectiveness of the parasitic wasp *Larra bicolor* as a bio-control agent of invasive *Scapteriscus* spp. mole crickets," "Developing Good Neighbor Practices, Agricultural Pesticide Operations Near Schools," "Conservation Management Tools for Forage Production," "Safety and Sustainability of Florida's Fruit and Vegetable Industry," "Graduate Training for Plant and Crop Biosecurity," "Marketing IPM as Green School Technology," and "Controlling Invasive Mole Crickets in Florida Pastures." One student was supported on outside research funds when 3(d) funding ended. Technical support was contributed by highly experienced personnel from the Entomology and Nematology Department (information technologies, graphics, administrative). The IPM Florida management structure on the website (http://ipm.ifas.ufl.edu, About Us) was followed with extra emphasis on communication (especially website content), funding for cooperators, education and training, collaboration with Cooperative Extension, and regional and national liaison. Planning and priority setting were accomplished by conducting nine IPM Florida Group meetings with written accomplishment reports provided by all of the participants. These reports were based on logs and work schedules maintained according to the IPM Florida Employment Agreement (website, About Us). Program recognition continues to increase through use of the IPM Florida logo by cooperators, distribution of the "Integrated Pest Management in Florida" DVD, delivery of labeled rulers and hand lenses, and application of IPM Florida stickers to materials and communications. The director was appointed to the Florida A&M University Courtesy Faculty. IPM Florida received a UF/IFAS, Extension Gold Image Award for the "Tomato and Pepper Grower's IPM Guide."

PROGRAM DELIVERY: Maintenance of the IPM Florida website continued to be a time-consuming priority accomplished by Plant Medicine students. The approximately 300-member distribution list for IPM information was combined with the UF/IFAS Extension Statewide Goals and Focus Areas list for "Plant, Animal and Human Protection" co-chaired by the director of IPM Florida. The IPM Florida mini-grants program supported 14 projects for a total of $80,680 (website, Grants Showcase). Activities included a keynote presentation at the SYSCO conference on sustainable agriculture, organizing and chairing the Southern Region State IPM Coordinators (SERA-IEG3) annual meeting, co-chairing the UF/IFAS Statewide Goals & Focus Areas team, submitting a manuscript to American Entomologist based on a survey of the national system of State IPM Coordinators, preparing a Southern Region State IPM Coordinators Position Statement on Federal Smith-Lever 3(d) Funding for State IPM programs, presenting information at Thrips workshops, and other related work. Contributions were sent for the SRIPM Center newsletter. Consultation was mostly by email; about 3,500 messages were sent this year. A considerable amount of time was invested in helping to organize grant proposal writing teams. The director chaired or co-chaired six Doctor of Plant Medicine and two M.S. graduate committees, served on one Ph.D. committee, and had two students graduate. Collaboration included Florida Yards and Neighborhoods, UF/IFAS Pesticide Information Office, Glades Crop Care, Extension workshops, Florida Department of Agriculture and Consumer Services, Southern Plant Diagnostic Network, and others. The benefits of IPM Florida were measured in terms of the number of collaborative projects initiated, completed and delivered to clientele groups, plus publications, presentations, grants, and consultation, including education and training (website, by category).

PROGRAM INVOLVEMENT: Collaboration with Cooperative Extension was extensive, particularly participation at county and statewide meetings. The director chaired the FAMU Center for Biological Control Advisory Committee meetings and contributed to the Florida State Horticultural Society, Florida Entomological Society, and other state organizations. A novel Extension/research project was completed on IPM in graduate housing at UF. A photographic database was prepared on the approximately 100 most damaging pests in Florida. A course and associated colloquium were provided in cooperation with the UF Plant Medicine Program, USDA-APHIS in Raleigh, North Carolina, and FAMU Center for Biological Control. An interdisciplinary pasture pests project was completed with agronomy, plant pathology, and agricultural and biological engineering, as well as entomology. The mini-grants review panel included all but one of these disciplines. IPM Florida collaborated statewide, including about 20 invited talks. Cooperation continued with the Florida Master Gardener program, Florida School IPM Advisory Committee, and USDA-APHIS Cooperative Agricultural Pest Survey (CAPS) program. The director chaired an on-site review of the Pest Management Unit, South African Sugar Cane Research Institute. He also served on the Steering Committee for the 6th International IPM Symposium.

ADMINISTRATIVE SUPPORT: IPM Florida received full support from the chairman of the Entomology and Nematology Department, the UF/IFAS administration, and key clientele groups. Professional development opportunities involved participation in meetings around Florida, and at St. Croix, Virgin Islands (SERA-IEG3); Durban, South Africa (International Congress of Entomology); Reno, Nevada (ESA), Stoneville, Mississippi (ANBP), Starkville, Mississippi (Insect Rearing Workshop), and Atlanta, Georgia (NE IPM Center grants panel).

Georgia 2009 IPM report

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Pecan

The UGA Cooperative Extension agent in Macon County was receiving 10-12 calls per week regarding pest control decisions for pecan weevil. This insect's distribution is sporadic, being in one orchard but not another one nearby, making decisions on when to treat difficult. The standard method of determining when to control the pest is to monitor with pecan weevil traps located through the orchard. Extension agents in Peach and Macon counties collaborated to provide pecan weevil traps to four growers so they could monitor the weevil emergence in their orchards. Through cooperation with USDA entomologists, 65 pecan weevil emergence traps were acquired. The growers were instructed on how to install the traps, how to monitor and when to make the decision to treat the orchard in question. All growers monitored the traps throughout the season and applied pesticides for pecan weevil based on their trap catches. Having a tool by which to determine the necessity and timing of pesticide applications for pecan weevil has eliminated spray applications for these growers. Before having traps, their sprays were based on the calendar. This year these sprays were based on presence of the pest.

Pecan

The Pecan Pest Management Hotline is a toll-free telephone line used by the UGA Extension Pecan Team to provide growers with current information about pest occurrence. Along with recommendations for pest management actions, this allows farmers in Georgia and across the pecan-producing region of the Southeast to keep ahead of potential problems and reduces crop losses. When asked at grower meetings, more than 90 percent respond that they call "often" or "regularly." Growers from as far away as Texas and New Mexico also use the hotline. With insecticide costs estimated to approach $10 million per year, and fungicide costs more than double that figure, profitability of pecan farming operations can only be sustained through careful, informed IPM decisions.

Pecan

Pest control with insecticides in any crop requires a continual search for new pesticides through field efficacy trials. Insecticides lose their registrations, pest become resistant to the currently used insecticides, problems arise with the environment or the insecticides disrupt natural controls. Federal reregistration efforts resulted in the loss of registration of aldicarb for use on several crops including pecan. Pecan aphids are highly reproductive pests with several generations per season and a high damage potential when they are not controlled with pesticides. Up until the present time, pecan growers have two primary systemic chemical controls for pecan aphids - imidacloprid and aldicarb. Pesticide resistance research at the Coastal Plain Experiment Station during 2008 indicated that the pecan aphids apparently can become tolerant of the systemic application of imidacloprid. The chemical insect control evaluations for pecan by UGA entomologists at the Experiment Station's Ponder Farm and on the farms of cooperating pecan growers provide up-to-date measurements of the ability of current insecticides and insecticides under consideration for registration on pecan to control the key insect pests of pecan.

Peanut

Insecticide use in Georgia cotton has declined dramatically since the late 1980s, with the successful elimination of the cotton boll weevil in the 1990s and the widespread deployment of Bt-transgenic cotton. However, in this reduced insecticide environment a complex of stink bug species has emerged as a significant pest threat to Georgia cotton, and other crops. UGA entomologists wanted to characterize the natural enemies of stink bugs in Georgia in an effort to understand how much mortality is inflicted by natural enemies on the stink bugs, and to determine if there might be opportunities to improve the efficiency of important enemies or possibly to import effective enemies from elsewhere to effect greater biological control. Reliance on natural enemies to manage stink bug populations reduces the need for grower inputs, and can help maintain the remarkable environmental and economic benefits that reduced insecticide inputs have accrued to Georgia cotton producers and the state of Georgia in recent years. Further, natural enemies work across the landscape so that greater efficacy of the natural enemy complex against stink bugs would benefit a range of crops in addition to cotton with no additional grower inputs. The role fire ants and Conocephalus grasshoppers play as predators of stink bug eggs would indicate that activities that promote these predators in cropping systems also may contribute to reduced stink bug problems. The discovery of a new parasitoid that attacks stink bug nymphs may have considerable potential to help suppress stink bug populations.

Peanut

The Randolph County Cooperative Extension agent is joining a cooperative effort to reduce the threat of soil borne disease in peanuts through the nighttime application of fungicides. These diseases include white mold, limb rot and Rhizoctonia solani. The research movement was initiated last year and it is still very limited. A three acre test plot was set up to collect and analyze data on four replications of nighttime applied fungicide versus a normal daytime fungicide application. Management plans were also evaluated with concern for the economic cost and control for the disease. Nighttime fungicide application plots averaged 1,115 pounds per acre more than fungicide applied during the daytime. This is a significant increase in yield and definitely promotes further investigation. The research can be used in helping growers' decisions on management of soil borne diseases, which can cost Randolph County growers an estimated $1 million in control cost and yield loss.

Cotton

Stink bugs are serious economic pests of many agricultural crops grown in Georgia, including cotton. These insect populations subsist and reproduce on a succession of agronomic and wild hosts during the year. UGA entomology cotton research team monitored boll damage, yield, and fiber quality in 1-acre cotton plots bordered by corn, peanuts and soybeans. Results show that damage, seed cotton yield, fiber quality, and lint value were all reduced by more than 50 percent in samples taken immediately adjacent to peanuts and soybeans, but not corn. This apparent edge effect reached about 60 feet into the cotton field. Growers should consider these findings in their whole farm planning to reduce the incidence of planting peanuts or soybeans and cotton adjacent to each other.

Cotton

Feeding by a complex of stink bugs including the green stink bug, southern green stink bug, and brown stink bug causes serious economic damage to developing cotton bolls. The UGA entomology cotton research program recently completed a 2-year study comparing stink bug sampling methods. Although acquisition of 20 bolls required only 2:05 minutes, subsequent dissection of these bolls required an additional five minutes per sample, making this the most time intensive sampling method. However, internal examination of bolls was 10-fold more sensitive than the remaining methods, which is important when the pest is difficult to detect because of an aggregated distribution. In a follow-up study, they examined external lesions as a means of quickly assessing damage and then compared that method to internal damage. The external lesion method could be completed in about one-half the time required for internal examination, but external lesions only correlate with about 70 percent of the internal damage.

Thrips

Thrips are important crop pests on many agricultural and horticultural crops that cause damage by feeding on various plant tissues. At least ten species of thrips act as vectors of virus. Previous studies indicated that pine pollen dusted onto leaves could increase the thrips oviposition on various crop hosts. So pine pollen could affect the overall population dynamics of the vector population. A UGA entomologist investigates possible connections between ambient pine pollen and thrips reproduction. The availability of pollen positively influences reproduction of two thrips species: tobacco thrips and western flower thrips. These thrips species are both major vectors of plant viruses. Studies suggest that pine pollen which is deposited on plants each spring will increase reproduction significantly which could have a major impact on thrips population prediction models for the Southeast where spring pine tree pollen is so prevalent.

Vegetables

The silverleaf whitefly, Bemisia tabaci, is a key pest of multiple vegetable crops grown in the fall in south Georgia. Recent trends have indicated potential insecticide resistance problems that threaten whitefly management programs in our fall vegetables. Management of silverleaf whiteflies has been an emphasis of UGA's vegetable entomology research and Cooperative Extension since this pest first appeared in the early

1990s. Research in Georgia has aided in identification of the proper application methods and timing to provide excellent control of this pest. Integration of this new chemistry into management programs comes at a critical time, given that resistance to the neonicotinoid insecticides has been detected in field trials for the last three years.

Vegetables

Proper pesticide use in commercial vegetable crops is critical for the maintenance of a high level of productivity in the face of the insect pest pressure that occurs each year in Georgia. The Vegetable Entomology Project at Tifton conducts cooperative vegetable pest control studies annually with various chemical companies. Experiments are conducted using randomized complete block designs and industry financial support for these tests were requested whenever possible. These tests included insecticide efficacy on cabbage, collard, cowpeas, cucumber, tomato, pepper, pumpkin, onions, squash, and sweet corn. Efficacy data was generated for hundreds of insecticide treatments in several vegetable crops. New vegetable pests have been identified as potentially causing more crop damage in Georgia than previously thought. Certain insecticide treatments were identified as unnecessary or inefficacious and the best treatments were reported to the UGA Cooperative Extension specialists. Providing information on the best treatments can help to reduce the overall amount of pesticide active ingredient applied to Georgia's ecosystem. This activity provides efficacy data for about $27 million in annual cost of insecticide investment by vegetable growers.

Tomato spotted wilt

Tomato Spotted Wilt Virus affects a large number of crops including peanuts, tomato, cotton, tobacco and ornamentals in the Southeast. This virus can be transmitted by thrips and is able to produce various symptoms on infected plants. Thrips population is known be adversely affected by change in weather patterns and variability in the climate. UGA biological and agricultural engineering research is focusing on establishing a better understanding of the relationship between seasonal climate variability, weather parameters and the incidence of TSWV in peanuts. They have worked on improving the TSWV risk index developed by scientists at University of Georgia for peanuts, by complementing or incorporating key weather parameters, to better predict spotted wilt severity of peanuts. Analyses of multi-year survey data using the historical meteorological data indicate a lower risk of spotted wilt severity during the La-Niña year, compared to El-Niño or Neutral year. In addition to the climate effect, their analyses also confirm the significance of peanut variety, planting date and the population density of the peanut in accurate prediction of TSWV disease severity. Yield risk assessment based on climate forecasts, disease and crop model results could aid in analyzing potential yield impacts of recommended planting dates.

Corn

Stink bugs have increased in the Georgia to become a serious pests of several crops including corn. UGA entomologists conducted studies in 2005 through 2008 near Plains and Tifton that examined which species infest corn, stink bug seasonal abundance in corn, the association of stink bug damage with corn smut infection and aflatoxin contamination, and grain damage losses during ear formation and kernel development. Based on this work, treatment thresholds for stink bugs were revised to one bug per two plants at stage VT and one bug per plant during pollination and early kernel development. The old thresholds were much lower at one bug per 20 plants and one bug per 10 plants, respectively. The new thresholds will be implemented in 2009 and should reduce the need to using insecticides to control stink bugs in corn.

SERA-IEG – 3 2008 Annual Report for Kentucky

Doug Johnson and Patty Lucas

PROGRAM MANAGEMENT: The Kentucky Integrated Pest Management program (UK-IPM) has been in place since before 1980. We are unsure when Smith/Lever 3(d) funding (S/L3(d)) began, but IPM demonstration projects began in ca. 1976. The total S/L 3(d) funding for the past several years and through federal FY2008 years has been $100,408. This figure reflects the 10% rescission that has been in place for at least five years, perhaps longer. Under the current dean and the two previous deans, at least since 1989, 100% of these funds have been administered by a designated UK-IPM coordinator. No other funds of any sort, federal / state / county / local, are dedicated to the UK-IPM program. However, past and current working groups, as groups and as individuals within groups, have been successful at securing competitive funding for numerous projects.

With the ending of the formula S/L3(d) funds at the close of federal FY08, UK-IPM applied to the new competitive funding process for 2009. We have been recommended for funding (preliminary notice only) at a level considerably less than our request, but near our previous formula level.

The current coordinator has served since 1989. We are unsure of how the S/L3(d) funds were handled before this date. Since that time, all S/L 3(d) funds come directly to the IPM Coordinator. None of these funds are used in support of the coordinators compensation package. The Department of Entomology supports the IPM program with the coordinators time. In addition the current IPM coordinator provides entomological expertise for several of the working groups. The coordinator has a 100% extension appointment in Entomology. There is no administrative appointment for the coordinator.

Since 1990, Ms. Patty Lucas has served the program as a 100% extension specialist for IPM. Ms. Lucas's compensation package is supported using S/L 3(d) funds. There is no administrative appointment for this position. In recent years Ms. Lucas has been successful in obtaining grant funding for various projects which contain salary support. Though this varies from year to year, this grant based salary support allows for using the corresponding S/L 3(d) funds in direct support of IPM programs. Ms. Lucas also serves as the Kentucky "State Contact" for the Southern Region Integrated Pest Management Center (SRIPMC).

The administrative contact is the current head of the Department of Entomology.

Given the lack of growth, and the "permanent" nature of the 10% rescission, in the S/L3(d) funds, combined with increased "overhead" created by compliance with a competitive grants process, and the continuing increase of costs of operations, we can expect a continual decrease in IPM programming. <u>These funds are absolutely critical</u> in maintaining a core program, and providing seed funding which allows working groups to function while competing for operational funds.

UK-IPM is in essence a series of subject matter specific working groups, to which the IPM Coordinator and specialists, provide guidance and support. Each working group operates independently to meet their educational goals with a focus on IPM. Both overall and within groups we communicate by a variety of methods including phone, e-mail, “list servs”, conference calls, video conferences, as well as face to face meetings. The overall steering committee meets annually in March. Individual working groups meet at different times depending largely on their production schedule. At these meetings priorities, opportunities are identified and program evaluation conducted.

PROGRAM DELIVERY: Kentucky continues to operate a diversified IPM program. UK-IPM currently supports statewide working groups in corn/soybean, wheat science, commercial ornamental plant production, pest diagnostics, and vegetable IPM. UK-IPM also supports individual and multiple county programs through a mini-grants program (this is at great risk by reduced funding and greater bureaucratic costs). Additionally, UK-IPM provides to 13 Extension / Research specialists subscriptions to “CDMS” pesticide label service. Our support for the “Plant Management Network” has been deleted due to insufficient funding.

As working groups and individuals UK-IPM collaborates with a large array of other programs. Examples include but are not limited to, Pesticide Safety Education (PSA), IR-4, and Cooperative Agricultural Pests Survey (CAPS) programs. In addition we work directly with the KY state pesticide “lead agency”, KY Dept. of AG, Division of Environmental Services.

Each working group produces publications, holds training sessions of various types (class, field etc,) to fit their particular program & clientele needs. In addition groups and individuals seek are routinely successful at obtaining extramural funding from such groups and the SRIPMC, Small Grain, Corn and Soybean growers associations. The program as a whole (UK-IPM) and working groups collect information from clientele to establish educational needs and to determine outcomes of the program. In 2008 UK-IPM purchased a TurningPoint (Turning Technologies Inc.) audience response system. This system has allowed us to incorporate questions in to our educational programs. Though we are still learning how to utilize the power of this technology we are now able to obtain significantly more results information that with paper surveys or verbal group interaction.

Over the years, UK-IPM working groups and individuals have received several awards. Two working group have received external awards in the past year. Corn/Soybean group received a project award form the Agronomy Society. Wheat Science group received the Integration Award from USDA, and Friends of SRIPM Center “Pulling Together” award from Southern Region IPM Center.

ACCOMPLISHEMNTS RELATED TO SERA OVER THE PREVIOUS YEAR

Annual Report information can be found on the Performance Planning and Reporting system at: http://www.pprs.info/. That this writing the annual report function has not been opened, but the “Success Stories” are available.

2008 IPM Annual Report
Mississippi State University
(SERA 003)

Cotton IPM Overview- Mississippi

In 2008, extension and researchers at Mississippi State University teamed up to create a pilot program implementing IPM strategies to control, insect, weed, and disease pests of cotton in the Mississippi delta region. Currently Mississippi producers, particularly in the delta region of the state, rely heavily on pesticides to control pests of row crops. Currently producers are facing serious threats from weed and insect pest that have shown increased tolerance to commonly used pesticides.

The pilot program called "Cotton D.E.M.O" (Demonstration and Education of Management Options) was implemented on five growers in the delta region in 2008. The program was implemented to demonstrate on producer farms sustainable management practices to help them identify potential problems limiting cotton production. The program also helps producers identify yield limiting factors associated with cotton production practices through intensive sampling and implementation of cultural and integrated pest management techniques. For example, entomologist are using host plant manipulation around field borders to limit build up of tarnished plant bug and spider mites densities as demonstrated by USDA-ARS in the late 1990's. On average this work showed a reduction of one insecticide application applied to the cotton by removing the early season broadleaf weed hosts. On three of the farms, we planted nectariless varieties to demonstrate reduction in tarnished plant bug numbers through host plant resistance. Also, early maturing cotton varieties were planted to show producers the value of getting the crop out early to avoid late season insect pressure. This work has saved producers approximately two insecticide applications compared to late season varieties. We have also worked with producers to eliminate field borders next to corn. Often corn/cotton interfaces experience extremely high numbers of tarnished plant bugs often requiring many more insecticide applications. By educating producers on the benefits of "blocking" cotton into areas away from corn it has helped eliminate some insecticide applications.

With the threat of glyphosate resistant weeds on the increase, weed scientist involved in the Cotton D.E.M.O. program are currently working with producers to educate them on the value of residual herbicides and alternate modes of action to help delay the onset of weed resistance. Weed scientist, are also educating producers about how to minimize the spread of weed seed through cleaning of equipment, proper herbicide rates, and not relying solely on the use of glyphosate for weed management.

Plant Pathologist involved in the Cotton D.E.M.O. program are working with producers to identify problems associated with disease and nematode issues. In 2008, pathologist performed nematode samples on one acre grids to identify species and abundance of nematode pest of cotton. Sample results indicated that every grower was well above University thresholds for root knot and reniform nematodes. Currently the Cotton D.E.M.O. program is working with these producers on crop rotations and site specific management of this pest for 2009.

In 2009, the program has expanded to include ten producer participants and will also include producers in the hill region of the state. Expected outcome: Producers will utilize a fully integrated pest control program across their farm. By utilizing a fully integrated pest control program, producers will not have to rely only on pesticides and delay resistance from insects and weeds in Mississippi.

Greenhouse Tomato IPM in Mississippi, 2008-2009

Greenhouse tomato production occupies about 18 acres in Mississippi, employing approximately 100 individuals and brings in an estimated 6 million dollars annually. Mississippi State University Extension and Research efforts are strong in the state, with almost all growers knowledgeable about the services available from the Extension Service. Most growers are currently practicing IPM methodology in their production systems, ranging from proper fertility, cultural practices of pruning and sanitation, and the use of either biological or bio-rational insect and disease control procedures. More and more growers are using these 'soft' chemistries in concert with marketing efforts to sell a more healthy product to consumers. Success is tremendous in this area. During the peak of the greenhouse tomato growing season, producers have no problem selling 100% of all product produced. IPM scouting still remains a concerted effort for MSU-ES staff. Recently, two greenhouses were identified with significant powdery mildew problems. Correct identification and recommendation of proper control products were implemented immediately. To date these two growers are powdery mildew free and continuing production as usual. These growers expressed gratitude for the timely reaction and solution to their problem.

Clarence H. Collison
Professor of Entomology
Head, Department of Entomology and Plant Pathology
IPM Coordinator

SERA-3 2008 ANNUAL REPORT FOR NORTH CAROLINA

Steve Toth, IPM Coordinator

PROGRAM MANAGEMENT: In December 2006, Dr. Mike Linker retired from North Carolina State University where he had served as the Extension IPM Coordinator for many years. Dr. Ed Jones, Associate Director, State Program Leader Agriculture, Natural Resources and Community and Rural Development, North Carolina Cooperative Extension Service, served as acting IPM Coordinator for North Carolina in 2007. In March 2008, Steve Toth, Extension Entomologist and Associate Director of the Southern Region IPM Center at North Carolina State University, was appointed to serve as IPM Coordinator for North Carolina. Thirty percent of his time is devoted to his responsibilities as IPM Coordinator and the remainder to the Southern Region IPM Center. The responsibilities for the IPM Coordinator in North Carolina include the following: serve as the University's major contact for IPM related issues, collaborate with campus and field extension and research faculty in conducting and communicating IPM programs, assist faculty in identifying and seeking state, regional and national level funding for IPM, manage the state's mini-grants program, assure stakeholder input into and recognition of IPM programs, represent North Carolina State University in regional and national meetings as the IPM liaison, and collaborate with IPM programs at other institutions. The IPM Coordinator manages the IPM 3(d) budget and serves as the coordinator of the annual federal IPM report.

PROGRAM DELIVERY: The mini-grants program has been the centerpiece of the North Carolina Extension IPM Program for more than a decade. Approximately $60,000 to 90,000 have been distributed annually to Extension specialists, research scientists and county Extension agents in North Carolina in the form of mini-grants to conduct projects that demonstrate IPM principles or solve an immediate clientele-identified need. Mini-grants are competed for by campus and field faculty and specific requirements for mini-grant projects are detailed in a three-page *Request for Proposals*. The Extension IPM Coordinator serves as the grants manager for the mini-grants program. Members of the North Carolina Extension IPM Program Advisory Committee act as a review panel to rank the proposals and make recommendations for funding. Of course, Advisory Committee members are not allowed to review or be present for discussions of projects for which they have a conflict of interest. The number and amount of funded projects depend on the federal support of the IPM program in North Carolina each year. Most proposals in the past have been funded in the $2,000 to $8,000 range. Grants are limited to a one year funding period.

After a year's absence, the IPM mini-grants program in North Carolina was again available to funding projects during 2008. On March 7, 2008, a request for IPM proposals was sent to the College of Agriculture and Life Sciences Department Heads, Departmental Extension Leaders and County Extension Directors, with an April 10, 2008 deadline. Although a late date for some projects, it was hoped that good proposals could be funded in 2008. A total of 20 proposals requesting $128,496 were submitted; 11 projects were funded at $76,108. A list of mini-grant projects funded by the North Carolina Extension IPM Program in 2008 is provided in Table 1.

Dr. Godfrey Nalyanya, Extension School IPM and Urban Entomology Specialist, was responsible for the implementation of Integrated Pest Management strategies for schools and municipalities in North Carolina and conducting the training programs for pest management professionals, school and municipal employees. He was also responsible for the management of the Extension School IPM Program in the state (http://schoolipm.ncsu.edu).

Mike Stringham, Extension Entomologist, addressed the management of arthropod and vertebrate pests of livestock and poultry in North Carolina, including mites, ticks, cockroaches, lesser mealworms, flies and rodents. His training activities emphasized the use of IPM for pests affecting animals and their production environments, as well as topics relating to human health and nuisance issues associated with livestock and poultry production in the state.

Bryan Davis, Agricultural Program Assistant, was an integral partner in the Christmas tree IPM program in western North Carolina. He worked through the county extension agents in three western North Carolina counties to provide educational programs to growers. Much of his time was spent in the field working side-by-side with growers and Hispanic farm workers to teach them scouting techniques, to calibrate spray equipment, and to identify causes of new problems. These practices resulted in lower exposure of pesticides among workers and less overall reliance on pesticides. The time spent in the growers’ own fields has increased IPM adoption among Christmas tree growers.

Stephen Schoof, Agricultural Research Technician, assisted and coordinated IPM related applied research and Extension activities on fruit and vegetable crops in western North Carolina. His responsibilities were in the area of applied research include the coordination of field trials on apples and fruiting vegetables related to the effect of pesticides on pest and natural enemy populations, development of action threshold levels, sampling programs, and insecticide resistance monitoring. His Extension responsibilities included dissemination of information through weekly updating of the Southern Appalachian Apple IPM Website, DUEX phone updates on pest activity, and faxing of updates to Extension personnel, growers and the crop protection industry.

PROGRAM INVOLVEMENT: Leadership of the North Carolina Extension IPM Program was provided by the Extension IPM Coordinator at North Carolina State University and an Advisory Committee composed of program stakeholders (Table 2). The Advisory Committee currently has two primary functions: 1) to provide advice and oversight to the Extension IPM Coordinator regarding the direction of the IPM program in the state; and 2) to serve as the review panel for the annual mini-grants program. The Extension IPM Coordinator communicated regularly with committee members via a listserv to transfer IPM information, provide program updates and seek advice. In addition, Advisory Committee members met on May 14, 2008 on the North Carolina State University campus to receive a program update from the Coordinator. The Advisory Committee also reviewed mini-grant proposals and made funding recommendations at this meeting.

PROGRAM SUPPORT: The North Carolina Extension IPM Program received full support from the Administration of the North Carolina Cooperative Extension Service, the Department Head and Departmental Extension Leader of the Department of Entomology at North Carolina State University and key stakeholder groups in the state. The general IPM 3(d) funds were managed by the IPM Coordinator. The bookkeeping staff of the Department of Entomology at North Carolina State University also provided support for the program.

Table 1. Members of the North Carolina Extension IPM Advisory Committee, 2008-2009.

Member Name	Affiliation
Wayne Buhler	North Carolina Pesticide Safety Education Program, North Carolina State University
Will Connell	North Carolina Agricultural Consultants Association
Nancy Creamer	Director of the Center for Environmental Farming Systems (CEFS), North Carolina State University
Jeanine Davis	North Carolina Specialty Crops Program, North Carolina State University
Alex Hitt	Organic Farmer, Peregrine Farms, Alamance County
Ed Jones	Extension Administrative Advisor, North Carolina Cooperative Extension Service
Frank Louws	Plant Pathologist; Vegetable crops (strawberries, tomatoes); North Carolina State University
David Monks	Research Administrative Advisor, North Carolina Agricultural Research Service
Mike Mitchell	North Carolina Department of Agriculture & Consumer Services, Structural Pest Control and Pesticides Division
Paul Mueller	Coordinator for the North Carolina Sustainable Agriculture Research and Extension (SARE) Program, North Carolina State University
Joe Neal	Weed Scientist; Nursery crops, Christmas tree production and landscape plantings, North Carolina State University
Godfrey Nalyanya	School IPM and urban entomology, North Carolina State University
David Orr	Entomologist; biological control; North Carolina State University
Fawn Pattison	Executive Director for the Agricultural Resources Center and Pesticide Education Project (environmental advocate)
Mitch Peele	North Carolina Farm Bureau, Public Policy
Jill Sidebottom	Forestry Extension; Christmas trees; North Carolina State University
Mike Stringham	Entomologist; Livestock and poultry IPM; North Carolina State University
Turner Sutton	Plant Pathologist; Fruit Crops (apples and grapes); North Carolina State University

Table 2. Mini-grant projects funded by the North Carolina Extension IPM Program in 2008.

Project Director(s)	Title of Project
Louws	Use of Anaerobic Soil Disinfestation to manage soil-borne disease in organic production systems
Nalyanya and Waldvogel	Creating a DVD to Accelerate Implementation of IPM in North Carolina Public Schools
Orr	Comparative Efficacy of Organic Pesticides for Flea Beetle Management and Their Impact on Beneficial Insects
Walgenbach	Measuring Codling Moth Resistance to Insecticides
Wantuch and Tarpy	Integrated pest management of Varroa mites in honey bee colonies using a novel approach to drone brood removal
Adkins	Evaluation of Mating Disruption Using Sex Pheromone to Control Oriental Beetle on Ornamental Nursery Crops in the Foothills of North Carolina
Richardson	Field In-Service Training and Improved Extension Materials for Aquatic Weed Management in North Carolina
Neal, Richardson, Burton and Moorman	In-service training for field faculty – Invasive weeds: biology, ecology and control
Ivors	Detecting and Monitoring Strobilurin Resistance in *Alternaria solani* on Tomato
Edmisten, Bacheler and Reberg-Horton	Feasibility of Organic Cotton Production in North Carolina
Stringham	Evaluation of application methods for new chemistries for lesser mealworm control in turkey brooder houses.

SERA-IEG3 Annual Report for IPM Oklahoma!, 2008.
Tom A. Royer, IPM Coordinator, Oklahoma State University

PROGRAM MANAGEMENT: Since 1984, IPM Oklahoma! has maintained a tradition of conducting highly interdisciplinary IPM programs through 13 IPM/ICM teams (alfalfa, cotton, greenhouse/nursery, tree fruit and nuts, vegetable, wheat, stored products, sorghum, soybean, peanuts, urban, school, weed). More information is available on the Web at **http://www.ento.okstate.edu/ipm/index.html.** In August 2006, Dr. Tom Royer assumed IPM Program responsibilities. Total annual funding from Smith Lever 3 (d) funding for the program included ca. $134,000 in "general" IPM funding and $98,500 in Cotton IPM funding.

In 2008, IPM Oklahoma! came under tremendous stress because of the change in funding structure that shifted to a new EIPM competitive funding program. Many of the projects that were being considered for multiple-year funding had to be put on hold due to concerns about being able to provide funding for the projects. Some of those projects included:

- Development of an integrated approach for managing black rot in grape ($10,000, 2009-2010)
- Web-based portal for turf grass management ($6,000, 2009-2010)
- Design and validate weather and forecast decision support tool to reduce pesticide drift through the Oklahoma Mesonet ($3800, 2009-2010).

PROGRAM DELIVERY: In 2008, several IPM projects were completed that received financial support from IPM Oklahoma!

- Enhancement of Horticultural Extension educational programs to foster IPM by Oklahoma grape and pecan producers ($2500)
- Educational Manual and program for controlling woody plants ($8000) 1000 manuals were printed and distributed to Agricultural Educators, producers and consultants.
- Comparison and demonstration of IPM benefits realized through multi-species grazing of native rangelands ($6495) Results showed that

Urban

- School IPM – OSU (IPM and Pesticide Education) remains a partner in the Southwest Technical Resource Center for School and Childcare IPM, along with TAMU and NMSU (http://schoolipm.tamu.edu). The IPM program received an additional grant of $52,000.00 from the Environmental Protection Agency to fund 6 demonstration IPM Schools, including one Native American school. This project is in its final year. To date, we have conducted 7 training sessions introducing IPM in each of the cooperative schools. The Oklahoma City Public School system requested assistance in developing a School IPM program for their 83 schools. The Oklahoma School IPM team provided training for 183 employees of the school system in February of

2009. We will continue to work with the school system to help them implement an IPM program.

Crops

- Wheat IPM – A grant from the Pest Management Alternatives Program for approximately $172,000.00 was obtained to validate and expand the implementation of the "Glance 'n Go" sampling method to Kansas and Texas for greenbugs in winter wheat. The program is in its second year and will It will measure changes in producer knowledge and adoption of Glance 'n Go, and evaluate the economics for use of the system.

  Based on estimates from initial surveys, at least 85,000 acres of winter wheat in Oklahoma were not sprayed with broad-spectrum insecticides during the 2007-2008 field season because Glance 'n Go sampling showed producers/agents that parasitism levels were sufficient to suppress aphids. This equates to at least $850,000 in savings, an estimated reduction of 680,000 ounces of organophosphates applied, and the undocumented beneficial environmental impacts of conserving insect predators and parasitoids in the agricultural landscape.

- Cotton - Cotton was grown on 144,481 acres in 2008. Transgenic cottons are being widely adopted. The newsletter Cotton Outlook, sponsored by the Cotton IPM program, and is edited by Terry Pitts, area Pest Management specialist. Area pest management specialists provided timely insect activity reports on thrips, stink bugs and cotton fleahoppers during the 2008 growing season through a weekly Cotton IPM newsletter http://osu.altus.ok.us/2008_cotton_updates.htm. Results of the timely reporting of insect activity allowed cotton producers to correct pest problems on more than 40,000 acres of cotton, resulting in a yield savings of nearly $320,000. The Oklahoma Boll Weevil Eradication Program is in its 11th year. It is currently in a maintenance phase with very little acres needing spraying. Marestail weed has become a problem because it is an important weed in no-till systems is not effectively controlled with glyphosate. J.C. Banks has developed a marestail management program that is being widely adopted by Oklahoma cotton producers.

- Canola - Canola is a potentially valuable crop for Oklahoma wheat growers because it can help them manage difficult grassy weeds such as Italian ryegrass, and cheat and it provides an additional cash crop. Acreage has grown in Oklahoma from 41acres in 2002 to over 5000 acres in 2008. However, several insect pests (aphids and caterpillars) attack winter canola throughout the winter and spring months causing economic damage. In a survey conducted in 2006, canola producers listed insects as the second most important production problem that they faced, and aphids (cabbage, turnip and green peach aphids) were the most important insect pest problem. Producers are unfamiliar with their management, and made multiple insecticide applications for their control, with limited success.

  Entomologists conducted research demonstrations in 2007-08 and showed that that aphid sprays could be reduced from four applications per season to one per season by planting seed treated with imidacloprid insecticide and using treatment thresholds of 200 aphids per plant. Results of the research demonstrations showed that producers could save an average of $30 per acre in spray costs with no loss in yield, resulting in $150,000 in potential cost savings from reduced pesticide applications to the 2008 crop.

Fruits/Nuts

- Oklahoma Agricultural Statistics Service report about 80,000 acres of pecans in production in Oklahoma with average annual production of nearly 17 million pounds. The farm gate value of Oklahoma's pecan crop ranges up to $40 million with a ten year average of about $13 million. Most years about 50 of Oklahoma's 77 counties report pecan sales. However, reports of the greatest volume and production consistency come from counties east of Interstate 35. The Pecan Management short course continues to be very popular, each reaching more than 90 growers. Several components of insect, disease and weed management are taught. The course is offered as an internet course or as a classroom course from March through September.
- The grape/wine is new in Oklahoma, and thus an emergent area for Extension education in IPM. The Grape Management course continues to be very popular, reaching more than 50 growers.

  While small in number, the Pecan and Grape IPM Management Short Courses reach more than 80% of the acres managed for each of these crops. One of the main modules for this training involves insect, weed and disease management.

Weed Management -

- Musk Thistle: The invasive weed, Musk thistle (*Carduus nutans* L) was first identified in Oklahoma in 1944, and is currently found in more than 62 counties. Infestations of musk thistle in improved pastures cause significant economic losses in Oklahoma. In 1998, Oklahoma legislators passed a law designating musk thistle, along with scotch and Canada thistles, as noxious weeds in all counties of the state.

  A musk thistle IPM program was developed in the early 1990s and has been implemented statewide through cooperative efforts of researchers, Extension personnel, and landowners. It focuses on increasing public awareness of the problem, development of educational information, demonstrating various control options, and introducing new biological control agents. Four demonstration and educational meetings were conducted in 2008 to landowners and NRCS employees. Extension educators and landowners collected approximately 47,000 musk thistle head weevils in Alfalfa and Grant, Garfield Pawnee and Okfuskee Counties in the spring of 2008 and released by 27 cooperators.

  To date, this program collected and redistributed more than 800,000 musk thistle head weevils and 31,910 musk thistle rosette weevils across the state. Landowners in NE Oklahoma have noted from 80% to 95 % decrease in number of musk thistle plants in areas where they are using an integrated approach that includes use of the musk thistle weevils. If the typical landowner applies 1 lb active ingredient of herbicides per acre annually, biological control has decreased the amount of herbicides applied to the environment by 7.1 million lbs per year. There are plans to collect and redistribute more weevils this year at 3 sites.

- Tamarix salt cedar biological control project is ongoing. IPM Oklahoma! received a grant to release *Diorhabda elongata* (Fukang strain) at the Salt Plains Wildlife Refuge. We received a permit from APHIS to release the beetle and will release it at two sites this summer and evaluate its establishment. Plans are if establishment is successful, to release beetles at other infested sites to augment other control measures.

- Brush management in rangeland and pastures. An Extension Publication, E-1001, “Chemical Brush Control Methods Manual” was produced and distributed to landowners across the state at educational meetings developed by individual counties. Two in-service trainings were also conducted to educate the Extension Educators on the use of the materials. To date, over 1,000 manuals have been distributed through County Extension Offices.

PROGRAM INVOLVEMENT: Collaboration with Cooperative Extension was good, with participation with OCES county, area and state specialists. Outside agency involvement included working with the Great Plains Canola Association, Oklahoma Department of Agriculture, Food and Forestry, Oklahoma Feed and Grain Association Oklahoma Wheat Research Foundation, Oklahoma Sorghum Commission, Oklahoma Wheat Growers Association, Oklahoma Pecan Growers Association, Oklahoma Grape Growers Association, Oklahoma Turf Growers Association, Oklahoma Golf Course Superintendents Association, Oklahoma Turf Research Foundation, Oklahoma School Plant Managers Association, US Fish and Wildlife Service and the USDA Agricultural Research Service.

ADMINISTRATIVE SUPPORT: IPM Oklahoma! received full support from the OAES/OCES administration, Department Heads of Entomology and Plant Pathology, Horticulture and Plant Pathology, Plant and Soil Sciences and key clientele groups. Professional development opportunities included participation in meetings in Oklahoma, St. Croix, Virgin Islands (SERA-IEG3), Reno, Nevada (ESA) and Dallas Texas.

SERA-IEG3 2008 ANNUAL REPORT FOR PUERTO RICO

Wanda Almodóvar

PROGRAM MANAGEMENT: The PR IPM Program has been in place since 1979. The actual IPM Coordinator has been in place since 2000 with 20% of his time dedicated to the program. The IPM Specialist (20%) has been in place since 2006. Total annual 3(d) funding is about $50,000. The IPM Coordinator has control of the 3(d) funds and less than 50% of the funds are used for salaries. Additional funding was obtained to complement the program and IPM personnel participates in research projects to develop Extension outreach.

The PR IPM management structure for 2008 put emphasis in educational materials; IPM guides, manuals and newsletters, and in the content of the Extension Crop Protection Specialists websites (http://academic.uprm.edu/walmodovar, http://academic.uprm.edu/ofarrill, http://academic.uprm.edu/alvarado. IPM information generated by each specialist is posted and updated in a monthly basis. The education and training program is part of the Cooperative Extension training program, and the program collaborates with different agencies like the Department of Agriculture, the International Institute of Tropical Forestry, the Department of Natural and Environmental Resources and APHIS. Also, the program was promoted through associations and agricultural societies within the College of Agricultural Sciences like the Farmers Association, Extension Specialists Association, Extension Agents Association, Researchers Association and the Puertorican Society of Agricultural Sciences. This was achieved by seminars, meetings, field days and open houses at the research stations facilities. The IPM Coordinator and the IPM Specialist participated in commodity meetings to define management priorities, information needs and to determine future projects.

PROGRAM DELIVERY The following educational materials were completed: IPM in Vegetable Gardens (PP presentation), Management of diseases in the home garden with natural fungicides (PP presentation and Fact sheet), Plantain and Banana Weevil Integrated Management (PP Presentation), Citrus Greening (Poster), Citrus leafminer (Poster), Forest Pests (Newsletter). Emphasis was given by Extension agents in educating plantain and banana growers in cultural practices, evaluation of disease incidence in the field and use of a fungicide application schedule for Black Sigatoka management. In coffee IPM the emphasis was made in development of educational information and research in biological control of the Coffee Berry Borer (Hypothenemus hampeii) and training growers in development of traps to monitor and estimate pest population in the field. In forest IPM the program emphasis was to identify actual pests or new exotic pests and give management recommendations, through visits to state forests and tree and ornamental nurseries. This information will be available through a periodical forest newsletter. The benefits of IPM in PR were measured in terms of collaboration with state agencies and groups, publications, presentations, and education and training.

PROGRAM INVOLVEMENT: Collaboration with Cooperative Extension was good with participation at meetings throughout the Island. IPM personnel contributed to meetings of the Puertorican Society of Agricultural Sciences, Forestry Conference, the Home Gardening Festival and open houses at the UPR Research Stations. Personnel of the Department of Natural and Environmental Resources were advised in forest IPM through field evaluation of forest pests in cooperation with the Forest Service. The Entomology Specialist was part of a committee composed by personnel of the University, private companies and the Agriculture Department to develop an insecticide resistance management plan for *Helicoverpa* zea as a result of the presence of an outbreak of this pest in the southern part of the island where the winter nurseries for corn production are located.

ADMINISTRATIVE SUPPORT: The IPM Program in Puerto Rico received full support from the chairman of the Crop Protection Department and the administration of the UPR-College of Agricultural Sciences. Access to 3(d) funds was not difficult. Professional development opportunities involved participation in meetings in Puerto Rico (Farmer Association, Organic Crops Forum, Fertilization forum) and in Miami (Caribbean Food Crops Society).

SOUTH CAROLINA IPM PROGRAM REPORT
SERA IEG-3 MEETING, PORTLAND, OR
MARCH 23, 2009

Contact: Dr. Geoff Zehnder, Coordinator, IPM & Sustainable Agriculture Programs, B28 Long Hall, Clemson University, Clemson, SC 29634; zehnder@clemson.edu

The Clemson (South Carolina) Extension IPM Program, coordinated by PD Zehnder since 2000, is a highly diverse and interdisciplinary effort involving the development of research-based information, which in turn is extended to the public through a variety of extension, education and outreach programs. A competitive mini-grants program supported by Smith-Lever 3(d) formula funds has provided support for projects that facilitate the adoption of environmentally-sound integrated pest management (IPM) in South Carolina through Extension outreach and applied research. Since 2000 the IPM grants program has supported 95 Extension and research IPM projects totaling $434,290. A listing of the grant awards and project reports and accomplishments is available at http://www.clemson.edu/ipm/funding.html.

While the mini-grants program has been an important component of the overall statewide IPM effort, many other IPM Extension and research projects are conducted with support from state and extramural funding. South Carolina IPM Program plans and accomplishments are submitted and archived on the CSREES Performance Planning and Reporting System (PPRS) in the form of plans of work, progress reports and success stories available on the PPRS website http://www.pprs.info/IPM and the state IPM website (http://www.clemson.edu/ipm/aboutcuipm.html#report). Most recent reporting targets particularly noteworthy accomplishments in school, urban/structural and honey bee IPM and in commodity emphasis areas of cole crops, melon, upland cotton and peach. Please refer to Appendices for more detailed information.

BRIEF REPORTS ON SPECIFIC COMMODITY AREAS

Corn and Soybean IPM: Research in 2007 and 2008 have shown that *Bt* corn and insecticide seed treatments do not significantly increase the yield of corn in South Carolina when recommended planting dates are used. While *Bt* corn reduced corn earworm injury, the major pests targeted by *Bt* corn (European corn borer and corn rootworm) are typically only sporadic pests in South Carolina. The value of *Bt* corn has similarly been questioned by other studies in the Southeast when recommended planting times are used (Buntin et al. 2004). Outreach programs with growers and agents may therefore help to reduce the amount of pesticides used in corn in South Carolina.

Field studies conducted in 2008 to evaluate different combinations of pre- and post-emergence herbicides for control of glyphosate-resistant (GR) *Palmer amaranth* demonstrated approximately 98%

control of GR-*Palmer amaranth* with pre-emergence treatments (alachlor, pendimethalin, flumioxazin). Post-emergence applications of lactofen and acifluorfen also provided excellent control. Training programs for growers and Extension agents will be conducted on the most effective, research-based pre- and post-emergence herbicide programs for management of GR-*Palmer amaranth*.

Cotton IPM: Collaborations among South Carolina and other regional cotton insect pest management specialists on a project addressing management of boll-feeding bugs in cotton supported by cooperating Southeast State Cotton Support Committees have resulted in refinements of current action thresholds and detailed analyses of insect impacts on fiber quality. Additional collaborative regional research has been done to validate and demonstrate the efficacy of new generation transgenic *Bt* cotton varieties against major lepidopteran species and their potential for resistance development, and to evaluate insecticide seed treatments and in-furrow application of pesticides that target early-season pests such as thrips and nematodes. It is imperative that the research-based strategies are incorporated into revised cotton pest management recommendations, and also to provide Extension agents and growers with training in the proper use/fit of these strategies in cotton pest management programs.

Cotton growers routinely apply nematicides uniformly over entire fields to prevent yield losses from nematodes despite the fact that nematodes are rarely uniformly distributed. The Khalilian laboratory at Clemson have developed a system for site specific placement of nematicides (SNP) based on soil conductivity mapping that is correlated with nematode density and is ready for commercial development (see Appendices for additional information). A training program will be implemented in 2009 to familiarize growers and Extension agents with the SNP system.

Peach IPM. Resistance in *Monilinia fructicola*, causal agent of brown rot disease, to the benzimidazole (BZI) and demethylation inhibitor (DMI) fungicides has caused significant crop losses for peach growers in the Southeast. The Schnabel laboratory at Clemson have identified, characterized and documented DMI resistance. An agar-based assay called 'Profile' has been developed for monitoring location-specific fungicide sensitivity profiles for *M. fructicola*. 'Profile' was tested in commercial orchards in 2008 with more than 25 peach growers participating. Training in use of the 'Profile' system will facilitate expanded site-specific resistance monitoring and the development of more effective disease management programs. Please refer to the Appendices for additional information on the 'Profile' system.

Consumer/Urban IPM. Increasingly school and governmental IPM programs require that only minimum risk products be used inside school buildings. At a board of directors meeting of the South Carolina Pest Control Association (SCPCA) on July 31, 2008, leaders of the pest control industry in South Carolina expressed a desire for more information on how to transition their businesses towards greater adoption of more "green" pest control methods. Training programs to be developed for pest control industry personnel in 2009 will address this need.

In the U.S., ants are considered by pest management professionals to be the top economic pest and by homeowners to be a more serious pest than cockroaches. Based on Extension records and ant surveys by the Benson lab at Clemson, there are approximately 200 species of ants in South Carolina, with only about 12 pest species. Based on Extension agent surveys of training needs, comprehensive training will be conducted in 2009 on the identification, biology, habits and effective control measures for pest ants to enable them to more effectively respond to inquiries from homeowners.

Each year over 70 million tons of pesticides and fertilizers are applied to home lawns and gardens (www.nwf.org/backyard). Approximately 30% of calls to the Clemson Home & Garden

Information Center (HGIC) are requests for information on home lawn and turf grass care. Questions indicate that homeowners are overly concerned about the appearance of their lawns, are quick to purchase pesticides to solve problems, but have little knowledge of the concepts of IPM. The Clemson HGIC staff will conduct homeowner training in 2009 on the concepts of IPM and in proper home lawn care to minimize adverse risks from improper use of pesticides.

APPENDIX 1. Additional information on Clemson IPM projects in specific commodity areas

Agronomic Crops: Corn and Soybean IPM

Insect pest management: Worldwide use of transgenic crops reached 114 million hectares in 2007, with the United States remaining the major adopter with 58 million hectares planted (James 2007). Commercial use of crops with transgenic traits conferring insect resistance increased the United States farm income by an estimated $1.9 billion in 2003 (Sankula et al. 2005). In 2008, transgenic corn (*Zea mays* L.) represented 80% of the total corn planted in the United States, including 17% single gene insect resistant and 40% stacked (herbicide tolerant and insect resistant) (USDA NASS 2008).

Transgenic corn hybrids containing the endotoxin of *Bacillus thuringiensis* (*Bt*) were initially produced to target the European corn borer, *Ostrinia nubilalis* (Hübner) (Koziel et al. 1993); however, other Lepidopteran pests can be controlled or suppressed with *Bt* corn, including southwestern corn borer, *Diatraea grandiosella* Dyar, fall armyworm, *Spodoptera frugiperda* (J.E. Smith), and corn earworm, *Heliocoverpa zea* (Boddie) (Buntin et al. 2004, Williams et al. 1997). Several modes of toxin expression characterize the different events of available *Bt* hybrids (Ostlie et al. 1997). Events Bt-11 and Mon810 express Cry1Ab toxins in both vegetative and reproductive structures throughout the season (Armstrong et al. 1995, Williams et al. 1997) and are commercialized as YieldGard (Ostlie et al. 1997). Event TC1507 expresses Cry1F toxins in mainly vegetative structures throughout the season and is commercialized as Herculex I. In addition, *Bt* rootworm corn hybrids are now available with events such as MON863 expressing Cry3Bb1 (Vaughn et al. 2005) and event DAS-59122-7 expressing Cry34Ab1 and Cry35Ab1 toxins (Herman et al. 2007). Second generation *Bt* corn will soon be available with genes coding for 2 toxins targeting corn borer pests (YieldGard VT Pro; toxin Cry 1A.105 + Cry 2Ab2).

Seeds are becoming a popular delivery support for many pesticides (Halmer 2000). In addition to transgenic traits, insecticide coated corn seeds are becoming more prominent in the US (Mullin et al. 2005). Several neonicotinoid insecticides are available, including Poncho (active ingredient: clothianidin), Gaucho (active ingredient: imidacloprid) and Cruiser (active ingredient: thiamethoxam). These systemic insecticides are absorbed and distributed throughout the plant as it grows and provide early season protection against injury by various insects including wireworms, seedcorn maggots, southern corn leaf beetles, chinch bugs, flea beetles, white grubs, thrips and sugarcane beetles (Wilde et al. 2004).

With such a diversity of options of seed incorporated insecticides in corn, it is necessary for growers to have the required information to determine if they should adopt these systems or not. *Bt* corn hybrids are very effective in controlling pests that are major problems in the mid-west. However, the insects targeted by these *Bt* products are generally not consistent pests in the Southeast. Studies have questioned the need for transgenic corn when recommended planting dates are used in Georgia (see Buntin et al. 2004). While proactive insecticide coated seeds are effective in controlling some seedling pests, their use is only warranted if pest pressure is sufficient. Corn seed is increasingly being treated with systemic neonicotinoid insecticides and untreated seed can be difficult to purchase; however different rates of insecticide seed treatments are available and low rates may often suffice.

Corn was planted on 355,000 acres in South Carolina in 2008. Replicated field studies in South Carolina began in 2007 to evaluate these products, and trials expanded in 2008 with tests at the Pee Dee REC and at the Edisto REC. In both years of research, *Bt* corn and seed treatments *did not significantly increase the yield* of corn. As well as in-service training to county agents on corn insect management, field days at both stations highlighted this research to growers in 2008. However, on farm trials are needed across a wider variety of environmental conditions to provide growers with hands-on experience with *Bt* and non *Bt* hybrids, and neonicotinoid seed treatments. It is likely that these products will be warranted under some conditions (i.e. soil type, history of field, etc.), but not under others.

The *cost benefit* of using these technologies needs to be clearly defined under commercial growing conditions in South Carolina. In addition, the use of insecticides always carries an *environmental risk,* which has been demonstrated with the impact of neonicotinoid seed treatments on selected non-target arthropods (Mullin et al. 2005). Likewise, selected insect taxa are less abundant in *Bt* corn fields than in non *Bt* corn fields without the use of insecticide (Marvier et al. 2008). The widespread adoption of transgenic *Bt* crops also places a high selection pressure on target insect populations and can accelerate development of resistance, raising concerns about the long term viability of transgenic *Bt* plants (Ostlie et al. 1997).

Two years of research at Pee Dee and Edisto Research Centers in 2007 and 2008 have shown that *Bt* corn and seed treatments do not significantly increase the yield of corn in South Carolina when recommended planting dates are used. Corn yields in 2008 at the Edisto REC were not significantly different in isolines with or without either the Bt-11 event ($F = 0.00$; df = 1,36, $P = 0.99$) or the TC1507 event ($F = 1.40$; df = 1,36, $P = 0.25$). Likewise, protection from early season pests did not increase yield using either a high rate of clothianidin (1.25 mg [ai]/seed; $F = 0.36$; df = 1,36, $P = 0.55$) or terbufos as a soil insecticide ($F = 0.79$; df = 1,36, P = 0.38).

These results suggest that growers may not need to invest in expensive technologies to control insects at such low levels of pressure. While *Bt* corn reduced corn earworm injury, the major pests targeted by *Bt* corn (European corn borer and corn rootworms) are typically only sporadic pests in South Carolina. The value of *Bt* corn has similarly been questioned by other studies in the Southeast when recommended planting times are used (Buntin et al. 2004). Outreach programs with growers and agents may therefore help to reduce the amount of pesticides used in corn in South Carolina.

Weed management in soybean and cotton: In South Carolina, Roundup-Ready™ crop varieties account for a majority of soybean acres in production. Benefits for growers adopting herbicide tolerant technology include reduction and/or elimination of tillage operations and reduced need for soil-applied residual herbicides. However, it put unprecedented selection pressure on *Palmer amaranth* to evolve resistance to glyphosate, the principal herbicide component of the Roundup Ready™ system (York et al. 2007). In addition, *Palmer amaranth* is resistant to several other herbicide families that play an important role in the absence of glyphosate. *Palmer amaranth* is a highly competitive weed in corn, soybeans, and cotton (Massinga et al. 2001; Morgan et al. 2001; Bensch et al. 2003; Klingaman and Oliver 1994; Monks and Oliver 1988; Rowland et al. 1999; Smith et al. 2000). In addition, *Palmer amaranth* extended emergence period and highly prolific seed production ensure that it will always be a problem in row crop agriculture, despite our best efforts (Monks and Oliver 1988; Keeley et al. 1987). In the face of the threat, growers need to be educated through field demonstrations on alternative, cost-effective management practices to deal with glyphosate-resistant *Palmer amaranth* while maintaining sound conservation practices (minimizing tillage).

Field studies were conducted in 2008 at Edisto and Pee Dee Research Centers to evaluate different combinations of preemergence and postemergence herbicides for control of glyphosate-resistant (GR) *Palmer amaranth* in South Carolina row crops, including soybean and cotton. Preemergence treatments included pendimethalin at 1.0 lb ai/A, alachlor at 1.0 lb ai/A, flumioxazin at 0.096 lb ai/A, chlorimuron at 0.019 lb ai/A, and chloransulam at 0.026 lb ai/A. Postemergence treatments included glyphosate at 0.75 lb ai/A alone and in combination with lactofen at 0.156 lb ai/A, fomesafen at 0.353 lb ai/A, acifluorfen at 0.75 lb ai/A, or chlorimuron at 0.008 lb ai/A. Preemergence treatments were applied shortly after planting. Postemergence treatments were applied at the 6" weed stage. An untreated check was included for comparison. *Palmer amaranth* was controlled > 98% in treatments receiving the pre-emergence treatments (alachlor, pendimethalin, flumioxazin). Post-emergence applications of lactofen and acifluorfen also provided excellent control of Palmer amaranth in this study (>92% control). Overall, soybean yield was not impacted by any of the herbicide treatments. These results indicate that where irrigation or rainfall is timely, preemergence programs will continue to play an important role in managing GR-*Palmer amaranth*. If pre-emergence herbicide fail to control GR-*Palmer amaranth* (i.e., not activated by irrigation or rainfall), then post-emergence applications of lactofen, fomesafen, and acifluorfen may be used.

Cotton Insect Pest Management: Clemson University's Extension IPM activities with insect pests of cotton and soybean will be in line with those of cooperating colleagues in the southeastern USA including Dr. Ames Herbert (VA), Dr. Jack Bacheler (NC), Dr. Phillip Roberts (GA) and other entomologists in the southeastern US. As a group, we will be pursuing cooperative Extension and demonstration efforts that traverse state lines in the Southeast. An example of regional cooperation includes continuation of work initiated on a project addressing management of boll-feeding bugs in cotton called "Identifying Practical Knowledge and Solutions for Managing the Sucking Bug Complex in Cotton: Research in the Southeast Region" supported by cooperating Southeast State Cotton Support Committees. Although that project resulted in refinements of current action thresholds and a detailed analyses of insect impacts on fiber quality, additional coordinated Extension efforts addressing stink bugs in cotton are needed because of EPA mandated major changes in availability of transgenic Bt technology in cotton after 2009/2010. As first-generation, single-gene Bt varieties of cotton are phased out, the importance of stink bugs in cotton and closely associated crops will be intensified. Another example of a cooperative project with colleagues in the Southeast is work on insecticide seed treatments and in-furrow pesticides that target early-season pests such as thrips and nematodes. This research-based information must be incorporated into Extension training programs and IPM recommendations for cotton. Additional collaborative Extension work will involve continued demonstration of transgenic Bt cotton efficacy and resistance development with major lepidopteran species, on-going monitoring efforts for insecticide resistance development in bollworm, *Helicoverpa zea*, to pyrethroid insecticides, and recommendations for management of insecticide resistance in stink bugs.

Nematode management:

Work in the Khalilian laboratory during the past eight years has shown that soil type and texture have a great effect upon distribution of nematode species, nematode population densities, and nematode damage potential (Khalilian et al. 2001 & 2003; Monfort et al. 2004a & 2004b; Wrather et al. 2003). The results also showed that the soil electrical conductivity (EC) can be used successfully to measure soil texture and predict the distribution of nematode species (Fig. 1) at a fraction of costs compared to conventional soil sampling methods currently used by farmers.

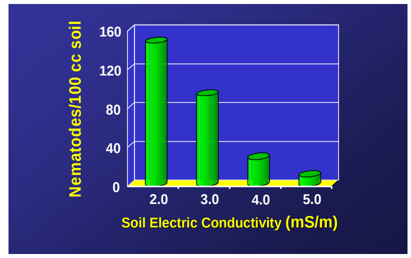

Figure 1: Effects of Soil EC on Columbia lance nematode

Figure 2. SNP system (Phillips Farm). Clemson University has developed a SNP system (for applying Telone II and Temik 15G nematicides) that is ready for commercial deployment and use by growers. With the SNP system, a soil electrical conductivity meter, (Veris 3100, Lund et al., 1999), is used to generate accurate, inexpensive geo-referenced, field-level soil textural maps. The EC map then is used to divide the field into several management zones with subsequent site-specific nematicide applications matching nematode population densities in each zone.

We have developed GPS-based equipment for controlling the rates of nematicides to match the spatial distribution of nematodes and have installed six SNP systems (fig. 2) on growers' equipment in Orangeburg, Hampton, Barnwell, Bamberg, and Marlboro counties. Tests of these systems have shown that both variable-rate applicators closely followed the recommended nematicide application-rate maps. Savings in Telone II applications ranged from 53% in the sandy portion of the field to 100% in the heavier soil portion of the field. Reductions in Temik15G rates ranged from 20% to 50% in the same soil types. By applying nematicides only where damaging levels of nematodes occurred, the variable-rate Temik 15G and Telone II applications increased lint yield by 5% and 7% compared to single uniform rate applications, respectively. This innovative system is being copied in other areas (GA, LA, MO, and AR) and is currently used by growers. Our system integrates information on numerous soil and crop parameters but is still simple enough to be user-friendly.

The electrical conductivity mapping system is commercially available in SC and some of our farmers are already using this technology as a nutrient-management tool. SNP technology can lead to substantial reductions in chemical use and subsequent adverse impacts on ground and surface water quality while increasing yields. Applicator exposure to a restrictive use of pesticide will also be minimized. Nematicides are applied only where damaging levels of nematodes occur.

Vegetable IPM

Pest management information and strategies incorporated into the Vegetable IPM training program will be adapted from a previously funded Southern Region SARE project led by Project Leader Zehnder to develop a sustainable agriculture training curriculum for agriculture professionals. The curriculum, entitled "IPM for Organic Crops" was recently developed over four years by regional experts on disease, insect and weed management using research based information and recommendations, and is currently available on the Cooperative Extension Curriculum Project website (http://srpln.msstate.edu/cecp/). The curriculum includes 11 modules on the following topics with a final exam:

- Introduction to the Course
- Cultural Practices for Managing Crop Diseases
- Cultural Practices for Managing Insect Pests
- Cultural Practices for Managing Weeds
- Overview of Biologically-Based IPM
- Biological Control of Diseases
- Biological Control of Insect Pests
- Biological Control of Weeds
- Overview of Monitoring & ID Techniques for Insect Pests, Weeds & Diseases
- Use of Approved Pesticides in Organic Production
- How to Conduct On-Farm Organic Pest Management Research

Participants in the course may explore topics in greater detail through the use of real world examples ("Get Real"), interactive exercises ("Get Interactive"), and links to supporting information available on the internet or other published works ("Get More").

The hands-on training with the curriculum will take place at the Clemson Organic Farm (Upstate region) and on four limited resource and minority-owned farms in the lower part of the state. The Clemson Organic Farm was established in 2001 and currently occupies approximately 15 acres of the Calhoun Field Laboratory, an area dedicated for agricultural research, teaching and public outreach programs. The Farm serves as a resource for experiential learning in sustainable agriculture and organic farming and over the years has hosted many training events for Extension agents and farmers in all aspects of sustainable agriculture including IPM (www.clemson.edu/sustainableag/student_farm.html).

Peach IPM

Resistance in *Monilinia fructicola* to the BZI and DMI fungicides has caused significant crop losses for peach growers in the Southeast (Zehr et al. 1991; Schnabel et al. 2004). The Schnabel laboratory have identified and characterized DMI resistance (Luo et al. 2008) and documented DMI resistance in the Southeast and along the east coast up to New York. Additionally they have found first evidence that QoI fungicide resistance is emerging in the Southeast due to heavy use of this chemical class since introduction in the late 1990s (data not published). Resistance is not yet widespread, opening up the opportunity for the development and implementation of new resistance management strategies. To address this issue, the Schnabel laboratory at Clemson along with University of Georgia scientists developed an agar-based assay called 'Profile' for monitoring location-specific sensitivity profiles (Amiri et al. 2008). 'Profile' determines the sensitivity of local *Monilinia* populations to the three most commonly used fungicide classes and identifies the most cost-effective spray program for brown rot control based on location-specific resistance profiles. In addition, 'Profile' counteracts selection of pathogen populations for fungicide resistance, making disease management and the entire operation more sustainable for the future. With the help of county agents 'Profile' was tested in commercial orchards in 2008 with more than 25 growers participating. The system facilitated orchard-specific fungicide recommendations and revealed new information that will help in formulating future management strategies. For example, a commonly recommended strategy to reduce the selection of resistant populations is to rotate chemical classes. However, analysis of 25 resistance profiles from South Carolina in 2008 revealed that a rotation of DMI and QoI fungicides selects for both DMI and

QoI resistance at the same rate as the individual classes alone (Fig. 1). This is contrary to common belief that rotation of chemical classes reduces selection of resistance. If this result can be verified in 2009, current extension recommendations need to be revised.

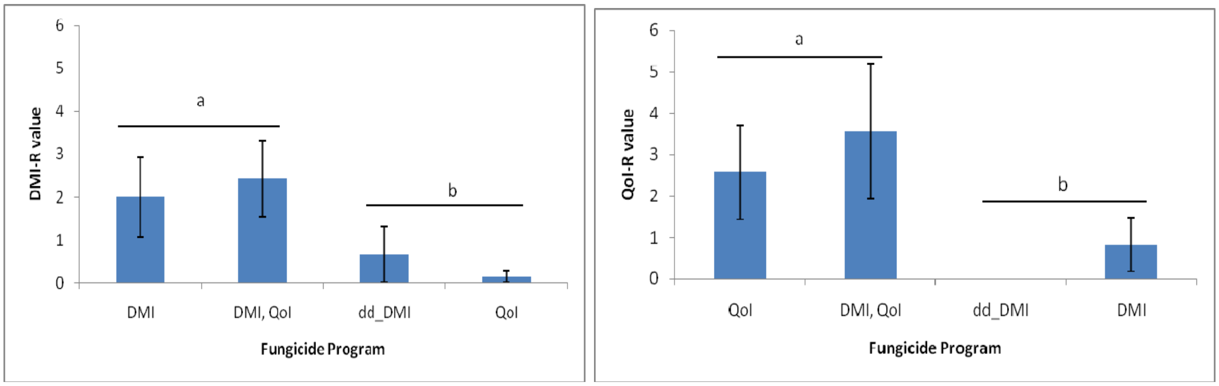

Figure 1. Alternation of DMI and QoI fungicides (second colums of each figure) selected for DMI and QoI resistance.

Consumer/Urban IPM: Home Lawn Care

South Carolina has the 9th highest rate of rural to urban land conversion in the United States, and a portion of this has been for the creation of home lawns (London & Hill 2000). Approximately 80% of US households have a lawn, with a total of over 21 million acres of private lawns (Borman et al. 2001). The Clemson Home and Garden Information Center (HGIC) was established to serve as a resource for the residents of South Carolina on establishment and maintenance of the home landscape. Approximately 30% of calls to the Clemson Home & Garden Information Center (HGIC) are requests for information on home lawn and turfgrass care. Questions indicate that homeowners are overly concerned about the appearance of their lawns and are quick to purchase pesticides to solve problems, but have little knowledge of the concepts of IPM. Many of the commonly used turfgrass pesticides have a high mobility in the soil and can be a source of groundwater contamination. Studies in Kentucky revealed that up to 90% of a 2,4-D lawn application could be lost to runoff on a sloped lawn during a simulated rainstorm, even hours after being applied (Schueler, T. and H. Holland. 2000). New synthetic pyrethroids have replaced some of the older, longer lasting and more groundwater-polluting lawn insecticides, notably diazinon. However, long term studies have not been conducted on the environmental effects from this class of pesticide, and synthetic pyrethroids are highly toxic to aquatic life (Mueller-Beilschmidt, 1990).

Each year over 70 million tons of pesticides and fertilizers are applied to home lawns and gardens (National Wildlife Federation; www.nwf.org/backyard). Amazingly, the average homeowner applies ten times the amount of chemical pesticides per acre that a farmer applies (Templeton et. al. 1998). Weed and feed products have become extremely popular, but often exacerbate lawn and woody plant problems. Not only can they injure the turfgrass when applied during the spring green-up period or during the hot days of summer, but accumulation beneath the dripline of trees and shrubs adds additional stress to these landscape plants. Because these products contain the lawn fertilizer, they are applied over the entire lawn. However, the weed killer portion may have been needed only on small problem areas, and it too is applied over the entire lawn.

Mis-management of cultural practices may also exacerbate pest problems. Frequent watering results in more shallow turfgrass rooting making grass more susceptible to disease and weed infestation. On the east coast of the US, 30% of residential water use is for lawn watering . Surveys in Virginia found that nearly 50% of homeowners watered their lawns at least once per week (Schueler, T. and H. Holland. 2000). Over 90% of the calls received by the HGIC for home lawn problems reveal that lawn irrigation systems are overused; i.e. run at least three times per week. The HGIC staff continually learns of significantly greater incidences of weeds, diseases and winter-kill of these over-watered home lawns. This in turn, results in the purchase of pesticides in an attempt to rectify the problem. Other cultural problems can arise from incorrect mowing height, dull mower blades, running irrigation in the early evening, over-fertilization and improper timing of application, and incorrect species of turfgrass selected. These forms of improper lawn care can result in excessive thatch buildup, greater incidence of disease, a thinner stand of grass which allows more weed seeds to germinate (McCarty 2003), and groundwater pollution (Borman et al. 2001).

APPENDIX 2: IPM PROGRAM SUCCESS STORIES

Promoting IPM Strategies in Cole Crops

Overuse of broad spectrum pesticides in cole crop production has long been a problem. Although these crops have a number of significant insect pests, they can be controlled by insecticides having fewer non-target effects. Since these crops have considerable, widely-touted health benefits, their consumption has risen in the past decade resulting in increased production. Reducing pesticide load on these crops as well as reducing the overt toxicity of pesticides used on them would benefit the environment and also make the crops themselves more wholesome due to reduction in pesticide residues or inherent toxicity of any residue that may be present.

Research has been conducted over several years to evaluate methods to reduce pesticide usage in cole crops. We have developed an effective economic threshold and a sequential scouting scheme for caterpillar pests of collard. A number of field days, on-farm demonstrations and presentations at regional vegetable production meetings have shown growers how to use the scouting/threshold program and demonstrated its effectiveness. A pictorial guide to pests of cole crops and their natural enemies has been produced (Integrated Pest Management for Cabbage and Collard Growers: A Growers Guide EB 156 Clemson University). Additional outreach projects in 2006 further extended the information (and the guide) to small-scale limited resource farmers in the upper Pee Dee region (Marlboro County) and the lower sea islands (Beaufort County).
Our efforts in South Carolina have resulted in a functional economic threshold for caterpillar damage on collard (the major brassica crop produced in South Carolina, the second leading producer of collard in the US), and a proven effective scouting program for caterpillar pests on collard. The program education efforts began in Lexington County, which grows over 2000 acres of collard. Growers here have used this program successfully for several years. Testimonials from these growers and presentations by them at field days and demonstrations have resulted in adoption by growers in other counties.

Adoption of the collard IPM program by growers has effectively reduced caterpillar damage in cole crops while reducing the overall number of pesticide applications. Also, the program has promoted the use of insecticides with reduced impact on the environment and human health, and has resulted in a marked reduction in the use of broad-spectrum insecticides which can exacerbate problems with secondary pests such as aphids or thrips. Reduction in secondary pest damage has been documented in areas where the program has been adopted.

We have shown that the economic benefits from the program resulting from an overall reduction in pesticide use has been greater than any additional input costs associated with scouting, using alternative pesticides, enhancement of biological control, or using augmentative biological control. Although an actual direct cause-and-effect relationship cannot be shown, there has been a dramatic increase in acreage Lexington County and other collard-growing areas where the program has been adopted since the inception of this program. Growers and county extension agents from North Carolina and Georgia have requested information on the program and have indicated an interest in promoting and adopting the program in these states.

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Development of an Effective Trapping System for Small Hive Beetle, an Introduced Pest of Honey Bees

The small hive beetle (SHB) is an introduced pest of honey bees and has now been found in Florida, Georgia, South Carolina, North Carolina, Pennsylvania, Ohio and Minnesota. SHB can be a destructive pest of honey bee colonies, causing damage to comb, stored honey and pollen. If a beetle infestation is sufficiently heavy, they may cause bees to abandon their hive. The beetles can also be a pest of stored combs, and honey (in the comb) awaiting extraction. Beetle larvae may tunnel through combs of honey, feeding and defecating, causing discoloration and fermentation of the honey.

Over the past several years Dr. Mike Hood has conducted field research with the goal to develop effective IPM tools for the US beekeeping industry. A primary focus as outlined in the state IPM Plan of Work is to develop safe, economical, and efficient alternative controls measures or methods for the SHB. Several years of research and field testing have resulted in the development of the Hood Small Hive Beetle Trap. The trap is a simple device that is attached to the bottom of the hive frame and filled with apple cider vinegar as an attractant. Beetles enter the trap and die. Testing in the field has demonstrated that the traps successfully capture and reduce SHB throughout the season when placed in newly established colonies.

Hood Small Hive Beetle Traps were first distributed in the spring of 2006 and are currently marketed by Brushy Mountain Bee Farm, Inc, Moravian Falls, North Carolina (www.brushymountainbeefarm.com). Over 3,000 traps have been sold to beekeepers throughout the US during 2006 by Brushy Mountain Bee Farm. Kelley Bee Supply www.kelleybees.com located in Clarkson, Kentucky is also currently marketing the trap. Traps have also been distributed to Australia for possible marketing in that country. The trap system will result in a significant reduction in pesticides applied for SHB control. As a result of this research beekeepers are now choosing non-chemical alternative control measures to manage SHB. Many beekeepers no longer apply insecticides for control of SHB and are using other non-chemical control measures which we are recommending including the Hood Small Hive Beetle Trap to manage this pest.

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Management of brown rot in the southeastern United States

Brown rot disease caused by the fungal pathogen Monilinia fructicola is one of the most serious diseases of peach in the southern U.S. and is a limiting factor in peach production. To compound the problem M. fructicola has developed resistance to members of the demethylation inhibitor (DMI) fungicides, the most effective chemical class for brown rot control. Thus peach growers currently have limited options for control of the disease.

In a comprehensive survey of brown rot disease in South Carolina peach production areas we have located resistant populations, isolated specific strains of the pathogen, and studied their sensitivity to various fungicides and their fitness.

Growers have been advised to rotate between DMI and strobilurin fungicides for preharvest brown rot control. They have also been advised to not use these materials any more for blossom blight control. We estimate that this change in management strategy has prevented a loss of $10 million due to brown rot disease. We are also confident that with these new strategies, resistance will not develop as quickly in SC.

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Field evaluation of the lipbalm tube method to assess fungicide sensitivity in Monilinia fructicola

Peaches are the most important tree fruit industry in the southeastern United States. The majority of production is concentrated in South Carolina (5,868 bearing hectares) and Georgia (4,856 hectares), and the value of the total utilized peach production in both states combined was estimated to exceed $64 million in 2004 (Anonymous, 2004). Aside from South Carolina and Georgia, several other southern states, including Alabama and North Carolina have peach industries with significant economic impacts (Anonymous, 2004).

An integrated approach is currently being used to control brown rot of peach, including sanitation practices, cultural methods, and chemical control measures (Brannen and Schnabel, 2005). Nonetheless, given the explosive nature of pre-harvest brown rot epidemics, management still depends heavily on the application of two or three fungicide applications in the final 2 to 3 weeks before harvest. Over the past 25 years or so, these applications have relied primarily on fungicides within a single class – the demethylation inhibitors (DMIs) such as propiconazole (Orbit), fenbuconazole (Indar), and tebuconazole (Elite). However, this crucial chemical fungicide component of pre-harvest brown rot control is beginning to fail, with potentially devastating consequences. Many growers in Georgia have already experienced significant outbreaks of brown rot in recent years (as documented by the yield loss figures for 2003 cited above), despite applying all aspects of the integrated management strategy, including pre-harvest applications of fungicides. Our latest research shows that resistant populations are emerging in other states as well, including South Carolina, Ohio, and New York (Luo et al., 2008).

In a comprehensive survey of brown rot disease in Georgia and South Carolina peach production areas we have located resistant populations and studied their sensitivity to various fungicides and their fitness. We have determined that label rates of DMI fungicides do not control these populations effectively (Schnabel et al. 2004) making the development of alternative strategies urgent. In an effort to establish site-specific resistance profiles that can help growers make science-based decisions on what products to spray for Brown rot management, we developed the lipbalm tube assay, a powerful tool that can determine resistance to three chemical classes (Amiri et al. 2008). They play a key role in brown rot control and consist of the DMI fungicides, QoI fungicides and the benzimidazoles. Currently we are training county agents from Alabama, Georgia and South Carolina to use that tool for resistance profiling. The agents recognize the need and the power of that tool and the response has been extremely positive.

The training sessions have raised awareness among county agents working with peach growers about the problem of fungicide resistance. It has broadened their knowledge about the specific resistance issues in the brown rot pathogen. They now have a tool available to determine the resistance profile of a certain location in their respective peach-growing area. The information gathered will lead to precision spray recommendations (and avoid unnecessary applications) that will reduce significantly the chance of growers experiencing control failure due to fungicide resistance. We estimate that this change in management strategy will prevent a loss of $10 million in Georgia and South Carolina in a brown rot-suitable year.

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Reducing Pesticide Risk through Education: A Program to Incorporate IPM Concepts into Elementary School Curricula

The amount of pesticides used in residential settings has surpassed agricultural pesticide usage. Young children are at greatest risk from accidental pesticide exposure because of their inquisitive nature and physiological susceptibility. Children are receptive to information on IPM, and if they have basic knowledge of pests, pesticide safety and IPM they will be less likely to be unnecessarily or accidentally exposed to pesticides. Further, as adults they will be more likely to implement non-chemical pest management methods and less likely to make prophylactic applications of pesticides. Because IPM is based on pest identification, biology and ecology combined with the needs of society, IPM is an ideal subject matter topic for the classroom. An IPM activity can touch on many disciplines and can be adapted to many areas in pre-existing curriculum. Students easily relate to the subject of IPM because pests are relevant to everyone’s daily life.

The overall goal of the project was to plan, develop, implement and evaluate a discovery-based learning curriculum for grades 4 and 5 to introduce students to the basic concepts of integrated pest management (IPM). A pilot curriculum project was conducted during the 2005/2006 school year for 4th and 5th grades at the A.R. Elementary School in Pickens, SC. The curriculum will serve as a model for adoption by other elementary schools. The approach was to adopt a main IPM theme that could be taught across disciplines (science, math, language arts, and social studies). Based on teacher input, IPM draft curricula were developed for 4th and 5th grade science, social studies and language arts classes. A 3-day teacher training session was organized and held at A.R. Lewis School and at Clemson University on July 25-27, 2005. The training was conducted by Clemson University urban IPM faculty and specialists. The purpose of the training was to give teachers a general overview of the concepts of IPM and reduced-risk pest control strategies, and also to introduce the curricula and to solicit input for any needed revision. Five teachers attended the training and provided comments on the curricula, which will be incorporated into the final IPM curricula for implementation. Teacher and student surveys were developed to evaluate the impact of the curricula on students, and to assess value to teachers.

Based on A.R. Lewis teacher input, the draft curricula were revised and customized IPM curricula were developed for 4th and 5th grade science, social studies and language arts classes. The two curricula were implemented at A.R. Lewis Elementary School during the 2005/2006 school year. Approximately 90 4th and 5th grade students participated. The curricula are available in PDF format at http://www.clemson.edu/scg/ipm/schoolipm_teachers.html.

Special school activities during the year related to the IPM curricula were also conducted. A "Bug Night" was organized at A.R. Lewis Elementary School on January 19, 2006. The event was attended by over 300 parents and children who participated in interactive and fun activities to familiarize them with insects and IPM. These included a "Fear Factor Café" which offered menu items made from insects, hands-on insect displays, and games and movies with insect themes. As a capstone project, students used GPS units to locate and map fire ant mounds around the campus and monitored the effectiveness of ant management strategies.

The five teachers who participated in the curriculum project indicated a unanimous high level of approval and support for the curriculum. They indicated that a key factor in the success of the curriculum was that the curriculum was specifically designed for grade 4-5 study areas and curriculum standards established for South Carolina. Thus, the curriculum provided "teacher and student friendly" tools to meet the curriculum standards, particularly the science curriculum standards which include: Characteristics of Organisms; Life Cycles; Organisms and their Environment; Habitats and Adaptations; Populations and Ecosystems; Organization and Classification of Living Things; Behavior; Availability of Food and Resources.

Student surveys were developed but students were not surveyed because of school administration concerns over privacy rights. However, teacher responses indicated that the curriculum was highly popular with students, and that students did gain competency with the concepts of IPM.

The curriculum is currently available for other schools to implement. We plan to meet with individuals from the South Carolina Department of Education and the South Carolina Math and Science Center to explore the feasibility of statewide implementation.

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Clemson University Urban Entomology Integrated Pest Management

Properly controlling termites in structures is complicated, prone to human or environmental mishaps and often costly to homeowners. The Clemson Urban Entomology Program in the Department of Entomology, Soils and Plant Sciences (ESPS) has a unique opportunity to train pest management professionals (PMPs) involved with termite control in the area of proper building inspection, structural calculations, treatment applications, and personal and environmental safety.

During 2006, in conjunction with the South Carolina Pest Control Association (SCPCA) and Clemson's Department of Pesticide Regulation (DPR), we offered four, two-day workshops for termite technicians. Two workshops, one in August and one in October, were designated the Apprentice Termite Techinican (ATT) Program and were designed for new termite control technicians. The other two workshops, one in September and one in November were designated the Master Termite

Technician, and were designed for termite control technicians with several years of experience. These programs have been taught in previous years, but in 2006 the programs were enhanced to help increase compliance with state regulations for proper termite treatments by practicing PMPs, to improve environmental and safety awareness and to improve our evaluation of the impact of the programs.

The content of the classroom materials were modified to meet these goals, and additions and improvements were made to a mock building foundation for hands-on training. These improvements included adding simulated subfloor construction, additional structural piers, deck steps and a demonstration area for instruction on proper treatment of sub slab substrates. Total enrollment was limited to less than 100 registrants to maintain a proper class size for quality hands-on instruction. Training focused on aspects for proper inspection techniques, calculation and application of termiticides formulations, non-chemical control strategies and environmental and safety awareness. At the conclusion of the ATT and MTT programs, participants took written and practical tests based on the information presented. A grade of 70% or higher was considered passing.
For the August ATT program, 20 of the 21 participants passed with 70% or higher with a mean score of 83.3%. For the October ATT program, 20 of the 20 participants passed with 70% or higher with a mean score of 83.4%. For the more advanced September MTT program, 17 of 26 participants passed with a score of 70% or higher with a mean score of 75.6%. For the November MTT program, 22 of 24 participants passed with a score of 70% or higher with a mean score of 74.8%.

Participants for the ATT and MTT programs were asked to complete an anonymous evaluation. Seven overall statements were presented on the evaluation using a Likert Scale of 1 to 5 with: 1 = strongly disagree, 2 = disagree, 3 = neither, 4 = agree and 5 = strongly agree. The following table summarizes the mean response for the ATT and MTT programs. The statements with average response scores for the two programs are provided below:

I am pleased that I participated in this program (4.8-4.9).
Overall, the presentations provided useful information (4.7- 4.8).
My knowledge of chemical control strategies for termites has increased (4.7-4.7).
My knowledge of non-chemical control strategies for termites has increased (4.5-4.5).
I expect to adopt new control practices as a result of attending this program (4.5-4.5).
My knowledge of safety for handling, delivering and applying termiticides has increased (4.7-4.6).
I am better prepared to comply with pesticide regulations (4.8-4.7).

On the MTT evaluations, participants were also asked: “Did you participate in the Apprentice Termite Technician Program?” “If yes, did you adopt information you learned at the ATT program?” In 2006, 17 MTT participants reported attending the ATT program and 16 (94%) reported that they did adopt information they learned at the ATT program.

In 2007, two ATT and two MTT programs are planned. Program content will be evaluated and necessary changes or improvements will be made. For example, ESPS, DPR and the SCPCA are working together to design and ultimately add additional structural features to the training foundation to enhance hands-on instruction. The planned changes will not be inexpensive, and we’ll have the challenge of ultimately securing funding to make the desired improvements. However, the overall program content of the ATT and MTT programs is solid and is making a positive impact on pest control professionals in helping them comply with state regulations and improved IPM, environmental and safety awareness.

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Urban IPM Apprentice and Master Termite Technician Training

Properly controlling termites in structures is complicated, prone to human or environmental mishaps and often costly to homeowners. The Clemson Urban Entomology Program in the Department of Entomology, Soils and Plant Sciences (ESPS) has a unique opportunity to train pest management professionals (PMPs) involved with termite control in the area of proper building inspection, structural calculations, treatment applications, and personal and environmental safety.

In 2007, in conjunction with the South Carolina Pest Control Association (SCPCA) and Clemson's Department of Pesticide Regulation (DPR), we continued to offer four, two-day workshops for termite technicians. Two workshops in August were designated the Apprentice Termite Technician (ATT) Program and were designed for new termite control technicians. Two workshops in October were designated the Master Termite Technician (MTT), and were designed for termite control technicians with several years of experience. These programs have been taught in previous years, but in 2006 and 2007 the programs were enhanced to help increase compliance with state regulations for proper termite treatments by practicing PMPs, to improve environmental and safety awareness and to improve our evaluation of the impact of the programs.

The major changes in 2007 included the construction of a 100 foot by 60 foot pavilion cover over the training foundation. This cover allowed the addition of more structural features to enhance the IPM training. In addition a 24 foot by 24 foot shed was added to the facility. Used to house training and demonstration equipment, the shed also provided a structure where proper storage of pesticides and maintenance of equipment can be demonstrated. With the new additions to the facility, the of the classroom materials was enhanced.

In general, training is limited to less than 100 registrants to maintain a proper class size for quality hands-on instruction. Training focuses on aspects for proper inspection techniques, calculation and application of termiticides formulations, non-chemical control strategies and environmental and safety awareness. At the conclusion of the ATT and MTT programs, participants take written and practical tests based on the information presented. A grade of 70% or higher is considered passing.
For the ATT programs, 46 of the 48 participants passed with 70% or higher, with a mean test score of 85%. For the more advanced September MTT programs, 28 of the 29 participants passed with a score of 70% or higher, with a mean test score of 81%. As in the past, participants for the ATT and MTT programs were asked to complete an anonymous evaluation. Seven overall statements were presented on the evaluation using a Likert Scale of 1 to 5 with: 1 = strongly disagree, 2 = disagree, 3 = neither, 4 = agree and 5 = strongly agree.

Participants responded to the following survey statements:
I am pleased that I participated in this program.
Overall, the presentations provided useful information.
My knowledge of chemical control strategies for termites has increased.

My knowledge of non-chemical control strategies for termites has increased.

I expect to adopt new control practices as a result of attending this program.
My knowledge of safety for handling, delivering and applying termiticides has increased.
I am better prepared to comply with pesticide regulations.

Average responses to the questions ranged from 4.5 to 4.9, indicating a high level of satisfaction with the program and comprehension of safe pest management practices and regulations.

On the MTT evaluations, participants were also asked: "Did you participate in the Apprentice Termite Technician Program?" "If yes, did you adopt information you learned at the ATT program?" In 2007, 9 MTT participants reported attending the ATT program and all 9 (100%) reported that they did adopt information they learned at the ATT program.

In 2008, two ATT and two MTT programs are planned, with dates set aside for a third ATT program if needed. Program content will be evaluated and necessary changes or improvements will be made. For example, ESPS, DPR and the SCPCA are continuing to work together to add additional structural features to the training foundation to enhance hands-on instruction. The planned changes will not be inexpensive, and we'll have the challenge of ultimately securing funding to make the desired improvements. For example, the new pavilion cover and shed cost $70,000. However, the overall program content of the ATT and MTT programs is solid and is making a positive impact on pest control professionals in helping them comply with state regulations and improved IPM, environmental and safety awareness.

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Refining Treatment Thresholds for Stink Bugs in Cotton in the Southeast – 2008

Cotton varieties with single-protein (i.e. Bollgard) protection from lepidopterans, afforded by genetic insertions from Bacillus thuringiensis (Bt) var. kurstaki, will become unavailable in a few years, and dual-protein (i.e. Bollgard II, WideStrike, VipCot) transgenic Bt varieties will become the only option for cotton growers. Given this scenario, the bollworm, Helicoverpa zea (Boddie), will no longer be the most damaging insect pest of cotton in the USA. The true bugs (Miridae – plant bugs and Pentatomidae – stink bugs) will most likely take over the number one spot, depending on region of the country. The tarnished plant bug, Lygus lineolaris, will be the most important insect pest of cotton in the Mid-South, the western tarnished plant bug, Lygus hesperus Knight, will remain predominant in western areas, and species of stink bugs, such as the green stink bug, Acrosternum hilare (Say), the southern green stink bug, Nezara viridula (L.), and the brown stink bug, Euschistus servus (Say), will be the most important group of insect pests of cotton in the Southeast.

There are considerable costs related to control of and losses to yield and fiber quality incurred from perennial infestations of the sucking bug complex in US cotton. In the Southeast, economic thresholds for stink bugs have been researched and adopted but need to be verified and refined if possible. Further development and validation of thresholds for the sucking bug complex in cotton will provide information needed to maximize yields and preserve high fiber quality. In 2008, we investigated treatment thresholds and application timings for stink bugs in cotton in North Carolina, South Carolina, and Georgia.

Cotton (Bollgard 2 / Roundup Ready Flex) was planted during late April and May in North Carolina, South Carolina, and Georgia. Percent boll damage was determined by randomly selecting quarter-sized bolls (10 or 25) from each plot. Each boll was evaluated for internal feeding injury and lint stain damage. Foliar applications of lambda-cyhalothrin (Karate 2.08CS) or cyfluthrin (Baythroid 1 or 2EC) at 0.033 lb (AI)/acre plus dicrotophos (Bidrin 8E) at 0.25 lb (AI)/acre were made based on percent internal boll injury (static at 10, 20 or 30%; or dynamic at 50, 30, 10, 10, 10, 30, 30, and 50% for weeks 1-8 of bloom, respectively) or on schedule (weekly; 3rd, 5th, and 7th week of bloom). Samples of insect density were taken regularly with a drop cloth to determine abundance and species present I plots. Data were processed using Agriculture Research Manager (ARM) (Gylling Data Management, Inc., Brookings, SD), and means were separated using Least Significant Difference (LSD) procedures following significant F tests using Analysis of Variance (ANOVA).

Data gathered in Georgia during 1998-2001 on preliminary development of boll-injury thresholds for stink bugs demonstrated that the technique of using symptoms of feeding injury to bolls could be used as an indirect sample of stink bug density. It was established that signs of feeding damage in bolls could be used as a monitoring tool to trigger insecticide application for stink bugs in cotton. Static treatment thresholds were established in most cotton-growing states because of this previous research. During 2007, multiple tests in the southeastern USA were established to refine treatment thresholds and other timings of insecticide application for stink bugs in cotton. In general, populations of stink bugs were very low during 2007. In North Carolina, there was an economic disadvantage to insecticide applications for bugs at the sites used in 2007. This was identical to results observed in 2006. In South Carolina, there were no significant differences in yield among the treatments tested at five of six trials in 2007. This also was consistent with 2006 results. In two of those six trials, season-long protection from early populations of plant bugs did not result in positive net returns, indicating that plant bugs were unimportant early in South Carolina during 2007. This was also consistent with results from 2006 concerning the importance of plant bugs in the Southeast at selected sites. At the one site with yield differences, the highest yields resulted when insecticide was applied during the 3rd, 5th, and 7th week of bloom or all weeks of bloom and squaring using scheduled applications; however, positive returns on insecticide investment were only realized when used at weeks 3, 5, and 7 of bloom or every week of bloom (6 wk). Combined data for South Carolina indicated that the variable threshold treatment (‘Dynamic’) resulted in the highest yield and net return ($15.45 with 1.75 applications on average). In Georgia, there were no significant differences in yield among treatments tested at five of six trials during 2007. At the sixth site, yields and net returns were lower in plots receiving insecticide than in untreated plots. Combined data for four trials in Georgia with common treatments indicated that the dynamic/variable threshold produced the highest net return, but comparisons of yields from three sites with treatments in common demonstrated that the 20% static threshold was most appropriate when compared with plots treated weekly during bloom or those entirely untreated. Yield data from all 2007 tests with common treatments addressing thresholds based on populations indices (internal feeding injury to bolls) and automatic applications for stink bugs were pooled for analyses. On average, the net economic return of using a 20% vs. a dynamic threshold were nearly identical (+$2.50 vs. -$1.35, respectively) and were greater than plots treated weekly during bloom, using the 10% threshold, or those left untreated. Combined results from the previous year indicated that insecticide applications applied during the 3rd, 4th, and 5th week of bloom were most effective in controlling populations of stink bugs and were consistent with previous results. During 2005, in what can be characterized as heavy pressure from stink bugs, threshold research in South Carolina and Georgia (9 sites) provided comparisons of weekly insecticide application during blooming, 20% internal injury, and plots remaining untreated. Yields and returns from plots treated weekly and at the 20% threshold were comparable, but some yield was lost under heavy stink bug pressure, suggesting that increased protection (i.e. <20% threshold) at critical times of the bloom period might result in less yield loss. Although cotton entomologists in the southeastern states currently recommend somewhat different internal boll injury levels as treatment triggers, the static thresholds appear effective and useful as a guide for control of stink bugs in cotton in the near-term. However, the importance of controlling bugs during certain portions of the blooming period (weeks 3-5) should be stressed to reflect the importance of crop phenology, population development of stink bugs, and timing of insecticide applications. In order to be more confident with recommendations regarding control of bugs in the Southeast, additional research on refining thresholds (particularly dynamic thresholds) for stink bugs in cotton is needed under higher pressure than that observed during the last two seasons. Nevertheless, the impact of these on-going studies undoubtedly is and will continue to be realized in reduced insecticide use in cotton as a result of improving recommendations for management of piercing-sucking pests.

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2008 Annual IPM Report
SERA 3 Annual Meeting, 23 March 2009, Portland, OR
Pat Parkman, University of Tennessee

Program Management

During 2008, the University's IPM Coordinator did not manage the Smith-Lever 3(d) funds. Two Extension Specialists, both entomologists (Field Crops and Urban), are supported by these funds and managed a small portion of them. Both Specialists have adequate technical support, facilities and equipment, but S-L 3(d) funds do not provide the majority of funding for them. Because the vast majority of these funds are used for salaries (Specialist, secretary/clerical, 0.5 technician), essentially none remains to operate a coordinated IPM program. The Specialists plans and priorities are usually dictated by stakeholder needs. The information reported here pertains to the activities and accomplishments of these Specialists.

Program Delivery

An IPM newsletter for field crops was sent directly, by e-mail or regular mail, to approximately 350 people on a weekly basis during the growing season. A regularly updated website, utcrops.com, contains production and pest management information for field crops. A new newsletter, *Pests and Pesticides: A Child-serving Facility IPM Newsletter*, was initiated this year and disseminated to the pest management decision-maker at each Tennessee school district. There is also a UT child-serving facility (i.e., school IPM) web site, http://schoolipm.utk.edu that provides resources to help schools and day cares adopt IPM. A companion website for the UT YEAH (Youth, Environment and Health) Research Team (http://utyeah.utk.edu) is concerned with children's environmental health. The *Imported Fire Ants in Tennessee* web site (http://fireants.utk.edu) is updated with the latest management options for these pests. Eleven field crops and 13 urban/fire ant Extension publications were produced. Pest management lectures and training was provided to more than 2100 and 1600 people for field crop pests and urban pests/fire ants, respectively. Surveys administered by Specialists and county Extension agents are used regularly to determine the University's impact on grower practices for cotton, soybeans, corn and wheat. An online school pest management interactive survey was completed by participating 100 school pest management decision-makers to determine levels of IPM being used by the schools.

Program Involvement

Obviously there is significant collaboration with Extension personnel at the state and county level. For example, Specialists in weed science, plant pathology and crop production help produce field crop IPM training materials. Other collaboration includes participating in the Southern Region School IPM Working Group, and the eXtension Fire Ant and Urban Communities of Practice. Both Specialists have active research programs. Research collaborations include a multistate/multi-institutional (AR, LA, MS, MO, TN) project to develop plant bug treatment thresholds in cotton; and cooperating with TN State Univ. on fire ant management research and the UT Arboretum on other pest ant management. Other interdisciplinary cooperation includes working with Extension Family and Consumer Sciences and the College of Social Work on the UT YEAH team.

Program Support

Other than Smith-Lever 3(d) funds received from CSREES, financial support is received from cotton and soybean commodity groups for pest management research. The Southern Region School IPM Working Group is supported by the SRIPMC. Funds are also received from industry for field crop pest and pest ant insecticide trials.

Texas IPM Report – 2008

Program Management

Dr. Fuchs retired in December 2008 from Texas AgriLife Extension after a productive 38 year career with the Texas A&M University System. He spent 15 years as the Statewide IPM Coordinator. The new IPM Coordinator was named in February 2009 after a national search.

The Texas IPM program is funded by both state and federal IPM funds, with the state awarding the $1.53 million and USDA CSREES EIPM providing $500,000. These funds are leveraged with funding from grower associations, industry grants, and funding from many other cooperating groups and granting agencies. About 85% of the budget is spent on salaries. AgriLife Extension employees include 21 Extension Agents IPM who work primarily in crop production/protection roles and serve from one to four counties. Serving Texas urban IPM needs are four Urban IPM Program Specialists. They are located in Dallas, Austin, San Antonio and Houston. Texas pecan producers are served by a statewide pecan IPM Program Specialist and Texas greenhouse and nursery growers are served by an IPM Program Specialist. And, Texas public schools are served by a statewide IPM Program Specialist who works with school administrators and employees providing a program to keep all Texas schools safe and pest free.

Texas IPM faculty collaborate with other Texas AgriLife Extension and Research employees at the county, district and state levels; leveraging and increasing the value of the overall Extension program to Texas stakeholders. And they cooperate with partners in Extension programs in other states and other agencies and entities. Texas IPM programs work closely with local Steering Committees but with involvement of Texas Pest Management Association, Commodity Associations, citizen groups, local and state governments, and other entities to provide direction in determining program objectives and acquiring program support. This effort supports the larger Texas AgriLife Extension Strategic Plan. Texas Pest Management Association is a statewide organization which represents agricultural producers in matters involving IPM. In addition to its program development role, TPMA is the entity which hires scouts and demonstration assistants who increase the impact of IPM and AgriLife Extension programming to local stakeholders and to the larger community.

Agriculture

Texas agronomic crop acreage in 2008 was 5.8 million acres of wheat, 5 million acres of cotton, 3.4 million acres of grain sorghum, 2.3 million acres of corn, 257,000 acres of peanuts and 230,000 acres of soybeans in 2008. A total of over 210 applied research/result demonstrations were conducted which addressed irrigation management, water conservation, water quality, fertility management, nematode management, variety selection, disease management, weed management, seed treatments, insect management, plant growth management, weather information (insect, disease and plant growth modeling), transgenic technology and electronic data collection. Over 230 issues were sent to a mailing list of newsletters to over 6,000 clientele.

More than 14,000 farms were visited. Two hundred sixty-eight news articles were prepared and 123 radio programs were given. Seventy-three scouts and 85 consultants were trained. Evaluations of 153 cotton producers from 10 IPM program units indicated the average value of the IPM program to their operations was $51.59 per acre.

Texas pecan acreage in 2008 was 180,000 acres. The pecan IPM program provided pecan nut casebearer forecasts on-line to pecan growers throughout the region. Fifty-five volunteers in Texas and Oklahoma monitored pecan nut casebearer flights with pheromone traps to initiate the predictive model. Predictions could be accessed at pecankernel.tamu.edu. Pecan IPM program evaluations have shown an economic impact of $6 million annually on the Texas economy.

Urban
In 2007 Texas had a population of nearly 24 million people, mostly located in the cities. The urban program worked with Habitat for Humanity to train 142 partner families in a common sense approach to IPM in the home. The vehicle for this educational program was ISEC (identify, sanitize, exclude and control) http://ipm.tamu.edu/isec/. The program demonstrated a number of new fire ant baits and evaluated several least toxic and organic approaches to fire ant control. Projects on phorid flies for biological control of fire ants continued to show that the parasitoids were becoming established and spreading in Texas. Monitoring and control projects with the recently introduced invasive species, Rasberry crazy ant, were conducted near Houston. The internet, web log pages, news releases, newsletters, television presentations at meetings and other means were used to address urban audiences. Urban Program Specialists worked with schools to teach many students about insects and IPM.

School IPM
Texas has 4.6 million students in public schools, 1,031 school districts and 8,195 school campuses. In 1991 the Texas legislature passed a law requiring schools to manage pests using IPM principles. One hundred and sixty-eight school districts received training in 2008. These schools had a combined enrollment of 1.48 million students. The School IPM newsletter reached an audience of 1,075 people and the School IPM website reached out to many more.

IPM Internship Program
The IPM internship program trained eight interns in 2008 and has trained 77 since 1998. These interns have been students at 10 universities.

Awards
Texas IPM agents and Program Specialists received 13 awards during 2008. These included the Southern Region IPM Center IPM Teacher Award, the Superior Paper Award by the American Association of Agricultural and Biological Engineers, and the Outstanding State IPM Program Award from the Southern Region IPM Center.

Administrative Support

The Texas IPM Program budget is controlled by the IPM Coordinator through the Associate Department Head and the Department Head of the Entomology Department. It is overseen by the Associate Director of Texas AgriLIFE Extension's Budget Center. District Extension Administrators are the supervisors for the Agents-IPM while the IPM Coordinator and the Associate Department Head for Texas AgriLIFE Extension supervise the IPM Program Specialists.

SERA-IEG3 2008 ANNUAL REPORT FOR VIRGINIA

Ames Herbert

PROGRAM MANAGEMENT and DELIVERY: The Virginia IPM Program was supported in 2008 by 3(d) federal funding which partially supported the salaries of three IPM technical support positions in the College of Agriculture and Life Sciences (CALS). The State IPM Coordinator has a 75/25 extension/research appointment in the Department of Entomology with statewide responsibility for insect pest management programs for soybean, cotton, peanut and small grains. The Pest Management Stakeholder Committee and the VCE Pest Management Planned Program Team met to provide input and guidance. In 2008, the IPM program was extended by 31.23 (FTEs) volunteer Virginia Tech specialist faculty (e.g., weed scientists, entomologists, plant pathologists, horticulturalists) and Virginia Cooperative Extension (VCE) agents throughout the Commonwealth during the reporting period (a 20% increase from 2007). A total of 670 volunteers from the private sector contributed 8,665 hours to IPM program activities. Totals of $2,353,528 and $543,284 in competitive and non-competitive grants, $350,592 in contracts, $19,243 in donations, and $4,355 in in-kind donations were generated from extramural funding sources for an annual total of $3,269,002 (a 2.4% increase from 2007) to support development and extension of IPM programs. A total of 860 workshops, short courses, media pieces (radio/television), demonstrations, seminars, presentations, and in-service training programs were presented to a varied audience including homeowners, public school officials, food preparation staff, pesticide dealers/distributors/handlers, growers, and forest, plant nursery, landscape, and golf course managers across the Commonwealth. There were 59,499 direct contacts with clientele (3.7% youth, 96.3% adult), 56,737 indirect contacts (emails, newsletters, telephone), and a total of 25,244 extended learners (4 or more hours of training). A total of 349 research-type publications were developed including scientific journal articles, book chapters, proceedings, reviews and reports. An additional 328 extension-type publications were developed including fact sheets, peer-reviewed documents, manuals, guides, newspaper and trade journal articles.

PROGRAM INVOLVEMENT: Collaboration with cooperating VCE agents and staff was extensive at the local, regional and statewide levels as individuals conducted local training programs and field days, as well as contributed to publications and strategic planning meetings. Outside agency collaborators included the Virginia Small Grains Growers Association, the Virginia Soybean Growers Association, the Virginia Pest Management Association, the Virginia Irish Potato Board, the Virginia Turfgrass Foundation, the Mount Rogers Christmas Tree Growers, the Virginia Christmas Tree Growers Association, and the Virginia Beekeepers Association. Cooperators also included associated faculty at the University of Kentucky, North Carolina State University, Clemson University, University of Georgia, Ohio State University, University of Tennessee, University of California-Riverside, and the Virginia-Maryland Regional College of Veterinary Medicine. Federal cooperators included the USDA IPM PIPE, the USDA Office of Pest Management Policy, the USDA NRCS, EPA, APHIS, and the USDA Southern Region IPM Center (SRIPMC).

PROGRAM SUPPORT:

As presented above, in 2008 3(d) federal funds ($134,507) via USDA, CSREES were used to partially fund three technical positions that are critical to the Virginia IPM Program and are housed in the Departments of Entomology, and Plant Pathology, Physiology and Weed Science. The greatest majority of support funding was generated through extramural efforts by faculty and agents. Support was also provided by many volunteers in the private sector, as well as in other state agencies (e.g., Virginia Department of Agriculture and Consumer Services), and organizations (e.g., the Virginia Agricultural Council, Virginia Farm Bureau). Support was also provided by the staff at the SRIPMC, especially regarding the management and maintenance of the Virginia Ag Pest Advisory.

ADMINISTRATIVE SUPPORT: The Virginia IPM Program received full support from the Dean of CALS, and the heads of the Departments of Entomology, and Plant Pathology, Physiology, and Weed Science. Professional development opportunities involved annual meetings of the Advisory Committee and Steering Committee of the SRIPMC, meetings at the Beltwide Cotton Conferences (San Antonio, TX), the National Entomological Society of America (Reno, NV), the Cotton Pest Management Seminar (Puerto Vallarta, MX), and the American Peanut Research and Education Society (Tulsa, OK).

SELECTED 2008 ACCOMPLISMENTS: *(see http://faculty.vaes.vt.edu/herbert, "2008 State IPM Program Impacts" for detailed descriptions and impact of each project listed below)*

Diagnostic clinics

- Virginia Plant Disease Clinic serves Cooperative Extension by diagnosing plant problems for Virginia growers.
- Virginia Tech Weed Identification Clinic report.

Soybean/corn/wheat

- Response of soybean to fungicide sprays in Virginia.
- Control of foliar diseases on soybean with fungicides.
- Soybean rust detection and control.
- Soybean rust education.
- Avoiding wheel traffic to narrow-row reproductive-stage soybean could save mid-Atlantic producers over $6.5 million.
- Nematode survey and management in Virginia corn and soybean fields.
- Description of new species of root-knot nematode, Meloidogyne species.
- The Virginia Corn Earworm Advisory increases profitability for Virginia soybean growers.
- VCE barley yellow dwarf virus educational program improves wheat yields.

Tobacco

- Improving Pythium disease control in tobacco greenhouses.
- Induced resistance to tobacco cyst nematodes to reduce dependence on traditional nematicides.
- Tobacco splitworm management.
- Tobacco insect pest management.
- Impact of conservation tillage on tobacco insect pests.
- Improving control of tobacco black shank.
- Insecticide resistance in the tobacco-adapted form of the green peach aphid.

Turfgrass/landscapes

- Identification of major weed species in turf and landscape beds.
- Discovering management solutions for troublesome grass weeds in turfgrass.
- Controlling brown patch on home lawns with less pesticide.
- Selecting and characterizing cold tolerant bermudagrasses and disseminating best management practices for their establishment and use as turf in cool climates.
- Transitioning overseeded turfgrasses.
- Impact of short course presentation “Turfgrass Entomology: Turf Insects”.

Weed management

- Identification of common chickweed with resistance to ALS-inhibiting herbicides.
- Weed management in nursery production.
- Biological control of Tree of Heaven.

Hemlock wooly adelgid

- Impact of systemic insecticides on survival and performance of two host-specific predator species of the hemlock woolly adelgid.
- On-line database monitoring and evaluation releases and recoveries of all non-native predators of the hemlock woolly adelgid.
- Quarantine evaluation and field studies of hemlock woolly adelgid predators collected from Japan and China.
- Dispersal and prey impact of *Laricobius nigrinus* Fender (Coleoptera: Derodontidae) on hemlock wooly adelgid in the eastern United States.

Gypsy moth

- Maintenance and development of the gypsy moth Slow the Spread Decision Support System.
- Information systems in the National Gypsy Moth Slow the Spread Project (STS).
- Gypsy moth monitoring, management and community education in Montgomery County.
- Refining mating disruption techniques in the gypsy moth IPM program.
- Georeferenced data collection using project-specific programmed PDAs

Fruit/vineyards

- Demonstration of efficacy of novel low-risk pesticide chemistry toward internal feeders of apple.
- IPM programs for apple and peach orchards.
- Virginia Fruit Web Site.
- IPM Extension recommendations for fruit crops.
- Risk assessment of Pierce’s disease for Virginia vineyards.
- IPM recommendations for NJ commercial vineyards.
- Assisting Virginia tree fruit producers with the transition from conventional pest management approaches.
- IPM research in primocane-bearing caneberries.

Ornamentals/greenhouses

- Synthesis of high geometric purity of (Z,Z)-3 13-octadecadienyl acetate as a major sexpheromone component of dogwood borer.
- Cornerstones of aquatic ecology of the plant destroying Phytophthora species.
- Minimizing tree losses from ambrosia beetle attack.
- York County residents implement effective pruning techniques to reduce pesticide use on ornamentals.
- Irrigation water treatment innovation: from water health to plant health.
- Investigations into the failure of heat protocols for the elimination of pinewood nematodes in wood.
- Specialty crop pest management and regulatory transition for growers.
- Glucosinolates as biofumigation agents.

Vegetables

- Cucurbit downy mildew management and monitoring in Virginia.
- Research on methyl bromide replacements in tomato.
- Virginia's Potato Disease Advisory

Peanut

- New weather monitors for the Peanut/Cotton Infonet.
- Regulatory approval for transgenic peanuts.
- Using the 'Southern Corn Rootworm Risk Advisory' for limiting loss and improving peanut profitability.
- Developing Sclerotinia blight resistance in peanuts.

Honey bees

- Honey bee queen production program for Virginia.
- Honey and beeswax analysis for miticide residue.
- Virginia Master Beekeeper Program.

Forage/pastures

- Hunting billbug losses prevented in Virginia orchardgrass hayfields through timely insecticide applications.
- Evaluating brush control products for use in southwest Virginia.

Urban/human health

- Evaluation of the efficacy of insecticidal products labeled for bed bug (*Cimex lectularius)* control.
- Investigations on the German cockroach reproductive physiology.
- Development of termite bait attractants and biopesticide formulation.
- New mosquitocides for control of malaria.
- Integrated pest management training for Virginia schools.
- Pre-construction termiticide application training for subterranean termite prevention.
- Minimizing injury and exposure to red imported fire ants.
- Neurotoxicants, dopamine neurochemistry, and Parkinson's disease.

International

- Regional IPM program for East Africa: Kenya, Tanzania and Uganda.
- Pest management in high-value horticultural crops in Eastern Europe.
- West Africa IPM CRSP Regional Consortium of Excellence.