poster abstracts

*Note: * by author name indicates presenting author.*

Best Practices—Agriculture

P001 Tolfenpyrad: A new broad spectrum insecticide from Nichino America, Inc.

*Scott Ludwig[1], sludwig@nichino.net, James Adams[2], Botond Balogh[3], Pedro Hernandez[4], Allison Walston[2], and Ken Chisholm[2]

[1]Nichino America, Inc., Tyler, TX; [2]Nichino America, Inc., Wilmington, DE; [3]Nichino America, Inc., Apollo Beach, FL; [4]Nichino America, Inc., Tulare, CA

Tolfenpyrad (Bexar®, Apta®, and Torac®) is a broad-spectrum, foliar contact insecticide. Its development began in 1996 in Japan and registrations were granted in 2002. Nichino America, Inc., a subsidiary of Nihon Nohyaku, is developing Tolfenpyrad for use in a wide range of crops in the U.S. Tolfenpyrad was registered on U.S. greenhouse-grown ornamentals in 2010, as Hachi-Hachi®. EPA approval for use on food crops and outdoor-grown ornamentals is expected in 2012. Tolfenpyrad has activity against several economically important insect pests of vegetable, fruits, nuts, vines, and row crops. It is active on Hemiptera, Thysanoptera, Lepidopera, Coleoptera, Diptera, Orthoptera, Eriophid mites and Tarsonemid mites. It has activity on all development stages of target insects. Tolfenpyrad also has fungicidal activity against certain species of powdery mildew and downy mildews. Tolfenpyrad has been classified by the Insecticide Resistance Action Committee (IRAC) under Group 21A, which are the Mitochondrial Complex I Electron Transport Inhibitors (METI). It works by inhibiting cellular respiration in the mitochondria. As a result, Tolfenpyrad causes rapid cessation of feeding and death of the pest usually within 24-48 hours.

P002 Some priority pest problems in small scale fruit and vegetable production in North Florida

*Muhammad Haseeb, Muhammad.Haseeb@famu.edu, Roaida Said, Bobby Phills, Alex Bolques, and Gohar Umar

College of Agriculture and Food Sciences, Florida A&M University, Tallahassee, FL

North Florida is located in a specific ecological zone, where selected fruits and vegetables are grown. During the summer and fall season, we established numerous small size demonstration plots and beds with vegetables including okra, beans, tomato, pepper, cauliflower, cabbage, broccoli, collard, eggplant, squash, and turnip. These plots form the basis for clientele training in IPM. Regular monitoring of pests and beneficial species was carried out. A number of species were collected and identified including *Nezara viridula*, *Euschistus servus*, *Epitrix fasciata*, *Anasa, tritis*, *Euphoria sepulcralis*, *Niesthrea sidae*, *Leptoglossus phyllopus*, *Microtheca ochroloma*, *Myzus persicae*, *Melitta cucurbitae*, *Brevicoryne brassicae*, *Plutella xylostella*, *Trichoplusia ni*, etc. In case of small fruits, new and healthy cultivars of apple, grapes, plum, persimmon, peach, chestnut, citrus, and figs were grown. Numerous insect and mite species were identified on fruit plants including *Conotrachelus nenuphar*, *Phyllocnistis citrella*, *Leptoglossus phyllopus*, *Homalodisca vitripennis*, *Harrisina Americana*, *Frankliniella bispinosa*, *F. tritici*, *Euphoria sepulcralis*, *Tetranychus urticae,* etc. Most of the new orchard plants (< 5 years old) are doing well except citrus. In addition, number of beneficial species including *Diaeretiella rapae, Harmonia axyridis, Trissolcus basalis, Trichopoda pennipes* were recorded. Efforts continue to develop/apply IPM recommendations against these pests. Growers are also participating in seasonal field days and student internships are offered and training on the IPM of small fruits and vegetables is being carried out.

P003 A successful participatory IPM approach against *Hyposidra talaca* Wlk., a devastating pest on tea

Sunil K. Pathak, skpathak3@gmail.com

North Bengal Regional R & D Centre, Tea Research Association, Nagrakata, West Bengal, India

Tea, *Camellia sinensis* (L) O. Kuntze, is the major commercial crop grown over one lakh (=100,000) hectare supporting the livelihood of nearly 2.5 lakh people in Dooars and Terai area of West Bengal, India. Recent outbreaks of a new species of looper caterpillar, *Hyposidra talaca* Wlk, Geometridae, on tea caused significant crop loss compelling the growers to use pesticides as the dominant method of control. In-depth studies during 2009-10 revealed its peculiar habit of heavy egg laying during winter in cracks and crevices of bark of tree trunks, peak moth emergence in the early part of the season, pupation in soil and tea frames, and a short life cycle with 6-8 broods in a year without winter diapauses, unlike earlier known looper species on tea, *Biston supressaria*. Based on information generated, an IPM package including light trapping of moths, collection of pupae, destruction of egg masses and egg laying moths on trees, killing of the caterpillars with new generation insecticides including an Insect Growth Regulator (IGR) and *Bacillus thuringiensis,* etc. were tried in a systematic manner during 2010-11. Special bulletins were issued and grass root level training and awareness workshops were organized in tea estates to popularize the IPM package. Survey data revealed that the participatory approach of IPM worked effectively to manage the pest with significant economic and environment benefits, increase of crop, a viable cost-benefit ratio and drastic reduction of synthetic pyrethroid used earlier in a large scale.

P004 Communicating IPM–A Potato Industry Collaboration with McDonald's

*Yves Leclerc, YNLECLER@mccain.ca[1], Leigh Morrow[2], Dave Ingersoll[3], and Richard Burres[4]

[1]McCain Foods (Canada), Florenceville-Bristol, NB, Canada; [2]McCain Foods USA, Inc. Easton, ME; [3]J R Simplot, Boise, ID; [4]ConAgra Foods, Kennewick, WA

In response to the market place, several organizations have developed a new Potato Integrated Pest Management Survey. Participants were McCain Foods, ConAgra Foods, Simplot, McDonald's, the National Potato Council, the Canadian Horticultural Council, several growers and the IPM Institute of North America. The Northeast IPM Center provided a grant toward building an internet application to implement the survey over the web. The potato IPM Survey is free to all growers, requires once yearly reporting and involves an extensive set of questions about best IPM practices. Fourteen survey sections list growing and resource management practices that could impact the health of the crop. A unique feature to update answers from the previous season makes the task of creating historical trends quite simple. Each practice is categorized as a Basic, Steward, Expert, or Master. This tiered approach allows for practice reporting by low-management to high-management IPM. By participation in this survey growers are able to report their level of IPM adoption to customers that require such information. Various reports allow growers to 1) compare their farm performance, practice-by-practice, to the average for the country, region, or market (frozen, chip, fresh, seed), 2) track their IPM adoption results over a five-year history, and 3) identify IPM practices of others they might also adapt. Grower web pages are accessible only by the grower with a registered business name and password. The detail results are only provided to food companies as selected by the grower. Public reporting is communicated through two web reports that provide country summary information and summary scores for the survey sections.

P005 Development of IPM technology for cumin (*Cuminum cyminum* L.) and its evaluation in farmer participatory mode

*M. M. Sundria[1], manu2015@rediffmail.com, H. R. Bishnoi[1], R.P. Jangir[1], B. S. Rathore[1], and R. Swaminathan[2]

[1]Agricultural Research Station (SK RAU, Bikaner), Mandor, Jodhpur, India; [2]Department of Agricultural Entomology, Rajasthan College of Agriculture (MPUAT) Udaipur, India

Field studies were conducted from 2006-07 to 2008-09 on development of organic plant protection modules along with IPM module in cumin (*Cuminum cyminum* L.) at Agricultural Research Station, Mandor, Jodhpur. The same modules except the IPM module were later validated during 2008-09 in farmers participatory mode at 2 locations of Shergarh tehsil of Jodhpur district and 2 locations one each in Siwana and Shiv tehsils of Barmer district in arid zone of western Rajasthan. It was found that only IPM module comprising with soil treatment with *Trichoderma viride* (2.5 kg/ha) + seed treatment with *Trichoderma viride* (6 g/kg) + I spray mancozeb (0.2 %) at 30 DAS, II spray mancozeb (0.2%), acephate 75 SP (750 g/ha) & wettable sulphur (0.2%) at 50-60 DAS and III spray, repeat II spray after 10-15 days of II spray reduced the per cent incidence of major diseases such as wilt, blight and powdery mildew from 8.1, 12.9 and 16.8 in unprotected treatment to 4.5, 3.4 and 7.8, respectively in IPM module. Aphid population ranged from 12.8 in unprotected control to 1.24 per umbel in the IPM module. IPM technology was found economically viable as indicated by net return (Rs. 6844/-) and incremental cost benefit (ICB) ratio (1:3.78). However, organic plant protection modules were effective in comparison to unprotected control but all the organic plant protection modules gave negative return and ICB ratio.

P006 A sentinel plot network across the southern United States: IPM to protect the U.S. soybean industry

*Tom W. Allen[1], tallen@drec.msstate.edu, Cliff M. Coker[2], John P. Damicone[3], Clayton A. Hollier[4], Tom Isakeit[5], Rich Joost[6], Bob C. Kemerait[7], Jim J. Marois[8], W. Scott Monfort[9], John D. Mueller[10], David L. Wright[11], and Ed J. Sikora[12]

[1]Mississippi State University, Delta Research and Extension Center, Stoneville, MS; [2]University of Arkansas, Southeast Research and Extension Center, Monticello, AR; [3]Oklahoma State University, Stillwater, OK; [4]Louisiana State University, Baton Rouge, LA; [5]Texas A & M University, College Station, TX; [6]The United Soybean Board, St. Louis, MO; [7]The University of Georgia, Coastal Plain Experiment Station, Tifton, GA; [8]University of Florida, North Florida Research and Education Center, Quincy, FL; [9]University of Arkansas, Rice Research and Extension Center, Stuttgart, AR; [10]Clemson University, Edisto Research and Education Center Edisto, SC; [11]North Central Soybean Research Program, Ankeny, IA; [12]Auburn University, Auburn, AL

Implemented in 2005, sentinel plots comprised of kudzu, soybean, and other important susceptible host plants have been used to monitor for the presence, spread, and severity of soybean rust (*Phakopsora pachyrhizi* Sydow) (SBR) throughout the United States. Since the inception of the sentinel plot program, SBR has been positively confirmed a total of 1,807 times representing county-level detection in 20 different states. In 79% of the detection instances the disease was identified from key states representing the Gulf coast, Midsouth, and important "bridge states" for the spread of SBR to northern soybean production areas including Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Oklahoma, South Carolina, and Texas. Even though the nine states contain approximately 10% of the U.S. soybean hectares they are crucial in the SBR-monitoring effort, continue to provide locations for fungicide efficacy trials, screening of breeding stock for SBR resistance, and training countless individuals to identify SBR. Support of the monitoring network continues by national, regional, and state soybean interest groups. A concerted effort to report the presence of SBR has been made through weekly in-season conference calls, numerous regional and state telephone hotlines, blogs, twitter accounts, recorded radio presentations, and an internet-based data clearinghouse that has become the Pest Information Platform for Extension and Education or ipmPIPE that currently includes information on plant diseases in addition to SBR. In all, the monitoring efforts have saved soybean producers untold hundreds of millions of dollars by keeping them abreast of the presence of SBR and limiting unnecessary fungicide applications.

P007 Integrated pest management of *Ralstonia solanacearum* on tomato in Uganda

*J. Karungi[1], jkarungi@agric.mak.ac.ug, G. Tusiime[1], P.R. Rubaihayo[1], R.N. Ssonko[1], D. Asiimwe[1], S. Kyamanywa[1], J. Kovach[2], S. Miller[2], and J.M. Erbaugh[2]

[1]School of Agricultural Sciences, Makerere University, Kampala, Uganda; [2]Ohio State University, Columbus, OH

'MT56', a tomato variety introduced to Uganda from the Ohio Agricultural Research and Development (OARDC) Breeding Program in USA had been observed to be moderately resistant to *Ralstonia solanacearum* L. in the country. Current research has aimed at confirming the resistance of the variety and exploring the efficacy of other cultural practices as a robust integrated management strategy for this priority tomato disease. In one study, eight tomato varieties CLN3022D, CLN3022F, CLN3024A, CLN2418 (from AVRDC); Tengeru-97, Moneymaker, Marglobe and Roma (commercial varieties in Uganda); and MT56 were inoculated with *R. solanacearum* at a population of 1×108cfu ml^{-1} in a complete randomized design with five (5) replications to record disease development on potted plants. *R. solanacearum* symptoms were apparent 10 days after inoculation (DAI) and developed differently across genotypes. MT56, CLN3024A, CLN24118A, and CLN3022D had the lowest disease incidence. Another study assessed the potential of grafting as a strategy for managing *R. solanacearum* on tomato. Five treatments were studied in a randomized complete block design: i) Onyx, a bacterial wilt susceptible commercial variety grafted on *Solanum complycanthum* (Kitengotengo), ii) Onyx grafted on *Solanum indicum* (Katunkuma), iii) Onyx grafted onto *Solanum* spp (Katengotengo), iv) Onyx, un-grafted as a check, and v) un-grafted MT 56 as a second check. Results indicated that grafting on different root stocks varyingly reduced the incidence of *R. solanacearum* on tomatoes, as well as fruit yield. Another trial assessed the effect of integrating MT56 with previously tested cultural practices of: i) mulching with straw, ii) staking with wooden sticks, vs. the untreated tomato plants in a randomized complete block design with 3 replications. Results indicated that mulched/staked plants had lower *R. solanacearum* incidences than untreated plants. The tactics used in the different trials that provided consistently good results have now been transferred to farmers where they have been widely adopted. Plans to release MT56 on the Uganda market have been initiated.

P008 Measuring adoption of sustainable viticultural practices in the Ozark Mountain Region

*Donn T. Johnson[1], dtjohnso@uark.edu, Andy Allen[2], Reid Smeda[3], and Keith Striegler[4]

[1]Department of Entomology, University of Arkansas, Fayetteville, AR; [2]Institute for Continental Climate Viticulture and Enology, University of Missouri, Columbia, MO; [3]Division of Plant Sciences, University of Missouri, Columbia, MO; [4]Flint Ridge Winegrowing Services, Fayetteville, AR

The 2005 grape grower survey results were tabulated as benchmarks of past viticultural practices. Since 2005, we demonstrated and verified best management practices in seven vineyard sites across AR and MO. Grape growers learned from these demonstration sites over time by participating in monthly, summer tailgate discussion meetings at the demonstration site of choice. In 2011, we printed and used the Ozark Mountain Vineyard Sustainability Assessment Workbook in eight workshops. Anonymously, 43 grape growers from AR and MO used TurningPoint response clickers to record their past and present viticultural practices as we discussed each issue in the Workbook. Overall, growers changed their average practices sustainability score from 2.82 (past) to 3.25 (being implemented) by adopting: yearly petiole analysis and soil analysis every two to three years aids in determining need, rate and timing of applications of NPK, macro- and micronutrients; selecting cultivars like Norton/Cynthiana for resistance to fungi; drawing cultivar maps of vineyard; hilling soil over grafts to minimize winter injury; appropriate canopy management of specific cultivars by trellis training, yield to pruning weight ratio, shoot density, shoot positioning and leaf removal; estimating yield and maintaining yield records; increasing soil water holding capacity by organic matter amendment; record irrigation water use; sample for, identify and note vineyard distribution of weeds, insects and disease symptoms; identifying grape scale and foliar grape phylloxera infestations; proper timing of insecticide applications, especially Lorsban Advance against grape scale crawlers; and rotate modes of action of pesticides. A voluntary Sustainable Vineyard Certification Program is being developed.

P009 Monitoring and on-farm management of rice hispa (*Dicladispa armigera*) in Karnataka, India

*Dandinashivara K. Sidde Gowda, sgowda81@hotmail.com, Thimmaiah Shivashankar, Mothukapalli K. Prasanna Kumar, and Shivalli B.Yogananda

Zonal Agricultural Research Station, University of Agricultural Sciences(B), Karnataka, India

Insect pests are major biotic production constraints in rice throughout the Indian subcontinent and Karnataka state is not an exception. Among the 28 insect species that have been reported on rice from the state, *Dicladispa armigera* (Oliver) was considered as a sporadic pest of rice confined to isolated rice growing areas. In recent years, rice farmers complained about the occurrence of this pest in newer locations and also expressed failure to control the pest using recommended insecticides. With this background, the pest was monitored in the southern parts of Karnataka to find out its extent of spread in newer areas. Further, on-farm demonstrations were conducted using different insecticides in the farmers' fields to manage this pest. The study revealed the spread of the pest to newer area (>2000 ha). The incidence was noticed on the seedlings and continued till panicle initiation stage and was more severe during the rainy season compared to summer. None of the rice varieties cultivated by the farmers were free from the pest. Intriguingly rice fields near canals and ravines had a higher incidence compared to rice fields away from canal and ravines. The management practices indicated application of insecticides in the nursery had less incidence of hispa. This was mainly due to reduction in the adult population in nursery, thus preventing the egg laying in the main field. Among the insecticides, cholrpyriphos 20EC at 270 g.a.i./ha was effective against adults, whereas imidacloprid 17.8 SL at 25 g.a.i/ha and thiamethoxam 25WG at 25 g.a.i./ha were effective against grubs present within the mined galleries of the leaves.

P010 Mulching methods impact on herb production and weed control in a certified organic production system

*Merritt J. Taylor[1], mtaylor-okstate@lane-ag.org, Charles L. Webber III[2], Angela R. Davis[2], and James W. Shrefler[1]

[1]Oklahoma State University, Agricultural Research and Extension Center, Lane, OK; [2]USDA, ARS, Wes Watkins Agricultural Research Laboratory, Lane, OK

The weed control challenges for horticulture production are formidable; however, these challenges are even greater for those considering organic crop production. Use of black plastic as a weed barrier is widely used and effective. The expense associated with black plastic as well as the ecological impact of disposal has a negative impact with its use. Research was conducted at Lane, Oklahoma on certified organic land at the USDA/OSU Wes Watkins research center to compare the impact of mulching types on weed control and herb yields. The 4 mulching treatments included black plastic, hay mulch (wheat and cereal rye), hay mulch over newsprint, and bare soil (no mulch). Four herbs, basil (*Ocimum basilicum* L.), sage (*Salvia officinalis* L.), garlic chives (*Allium tuberosum* Rottler ex Spreng.), and arugula (*Eruca vesicaria* (L.) Cav. ssp. sativa (Mill.) Thell.), were transplanted into the four mulching treatments in 4 replications. Weed control efficacy of the mulching treatments were determined by recording the time required to maintain the plots weed-free by hoeing and hand-weeding. Herb yields were determined for each mulching treatment. Arugula and garlic chives produced the best yields on the black plastic. Basil and sage produced their highest yields when grown without

a mulch (bare ground). The black plastic and bare soil treatments required the most time to hand weed compared to the hay and hay/newsprint mulches, which required the least. The research demonstrated the importance of selecting the appropriate mulch for the specific herb and the potential benefits of natural and biodegradable mulches.

P011 Soil health and integrated pest management program for vegetables-A prescriptive approach

Gordon Johnson[1], *Joanne Whalen[2], jwhalen@udel.edu, Bob Mulrooney[1], and Kate Everts[3]

[1]Plant and Soil Sciences Department, University of Delaware, Newark, DE; [2]Department of Entomology, University of Delaware, Newark, DE; [3]Plant Science and Landscape Architecture, University of Maryland , College Park, MD (joint appointment with the University of Delaware's Cooperative Extension System)

Soil quality and health research has been conducted for more than twenty years throughout the United States. Funded by the E-IPM Program, our team has focused on soil health as it relates to disease and nematode management and overall root health in vegetable crops. To address these issues, producers need to consider many factors including tillage practices, compaction, crop rotation, soil fertility, and root pests with a goal of creating a healthier soil. In 2009, the program focused on demonstrations and field days highlighting the use of 3 different composts compared to no compost and fumigation on a poor soil health site and a good soil health site and demonstrations of biofumigant mustards and sorghum species at these sites. In 2010-2011, forty six consultants and interested producers attended one of 3 field trainings on evaluating soil health and over 172 attended a soil health seminar. During this period, on farm demonstrations, testing, and sampling activities were conducted on over 1200 acres of vegetable production where cover crops and compost were being used extensively. So what makes our program different? We are approaching soil health from an integrated approach looking at field specific recommendations over multiple years in fields identified as having problems. A four phase approach has been developed: (1) identification of cooperating producers and fields (11 growers), (2) soil health measurements (21 fields), (3) prescriptive treatments developed, and grower implements plans (21 fields), and (4) assessment of prescription effectiveness to be done in 2012 and 2013.

P012 Suppression of Cuban Slug (*Veronicella cubensis*) (Pfiefer) using select practices in the CNMI

*Alejandro Badilles[1], abadilles@yahoo.com, Arnold Route[1], and Jack Manglona[2]

[1]Northern Marianas College-CREES, CNMI; [2]Rota Island Producer, CNMI

The Cuban slug (*Veronicella cubensis* L. Pfeiffer) has recently risen in prominence as an agricultural, ornamental and nuisance pest on the island of Rota, CNMI. This study examines and demonstrates the most effective suppressing practice for Cuban slug during testing of three available management practices at weekly observations. Results showed that three practices at weekly observations; Ducks Feeding on Cuban Slug, Neem (*Azadirachta indica* L. Adelb.) Extract and Slug Pellets (Deadline M-Ps) suppressed the population of Cuban slug. Observations indicated that these practices should be effective at controlling Cuban slug.

P013 Evaluation, validation and economic analysis of biointensive IPM in okra (*Abelmoschus esculentus* l. Moench) in India

*Nutan Kaushik, kaushikn@teri.res.in, Vivek Sharma, and Vister Joshi

The Energy and Resources Institute (TERI), Darbari Seth Block, India Habitat Centre, New Delhi, India

Vegetable farmers encounter severe insect and disease problems and end up applying 15-30 sprays of chemical pesticides. Okra is an important vegetable crop of India. Evaluation of an okra IPM module was conducted in a farmers participatory approach during 2008 and 2009 and large scale validation was done in 2010 with an objective to promote usage of biopesticides to control okra pests and minimize sprays of chemical insecticides. The IPM technology for okra was very effective in reducing pest populations and was comprised of soil treatment with neem cake at 100 kg/ acre and *Paecilomyces* at 5 kg/acre, seed treatment with *Trichoderma* + *Pseudomonas*, installation of yellow sticky traps at 12/acre, pheromone traps for monitoring and mass trapping at 8/acre, hand collection of infected fruits and larvae, 2 sprays of *Beauveria*, 3 sprays of Neem, one each Bt and NPV with the support from 1 spray of Spinosad. IPM practices reduced the 70% of chemical insecticide spray while incorporating biopesticides, traps, botanicals and timely planning which reduced the chemical load to the environment and consumers. Highest yield and CBR were achieved in IPM compared with non-IPM farms.

Best Practices—Natural Resources

P014 Rangeland grasshopper IPM program makes a significant economic impact on Wyoming agriculture

*Alexandre V. Latchininsky, latchini@uwyo.edu, and Scott P. Schell

Department of Ecosystem Science and Management, University of Wyoming, Laramie, WY

Grasshoppers are important economic rangeland pests in Wyoming and other 16 western US states, causing an estimated one billion dollar in forage loss every year. The University of Wyoming's entomologists had developed, refined, and delivered to clients an Integrated Pest Management (IPM) method of Reduced Agent and Area Treatments (RAATs) for rangeland grasshoppers. RAATs is a strategy in which the rate of insecticide is reduced from traditional levels and untreated swaths (refuges) are alternated with treated swaths. RAATs work through chemical control, meaning grasshoppers are killed in treated swaths and as they move out of untreated swaths, and conservation biological control, which allows natural enemies preserved in untreated swaths to suppress grasshoppers. To make RAATs available to a wide variety of stakeholders, we developed Extension educational materials (brochures, leaflets, posters and field guides) and delivered a state-wide educational program on grasshopper biology and management at public meetings in 17 affected Wyoming counties in 2009-2010. The 2010 grasshopper outbreak was the worst in 25 years, and 5,903,616 acres of rangeland were protected in Wyoming using the RAATs method. Had ranchers used the traditional, blanket application of insecticides labeled for grasshoppers at conventional high rates, the entire program would have cost $21.8 million. RAATs effectively reduced pest grasshopper densities below the economic level, but the resulting cost was only $8.7 million. This means the savings of $13.1 million to Wyoming agriculture, allowing Wyoming agriculturists to survive the severe pest outbreak and maintain the viability of their operations without harming the environment.

Management—Agriculture

P015 Pest threat of the invasive brown marmorated stink bug to vegetable crops in the U.S.

*Thomas P. Kuhar[1], tkuhar@vt.edu, Galen P. Dively[2], Joanne Whalen[3], George C. Hamilton[4], Gerald Brust[5], and Katherine L. Kamminga[1]

[1]Department of Entomology, Virginia Tech, Blacksburg, VA; [2]Department of Entomology, University of Maryland, College Park, MD; [3]Department of Entomology, University of Delaware, Newark, DE; [4]Department of Entomology, Rutgers University, New Brunswick, NJ; [5]University of Maryland, Central Maryland Research and Education Center-UMF, Upper Marlboro, MD

The brown marmorated stink bug (BMSB), *Halyomorpha halys* (Stål), was accidently introduced into the United States from Asia probably in the mid-1990s. Since the pest was first identified in 2001 in Allentown, Pennsylvania, it has spread to numerous states as well as southern Ontario, Canada. Currently, significant pest populations of the bug remain centered around the mid-Atlantic U.S., but appear to be spreading fast. Much notoriety and media attention has been given to BMSB over the past year, particularly related to its role as a nuisance pest aggregating in man-made structures in the fall and as a devastating pest of tree fruit. Herein we report on the pest potential of this exotic bug to vegetable crops based on our observations over the past two years in the mid-Atlantic U.S. BMSB feed by inserting their piercing-sucking mouthparts (stylets) into leaves, stems, and especially fruiting structures of plants. Feeding by both the adults and nymphs results in white blotchy scars, necrotic areas, misshapen fruit, and fruit rot of a wide range of vegetables. Based on our observations in the mid-Atlantic U.S., the vegetable crops that are preferred by BMSB are sweet corn, beans, peppers (sweet and hot), eggplant, tomato, and okra. However, the bug will feed on almost anything, and additional vegetable crops may be at risk to this pest in heavily-infested areas, farms, or gardens.

P016 Brown marmorated stink bug in specialty crops: Biology, ecology, and management

*Elizabeth Myers[1], ebm24@cornell.edu, Tracy Leskey[2], Art Agnello[3], Chris Bergh[4], Jay Brunner[5], George Hamilton[6]; Jay Harper[7], Cerruti Hooks[8], Carrie Koplinka-Loehr[1], Grzegorz Krawczyk[7], Peter Shearer[9], Jim Walgenbach[10], and Joanne Whalen[11]

[1]Northeastern IPM Center, Cornell University, Ithaca, NY; [2]USDA-ARS Appalachian Fruit Research Station, Kearneysville, WV; [3]Cornell University, Geneva, NY; [4]Virginia Tech, Winchester, VA; [5]Washington State University, Wenatchee, WA; [6] Rutgers University, New Brunswick, NJ; [7]Pennsylvania State University, University Park, PA; [8]University of Maryland, College Park, MD; [9]Oregon State University, Hood River, OR; [10]North Carolina State University, Mills River, NC; [11]University of Delaware, Newark, DE

The brown marmorated stink bug (BMSB), *Halyomorpha halys* (Stål), has emerged as an unprecedented threat to specialty crops in North America. The pest caused severe damage to mid-Atlantic sweet corn, pepper, tomato, apple, and peach crops in 2010, and it continued to present season-long pressure and significant problems in 2011. An invasive pest from Asia, BMSB has a huge host range, feeding on over 300 species altogether, including tree fruit, small fruit, vegetables, row crops, ornamentals, and woodland trees. The value of susceptible crops in the 36 states where BMSB has been established or detected exceeds $21 billion. Growers have sprayed aggressively to keep BMSB in check, but this approach threatens beneficial insects and undermines IPM programs that growers have worked hard to establish and maintain. A team of 51 researchers across the country is collaborating to gain an understanding of the biology and phenology of BMSB in specialty crops, and is using that knowledge to develop monitoring and management tools such as traps and lures, biopesticides, and natural enemies. The project, supported by a USDA Specialty Crop Research Initiative grant, unites researchers from ten institutions and integrates stakeholder input and research findings. A coordinated outreach effort delivers practical solutions to the growers who need them, with an emphasis on integrated pest management. This poster presents a map of BMSB's presence in North America, pest identification images, and a synopsis of research and outreach conducted to date.

P017 Extension integrated pest management coordination and support competitive grants program successes

*Martin A. Draper, mdraper@nifa.usda.gov, Elizabeth L. Ley, and Michael S. Fitzner

Institute of Food Production and Sustainability, National Institute of Food and Agriculture, United States Department of Agriculture, Washington, DC

Federal support for the states' network of integrated pest management efforts changed radically in 2008. States began to compete for IPM funds that were previously allocated on a formula basis. In addition, 1890 land-grant institutions became eligible to compete for funds that previously were allocated only to 1862 institutions. These actions represent the most significant program changes since the formula program was initiated in the 1970s. The new Extension IPM program requires that activities be grouped among coordination, collaboration and ten program emphasis areas: agronomic crop, high value/high input, conservation, school, housing, recreational lands, and consumer/urban IPM, along with pest diagnostics, vectors of human disease, and wide-area pest monitoring. More than 300 program outcomes were reported from the 53 awards granted in the first year of competitive funding. Most outcomes were reported in the high value/high input program area (largely specialty crops), followed by agronomic IPM, and urban IPM. More midterm outcomes were reported than would normally be expected from a one year program. Over 160 project outcomes reported changes in knowledge, with nearly 140 more documenting changed behavior. Grantees reported from 1-26 outcomes with a mean of 5.6 outcomes per grantee. Historic data from the earlier formula program likely provided a useful baseline from which to measure changes. Significantly, all funded program areas reported qualitative improvements in IPM knowledge and an increased interest or activity in pest monitoring. Because of the common program areas in the new competitive program it is possible to aggregate the program successes and outcomes.

P018 A new paradigm in IPM education: professional practitioners for managing a more sustainable future

*Gary L. Hein, ghein1@unl.edu, Tara Wood, Laura Dotterer, Kevin Korus, Dori Osantowski, and Chris Borman

Doctor of Plant Health Program, University of Nebraska–Lincoln, Lincoln, NE

Numerous challenges threaten the ability of U.S. and world agriculture to attain a secure and abundant food supply. However, effectively addressing these challenges and moving toward more sustainable agricultural systems will create

opportunities for agriculture that will positively impact rural communities and extend throughout the national economy. Creating opportunities from these challenges will require greater management expertise, and thus, require a greater number of advisors and other professionals serving production agriculture with the comprehensive skills critical to the development and management of increasingly complex production systems. The mission of the Doctor of Plant Health Program at the University of Nebraska – Lincoln is to produce plant practitioners with comprehensive expertise and experience across the various disciplines that impact plant health and plant management. These plant practitioners will integrate from across this expertise to diagnose and solve plant health problems and to develop integrated plant and pest management systems that maximize the system's economic, environmental and social sustainability. These plant practitioners are vitally needed to manage American's agriculture and landscapes and move them toward a more sustainable future.

P019 Distribution of herbicide resistance in Palmer amaranth populations across North Carolina

*Amy Hoffner, aehoffne@ncsu.edu, David Jordan, and Alan York

Department of Crop Science, North Carolina State University, Raleigh, NC

Palmer amaranth has become one of the most challenging pests to manage in cropping systems across the southern United States. Glyphosate resistance in Palmer amaranth was first confirmed in North Carolina in populations examined in 2005. A broader geographical survey across the Piedmont and Coastal Plain region was conducted during fall 2010 using a grid sampling procedure. A total of 242 predetermined sites were selected. If no Palmer amaranth was found at the pre-designated site, an effort was made to survey surrounding areas within a one-mile radius. A total of 126 populations were sampled from soybean and cotton fields. Plants from seed collected at these sites including confirmed glyphosate-resistant and glyphosate-susceptible populations were grown in a greenhouse. Response of populations to a range of rates for fomesafen, glufosinate, and glyphosate was determined based on visible control and the number of surviving plants. Glyphosate resistance was found in 98% of the 126 Palmer amaranth-infested fields. Preliminary results with fomesafen and glufosinate do not point to resistance to these herbicides. Results from this survey provide information that can be used to assist in developing comprehensive strategies for glyphosate-resistant populations of Palmer amaranth across much of North Carolina and provide a baseline reference for future development of resistance in Palmer amaranth populations to herbicides other than glyphosate.

P020 Doesn't the EPA regulate pesticide use? Why do we need the pesticide risk mitigation engine?

*Thomas Green[1], ipmworks@ipminstitute.org, Chuck Benbrook[2], Karen Benbrook[3], Michael Guzy[4], Paul Jepson[5], Jonathan Kaplan[6], Susan Kegley[7], Pierre Mineau[8], and Wade Pronschinske[1]

[1]IPM Institute of North America, Madison, WI; [2]The Organic Center, Troy, OR; [3]BCS-Ecologic, Troy, OR; [4]Department of Biological & Ecological Engineering, Oregon State University, Corvalis, OR; [5]Integrated Plant Protection Center, Oregon State University, Corvalis, OR; [6]Natural Resources Defense Council, Santa Monica, CA; [7]Pesticide Research Institute, Berkeley, CA; [8]National Wildlife Research Centre, Environment Canada, Ottawa, ON, Canada

Pesticides are invaluable tools for food and fiber production, but pesticide use presents risks that must be carefully managed. The Pesticide Risk Mitigation Engine (PRiME) is a user-friendly web application designed to help mitigate the environmental impacts of pesticide use by improving the selection of pest management options and conservation practices. Using a novel approach to risk calculation based on site-specific conditions, pesticide properties and empirical field impact data (where available), PRiME estimates risk to workers, consumers, birds, small mammals, earthworms and aquatic ecosystems. PRiME weighs impacts of application methods and the quantity and frequency of application, and uses NRCS soils data and other site-specific information, such as conservation practices and the presence of sensitive areas, to improve the accuracy of risk calculations and help the user make informed decisions about pesticide use and risk mitigation. Using state-of-the-art pesticide fate and transfer modeling and a suite of environmental risk indicators, PRiME can be useful in supporting IPM programs by helping to minimizing the environmental risks when chemical suppression is necessary. A beta version of PRiME has been online and operational since 2009 and has been pilot tested in a number of cropping systems across the U.S. and abroad. Poster will describe the science behind our risk modeling, benefits to users, features of our web application, and the challenges of integrating pesticide risk analysis into an IPM system.

P021 Effective habitat protection: A consultative and cooperative process

Scott Kirby, *Tim MacDonald, tim.macdonald@hc-sc.gc.ca, and Mary Mitchell

Environmental Assessment Directorate, Pest Management Regulatory Agency, Health Canada, Ottawa, Ontario, Canada

The mandate of the Pest Management Regulatory Agency (PMRA) includes protecting the environment from unintended effects of pesticide use. Where necessary, mitigation

measures, including no-spray buffer zones, are specified on product labels to reduce pesticide exposures in non-target habitats to acceptable levels. Feedback from stakeholders indicates that the current approach can be logistically difficult to implement and enforce, can have an economic impact for producers and can sometimes conflict with other initiatives aimed at protecting habitat. To address these issues, the PMRA is working with stakeholders to develop an improved habitat protection policy that will more effectively balance environmental protection with agricultural production. The consultative process was launched with a multi-stakeholder workshop that gathered information from diverse perspectives, identified existing programs and policies and discussed the practicality of current mitigation measures. The workshop identified that a different approach to habitat protection was required, one which accounts for local conditions and encourages best management practices and environmental stewardship. Workshop recommendations included the conduct of a legislative scan to identify regional policies, regulations and initiatives that could impact the successful development of a habitat protection policy. Regional consultations were also identified as crucial. Consultations continued with meetings in each province, bringing together regulators, representatives from the agriculture sector and NGOs. These meetings identified weaknesses in the current approach, regional issues that needed to be considered in moving forward, and explored policy options that would satisfy the Agency's mandate while minimizing negative impacts on agricultural production.

P022 Use of *Solanum torvum* as a rootstock in brinjal (*Solanum melongena* L.) to manage root knot nematode

*J. Sherly, sherlyvegetable@gmail.com, L. Pugalendhi, and M. Sivakumar

TamilNadu Agricultural University, Coimbatore, India

Five wild species of *Solanum* viz., *S. torvum*, *S. viarum*, *S. xanthocarpum*, *S. incanum* and *S. elaegnifolium* were screened against root knot nematode, *Meloidogyne incognita* under artificially inoculated glass house condition. The cultivated brinjal CO 2 was used as a check. The result revealed that the species *S. torvum* had the lowest root knot index (RKI) value of 2. Other species *S. xanthocarpum* (RKI-3), *S. incanum* (RKI-3), *S. elaegnifolium* (RKI-3), *S. viarum* (RKI-4), and variety CO 2 (RKI-5) recorded the highest values. The biochemical traits which impart resistance to root knot nematode viz., phenols, ortho-dihyroxy phenols and ascorbic acid were the highest in *S. torvum*. The active defense enzymes such as peroxidase (PO), polyphenol oxidase (PPO), phenylalanine ammonia lyase (PAL) and acid phosphatase were also higher in the species *S. torvum* roots. Histopathological study also revealed that the species *S. torvum* has healthy cambial tissues and translocation vessels against root knot nematode infestation. Twenty graft combinations with wild *Solanum* species that were also screened against *M. incognita* indicated that the graft combinations with *S. torvum* (*S. torvum*+ Hybrid Derivative (HD) 1, HD2, HD3 and COBH 2) exhibited lower RKI values. Based on RKI values, *S. torvum* was graded as 'Resistant' against *M. incognita* and can be recommended as the best rootstock for brinjal.

P023 Biological control of white mold of snap bean with low rate Contans application

*Alexandra Stone, stonea@hort.oregonstate.edu, and Mikio Miyazoe

Oregon State University, Corvallis, OR

White mold (*S. sclerotiorum*) is a serious disease of snap beans. *Coniothyrium minitans* is a mycoparasite of Ss and commercially available as Contans (www.prophyta.com). Cm parasitizes sclerotia at 50–68°F. Contans has been applied at 2–6 lb/A before or at planting. The goal of this project was to evaluate efficacy of a 1.5 lb application after bean harvest on Cm and Ss dynamics and disease severity in subsequent bean crops. Fall Contans applications to flailed crop residues on the soil surface generated biocontrol epidemics over 12 mos; Cm from the initial Contans application colonized sclerotia and those colonized sclerotia oozed spores from pycnidia throughout the winter which splashed and generated new infections. Six mos after a November Contans application to diseased residues, Cm colonization of sclerotia was 47% in Cm+ compared to 3% in Cm- fields; mean sclerotial viability in Cm+ and Cm- fields was 67 and 98%. Susceptible (91G) and moderately resistant (6230) beans planted 7 mos after application exhibited 23 and 7.5% foliar disease severity in the Cm- fields, and 7 and 1% in the Cm+ fields. Pod mold incidence in 91G and 6230 was 17 and 11% in the Cm-, and 7 and 3% in the Cm+ fields. Ten mos after application, viability in Cm+ and Cm- fields was 8.5 and 74%; 22 mos after, sclerotial viability was 5 and 22%. Low rate Contans applications reduced sclerotial viability by 32 and 77% at 7 and 22 mos after application and reduced subsequent bean crop disease severity.

P024 Site-specific technology to better manage nematodes in cotton

*Charles Overstreet[1], coverstreet@agcenter.lsu.edu, Edward McGawley[1], Deborah Xavier[1], Manjula Kularathna[1], Melea Martin[1], Dennis Burns[2], and Ralph Frazier[3]

[1]LSU Agricultural Center, Department of Plant Pathology and Crop Physiology, Baton Rouge, LA; [2]County Agent Tensas Parish, St. Joseph, LA; [3]County Agent Madison Parish, Tallulah, LA

Cotton production is severely impacted by several nematode species in the Mid-South areas of the United States. The major

nematodes are the reniform and Southern root-knot nematodes. Management strategies often include the use of nematicides to try to deal with these nematode pests. Nematicides may not be required throughout a field due to population levels of the nematode or changes within soil texture. Fields may be divided into zones based on apparent electrical conductivity as measured by a Veris 3100 Soil EC Mapping System. The use of verification strips which includes both treated with nematicides and untreated rows throughout the soil zones can be used to identify where the problems are occurring and where nematicides are needed. A number of fields have shown as much as 25-75 % reductions in the need for a nematicide. These site-specific uses of nematicides can result in considerable savings for producers while providing better efficacy of nematicides and reduced impact to the environment.

P025 Propagating azalea stem cuttings free of binucleate *Rhizoctonia* spp.

*Warren Copes[1], warren.copes@ars.usda.gov, and Eugene Blythe[2]

[1]USDA ARS Southern Horticultural Laboratory, Poplarville, MS; [2]Coastal Research and Extension Center, Mississippi State University, South Mississippi Branch Experiment Station, Poplarville, MS

Azalea web blight, caused by binucleate species of *Rhizoctonia* (BNR), occurs yearly on some azalea cultivars during nursery production in the U.S. Azalea shoots collected for cutting propagation can harbor the pathogen, thus allowing the disease to be perpetuated. Previous studies have demonstrated that submerging Rhizoctonia-infested azalea stem pieces in 50°C water for 21 minutes eliminates the pathogen and that hot water treatment did not adversely affect root development of twelve commonly grown azalea cultivars. However, subsequent contamination may occur in propagation houses. Polyethylene fabric and gravel floors were sampled in commercial nurseries one week after the previous season's rooted cuttings were removed. BNR were recovered from 1 to 9 of 96 swabs per floor in five propagation houses. Propagation houses are usually left empty for 6 weeks before being filled with trays of the current year's stem cuttings. When fabric and gravel infested with BNR were placed in direct sun or under 70% shade, recovery of BNR declined to 4 and 25%, respectively, over 6 weeks. When infested fabric and gravel substrates were placed beside and under trays of rooting stem cuttings for 3 months, the peat media in trays was not colonized by BNR fungi. Although BNR fungi can infest azalea stem cuttings and floors of propagation houses in nurseries, hot water treatment of stem cuttings is recommended, whereas sanitation of floors is only suggested. Further studies are in progress to develop a comprehensive integrated program to produce azalea plants free of BNR fungi.

P026 Seasonal dynamics of viruliferous *Thrips tabaci* (L), Vector of Iris yellow spot virus in onion in the Pacific Northwestern USA

*Sudeep Bag[1], sudeep.bag@email.wsu.edu, Silvia I. Rondon[2], and Hanu R. Pappu[1]

[1]Department of Plant Pathology Washington State University, Pullman, WA; [2]Hermiston Agricultural Research and Extension Center, Oregon State University, Hermiston, OR

Iris yellow spot virus (IYSV) continues to be a major constraint to both onion bulb and seed production in the pacific northwestern (PNW) states in the USA and in many onion-growing regions of the world. *Thrips tabici* Lindeman (onion thrips) acts as both pest and a virus vector thus causing damage to onion production in more than one way. Since the virus is not seed-transmitted, thrips play a major role in virus spread and the disease outbreak. As part of a multi-year study to determine the seasonal dynamics of vector populations, onion thrips were collected during June-August of 2008 and 2009 from two different onion fields in Umatilla County, OR. Both years, individual, live adult thrips were collected at an interval of seven days from ten sites within each field and tested for the presence of IYSV using direct antigen coated enzyme linked immunosorbent assay against the non structural protein (NSs) of IYSV to identify and differentiate between the transmitters from non-transmitters. Results indicated that the highest number of thrips populations were observed in the middle of July and correlated with the highest percentage of viruliferous thrips during the same week for both years The ELISA test facilitated rapid testing of a large number of field-collected thrips to determine the proportion of thrips that are potential virus transmitters. Information on the seasonal dynamics of viruliferous thrips among thrips populations could help refine vector management tactics with the overall goal of improving existing IPM strategies.

P027 Effective management of Phytophthora blight (*Phytophthora capsici*) of peppers in Illinois

*M. Babadoost

Department of Crop Sciences, University of Illinois, Urbana, IL

Phytophthora blight, caused by *Phytophthora capsici*, is one of the most important diseases of peppers worldwide. *P. capsici* infects more than 50 species in 15 plant families. The pathogen can infect pepper plants at all growth stages. P. capsici infects roots, crown, stems, leaves, and fruit, causing seedling damping-off, stem lesion, stem blight, leaf spot, and fruit rot. The affected plants usually die within a few days. We have developed effective methods for management of Phytophthora blight of peppers in Illinois, which include: (i) using resistant

cultivars, (ii) cropping rotation with non-host plants, and (iii) application of fungicides. To identify resistant pepper cultivars to P. capsici, more than 100 cultivars/accessions of peppers were tested in the greenhouse and field. Cultivars Alliance, Aristotle, Aristatol-XR3, Declaration, Emerald Isle, Enza, Paladin, Polaris, Reinger, Revolution, Seigers-9915776, Snapper F1, and several experimental lines were resistant to Illinois isolates of P. capsici. In Illinois, P. capsici oospores survive in soil for at least three years and remain viable. Thus, three years or longer of crop rotation with non-host plants is needed for effective management of P. capsici. More than 50 potential fungicides were testes for their efficacy for control of P. capsici on peppers. The effective fungicides against *P. capsici* in Illinois are captan (Maestro 80DF), cyazofamid (Ranman 400SC), dimethomorph (Forum 4.16SC), famoxadone + cymoxanil (Tanos 50DWG), fluopicolide (Presidio 4SC), mandipropamid (Revus 2.09SC), mefenoxam (Ridomil Gold Copper 65WP, Ridomil Gold EC 4SC), and Zampro (an experimental fungicide).

P028 Role of border crop for the management of chilli leaf curl caused due to thrips, *Scirtothrips dorsalis* (Hood) and mites, *Polyphagotarsonemus latus* (Banks)

*M.H. Tatagar[1], mtatagar@rediffmail.com, J.S. Awaknawar[2], R.S. Giraddi[2], H.D. Mohankumar[3], and C.P. Mallapur[2]

[1]Horticulture Research Station, Haveri, University of Horticultural Sciences, BAGALKOT, Karnataka, India; [2]Department of Agricultural Entomology, University of Agricultural Sciences, Krishinagar, Dharwar, India

Field experiments were carried out for two years during kharif 2006 and 2007 at the Agricultural Research Station, Devihosur, Haveri, Karnataka to find out the effect of border crops for the management of chilli leaf curl caused by thrips and mites. The experiment consisted of eight treatments with five replications in each treatment. Border crop of maize was sown 15 days prior to chilli planting. Raised nursery seed beds were prepared with seeds of *Byadagi dabbi*. Seedlings 35 days old were transplanted in the main field. Among different treatments, the chilli crop bordered by two rows of maize at every 0.5 acre area (31.2x60sqm) with two spray interventions (Neemazal 1% at 2 ml per liter at 7 weeks after transplanting (WAT) followed by Difenthiuron 50 WP at 0.75 g per liter at 9 WAT) recorded higher yield (6.90 q/ha) with less leaf curl damage due to thrips (0.70 LCI/plant) and mites (0.19 LCI/plant) at 13 WAT. This treatment was significantly superior to all other treatments and the standard check. Further, chilli plots surrounded by two rows of maize all along the border (untreated) recorded significantly more numbers of coccinellid population (2.56 no/p) at 15 WAT compared to the chilli crop bordered by maize (treated-1.18 no/p).

P029 Habitat management to conserve wolf spiders, natural enemies of insect pests, in rice paddies in Japan

*Hidehiro Inagaki[1], hidehiro1_inagaki@pref.shizuoka.lg.jp, Kazuo Matsuno[1], Minoru Ichihara[1], Chieko Saiki[1], Shou Yamaguchi[2], Syunsuke Mizumoto[2], and Masayuki Yamashita[2]

[1]Shizuoka Prefectural Research Institute of Agriculture and Forestry, Shizuoka, Japan; [2]Faculty of Agriculture, Shizuoka University, Shizuoka, Japan

Wolf spiders (Araneae: Lycosidae) are an important natural enemy of rice insect pests. We identified two management practices for the conservation and enhancement of wolf spiders used as a biological control. 1) One is the mowing management of ridges between rice paddies constructed for water control. We investigated seasonal changes in the population density of wolf spiders in rice paddy fields and demonstrated that the ridges between rice paddy fields may be a good source of wolf spiders in these fields. In addition, the number of wolf spiders increased considerably after mowing the ridges, and these spiders were observed under the cut plants on the ridges. These results indicate that the mowing management of the ridges between rice paddy fields may be effective in increasing the number of wolf spiders. 2) Another practice is to use cover plants for previous crop in rice cultivation. In Japan, Chinese milk vetch (*Astragalus sinicus* L.) cultivation is traditionally used as green manure and living mulch in rice paddies. We demonstrated that Chinese milk vetch cultivation before rice transplanting increases the population of wolf spiders during rice cultivation. We concluded that these two management practices, mowing ridges and Chinese milk vetch cultivation before rice transplanting increases the population of wolf spiders in rice paddy fields which, in turn, will control of rice insect pests. These practices are expected to lead to a decrease in the population of rice pests.

P030 Incidence of sapota bud borer, *Anarsia achrasella* Bradley and its management

D. Jemla Naik, djn97@rediffmail.com, S.D. Rangaswamy, D. Thippesha, and K.M. Devaraju

Zonal Horticultural Research Station, Karnataka, India

The scenario of this zone is entirely different because of its peculiar climatic conditions and soil type. The zone receives a mean annual rainfall of 2173 mm, of which nearly 80 percent is received between June and September. The major fruit crops in this zone are banana, sapota and guava. The sapota is cultivated in barren lands where the land is unsuited for cultivation of plantation crops, mainly coffee. The bud borer (*Anarsia achrasella* Bradley) is one of the important pests and was active throughout the year. The emerged young ones initially scrape and bore a hole and enter inside feeding on the inner bud

contents. To manage this pest an experiment was conducted at Zonal Horticultural Research station, Mudigere, from 2008 to 2010. The results indicated that the observations of incidence of bud borer population recorded with a varied population ranged from 11.22 to 26.66 percent in different months. The maximum incidence was recorded from February to April months. The results on efficacy of insecticides indicated that all the treatments were found effective in minimizing the incidence of bud borer compared to the untreated control. Among the treatments Phosalone at 2ml (4.18%) followed by Neemoil at 4ml (4.19%) were found effective followed by Triazophos 2.5ml (5.11%), Quinalphos at 2ml (5.18%), Chloropyriphos at 2.5ml (5.38%), and fish oil at 4ml (5.96%). The results indicated that Phosalone 35EC and Neemoil 4ml per liter of water were found effective and would be an alternative to Dimethoate 1.7ml per liter of water.

P031 Initial response to European grapevine moth, *Lobesia botrana*, in North America

*Lucia G. Varela[1], Monica L. Cooper[2], and Rhonda J. Smith[1]

[1]University of California Cooperative Extension, Santa Rosa, CA; [2]University of California Cooperative Extension, Napa, CA

An invasive species, the European grapevine moth, *Lobesia botrana*, was detected in Napa County vineyards in 2009 triggering state and federal regulatory action. Growers needed to control a pest for which they had no knowledge of the biology, life cycle, monitoring and management practices. Furthermore, we were fearful of disrupting biological controls of several grape pest species. As data gaps were identified, a multipronged research program was initiated to study the biology and life cycle under California conditions, to assist growers to monitor and control this pest, and to address regulatory questions regarding detection and delimitation to preclude the spread of this pest. We undertook 15 trials to evaluate winter mortality factors, validate monitoring tools, determine the host range, evaluate organic and conventional insecticides and study larval mortality during the winemaking process. Shortly after the first detection we published a literature review describing the current knowledge of life cycle and management on the UC IPM Exotic and Invasive Pests webpage. Information generated from field observations and research trials was reported weekly or semiweekly through UCCE Napa County European grapevine moth newsletter. Technical information, coupled with photographs of different life stages, is used by subscribers to train their crews and to appropriately time control measures. This alert system supplies grape growers in all affected regions of the state access to the most current detection, biology, management and regulatory information. Our management guidelines on materials and timing will continue to be implemented in 2012, a critical year to meet the criteria for deregulation.

P032 Integrated and biorational approaches to the management of major key pests of tomato and cabbage

M.L.Chatterjee, chatterjee_monilal@rediffmail.com

Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidlaya, India

During the past three decades, efforts have been made to reduce the risk of human exposure to pesticides, especially insecticides. There is a great demand for safer and more selective insecticides that spare natural enemies and non-target organisms. The limited number of target sites exploited by conventional insecticides has created problems with resistance to these insecticides. The present investigations were conducted to test the effectiveness of some new chemicals viz. pthalic acid diamide (flubendiamide), microbial pesticides (Spinosad, emamectin benzoate, *Bacillus thuringiensis* and chlorfenapyr) and IGRs (novaluron, lufenuron and methoxyfenozide) in comparison with one traditional insecticide (chlorpyriphos + cypermethrin) in controlling two important lepidopteran pests i.e *Helicoverpa armigera* on tomato and *Plutella xylostella* on cabbage. The field experiments were conducted for two consecutive years with damage incidence and yield compared at the end. The overall good performance was found in the case of flubendiamide, spinosad, emamectin benzoate and chlorfenapyr in reducing damage caused by fruit borer on tomato and diamond-back moth on cabbage and led to increases in yield. Among the IGRs, novaluron performed well against all the insects, but lufenuron and methoxyfenozide expressed comparatively lower performance than other selected insecticides. *Bacillus thuringiensis* performed moderately well against the insect pests. All the chemicals except the mixed formulation of chlorpyriphos and cypermethrin were comparatively safer to natural enemies: spiders, *Menochillus*, *Chrysoperla* and *Cotesia*. The lepidopteran pests are highly vulnerable to the chemicals used in the experiment with their new mode of action and high selectivity. They are much safer to non-target organisms and quickly degraded to non-toxic products and have potential use in IPM systems.

P033 Integration of pre-shipment hot water shower as a quarantine treatment for ornamental plants

*Arnold Hara, arnold@hawaii.edu, and Ruth Niino-DuPonte

University of Hawaii at Manoa, College of Tropical Agriculture and Human Resources, Komohana Research and Extension Center, Hilo, HI

Heat treatments in the form of hot water dip, drench and shower are highly effective against many quarantine pests, and have been used to disinfest agricultural commodities, such as fruits and vegetables, for decades. A portable, commercial-scale hot water treatment facility was constructed by modifying a 7.3 m shipping container mounted onto a 12.2 m trailer.

Hot water is delivered at approximately 70 gpm with 40 psi through 110 Full Jet wide-angle full cone nozzles (0.65 GPM at 40 psi per nozzle) into the chamber, achieving the target temperature in 4 min when loaded with 20 potted *Dracaena derimensis* (11.4 L pots). Efficacy of hot water on several quarantine pests were documented: coqui frog (*Eleutherodactylus coqui*) 43°C for 5 min; slugs and snails 45°C for 15 min; stinging nettle caterpillar (*Darna pallivitta*) 49°C for 10 min; little fire ant (*Wasmannia auropunctata*) 45°C for 10 min. Tolerance of a variety of potted plants, including orchids, anthurium, bromelids, palms, dracaena cultivars, and Norfolk Island pine, to hot water was also verified; protocol modifications were implemented to decrease heat injury to sensitive plants without compromising efficacy, including conditioning by exposure to hot water at sub-target temperatures prior to treatment. From 2008-2010, at least $1.3 million worth of plants were treated with hot waterand successfully passed quarantine inspection in California, Guam, and Honolulu. Hot water as a pre-shipment treatment can be integrated into commercial potted plant export operations as part of a systems approach to quarantine security.

P034 Introduction of gall wasp (Quadrasticus erythrinae) tolerant plants for tribals lively hood

Thimmaiah Shivashankar, tshivashankark@gmail.com, and Chinaaiah Doreswamy

University of Agricultural Sciences (Bengaluru) Mandya, Karnataka, India

In Chamarajanagar province of Karnataka, India, around 3000 tribals cultivate and sell betel vine (*Piper betle*), an important traditional crop. These tribals worship the betel vine gardens as god. These tribals have lost both the standards (Erythrina) and the main crop betel vine in two years (2003-2004). Examination revealed the death of standards due to invasion of a new pest *Quadrasticus erythrinae* (gall wasp). The tribals lost their very livelihood and social status as well. Looking to this a study was initiated to find an alternate species / race / plant of *Erythrina* sp. to substitute for rejuvenation of betel vine gardens. Six species of *Erythrina* including three wild races were collected from 5 districts of south India. Prior to collection, the intensity of *Q. erythrinae* incidence was recorded. Incidence intensity was classified into 4 categories: severe gall formation coupled with death of plant (category 4) to galls occurring without affecting the growth of plants (category 1). Manipulative experiments by releasing the wasps after establishing plants revealed that *Erythrina subumbrans* showed the highest tolerance (category 1) to the gall wasp. This species was multiplied and was given to the tribals as part of an IPM programme. During 2011 a total of 38 betel vine gardens have been rejuvenated, revived and along with the pride and glory of the tribals.

P035 IPM options for Lygus bug management in Texas High Plains cotton

*Ram B. Shrestha, rshrestha@ag.tamu.edu, Stanley C. Carroll, W. Owen McSpadden, and Megha N. Parajulee

Texas AgriLife Research and Extension Center, Lubbock, TX

Lygus hesperus is an important and emerging insect pest of cotton in the Texas High Plains. While plant breeders and agricultural companies are aggressively working toward developing transgenic cotton cultivars for enhanced Lygus management, our current approach largely relies on crop scouting and application of insecticides. Excessive application of pesticides has resulted in resistant Lygus populations in many cotton producing areas. The Texas A&M AgriLife Cotton Entomology Program has been investigating various aspects of Lygus bug biology, behavior, ecology, insect plant interactions, identification, and sampling with an overall goal to develop an ecologically intensive and environmentally sustainable management approach. Toward this objective, a series of laboratory, field, and landscape level studies have been conducted in the last 10 years. This presentation will highlight key findings of those studies, in particular reference to the integration of various tactics and development of an IPM based Lygus management model for Texas High Plains cotton.

P036 Management of pod borer, *Helicoverpa armigera* infesting chickpea with new insecticide molecules

D. N. Kambrekar, kam_ent@rediffmail.com

Regional Agricultural Research Station, Bijapur, Karnataka, India

Chickpea is a principal legume crop of Karnataka state in India, occupying about an area of 479,000 hectares with a production of 281,000 tonnes. Gram pod borer, *Helicoverpa armigera* (Hubner) is the most destructive pest of chickpea. The extent of loss has been estimated at $5 billion on various crops worldwide. In the case of chickpea and pigeonpea the estimated loss is about $27 million. The losses due to this pest ranged from 10 to 80% in terms of pod damage in Karnataka. To combat this pest around $5 billion is being invested on insecticides on various crops worldwide. The present study was planned to investigate the effect of newer molecules viz., Emamectin benzoate 5% SG and Indoxacarb 14.5 SC on pod borer, *H. armigera* at the Agricultural Research Station, Annigeri (University of Agricultural Sciences, Dharwad-Karnataka-India) on chickpea variety Annigeri-1 during rabi 2010-11. Emamectin benzoate 5% SG at 13 g a.i /ha has recorded maximum larval reduction (100%), lesser pod damage (4.56%) and higher grain yield of chickpea (8.61q/ha) which is followed by Emamectin benzoate 5% SG at 11 g a.i/ha. Further, Indoxacarb 14.5% SC at 75 g a.i/ha has recorded maximum larval

reduction (100%), lesser pod damage (4.43%) and higher grain yield (8.52q/ha) of chickpea which is followed by Indoxacarb 14.5% SC at 50 g a.i/ha. These two new chemicals can be effectively used for the management of *H. armigera* in chickpea.

P037 Mediterranean fruit fly in Iran and proposal for its eradication

*Roghaiyeh Karimzadeh, r_karimzadeh@tabrizu.ac.ir, and Mir Jalil Hejazi

Department of Plant Protection, College of Agriculture, University of Tabriz, Tabriz, Iran

In Iran, Mediterranean fruit fly *Ceratitis capitata* (Wiedemann) was first reported in Khorasan province in 1976. It did not establish in this province due to serious control measures and cold weather. The next occurrences of Med fly were reported in Mazandaran province from 1980 to 1982. But, a change in weather pattern, along with control measures, prevented its spread and establishment. In 2006 low levels of Med fly infestation were reported again in some counties of Mazandaran. All counties of Mazandaran were found to be infested in 2010. The pest was also reported from Kermanshah province in 2010; and East Azarbaijan, Fars, Guilan, Golestan, Tehran and Yazd provinces in 2011. Further spread and establishment of Med fly would be disastrous to Iranian agriculture. Therefore, serious area-wide control, using prevention and eradication measures, are absolutely necessary. The 1st steps would be detection of the pest using pheromone and other traps; and generating accurate spatial distribution maps. The next steps would be to predict areas vulnerable to establishment of this pest using geographic information system. Employing control methods including quarantine measures, cultural practices, mass trapping, using baits, chemical insecticides, and sterile insect release technique (SIT) will help eradicate the pest from areas of establishment. Close cooperation of Plant Protection Organization and other related organizations and institutions of Iranian Ministry of Agriculture will be necessary to succeed in this important task.

P038 Responding to spotted wing drosophila-The Michigan experience

*Keith Mason[1], masonk@msu.edu, Rufus Isaacs[1], Steve Van Timmeren[1], Noel Hahn[1], Larry Gut[1], Mark Whalon[1], Amos Ziegler[1], Joy Landis[1], Bob Tritten[2], Diane Brown[2], Carlos Garcia-Salazar[2], Amy Irish-Brown[2], and Nikki Rothwell[2]

[1]Department of Entomology, Michigan State University, East Lansing, MI; [2]Michigan State University Extension, East Lansing, MI

Spotted Wing Drosophila, *Drosophila suzukii*, is a new pest of fruit in the US that has recently invaded the Great Lakes region. A team of Michigan State University research and extension staff, industry stakeholders, and state and federal agencies are working together to understand more about the timing, distribution, and management of this threat to Michigan's fruit industries. First discovered in Michigan during late 2010, flies have now been trapped in 22 counties across Michigan. The late season activity of this insect poses a serious threat to late harvested varieties of blueberries and raspberries, and may have an impact in cherries and peaches in this region. It may also lead to abandonment of IPM control programs in favor of calendar-based spray programs during harvest. Our activities reported here include monitoring the spread of Spotted Wing Drosophila in Michigan, testing different trap designs and attractants, refining larval sampling methods, determining the relationships between fly catch and fruit infestation, evaluating the efficacy of Spotted Wing Drosophila control options including comparison of conventional and organic management methods, and distributing relevant information to stakeholders in a timely fashion.

P039 Online survey of California pest control advisers serving the almond industry

*William M. Coli, wcoli@umext.umass.edu, and William A. Miller

University of Massachusetts Extension, College of Natural Sciences, University of Massachusetts, Amherst, MA

Almonds are an important crop in California, currently encompassing over 825,000 total acres, of which 740,000 are bearing (2010 data). Almonds have long been the focus of research and extension efforts by the University of California IPM Program. A summary is presented of previously-published grower surveys conducted 10 years apart that demonstrated the extent of grower adoption of IPM tactics and described significant reductions in the use of dormant sprays of organophosphate insecticides against key direct pests. As a follow up to the earlier grower surveys, the authors worked closely with UC Davis, the California Almond Board and others to design an online survey of almond pest control advisors (PCAs), a group that had never previously been the subject of an extensive IPM-related survey. Investigators we not able to identify a comprehensive sample of almond PCAs or establish conclusively the total number of such individuals/businesses currently operating in California. However, with the assistance of the California Almond Board, the Association of Applied IPM Ecologists (AAIE) and the California Association of Pest Control Advisors (CAPCA), we were ultimately able to publicize the opportunity to complete the survey to 960 PCAs who are active members of CAPCA as well as a group of 92 PCAs who attended the 2010 Almond Industry Conference in Modesto, CA, Data are presented on results from a total of 151 surveys that were eventually completed, representing 494,658 acres of almonds in 11 California counties.

P040 Opportunities for public and private-sector IPM specialists to enhance NRCS programs for IPM

*Thomas Green[1], ipmworks@ipminstitute.org, Peter Werts[1], Wade Moder[1], Bill Kuenstler[2], Pete Goodell[3], Allison Jones[4], and Michael Rozyne[5]

[1]IPM Institute of North America, Madison, WI; [2]Central National Technology Support Center, Fort Worth, TX; [3]University of California Statewide PM Program, Parlier, CA; [4]National Alliance of Independent Crop Consultants, Collierville, TN; [5]Red Tomato, Canton, MA

Beginning in 2012 the USDA Natural Resources Conservation Service (NRCS) is implementing significant changes to the eligible practices and cost-share payments for its Environmental Quality Incentive Program (EQIP) practice standards, including IPM. EQIP supports IPM adoption by providing growers access to technical and financial assistance. These changes will require new strategies to educate growers, IPM stakeholders and consultants on the significance of these changes and how they can influence policy makers to continue strengthening conservation programs for IPM. Since 2006, the North Central NRCS & IPM Working Group has encouraged farmer adoption of IPM practices through participation in NRCS conservation programs and has developed successful mechanisms for facilitating collaborations between NRCS and IPM stakeholders to address impediments to IPM adoption. Outreach in Iowa, Indiana, Ohio and Minnesota has lead to new IPM options for specialty crop producers. Projects in Illinois, Kansas and Florida have helped identify impediments to IPM adoption and educated growers on current opportunities to participate in NRCS conservation programs. A lack of qualified private-sector Technical Service Providers (TSPs) to help growers implement IPM programs is a significant limitation to the expansion of EQIP for IPM. To address this concern the working group has begun developing an IPM practitioner's exam to help qualify consultants as TSPs. Future USDA Farm Bills will determine the level of support for IPM in NRCS conservation programs and our poster will illustrate the importance of continued enhancement of these programs with collaborations between the public and private sector.

P041 Outcomes of Germany's national action plan on sustainable use of pesticides

*Bernd Hommel, Bernd.Hommel@jki.bund.de, Bernd Freier, and Jörn Strassemeyer

Julius Kühn-Institut (JKI), Federal Research Centre for Cultivated Plants, Institute for Strategies and Technology Assessment, Kleinmachnow, Germany

Germany's national action plan on sustainable use of pesticides (NAP) was implemented in 2008 and acts as an umbrella of new and existing activities, mainly aiming for further risk reduction of pesticide use beyond the legal conditions. The Julius Kühn-Institut is responsibly involved with research, progress measurement and reviewing. The main targets comprise reduction of (a) environmental risk by 25% and (b) exceeding maximum residue limits (MRLs) in food to under 1% till 2020. Particular emphasis is placed on limiting the use of pesticides to the necessary minimum in order to avoid unnecessary applications and to increase the use of preventive and non-chemical methods. The set of measures comprises 23 single activities with focus on (a) promotion of research and innovation and (b) improved knowledge and information. Progress is determined with specific indicators, control and monitoring programs, and a network of reference farms. After 3 years, the results are promising. Based on the network of reference farms, treatment index scores are without an up- or down-trend, and more than 85% of all treatments from 2007 to 2010 complied with the necessary minimum. The 25%-target for risk reduction in the aquatic and terrestrial environment is reached for herbicides and insecticides but not yet for fungicides. In 2009 and 2010, the 1%-target for MRLs was not achieved in all product groups. Nevertheless it is necessary to intensify the efforts to achieve the ambitious NAP goals.The currently revised action plan will start in 2013 and mainly focus on voluntary implementation of crop and sector specific IPM guidelines.

P042 Papaya mealybug on mulberry and its management through classical biocontrol

*E.I. Jonathan, directorcpps@tnau.ac.in, C.A. Mahalingam, and S. Suresh

Centre for Plant Protection Studies (CPPS), Tamil Nadu Agricultural University, Coimbatore, India

Paracoccus marginatus, commonly called papaya mealybug, is a new record, exotic in origin which seems to have been introduced into India during 2008. It is a polyphagous pest first noticed during January 2010 in Annur and surrounding areas on mulberry and many other crops, including weeds. The incidence was very high (80-100%) from January to July 2010, during which period the pest was rampant and multiplied uncontrollably without any effective natural enemies and proper pesticides specific for the mulberry ecosystem. The Department of Sericulture, Tamil Nadu Agricultural University, Coimbatore devised an IPM package to manage papaya mealybug on mulberry. After adoption of the chemical-based IPM package, the papaya mealybug population came down considerably, however it hovered around 40-50%. After November 2010 the chemical-based IPM package was no longer recommended because of the cost of chemical controls, the pollution of the mulberry ecosystem and the unscrupulous use of pesticides. Consistent efforts by all government organizations paved the way for the receipt of three parasites from USDA. An aphelenid parasitoid, *Acerophagus papayae* was multiplied by the Department of Sericulture, TNAU, Coimbatore and released in infested areas all over Tamil Nadu. The damage which was around 15-30% during January 2011 declined gradually to 2-3% through June. As of now, the papaya mealybug

population is minimal (< 2-3%) in areas where damage was recorded during 2009-2010. At present, pesticide sprays on mulberry have been stopped which resulted in more profits to farmers and more importantly saved the environment. This is one of the great successes in pest management using biological control, during the recent past.

P043 Pest management scenario under IPM in Northeastern part of India

*Ashim Chowdhury[1], ashikly@hotmail.com, J. Tarafder[2], and M. Ahmed[3]

[1]Department of Ag Chemistry and Soil Science, IAS, Calcutta University, Kolkata, India; [2]Department of Plant Pathology, BCKV(SAU), India; [3]Government of West Bengal, India

Agriculture has always been a core sector of the Indian economy, contributing about 21% to the GDP. Pest management is an important criteria to provide food security because an estimated 36% of the attainable, agricultural output is lost due to various pests. India has emerged as one of the largest producers of pesticides in South East Asia and the development of the sector needs quality agricultural practices. Effective hygiene control, therefore, is vital to avoid the adverse human health and economic consequences of food borne disease. Everyone has a responsibility to assure that food is safe and suitable for consumption. Pest management is a must that is nothing but to follow the concept of IPM and biorational pesticides as per the requirements for economic farming. India is also the world's largest consumer of tea, especially in the Northeastern region, as a human health drink. But with the use of over 600 pesticides it also upsets the natural tea ecosystem, causes pesticide residue and tainting problems in made tea, the resistance problem, toxic load to the environment and the resurgence of pests. This is the main constraint for export of tea globally. Use of biorational chemicals at the right time and doses for pest management under IPM in commercial crops is inevitable. The right execution of IPM should be backed up by precision monitoring, residue, and imposition of regulations at all levels. Some specific management in some important commercial crops in this part of India; viz; eggfruit, rice and tea will be presented.

P044 Precision area-wide management of *Eurygaster integriceps* Put. (Hemiptera: Scutelleridae) in Iran

*Mir Jalil Hejazi, mjhejazi@tabrizu.ac.ir, and Roghaiyeh Karimzadeh

Department of Plant Protection, College of Agriculture, University of Tabriz, Tabriz, Iran

Eurygaster integriceps Put. (Hemiptera: Scutelleridae) is the most economically important pest of wheat and barley in west and central Asia including Iran. Currently, the use of chemical insecticides is the main effective method for controlling this pest. Every year several thousand hectares of wheat and barley are sprayed traditionally for control of this pest and hundreds of tons of chemicals enter the environment. Such applications cause environmental pollution, natural enemy suppression, and outbreak of secondary pests. Preliminary studies have revealed that distribution of *E. integriceps* populations is aggregative in space; and site specific pest management is applicable towards controlling this pest. These studies indicated that site-specific spraying has the potential to control *E. integriceps* to an acceptable level, reduce the amount of insecticide used, and conserve natural enemies in untreated refuges. In another study, it has been determined that radiation reflectance of the plants infested with *E. integriceps* is different from healthy plants. Precision area-wide management using new technologies including remote sensing, global positioning and geographic information systems, and variable rate technology is proposed for effective and economical control of this pest. These technologies currently are not used against this pest in Iran, but preliminary investigations have been conducted. Limiting insecticide applications to specific areas can reduce chemical use, reduce environmental pollution and, conserve natural enemies.

P045 Pymetrozine–A novel insecticide for planthopper management

*S. Suresh, ssureshsupra@gmail.com, S. Preetha, P. Karuppuchamy, E.I. Jonathan, and R. Samiyappan

CPPS, TNAU, Coimbatore, India

The brown planthopper (BPH) is one of the major constraints in Tamil Nadu, India and in other South East Asian countries. Recent reported outbreaks are due to unwarranted use of insecticides, especially synthetic pyrethroids for the management of rice leaffolder in the early vegetative phase. The majority of the farmers take management action only after seeing the hopperburn symptom and as a result, they are using a greater quantity and more rounds of insecticidal sprays for BPH management. Imidacloprid and thiamethoxam are the common insecticides used for the management. Because of indiscriminate use of imidacloprid in certain locations of Tamil Nadu, there was poor control. A new insecticide, Pymetrozine (from a chemical class pyridine azomethines) was tested which has a novel mode of action involving neuroregulation or nerve-muscle interaction and acts by preventing feeding. Feeding prevention (prevent inserting their stylus into the plant tissue) by pymetrozine was evaluated at Tamil Nadu Agricultural University, Coimbatore, India against BPH in the field and toxicity tested against the wolfspider, *Pardosa pseudoannulata* in the lab. The results indicated pymetrozine was moderately toxic to BPH. Pymetrozine at 100, 125 and 150 g a.i. ha-1 persisted for a period of 6, 10 and 14 days, respectively. Based on LC50 values, pymetrozine was found to be moderately toxic to miridbug, *Cyrtorhinus lividipennis* and *Trichogramma chilonis*. In pot culture studies on rice, the mortality of miridbug was found up to 14 days in the case of pymetrozine at higher doses. It is an ideal insecticide effective against BPH and moderately toxic to mirid, *C. lividipennis*, *Trichogramma* and the spider, *Pardosa* which can fit very well in rice IPM.

P046 Reducing pesticide risk by integrating biopesticide tools in sustainable production systems

J.X. Zhang, T. Laengle, and *Leslie Cass, leslie.cass@agr.gc.ca

Pest Management Centre, Agriculture and Agri-Food Canada, Ottawa, Ontario, Canada

The Pest Management Centre (PMC) of Agriculture and Agri-Food Canada was established to improve growers' access to newer, safer pesticides, and to production approaches that reduce reliance on pesticides. The Pesticide Risk Reduction Program (PRRP) of PMC focuses on delivering reduced risk pest management solutions, including biological controls and integrated approaches, for both major and minor crops. Use of biopesticides and incorperating them into IPM programs for crop pest management is a key element of the PRRP's effort to reduce the risks to human health and the Canadian environment from pesticide use in agriculture. The PRRP consults nationally with stakeholders to select biopesticide projects to address priority pest issues on selected crops every year at the Annual Biopesticide Setting Workshop held by the PRRP in March. Support provided to priority projects ranges from regulatory support in assembling submission packages to financial support for field trials to generate efficacy and crop tolerance data for new product registration or label expansion. Information about the biopesticide-related activities of the PRRP of AAFC's Pest Management Centre is presented, along with successes achieved to date.

P047 Agriculture and Agri-Food Canada programs in support of sustainable pest management

*Leslie Cass, Leslie.Cass@agr.gc.ca, and Cezarina Kora

Agriculture and Agri-Food Canada, Pest Management Centre, Ottawa, Ontario, Canada

Since early 2000, following the recommendations coming out of the 1998 OECD IPM workshop and in response to the growing concerns of Canadian citizens over the impact of pesticides on the health of humans and environment, the Canadian Government has placed a particular emphasis on strengthening sustainable production in agriculture. As part of Agriculture and Agri-Food Canada's strategic 5 year plans, laid out under the Agriculture Policy Framework (2003) and later under the Growing Forward policy framework in 2008, a number of environmental programs were established to enable sustainable agriculture production. These programs are providing improved grower access to best management practices including, among others, safer pest management alternatives and IPM implementation opportunities. The poster presentation provides information on relevant programs, which touch the four areas of: establishing priorities and standards; aligning research; technology transfer to industry and on-farm implementation; and, assessing environmental performance. AAFC is committed to delivering programming which enhances innovation and competitiveness in an environmentally sustainable manner, for the benefit of growers, the environment and the society at large.

P048 Seed and seed applied technologies: Integrated approaches for managing global insect and disease pests

*Paula Davis, paula.davis@pioneer.com, Greg Lamka, and Sandy Endicott

Pioneer Hi-Bred, Johnston, IA

During the last 10 years, advances in molecular breeding, plant resistance (both native and transgenic traits), and seed applied technologies have revolutionized insect and disease management for global field crops including corn, soybeans, and canola. This poster will provide global examples of successful integration of improved germplasm, GM traits, and seed applied technologies into product concepts. Multiple product concepts can be offered into the market place to meet field by field placement needs. Future opportunities and challenges also will be discussed.

P049 Site specific applications via integration of existing weather networks and proven predictive models

Peter Oudemans[1], *Jon Clements[2], clements@umext.umass.edu, Terence Bradshaw[3], David Robinson[4], Lorraine Berkett[3], and Juliet Carroll[5]

[1]Department of Plant Biology and Pathology, Rutgers University, Chatsworth, NJ; [2]Department of Plant, Soil, and Insect Sciences, University of Massachusetts, Belchertown, MA; [3]Department of Plant and Soil Science, University of Vermont, Burlington, VT; [4]Department of Geography, Rutgers University, Piscataway, NJ; [5]New York State IPM Program, Cornell University, Geneva, NY

Site specific agriculture is dependent on several components. At its heart are the collection, analysis and application of data for increasing agricultural efficiency. Our goal is to develop site specific applications for specialty crops such as apples, cranberries, blueberries and grapes. Regional and state-wide weather networks have been established through a variety of agencies. In New York, the NYS IPM Program and the Northeast Regional Climate Center operate a mesonet of grower-owned weather instruments in the Network for Environment and Weather Applications (NEWA). The weather data collected is analyzed and implemented online in 20 interactive pest and disease forecast models. Recent expansion of this mesonet into Massachusetts and Vermont now delivers site specific applications in these states. In New Jersey, the office of the State Climatologist maintains three weather networks (MesoNet, SafteyNet and RISE) which include over 60 stations distributed across the state. In 2011, we added these weather networks to the NEWA system to provide site specific disease

and insect prediction models. National Weather Service data from airport locations in NY, MA, VT and NJ, as well as adjacent areas in neighboring states, have also been implemented in the network. Integration of existing weather networks with established predictive models provides a significant value-added product for farmers and field professionals. It is critical to make these systems sustainable, available and useful to our grower community.

P050 The University of Maine Cooperative Extension strawberry IPM program

*David T. Handley[1], david.handley@maine.edu, and James F. Dill[2]

[1]University of Maine, Highmoor Farm, Monmouth, ME; [2]University of Maine, Pest Management Office, Orono, ME

The University of Maine Cooperative Extension Strawberry IPM program was initiated in 1993 to help farmers better manage the challenging pest complex associated with this crop. An additional objective was to make pest management practices more "consumer-friendly" because nearly the entire strawberry crop is sold fresh to costumers as "pick-your own". The strawberry pest complex in Maine is relatively small, but poses a serious threat to this high-value crop, and thus intensive preventative control methods were often employed, using high amounts of pesticides to control the most common insect and disease problems, including tarnished plant bug (*Lygus lineolaris*), strawberry bud weevil (*Anthonomus signatus*), two spotted spider mites (*Tetranychus urticae*) and gray mold (*Botrytis cineria*). The IPM program introduced pest monitoring techniques, including weekly scouting, and economic action thresholds to determine the necessity and timing of sprays. Additionally, the program has worked with growers to develop alternative strategies such as pest resistant cultivars, biological control and insect barriers. The program serves over 60 farms statewide, and works with neighboring states to provide information throughout the region. Ten sites within Maine are monitored during the growing season and regularly updated information is delivered to growers statewide through weekly newsletter, e-mail, and blog updates. In 2011, a new monitoring program for spotted wing drosophila (*Drosophila suzukii*) was initiated and will be a major thrust of the 2012 program.

P051 Measuring up! Involving stakeholders in assessment of an industry's IPM revolution

*Lydia M. Brown, lbrown@cals.arizona.edu, Peter C. Ellsworth, Alfred Fournier, William McCloskey, and Wayne Dixon

University of Arizona, Arizona Pest Management Center, Maricopa Agricultural Center, Maricopa, AZ

The availability of accurate, real-world data on pest management practices, crop pest losses, and associated costs are critical to assessing the adoption and impact of IPM programs. We engage agricultural stakeholders through annual survey workshops to develop data on crop pest losses, control costs, target pests, and pesticide use. These data, now spanning over 30 years for cotton, are useful in documenting adoption of IPM practices, economic savings to growers, and large-scale changes in pest management practices. The workshops encourage and reward stakeholder input, foster collaborative relationships with key stakeholder groups, and provide high quality data on pest management practices and their economic impacts. For example, the last 5 years have shown the lowest insecticide use in cotton on record (32 years) at just 1.5 sprays season-long, reducing insecticide loads on the environment by more 1.6 million pounds of active ingredient annually and saving growers over $10 million per year. In addition to quantitative data, stakeholders identify the specific intent or intended targets of pesticide inputs, so the resulting data provide unique insights into the decision-making experience of each pest manager. These insights help guide existing and new programs in IPM research, implementation, and outreach. Our dialog with stakeholders helps us identify emerging pest issues and changing needs of stakeholder communities The ability to measure impacts and industry practices is useful for generating interest in and sustaining support for our IPM programs, which in turn have produced great economic benefits for growers.

P052 FAO Desert Locust early warning system

Keith Cressman, keith.cressman@fao.org

UN Food & Agriculture Organization (FAO), Rome, Italy

The Desert Locust is probably the oldest and most feared migratory pest in the world, plaguing farmers in Africa and Asia since Phaoronic times. Under optimal conditions, locusts increase rapidly and form swarms. A single swarm, larger than New York City, can contain billions of insects, migrate across continents, and eat enough food for 2,500 people in one day. During plagues, vulnerable households can find themselves in debt, limited national resources are rapidly depleted, and food security can be at risk in affected countries. It can take several years and hundreds of millions of dollars to bring a plague to an end. The Food and Agriculture Organization (FAO) of the United Nations operates an early warning system to keep the international donor community and affected countries informed of the Desert Locust situation and potential developments concerning the scale, timing, and location of expected breeding and migration. The system is the basis of the preventive control strategy to reduce plagues. It relies on survey and control operations carried out by well-trained national teams who use remote sensing products to identify, monitor, and treat locust infestations, as well as, handheld geo-referenced devices to record and transmit field data to analysts and decision-makers in real time. Data are shared through a network of national locust control centers that allow FAO to monitor the global situation using GIS technology and warn countries of impending invasion. FAO, supported by donors, puts substantial efforts into strengthening national capacities during recession periods and organizes control campaigns during locust emergencies.

P053 New Zealand and Australian regulations of generalist predators in the glasshouse industry

*Kate Bromfield[1], Kate.Bromfield@epa.govt.na, Steve Wratten[2], Paul De Barro[3], and Cora Drijver[1]

[1]Environmental Protection Authority, Wellington, New Zealand; [2]Lincoln University, Canterbury, New Zealand; [3]CSIRO, Australia

The introduction of biological control agents (BCA's) into New Zealand is regulated under the Hazardous Substances and New Organisms (HSNO) Act through the Environmental Protection Authority (EPA). The recent invasion of the tomato potato psyllid and the potential withdrawal of registration for organophosphate and carbomate pesticides have meant that crops in the glasshouse industry may be left without effective controls for several arthropod pests. In response, the EPA is considering the implications of the Act for introductions of generalist BCAs as replacements. The HSNO Act requires the consideration of five minimum standards regarding the impact of new organisms, and risks and benefits are considered after these have been met. One key standard is the impact on non-target species, which in most cases is measured through assessments of host specificity. A similar situation exists in Australia. Therefore, the challenges facing applications to introduce polyphagous natural enemies are the assessment of non-target impact and the perception verses quantification of risk. As a consequence, biological control programs in New Zealand and Australia avoid species that are not host specific. In Australia, the parasitoid, *Encarsia formosa,* is effective against greenhouse whitefly and was first introduced in 1934. However, it is now known globally to parasitize at least 15 species of whiteflies including, in the laboratory, some native Australian species. However, in Australia it is rarely detected outside of protected cropping and never in natural systems. So, how predictable is impact and is the precautionary approach a reasonable one in terms of net benefit?

P054 The red palm weevil, *Rhynchophorus ferrugineus*, and IPM

*Aziz Ajlan[1], aajlan@hotmail.com, Khalid Alhudaib[1], and J. R. Faleiro[2]

[1]Department of Arid Land Agriculture, College of Agriculture and Food Sciences, King Faisal University, AlHassa, Saudi Arabia; [2]Mariella, Arlem-Raia, Salcette, Goa, India

The red palm weevil (RPW), *Rhynchophorus ferrugineus*, is attacking about 19 palm species worldwide. RPW was discovered in the mid1980's in the Arabian Gulf from where it moved into Africa (Egypt) in the early 1990's and, subsequently, into Europe (Spain) due to transporting infested offshoots into the area. Currently, it is devastating palms in the Mediterranean basin. In 2010, it gained entry into Laguna Beach, California and, in early 2009, into the Caribbean (Curacao Island). RPW prefer to infest young palms 20 years old and less; a single female laying about 300 eggs in cracks, crevices, and wounds that hatch into damage grubs. All stages (egg, larva, pupa and adult) are spent inside the palm trunk. Early symptoms are difficult to detect; neither damage nor larva can be seen. Overlapping generations appear inside the palm with serious tissue damage, while a brownish viscous liquid is oozed out and of chewed fibers are protruded from small holes in the trunk. Infested palms are not responding to curative treatment and have to be eradicated. RPW is currently managed through a pheromone based Integrated Pest Management (IPM) strategy where early detection of infestation is the key to ensure success. Implementing international and local plant quarantine regulations is essential. Field sanitation and cultural practices are one of the important components to prevent weevil infestation. No effective biological agent has been found. The first web site (http://www.redpalmweevil.com) on this global pest was established in 1998.

P055 Toxicity and safety of Spiromesifen 240 SC and imidacloprid 70 WG

P. Natesan[1], *S.V. Krishnamoorthy[2], kitcha.tnau@gmail.com, S. Kuttalam[2]

[1]Field Development Executive, Bayer Crop Sciences Limited, Coimbatore, Tamil Nadu, India; [2]Department of Agricultural Entomology, Centre for Plant Protection Studies, Tamil Nadu Agricultural University, Coimbatore Tamil Nadu, India

Acute toxicity of Spiromesifen 240 SC against *Tetranychus urticae* Koch and imidacloprid 70 WG against cucumber sucking pests and their safety to *Trichogramma chilonis* Ishii and *Chrysoperla zastrowi* Sillemi. were studied. Acute toxicity of Spiromesifen 240 SC was assessed through leaf disc bioassay (40 mm dia okra leaves) and percent mortality of mites was assessed 24 and 48h after release. IRAC bioassay method No. 8 was used for imidacloprid 70 WG against *Aphis gossypii* Glover and *Amrasca biguttula biguttula* Ishida and leaf dip assay method for *Bemisia tabaci* Gennadius and *Thrips palmi* Karny. Mortality was recorded at 48h after exposure to the insecticides and log concentration probit mortality curves were fitted. Invitro studies assessed safety to *T. chilonis* and *C.* carnea. Results revealed that LC50 of spiromesifen 240 SC, propargite 570 EC, fenazaquin 10 EC and dicofol 18.5 EC against *T. urticae* was 0.693, 3.925, 5.309, and 19.824 ppm respectively. LC50 of imidacloprid 70 WG against *A. gossypii*, *A. biguttula biguttula*, *B. tabaci*, *T. palmi* was 1.888, 0.081, 2.040 and 3.032 ppm, respectively. Spiromesifen 240 SC and imidacloprid 70 WG at test concentrations recorded 79.18 – 87.66% *T. chilonis* adult emergence and 76.90 – 84.44% parasitization. The egg mortality of *C.carnea* was in the range of 4.84 – 10.58 for the test compounds. Studies suggested that Spiromesifen 240 SC at 96 g a.i/ha and imidacloprid 70 WG at 24.5 g a.i/ha are a good fit in an IPM program.

P056 20 years of agricultural pesticide use data reveal dramatic reduction in broadspectrum insecticides

*Al Fournier[1], fournier@cals.arizona.edu, Peter Ellsworth[2], Wayne Dixon[1], John Palumbo[3], and Jack Peterson[4]

[1]University of Arizona, Arizona Pest Management Center and Maricopa Agricultural Center, Maricopa, AZ; [2]University of Arizona, Arizona Pest Management Center and Department of Entomology, Maricopa, AZ; [3]University of Arizona, Arizona Pest Management Center and Department of Entomology, Yuma, AZ; [4]Arizona Department of Agriculture, Environmental Services Division, Phoenix, AZ

While a variety of data sources (e.g., surveys and sales reports) are used nationally to document agricultural pesticide use, only Arizona and California currently require "real time" pesticide reporting for regulatory purposes. Arizona lacks 100% use reporting, but requires reporting for all "for hire" and aerial applications, and certain other uses. Because of industry practices, use reports for certain crops and pests are representative of general trends in Arizona agriculture. The University of Arizona, Arizona Pest Management Center (APMC) has partnered with the Arizona Department of Agriculture (ADA) to develop a 20-year historical database of Arizona pesticide use reports, integrated with other resources such as EPA product look-up tables. We analyzed pesticide use data for two major crops, cotton and lettuce, and charted 20-year use trends for major insecticide chemistries. While specific use patterns vary by crop and chemical class, overall results show a dramatic reduction in the use of broad-spectrum insecticides including organophosphates, carbamates and pyrethroids (except in lettuce), and an increase in adoption and use of selective chemistries that help maintain natural enemy populations and reduce risk to human health and the environment. For example, in cotton we have seen a 10-fold reduction in insecticide use, from historic highs in 1995 to historic lows in 2010. Over the same timeframe we have seen an increased integration of selective products into pest management programs. When combined with other data sources, we can write powerful statements about the environmental and economic impact of these changes for the Arizona agricultural industry.

P057 Pesticide use and risks in horticultural farm enterprises in Uganda

Julian Kirinya[1], *Jackline Bonabana-Wabbi[1], jbexim@gmail.com, Daniel Taylor[2], George Norton[2], Margaret Mangheni[1], Mark Erbaugh[3], Samuel Kyamanywa[1], Jeninah Karungi[1], and Geofrey Tusiime[1]

[1]Makerere University, Kampala, Uganda; [2]Virginia Tech, Blacksburg, VA; [3]The Ohio State University, Columbus, OH

The horticultural sector in Uganda is growing at a rate of 20% per year. However, it is hampered by a wide range of constraints mainly pests and diseases prompting farmers' use of calendar pesticide sprays as the main control strategy thereby exposing farmers to a host of pesticide risks when incorrectly used. This study was conducted in Uganda to understand pesticide handling and risks among IPM intervention and non-intervention areas. Results show that 62% of the surveyed farmers were aware about the presence of alternatives to pesticides in the intervention areas mainly due to receipt of pesticide use and handling training. There existed stark differences between IPM intervention and non-intervention areas regarding pesticide exposure and risks arising from improper handling – higher in the non-intervention areas. About 60% of the farmers in the intervention areas followed usage instructions while 74% of the farmers in non-intervention areas did not read and understand the instructions. Only 10% of farmers in the non-intervention areas were aware about negative effects of pesticides on humans compared to 92% in the intervention areas. During spraying and at mixing stage, 74% of farmers in non-intervention areas did not use protective gear. About 21% of the pesticide applicators used the mouth to unblock a blocked nozzle, thereby directly exposing themselves to potential pesticide contamination and/or poisoning orally. Despite the above, even in the non-intervention areas 60% believed that pesticide use could be reduced without reducing yield implying fertile ground for potential IPM adoption.

P058 State Phytosanitary Administration state body for implementation of IPM in the Czech Republic

Stepanka Radova, stepanka.radova@srs.cz

State Phytosanitary Administration, Department of Integrated Pest Management Methods, Brno, Czech Republic

State Phytosanitary Administration (SPA) was established in 1996 based on the legislative act no. 147/1996. This institution covers obligations dealing with plant protection, mechanization for plant protection, pesticide registration, measurements to prevent of introduction of quarantine plus invasive harmful pests and phytosanitary emergency actions according to the novelized legislative act (326/2004). SPA carries out monitoring of harmful organisms (HO) in the territory of the CZ. Surveys are carried out in equally located observation points and outside of them. Survey reports are compiled as annual overviews, including weather conditions. Except of information including monitoring of HO, terrain inspectors collect also information about usage of pesticides by farmers. The main tasks of SPA is providing: 1) actual information about occurrence of HO in form of weekly reports or digital maps of CZ with the occurrence of chosen HO with details of the spot where the monitoring was carried out, 2) access to the decision support system – sum of effective temperatures (SET) of chosen insect pest and prognosis model for potato light blight, septoria leaf blotch and leaf spot of beet). For the fulfilling Directive 2009/128/ES some additional steps had to be done. New special web portal for farmers is planned to create. This tool is going to contain all necessary information for the

decision and to interact with registered users after inserting their own data (e.g. crop, actual weather conditions, time of plant emerge). SPA represents an important element of IPM implementation with broad scale of phytosanitary activities.

Management—Natural Resources

P059 Endophytic fungi from *Schinus molle* L. as new biological control agents of black bean aphid in Algeria

*Oussama Ali Bensaci, benssaci.oussama@univ-batna.dz, Nadia Lombarkia, and Khamsa Rouabah

Laboratoire d'Amélioration des Techniques de Protection Phytosanitaires en Agrosystèmes Montagneux (ATPPAM), Agronomy Department, ISVSA, University of Batna, Algeria

Aphicide activity of culture filtrates of three endophytic fungal taxa, isolated from fruits of the introduced Peruvian pepper tree (*Schinus molle* L.) was tested as being an alternative and biological way for a reasonable control of the black bean aphid (*Aphis fabae* Scop.) in Algeria. We hypothesized that these fungi can be exploited in biocontrol programs against this harmful aphid in semi-arid legume agroecosystems. After the spray at various concentrations (25%, 50%, 75% and 100%) of individuals maintained on excised bean leaflets, it turned out that the filtrate of *Cladosporium echinulatum* had a dramatic effect for a longer period (after 24h), maximum mortalities were obtained for concentrations of 50% and 75% with a rate of 78.67%. However, *Fusarium equiseti* recorded a significant impact in short term (after 2 hours) with an average mortality of 73.33% at 50% concentration. The filtrate from *Alternaria* sp. had a remarkable effect at 75% concentration (with an average mortality of 70.60%). The obtained results allow us to visualize in a way, the so-called "effective or optimal concentration" against the black bean aphid. On the other hand, a strong proteolytic activity has been shown in *F. equiseti* and *C. echinulatum* taxa. The peak of this activity was reached on the second day for the two fungal species, with an index of 0.53 for *F. equiseti* and 0.92 for *C. echinulatum*, before falling the next day. The resulting regression analysis revealed a negative correlation between radial growth and induction of proteolytic activity especially for *C. echinulatum*. It is recommended to pursue further studies to assess the diversity of endophytic mycoflora in the Peruvian pepper tree, targeting other pest organisms, but also to know the ideal technical conditions for obtaining the active fungal ingredients to be used as bio-aphicide, whose performance will be considered with more efficient formulations, such as the invert emulsion.

P060 The Continental Dialogue on Non-Native Forest Insects and Diseases: A new IPM venue?

G. Keith Douce[1], kdouce@uga.edu, and Bill Toomey[2]

[1]Center for Invasive Species & Ecosystem Health (and Dialogue Steering Committee member), University of Georgia, Tifton, GA; [2]North American Director of Forest Health Protection, The Nature Conservancy, Sheffield, MA

The Continental Dialogue on Non-Native Forest Insects and Diseases http://www.continentalforestdialogue.org/ is a unique, voluntary coalition of non-profit, business, industry, government, landowner, and academic entities focused on maintaining healthy forest landscapes by preventing the introduction, establishment and spread of harmful non-native (invasive) forest insects and diseases in North America. The Dialogue serves as a central forum for stakeholders and partners to identify areas of mutual interest and develop consensus around strategies and actions aimed at: 1) raising awareness of the problem; 2) improving effect public and private early detection and rapid response efforts; 3) improving slow-the-spread programs to minimize damage and buy time for the development of new tools to combat these invasive pests; 4) encouraging restoration of native species in areas where populations of invasive species have been eradicated. A national steering committee oversees Dialogue work and provides linkage to and coordination with the diverse Dialogue constituency. The steering committee oversees the development of operational strategies that are implemented through The Dialogue constituency and by supporting and encouraging improvement of existing federal, state, and provincial programs. Some of the higher visibility initiatives that The Dialogue has lead or played a major role in developing and implementing include: Don't Move Firewood http://www.dontmovefirewood.org/; Lurking in the Trees http://www.dontmovefirewood.org/lurking-in-the-trees/ , and Plant Smart http://www.plantsmart.org/. See The Dialogue websites to learn more about The Dialogue and how to increase the role that IPM can play in carrying out Dialogue activities, or talk with one of the authors.

P061 Theoretical basis of pest management

V.B. Sapunov, sapunov@rshu.ru

Russian State Hydrometeorological University, St. Petersburg, Maloohtinsky, Russia

The aim of work is synthesis of theoretical ecology and practical pest management. The use of pesticides may lead to unpredictable results. Very often we take into account only toxic effect to insects. The interaction between pesticide and ecological system is complicated process consisting of many phenomena. There are three main effects of pesticides: 1) Ecological one leading to a simple decrease of the abundance of the threaded populations on after treatment; 2) Selection for pesticide resistance; 3) Genetic destabilization and increase

of variability of all population effected by pesticides both pests and human. There is generalized reaction at the level of ecological systems. There is no theory of such a reaction. We are toward such a theory. According to global ecology (Vernadsky, 1926), this reaction must be dynamiccally resistant. That is, relation between species must be changeable and the changes may be accompanied by stability of general structure of ecological systems. Stress state increases variability and adaptive potencies of population. During some generations depression is followed by increase of fecundity. Hence, use of pesticides may have results reciprocal to needful. Fertility of pests may increase after human efforts. Hence, any struggle against pests needs take into account any direct or indirect ecological results of pesticide use. Modern population biology and ecology may help us to make such a prediction.

Management—Urban

P062 School IPM program impact assessment

*William M. Coli, wcoli@umext.umass.edu, and William A. Miller

University of Massachusetts Extension, College of Natural Sciences, University of Massachusetts, Amherst, MA

Here we report on results of an online survey administered to Regional School IPM Working Group (WG) members. Surveys obtained information on five categories of impact for School IPM: environmental, economic and human health impact of IPM for school landscaping; and economic and human health impact of IPM for school interiors. For each impact area, respondents were asked about their involvement with educational programming and whether they were aware of any assessments of impact. Of 172 potential respondents, a total of 56 surveys were completed, a 33% response rate. A majority of respondents represented University Extension (55%), followed by State or Federal agencies (33%), professional pest management companies (13%) and non-profit organizations (9%). Most respondents were involved with IPM education (91%), followed by implementation (66%), evaluation (46%), research (21%), enforcement/regulation (14%) and funding (11%). A majority of respondents reported no awareness of impact assessments, either previously conducted, ongoing or planned. The most commonly assessed impacts were the Economic Impacts of IPM for School Interiors (30% of respondents), followed by the Human Health Impacts of IPM for School Interiors (21%) and Environmental Impacts for School Landscaping (24%). Very few assessments were reported for Economic Impacts of IPM for School Landscaping and Human Health Impacts for School Landscaping. Assessments were typically focused on measuring knowledge changes and behavior changes in the populations that were the target audience for various types of education programming. Assessments of long-term changes in economic and environmental conditions or in human health were not frequently reported.

P063 2011 Survey results: Tennessee's school IPM race to the top

*K. Vail, kvail@utk.edu, and P. Barnwell

Department of Entomology and Plant Pathology, University of Tennessee, Knoxville, TN

IPM adoption in Tennessee schools is slowly increasing. In 1997, indoor school IPM adoption was estimated at 12% (74% return) and in 2002, had reached 25% (36% return). In 2008, only 6.7% of school districts completed the online survey, but 54% of the schools were using high level IPM. A 2011 school district phone survey (71% response) validated the 2008 results. Roughly 65% of the school districts are using most (>70%) of the IPM practices queried about in the survey. IPM practices included having a pest management policy, using a person trained in pest management to decide that pesticides need to be applied and to make pesticide applications, using a monitoring system or inspections to help determine when and where pesticides should be applied, pest-proofing, using cockroach baits, applying pesticides in cracks and crevices, using a logbook, keeping occupants out of treated areas and not spraying buildings or equipment for head lice. Most school districts are keeping occupants out of pesticide-treated areas overnight (73%). What needs improvement? A schedule is still determining when pesticides are applied in 51% of the school districts. Also, 50% of respondents are still spraying baseboards regardless of pest presence. Baiting for cockroaches is only performed in 50% of the school districts. Based on these first three needed improvements, 50% may be a better estimate of Tennessee schools using IPM. Partnering with the Tennessee School Plant Management Association and using demonstrations funded by a USDA-NIFA Extension IPM- CS Coordinated Program Grants has helped increase adoption.

P064 Green Shield Certified–Authenticating real IPM service providers, programs and facilities

*Caitlin Seifert, cseifert@ipminstitute.org, Thomas Green, and Jodi Schmitz

IPM Institute of North America, Madison, WI

Green Shield Certified is an independent, non-profit certification program that promotes practitioners of effective, prevention-based pest control while minimizing the need to use pesticides. Green Shield Certification is available to qualifying pest control professionals and programs as well as buildings and facilities where our standards are attained. Since Green Shield's beginning in 2007, 37 service providers have been certified according to a set of rigorous standards developed and maintained by the IPM Institute of North America. Several more service providers are engaged in the process of attaining certification. Four facilities and two IPM programs have been certified. Green Shield Certified is refining a certification specialized for health care facilities and is interested in establishing

certification programs for professional landscape services and individual pest management professionals. Poster will highlight the program's progress to date, opportunities in the green building movement, benefits to those certified and plans for the future of Green Shield Certified.

P065 Larvicidal activity of selected plant extracts against *Aedes albopictus* Skuse (Diptera: Culicidae)

Hazrat Bilal, bilalento@yahoo.com

Health Services Academy, Pakistan

Plant based insecticides may serve as suitable alternative as biocontrol techniques in the future. The present study has explored the effect of ether extracts of *Emblica officinalis, Ricinus communis, Acacia coucinna, Cinnamomum tejpata, Piper nigera, Coriandrum sativum, Olea vera, Linum usitatissimum, Syzygium aromaticum,* and *Nigella sativa* against larvae of *Aedes albopictus* under laboratory conditions. Larvae were exposed to a range of concentrations of each extract. The larval mortality was assessed after 24 and 48 hours exposure and LC50s were calculated for each time interval. All extracts showed moderate larvicidal activity. The lowest LC50 was found in *Coriandrum sativum, Nigella sativa,* and *Syzygium aromaticum* at a dose of 363.7 ppm, 377.5 ppm and 403.4 ppm, respectively, after 24 hours exposure whereas, the amount of extracts used reduced to 263.9 ppm, 300.8 ppm and 342.2 ppm, respectively, after 48 hours. In terms of lethal time response again *Coriandrum sativum, Nigella sativa,* and *Syzygium aromaticum* showed less time to produce 50 % mortality (14.28, 17.77 and 17.99 hours). These plants extracts are therefore promising as alternatives to synthetic insecticides in mosquito control programs. These data provide the basis to use the plant extracts against *Aedes albopictus*.

Outreach—Agriculture

P066 Bugwood Center (www.bugwood.org) web resources to support IPM implementation

*G Keith Douce[1], kdouce@uga.edu, J. LaForest[1], C. Bargeron[1], Howard Schwartz[2], and Mary E. Burrows[3]

[1]Center for Invasive Species & Ecosystem Health, University of Georgia, Tifton, GA; [2]Department of Bioagricultural Sciences and Pest Management, Colorado State, University, Fort Collins, CO; [3]Department of Plant Sciences and Plant Pathology, Montana State University, Bozeman, MT

IPM implementation requires knowledge of IPM philosophies, methodologies and management options to maintain pests at levels that are economically sound. Although explicit knowledge of the local situation and conditions is essential, many IPM system components such as identifying an insect, a disease organism, or a weed species; damage symptoms; organism life cycles; survey methodologies; crop production processes or crop growth stages are common across cropping system and geographical locations. In the U.S., IPM programs have historically been developed and delivered to clientele at the state-level through the State Land Grant University. Although extensive informational sharing and utilization of educational resources across state and regional boundaries occurs, for the most part those resources are developed and delivered within a state. The World Wide Web and other IT systems offer IPM educators new tools and ways of delivering information and programming to clientele. We believe that these systems can be built in ways that enable IPM specialists to collaboratively build, access and utilize information that can be used "as is" or adapted for use in and integrated into local IPM educational programs. The Bugwood Center systems (aka Bugwood Network) are the result of these collaborations and provide on-line, downloadable access to: 1) over 150,000 educational-use images (www.IPMImages.org); 2) a collaborative Wiki system (http://wiki.bugwood.org/); 3) EDDMapS early detection and distribution mapping system (www.EDDMapS.org); 4) extensive information about invasive species (www.invasive.org). Bugwood Center web systems received 252 million hits and served 31 million pages of information to 9.3 million users in 2011.

P067 Preparing for the brown marmorated stink bug in Iowa

*Laura Jesse[1], ljesse@iastate.edu, Adam Sisson[1], Erin Hodgson[2], and Sharon Parker[3]

[1]Integrated Pest Management, Iowa State University, Ames, IA; [2]Department of Entomology, Iowa State University, Ames, IA; [3]Department of Plant Pathology and Microbiology, Iowa State University, Ames, IA

The brown marmorated stink bug (BMSB) made headlines in 2010 as it damaged fruit, vegetable, and field crops in the eastern U.S. In Iowa, there was a great deal of concern from commodity groups, particularly one representing soybean growers, as the BMSB can cause considerable yield losses due to direct feeding on the soybean and by causing a condition called green stem. The Iowa State University IPM program responded by emphasizing proper identification of the BMSB as there are many 'brown' stink bugs in fields, including the beneficial spined soldier bug. We wanted to ensure that farmers were aware of the potential BMSB problem, and also to realize that right now treatments are not necessary and may not be necessary in Iowa for many years. We produced an identification guide and began a monitoring program to ensure that when BMSB establishes populations in Iowa we will be able to give farmers timely information. We collected and identified stink bugs from sweep samples of soybean fields, placed monitoring traps in several locations across the state, and conducted outreach efforts for homeowners and pest management professionals who will likely encounter BMSB first as an accidental invader.

P068 Protect U.S. offers new invasive species educational material for educators, clientele, and K-12

*Stephanie D. Stocks[1], sstocks@ufl.edu, Susan T. Ratcliffe[2], Amanda C. Hodges[1], and Martin W. Draper[3]

[1]Department of Entomology and Nematology, University of Florida, Gainesville, FL; [2]Department of Crop Sciences, University of Illinois at Urbana-Champaign, Urbana, IL; [3]USDA-NIFA, Washington, DC

Protect U.S., the community invasive species network (www.protectingusnow.org), is concerned with protecting the U.S. from exotic, invasive species through a coordinated educational program. Protect U.S. is a collaborative partnership between the National Plant Diagnostic Network (NPDN), Regional Integrated Pest Management Centers (IPM), United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine (USDA-APHIS -PPQ), National Institute of Food and Agriculture (USDA-NIFA), the National Plant Board (NPB), the Department of Homeland Security (DHS), your local Land Grant University Cooperative Extension Service, and other organizations involved in exotic species extension and regulatory activities. Protect U.S. has facilitated the development of educational material on various invasive species topics and delivers them in three different online formats: scripted presentations for use by educators (extension agents, professors, naturalists, etc.), e-learning modules for use in independent study (small farms, homeowners, general public, master gardeners, etc.), and K-12 lesson plans (correlated to National Science Education Standards and complete with scripted presentations, experiential activities, and student handouts). The materials include information on identification, life cycle, hosts, description of damage, methods of dispersal, and IPM management recommendations. The Protect U.S. Program benefits residents of the United States by providing these residents with the technical information to reduce the introductions and spread of exotic, invasive species.

P069 A collaborative approach to managing the threat of a new invasive pest to the BC blueberry industry

Carolyn Teasdale[1], *Kristine Ferris[1], kristine@escrop.com, Tracy Hueppelsheuser[2], Mark Sweeney[2], and Karina Sakalauskas[3]

[1]E.S. Cropconsult Ltd. Surrey, BC, Canada; [2]BC Ministry of Agriculture, Abbotsford, BC, Canada; [3]BC Blueberry Council, Abbotsford, BC, Canada

Blueberry IPM has been practiced in the Fraser Valley, British Columbia since the early 1990s and monitoring protocols and thresholds have been established for major pests. On average, farms practicing blueberry IPM make four insecticide sprays in a typical year. Since the establishment of Spotted Wing Drosophila (SWD) in 2010, the disruption of existing IPM programs has been a threat as infestations can be economically devastating, therefore growers have a low tolerance for SWD—sprays may be made as often as every seven days. In order to effectively communicate information to growers while still learning about this new pest, ongoing collaborative efforts have been made between government, industry-funded provincial councils and a private IPM consulting firm. Area-wide trapping for SWD was conducted during the 2010 and 2011 field seasons. In each field season, traps in multiple fields located across the Fraser Valley were checked weekly over a period of five months. SWD trap catches were reported and corresponding management recommendations were updated weekly on the BC Ministry of Agriculture's website, as well as sent out electronically via the BC Blueberry Council's Blueberry IPM Newsletter to 198 blueberry growers. Trap catches were also presented at regional field days and conferences in both years. This information helped growers make informed management decisions in relation to SWD incidence and life cycle and prevented unnecessary sprays. Among a representative group of growers, fewer sprays were made for SWD in 2011 than in 2010 due to these on-going outreach efforts.

P070 A comprehensive interdisciplinary Vermont Extension IPM program addressing stakeholder priorities and needs

*Ann Hazelrigg, ann.hazelrigg@uvm.edu, Lorraine Berkett, Sid Bosworth, Heather Darby, and Margaret Skinner

Plant and Soil Science Department, Jeffords Hall, University of Vermont, Burlington, VT

The coordinated, multidisciplinary Vermont IPM Program addresses essential IPM needs as identified by stakeholders in the state as well as advancing the goals of the National IPM Roadmap by building sustainable pest management systems that improve economic profitability and reduce the potential risks to human health and the environment. The overall goal of the Vermont IPM Program is to reduce economic, health, and environmental risks associated with pest management activities in the following areas of emphasis using a trans-disciplinary approach including both alternative and organic techniques: IPM in Agronomic Crops; IPM in Specialty Crops; and IPM in Consumer/Urban Environments. These areas are extremely well matched with the expertise and capacity at the University of Vermont (UVM). The specific IPM programs involve extensive collaboration with grower associations, state/federal agencies, and regional and national institutions. Methods of information delivery include one on one communication, field validation trials, in depth workshops, training sessions, presentations, websites and newsletters. Vermont is a very rural state; agriculture is essential to the vitality of its rural communities. The EIPM funds are critical to allowing Vermont to continue to deliver high-quality IPM programs that effectively address local, state, and National IPM Roadmap priorities and needs.

P071 A regional sampling network for insect pests of potato in the Columbia Basin of Washington

*Carrie H. Wohleb[1], cwohleb@wsu.edu, Andrew Jensen[2], and Timothy D. Waters[3]

[1]Washington State University Extension, Ephrata, WA; [2]Washington State Potato Commission, Moses Lake, WA; [3]Washington State University Extension, Pasco, WA

A regional sampling network was established in the Columbia Basin of Washington to provide potato growers with current information about the size and location of important insect pest populations. It functions as an early warning system that prompts growers to intensify scouting in their potato fields when pests are detected in the region. The sampling network targets three key insect pests: green peach aphid (GPA), beet leafhopper (BLH), and potato tuberworm (PTW). Each of these pests should be monitored closely and managed as needed to minimize yield and quality losses that can result from the insects feeding, and in the case of GPA and BLH from the pathogens they transmit to potatoes. In addition to targeted pests, other foliar arthropod pests and insect predators are monitored and reported on when their numbers are significant. Potato fields across the region are monitored weekly from May to October, and results are reported in "potato pest alerts" sent via e-mail to 260 subscribers. The alerts are summary reports with links to further information, including maps showing insect counts across the region, graphs of insect population trends, and IPM recommendations. When subscribers were asked in an online survey how they use the alerts, 90% indicated that they use them to be more aware of insect populations in the region, 68% use them to know when to scout for insects, and 42% use them to learn about IPM strategies for managing pests. This program has increased application of IPM strategies by Columbia Basin potato growers.

P072 Influence of socioeconomic factors in usage of IPM among hot pepper producers in Uganda

*J. Karungi, jkarungi@agric.mak.ac.ug, J. Kwesiga, W. Ekere, R.G. Nalugo, F. Muzira, M.K.N. Ochwo-ssemakula, and S. Kyamanywa

School of Agricultural Sciences, College of Agriculture and Environmental Sciences, Makerere University, Kampala, Uganda

Hot pepper is one of the major high value non-traditional produce exports in Uganda. However, production is greatly constrained by insect pests and diseases. IPM technologies are recommended as a means to control the pests while minimizing potential risks from usage of chemical pesticides. However, widespread voluntary utilization of IPM is unlikely to occur unless change agents have a better understanding of the socio-economic factors that influence farmers' use of control technologies. This study investigated the socio-economic factors affecting the utilization of IPM strategies in hot pepper production in five districts in Uganda. Primary data was collected from 84 randomly selected hot pepper farmers using pre-tested semi-structured questionnaires. Data was analysed using SPSS and Excel packages and a logistic regression analysis was used to assess the relationship between different variables and utilization of IPM practices. Results indicated that the socioeconomic variables of age, educational level, and gender influenced utilization of IPM practices. There was relatively large variation in the ages of farmers in the different locations of the survey; the mean age was 41.8. Wakiso district had the lowest mean age of the farmer at 31.47 while Mpigi district had the highest at 50.17. The youngest farmer was 17 years and the oldest was 80 years. The average level of education of the respondents was 7.28 years of formal schooling. There were more men involved in the hot pepper production (77%) than women (23%). These factors have to be taken into account when developing IPM technologies for hot pepper.

P073 Using farmer perceptions to establish an initial IPM research agenda for arabica coffee production in Uganda

*J. Mark Erbaugh[1], erbaugh.1@osu.edu, Jenina Karungi[2], Patrick Kucel[3], and Joseph Kovach[4]

[1]The Ohio State University, International Programs in Agriculture, Columbus, OH; [2]Makerere University, College of Agricultural and Environmental Sciences, Kampala, Uganda; [3]Coffee Research Center, Kituza, Uganda; [4]The Ohio State University, Ohio Agricultural Research and Development Center, Department of Entomology, Wooster, OH

In Uganda, coffee production continues to be limited by a variety of insect pests and diseases. The Integrated Pest Management Collaborative Research Program (IPM CRSP) initiated a farmer participatory IPM (PIPM) research approach with arabica coffee (*Coffea arabica* L.) growers on Mt. Elgon in Uganda in 2007. The first step in applying this approach and the main purpose of this study was to identify and group farmer perceptions of primary production and pests constraints to determine an initial research and training agenda. Constraint assessments can be improved by grouping farmers who share similar production practices and problems into research domains and has proven to be an efficient method for deriving farmer demand-driven research priorities that can help focus research and eventual technology dissemination strategies. Interviews were conducted with 127 arabica coffee growers in three districts of Uganda. Logistic regression was used to examine various factors that may be important in domain construction. The results indicated that using elevation to demarcate coffee production zones was the most effective concept for constructing domains and effectively differentiated coffee production and priority pests and disease constraints. Socioeconomic criteria had limited effects on farmer perceptions of pests. A future IPM research agenda

would target coffee stem borer, berry borer, and leaf rust in the low zone (1500 meters). Future farmer training programs would focus on insect and particularly disease identification and management.

P074 Adoption of production and pest management practices for peanut in Ejura, Ghana

Michael Owusu-Akyaw[1], Grace Bolfrey-Arku[1], Brandford Mochiah[1], Rick Brandenburg[2], and *David Jordan[3], David_Jordan@ncsu.edu.

[1]CSIR-Crops Research Institute, Kwadaso, Kumasi, Ghana, West Africa; [2]Department of Entomology, North Carolina State University; [3]Department of Crop Science, North Carolina State University, Raleigh, NC

Development and implementation of appropriate technologies are important for peanut production systems around the world. A USAID-funded IPM project was established in Ghana over the past decade to develop appropriate interventions for resource-poor farmers growing peanut and other crops. In one example during the project, a survey of 24 farmers in one small village demonstrated the value of relatively simple interventions including determining seed germination prior to planting, establishment of optimum plant populations in rows, and incorporation of local soaps to minimize rosette and fungal pathogens using Farmer Field Schools. Implementing these strategies resulted in a 2.5-fold increase in peanut yield of a locally available cultivar. A smaller subset including six growers from this group was interviewed in more detail because they had access to improved cultivars during the previous two years. When combining improved cultivars with the simple production and pest management interventions used by the entire group, a 4.25-fold increase in yield over traditional practices was noted. Results from this survey indicate that simple interventions can have a dramatic increase in yield and that benefits of further refinement occurs incrementally compared to early interventions. Future efforts will include gaining access to more villages using the Farmer Field School Approach and incorporating new technologies including herbicides and fungicides.

P075 Development of a comprehensive IPM website for Virginia market type peanuts

Bridget R. Lassiter[1], Gail G. Wilkerson[1], *David L. Jordan[1], david_jordan@ncsu.edu, Greg Buol[1], Rick L. Brandenburg[2], Barbara B. Shew[3], Ames Herbert[4], and Pat Phipps[4]

[1]Department of Crop Science, North Carolina State University, Raleigh, NC; [2]Department of Entomology, North Carolina State University, Raleigh, NC; [3]Department of Plant Pathology, North Carolina State University, Raleigh, NC; [4]Tidewater Agricultural Research and Extension Center, Virginia Tech, Suffolk, VA

A comprehensive database-driven website was created to provide information to extension agents and growers in the Carolinas and Virginia regarding peanut production and IPM decisions. The website (www.peanut.ncsu.edu) hosts a Peanut IPM Risk Management Decision Aid (http://www.peanut.ncsu.edu/riskmgmt/Risk.aspx), and also serves as an educational resource to help stakeholders identify and manage pests, and learn about a wide variety of management and production topics. The website displays over 35 individual information sheets, authored by the PIs, that detail various production and management topics (i.e. planting, harvest, and maturity), as well as specific disease and insect identification and control methods. The website also features a key word index that links like publications and topics, and it provides access to Virginia and North Carolina weather-based disease advisories. From the homepage there are links to Cooperative Extension Service publications such as production manuals and pesticide handbooks. "Peanut Notes" and alerts are periodically posted to the site throughout the growing season to address current issues that may be of interest to stakeholders. Authorized project personnel can update the website using a web-based editing program that facilitates creation of html documents, uploading of pdf files and images, and automatic key word searches of documents. Users can search the website using the key word index, author, publication date, or publication number. The website has been demonstrated to Cooperative Extension Service agents and growers through field days and workshops specific to peanut production in North Carolina.

P076 Dairy cattle IPM outreach: NYS Integrated Pest Management in barns, on pastures, on the web

*J. Keith Waldron[1], jkw5@cornell.edu, Ken L. Wise[1], and Donald A. Rutz[2]

[1]NYS Integrated Pest Management Program, Cornell University, NYSAES, Geneva, NY; [2]Department of Entomology, Cornell University, Ithaca, NY

Dairy Integrated Pest Management (IPM) is an important component of Cornell University's NYS Livestock and Field Crop IPM Program extension outreach. This effort is closely allied with the Cornell University Veterinary Entomology program and draws upon it and other land grant institutions for research-based dairy cattle IPM information. The focus of the dairy IPM effort is to enhance producer, agricultural industry and extension personnel knowledge and skills regarding integrated approaches to managing biting and nuisance fly issues affecting dairy cattle in barns and on pasture. In addition to servicing the pest management needs of the state's conventional and organic dairy producers through on and off farm educational meetings, the program has enhanced dairy fly management information delivery electronically via a teleconference, a webinar, and an on-line train the trainer module. An organic dairy IPM guide has recently been published and is also available on-line. These resources contain IPM material and

approaches appropriate for use in the northeast US and many other dairy production regions with similar fly pest issues. A "moodle-based" training module is now in development for clientele to learn dairy cattle IPM and earn pesticide recertification credits. An update on recent NYS Livestock IPM activities, resources and program status will be presented. Dairy cattle IPM information can be found at: http://www.nysipm.cornell.edu/livestock/default.asp.

P077 Development of an IPM curriculum and crop scouting competition for Iowa youth

*Adam J. Sisson[1], ajsisson@iastate.edu, Daren S. Mueller[1], and Jay W. Staker[2]

[1]Integrated Pest Management, Iowa State University, Ames, IA; [2]Extension 4-H Youth Development, Iowa State University, Ames, IA

The perceived importance of IPM principles is declining, making efforts to educate next generation farmers and agronomists important. The goal of this project was to increase IPM knowledge among future corn and soybean farmers and agronomists. In 2011, we developed a 14-part IPM curriculum covering several topics including an IPM introduction, scouting basics, and disease, insect and weed management. This curriculum, along with Iowa State University (ISU) field guides, was sent to 234 secondary and post-secondary agriculture educators and was made available to 4-H groups. A survey of over 100 agriculture educators revealed 36% used the field guides and curriculum in the classroom; 54% planned to use them. The curriculum was rated "Effective" and "Very effective" by 36% and 39% of respondents, respectively. Curriculum and field guides could be used to help prepare for the associated crop scouting competition, held August 19, 2011 near Ames, Iowa. Teams prepared a community service project and scouting report before the competition. The competition consisted of a written test and 10 in-field exercises covering a variety of topics such as corn and soybean insects and diseases, crop staging, and weed identification. Students rotated through field stations and were judged as a team by ISU Extension and Outreach faculty and staff and others. We learned valuable information from our first competition and will implement this knowledge as we plan future competitions. This project will foster lifetime understanding of IPM concepts in corn and soybean and the importance of IPM within the farmer–agronomist–consumer circle.

P078 Distance delivery for continuing education and characterizing Florida's licensed applicators

Fred Fishel, weeddr@ufl.edu

Department of Agronomy, University of Florida, Gainesville, FL

The University of Florida offers continuing education units (CEUs) via distance technology using Polycom® to meet requirements for applicators of pesticides to renew their licenses. A large statewide event conducted in 2010 also conducted a needs assessment of this group concerning CEUs. Results indicate that these applicators strongly prefer earning CEUs rather than retesting for renewal, they don't mind short travel distances and paying nominal fees to attend programs. Distance delivery was a first-time experience for most in obtaining CEUs, and they were overwhelmingly positive about attending such an event in the future.

P079 Ecologically-based Integrated Pest Management packages for food security crops in Central Asia

*Karim Maredia, kmaredia@msu.edu, and Joy Neumann Landis

Department of Entomology, Michigan State University, East Lansing, MI

Through funding from USAID, Michigan State University, University of California-Davis, and Kansas State University in collaboration with CGIAR/ICARDA-Project Facilitation Unit are implementing a regional IPM project in Central Asia. This regional project is a part of the Global IPM CRSP project management by the Virginia Tech University. The focus of this project is to develop and deliver ecologically-based IPM packages to local farmers for three food security crops (Wheat, Potato and Tomato) targeting three countries in Central Asia (Tajikistan, Kyrgyzstan, and Uzbekistan). The project includes collaborative research, IPM demonstration sites, and extension/outreach through farmers field schools (FFS). Training for students, scientists and farmers along with institutional capacity building is an integral part of this regional IPM project. The cross-cutting components include diagnostics, viruses, gender issues, communication and advocacy, and socio-economic impact assessment. The project maintains a website at: http://www.ipm.msu.edu/central-asia.htm

P080 Giving IPM a VOICE

*Carrie Koplinka-Loehr[1], ckk3@cornell.edu, Thomas Green[2], Norm Leppla[3], Kim Leval[4], Pam Marrone[5], Bob Rosenberg[6], Michael Rozyne[7], and James VanKirk[8]

[1]Northeastern IPM Center, Cornell University, Ithaca, NY; [2]IPM Institute of North America, Madison, WI; [3]Florida IPM Program, University of Florida, Gainesville, FL; [4]Northwest Coalition for Alternatives to Pesticides, Eugene, OR; [5]Marrone Bio Innovations, Inc., Davis, CA; [6]National Pest Management Association, Fairfax, VA; [7]Red Tomato/Eco-Apple, Plainville, MA; [8]Southern Region IPM Center, North Carolina State University, Raleigh, NC

For more than four decades, public funding for IPM research and education has generated major economic, environmental, and health benefits for the United States. With recent cutbacks, however, certain federally-funded IPM programs have been eliminated. Who is in a position to rally for IPM funding? Although IPM stakeholders include growers, scouts, consultants, educators, and researchers, few people would define

themselves as IPM activists. Conversely, other programs that benefit growers and the environment have long since established advocacy arms that educate policy-makers and tread where land grant personnel dare not go. An organization known as IPM Voice coalesced out of the 2009 International IPM Symposium and is now fully incorporated as an independent nonprofit 501(c)(3), with a growing membership and list of accomplishments. Its mission is to advocate "for progressive integrated pest management to improve environmental, social and economic conditions through the application of scientific principles." This poster presents trends in federal IPM funding, how IPM Voice was founded, its impact on public policy, and its plans for the future.

P081 Increasing IPM uptake among growers in southwestern BC: Three case studies of industry-lead outreach

Carolyn Teasdale[1], Heather Meberg[1], Karina Sakalauskas[2], Val Fair[3], Robert Butler[3], Dan Sigfusson[4], *Renee Prasad[1,5], renee@escrop.com

[1]E.S. Cropconsult Ltd. Surrey, BC, Canada; [2]BC Blueberry Council, Abbotsford, BC, Canada; [3]BC Potato and Vegetable Growers Association, Delta, BC, Canada; [4]Abbotsford Growers Cooperative, Abbotsford, BC, Canada; [5]Agriculture Technology Department, University of the Fraser Valley, Chilliwack, BC, Canada

In the Fraser Valley a diverse mix of horticultural crops are grown. IPM implementation varies across commodities. For example, approximately 80% of the potato acreage is monitored weekly but less than 30% of the blueberry and raspberry acreages are monitored on a regular basis. A concern across all three commodities is the spread of arthropods, or diseases from fields where management is not being effectively carried out, to fields that are under an IPM program. An additional concern is that misuse of pesticides by some growers can potentially tarnish the reputation of the entire commodity group. To expand the uptake of IPM, the potato, blueberry, and raspberry commodity groups have developed strategies for increasing IPM practices amongst their growers. All three groups have implemented a weekly newsletter which provides updates on pest status during the growing season. The potato newsletter initially focused on late blight management, but now includes the status of secondary pests and storage diseases. The blueberry newsletter includes information on monitoring techniques. All three newsletters provide general advice on the proper timing of pesticide applications. Additionally, raspberry growers have held drop-in sessions for growers to view insect and disease samples. Distribution to the 140, 200, and 120 recipients of the potato, blueberry and raspberry newsletters, respectively, occurs electronically or by fax. Measures of success of the newsletter approach include: improved management of key pests, better understanding of pest biology, and increased attention to cultural practices for pest control across all commodities.

P082 Integrated pest management survey for insect and disease pests of oilseed crops in North Dakota

*Janet Knodel[1], janet.knodel@ndsu.edu, M. McMullen[2], S. Markell[2], R. Ashley[3], G. Endres[4], D. Waldstein[5], C. Larson[6], and D. Nelson[6]

[1]Department of Entomology, North Dakota State University, Fargo, ND; [2]Department of Plant Pathology, North Dakota State University, Fargo, ND; [3]Dickinson Research Extension Center, North Dakota State University, Dickinson, ND; [4]Carrington Research Extension Center, North Dakota State University, Carrington, ND; [5]North Central Research Extension Center, North Dakota State University, Minot, ND; [6]North Dakota Department of Agriculture, Bismarck, ND

The goal of the Integrated Pest Management (IPM) Survey of North Dakota State University (NDSU) is to detect the presence and population density of insect pests and diseases that are common in selected agricultural crops grown in North Dakota. Results of surveys in soybean and sunflowers are presented for the past five years (2006 to 2011). Crop scouts operated out of five geographically different locations: Dickinson in the southwest, Minot in the north central, Carrington in the central, Langdon in the northeast, and Fargo in the southeast. Monitored insect pests and diseases included soybean aphid, and sunflower beetle, banded sunflower moth, sunflower head moth and sunflower downy mildew. Sunflower survey data documented the population decline of sunflower beetle due to changes in control strategies, and also the sporadic nature of migratory pests, such as sunflower head moth. Sunflower downy mildew was common and widespread in 2009. When populations of soybean aphids were high, pest alerts provided timely management information to North Dakota producers, crop consultants and others in agriculture.

P083 IPM Internships-Training IPM Professionals for the Future

*Charles T. Allen, ctallen@ag.tamu.edu, Kerry Siders, Brant Baugh, Scott Russell, Manda Anderson, Warren Multer, Richard Minzenmayer, David Drake, Molly Keck, Stephen Biles, and Bill Ree

Texas AgriLife Extension Service, College Station, TX

Who will develop and train the IPM practitioners needed by US agricultural producers and urbanites in the future? Colleges and universities do a good job in classroom settings teaching students the basic theories and science they will need. But there are few opportunities for students to gain practical experience in the field with IPM professionals. For 13 years, Texas AgriLife Extension Service has sponsored IPM Internship opportunities for students to work with IPM Agents and get hands-on IPM experience. They have learned essential IPM related skills such as pest/beneficial identification, establishment of research trials, field scouting, and data collection/summary. In addition, they have an opportunity to develop

life-skills such as working in teams and communicating in the adult world, writing, speaking and organization of projects/ ideas. Partners with Extension in providing the internships have been: local farmers, Texas Pest Management Association (TPMA), USDA NIFA, Cotton Incorporated, Texas Master Gardeners and numerous seed and agricultural chemical companies. Since 1998, there have been 90 student interns trained in this program. This poster will provide excerpts from 2010 and 2011 student interns end-of-season reports. It will focus each student's perception of the impact of the internship on their professional development and career plans.

P084 IPM of the white stem borer and root mealybugs on Arabica Coffee in the Mt Elgon region in Uganda

*S. Kyamanywa[1], skyamanywa@agric.mak.ac.ug, P. Kucel[2], G. Kagezi[2], K. Nafuna[3], C. Ssemwogerere[1], J. Kovach[4], and M. Erbaugh[4]

[1]School of Agricultural Sciences, Makerere University, Kampala, Uganda; [2]National Coffee Research Centre, Mukono, Uganda; [3]Agric. Extension Office, Sironko District, Uganda; [4]Ohio State University, OARDC, Wooster, OH

The coffee sector is very important to Uganda's agriculture development and transformation agenda. If production levels are to be maintained, safe and effective management strategies for priority pests need to be developed and implemented. A biological monitoring survey of arabica coffee pests in the Mt. Elgon region conducted by the IPM CRSP program in Uganda during 2006-2007 identified *Planococccus irenues* and *Bixadus sierricola* as the most prevalent insect pests, at both high and low altitude. Management options against the pests were developed and evaluated including stem smoothing and wrapping. These were found to consistently reduce the incidence of *B. sierricola* (by 37.4% and 31.2%, respectively). Enhancement of soil fertility through application of a commercial fertilizer (CAN), animal manure, or intercropping with beans was found to reduce *P. irenues* damage (by 62.2%, 48.1% and 22.2%, respectively). These management options were validated on-farm during the 2009-2010 period after which efforts were focused on disseminating the technologies to coffee farming communities. A Farmers field school (FFS) approach was used to disseminate these management practices in Sironko district, Buwasa Sub County. The FFS has a membership of 63 farmers (40 males and 23 females). Regular sessions of the FFS have been implemented and farmers are in agreement that the technologies are effective and have reduced losses in the short term. However, they noted that stem wrapping was not very practical because termites destroy the banana fiber wraps as soon as they are applied necessitating frequent re-wrapping. Plans for upscaling the technology to more sub counties are underway.

P085 Five PEAs in a pod: Progress towards addressing the program emphasis areas for IPM Oklahoma!

*Tom A. Royer, tom.royer@okstate.edu, J. Armstrong, B. Kard, J. Edwards, K. Giles, D. Hillock, K. Kelsey, T. Peeper, J. Talley, and K. Toscano

Oklahoma State University, Stillwater, OK

IPM Oklahoma! http://www.ento.okstate.edu/ipm/ has a notable record of successfully introducing interdisciplinary IPM programs for Oklahoma agricultural producers and more recently, in urban settings and public schools. Our program addresses Extension IPM programs in the following Program Emphasis Areas: (1) IPM Implementation in Agronomic Crops, (2) IPM Implementation in Animal Systems, (3) IPM Training for consumer / Urban Environments (4) IPM in Public Health, and (5) IPM Training and Implementation in Schools.

P086 The new IPM program at Lincoln University of Missouri, an 1890 Land-Grant University

Jaime C. Pinero, pineroj@lincolnu.edu

Lincoln University of Missouri, Jefferson City, MO

Lincoln University of Missouri (LU), an 1890 Land-Grant University located in Jefferson City, the state Capital, has served the needs of under-served Missourians since 1866, and its role in education and service to stakeholders throughout the state and the nation has long been recognized. The LU Cooperative Extension (LUCE) IPM was created in April, 2010, with the main goal of developing and promoting affordable alternative IPM strategies for insect management in vegetable and small fruit production in Missouri. Even though the IPM program works with all Missouri residents, emphasis is being made to provide under-represented, low-income, and minority farmers with research-based information on effective and environmentally-friendly IPM tactics. Our main goal is that farmers increase the level of awareness and adoption of IPM components leading to increased profits while decreasing inputs and pesticide use. We carefully listen to concerns that farmers have about how to prevent and solve pest problems. We then respond to their needs by delivering the most up-to-date research-based information through Extension activities that include one-to-one interactions, workshops, presentations, extension publications, and on-farm demonstration trials. When information is not available, we conduct research and communicate our results back to the growers with the hope that they will implement the new findings. The main extension activities, outputs, and impacts generated for the first 20 months since program's inception will be presented. A description of the central investigations involving insect sensory ecology and behavior that are being conducted with the foremost goal of developing biologically-based, effective and sustainable IPM technologies will also be discussed.

P087 Gender issues in Integrated Pest Management (IPM) in Tajikistan

Linda Racioppi[1], racioppi@msu.edu, Zahra Jamal[2], and Hashini Galhena[3]

[1]James Madison College of Public and International Affairs, Michigan State University, East Lansing, MI; [2]Center for the Study of Gender and Sexuality, University of Chicago, Chicago, IL; [3]Department of Crop and Soil Sciences, Michigan State University, East Lansing, MI

Women play an important and critical role in food production and food security in developing countries around the world. As a part of the Global IPM CRSP project funded by the USAID and managed by Virginia Tech University, Michigan State University in collaboration with the Tajik Academy of Agricultural Sciences is implementing an IPM program in Tajikistan in Central Asia. The focus of this project is to develop and deliver ecologically-based IPM packages for wheat crop to local farmers in Tajikistan. The project includes collaborative research, IPM demonstration sites, extension/outreach to local farmers through farmers field schools (FFS), and student training in collaboration with local universities. Because of the civil war and the out-migration of men from the country, women are very active in agriculture and farming in Tajikistan. They not only provide much of the labor for large private farms but also tend home gardens, which produce more than half the country's food and help ensure household food security, and informal plots which supply medicinal plants. Despite their central role in agriculture, women are frequently left out of decision making and training on crop production and IPM. Gender considerations are therefore important cross-cutting components of this project. This poster summarizes the information collected through interactions with women farmers and other stakeholders on gender issues in IPM during the two site visits conducted in 2010 and 2011 in different parts of Tajikistan.

P088 Natural enemies of vegetable crop pests workshop

*Jim Jasinski[1], Jasinski.4@osu.edu, Mary Gardiner[2], Megan Woltz[3], Alexandria Bryant[3], and Brett Blaauw[3]

[1]Ohio State University Extension, IPM Program, Urbana, OH; [2]Department of Entomology, Ohio State University, Columbus, OH; [3]Department of Entomology, Michigan State University, East Lansing, MI

The Great Lakes Vegetable Working Group (GLVWG) recognizes the importance of natural enemies and their role in pest management in vegetable crops. In 2011-12, six natural enemy workshops are scheduled to be conducted by GLVWG members in five states and Ontario, Canada, mostly in association with larger state level fruit and vegetable conferences. Each workshop is tailored to the needs of the growers at that location, with a strong emphasis on identification, mulching and strip tillage, habitat and floral planting management practices. The first workshop was held at the Great Lakes Fruit and Vegetable Expo in Grand Rapids, MI on December 8th, and was viewed as the model for other workshops to follow. Before and after the two hour workshop, pre and post tests of the natural enemy related subject matter were obtained from the 31 growers in attendance using Turning Point technology clickers. At the conclusion of the workshop some of the knowledge gained by growers included 68% correctly identified images of natural enemies, 90% correctly recognized the importance of large floral plantings on biological control of pests in nearby crops, and 95% understand that diversifying surrounding habitat has a positive effect on natural enemy populations.

P089 NEWA resources for implementation of IPM in Lake Erie vineyards

*Timothy Weigle[1], thw@cornell.edu, Wayne Wilcox[2], Greg Loeb[3], and Juliet Carroll[4]

[1]NYS IPM Program, Cornell University, Portland, NY; [2]Department of Plant Pathology and Plant Microbe Biology, Cornell University, Geneva, NY; [3]Department of Entomology, Cornell University, Geneva, NY; [4]NYS IPM Program, Cornell University, Geneva, NY

The 30,000-acre Lake Erie grape belt in New York and Pennsylvania is the third largest grape growing region in the United States and is home to the largest planting of Concord grapes in the country. Concord grapes in this region are typically produced for bulk juice, jams and jellies with some going into bulk wine production as well. The focus of grape IPM programming has been on research-based IPM technologies and practices that growers can implement in their vineyards to manage pests in an environmentally and economically sustainable manner. Over the past several years, the NYS IPM Program has made it a priority to provide growers in the Lake Erie region, as well as those across the Northeastern United States, with site specific applications utilizing weather information to implement a vineyard IPM strategy. The Network for Environment and Weather Applications (NEWA), newa.cornell.edu, now provides access to interactive site-specific disease forecasts and a newly developed grape berry moth phenology model. Through grape grower participation, seven RainWise weather instruments now provide weather data for three distinct microclimates in the Lake Erie region and the weather parameters necessary for implementing the grape IPM models. Stakeholders, research, and extension personnel in the Lake Erie Regional Grape Program can now access site specific applications to further IPM adoption, readily distribute IPM predictive model information alerts, and conduct crucial viticulture research in this region.

P090 On the road again: Taking hands-on greenhouse IPM workshops to the growers

*Elizabeth Lamb[1], eml38@cornell.edu, Brian Eshenaur[1], Neil Mattson[2], and John Sanderson[3]

[1]New York State Integrated Pest Management, Geneva NY; [2]Department of Horticulture, Cornell University, Ithaca NY; [3]Department of Entomology, Cornell University, Ithaca, NY

Ornamental sales rank second in New York State and there are ornamental greenhouses in almost every county. NYS IPM initiated an "IPM In-depth" hands-on workshop at Cornell in 2008 to provide IPM programming to greenhouse growers. While growers appreciated the hands-on style of programming, we realized that access was limited to those that could travel to campus. In collaboration with NY Farm Viability Institute for funding, and NYS Flower Industries, NYS IPM created a 'mobile' hands-on workshop series to get IPM training to growers throughout the state. Programs are held in association with Cooperative Extension educators because of their grower contacts and regional knowledge, although many do not have greenhouse or commercial horticulture responsibilities. The agenda includes 3 modules; insect management, disease management and production factors that relate to IPM. IPM and Cornell faculty teach the modules, using microscopes, meters, plants and insects. Since the program started in 2009, we have held 13 IPM In-depths in 11 counties. There have been 227 attendees – who identify their businesses primarily as wholesale or retail greenhouses, garden centers, landscapers or nurseries. Eighty percent (2010-2011) have not attended an IPM In-depth program on campus, so we are working with a clientele that we had not previously reached. While direct face-to-face exchange of information is an 'old school' method of programming, it is effective and we have found that initial grower contacts through the In-depths lead to a continuing connection and their recognition of NYS IPM as a source of IPM information.

P091 Online educational modules for disseminating IPM information

*Abby Seaman[1], ajs32@cornell.edu, and Ronald Gardner[2]

[1]New York State Integrated Pest Management Program, Cornell University, Geneva, NY; [2]Pesticide Management Education Program, Cornell University, Ithaca, NY

In collaboration with several content providers, we developed a series of educational modules using Moodle, an open-source software resource for creating and managing online courses. These courses were developed to qualify for pesticide applicator training recertification credits through the New York State Department of Environmental Conservation. A variety of content types were used to create the modules, including text and photos, narrated PowerPoint presentations, and videos. Each module includes pre- and post-tests that allow us to measure changes in understanding of module content. Students must to score at least 80% on the post-test to qualify for recertification credits. Students who used the modules increased their knowledge of IPM topics an average of 38%. Moodle is a powerful outreach tool for creating online content and measuring learning outcomes. Many types of existing content can be integrated into Moodle, providing an additional outreach avenue for IPM information.

P092 Online phenology and infection risk modeling system–2012 update

*Leonard Coop[1], coopl@science.oregonstate.edu, Paul Jepson[1], and Carla Thomas[2]

[1]Oregon State University, Integrated Plant Protection Center, Corvallis, OR; [2]University of California–Davis, Department of Plant Pathology and NPDN, Davis, CA

Online IPM decision support tools have expanded at the website http://uspest.org/wea. New "virtual weather stations" supplement more than 17,000 actual stations and were tested for numerous crops during 2011. This feature allows users to click in a Google map to generate virtual weather data (interpolated from nearby stations), offering pest models to run at site-specific locations. New high resolution maps of disease infection risk are being tested in 2012. Models are also linked to two types of site-specific 7-day weather forecasts (Fox Weather, LLC and National Weather Service Digital). The system now include over 73 phenology (degree-day), 18 hourly driven (mainly plant disease infection risk, and chilling unit, models, daily updated degree-day maps with new Google Maps interface, and a 48 state custom degree-day mapping calculator now with GIS data download capability. All models and settings are now integrated into the "MyPest Page" which can serve as a portal to decision support needs for numerous cropping systems over the USA. The system was expanded to serve national plant biosecurity needs since 2005, via the NPDN (National Plant Diagnostic Network), numerous CSREES/NIFA grant programs, and a Western Specialty Crops PIPE (Pest Information Platform for Extension and Education) grant. New and updated models in the system include muskmelon Melcast, spotted wing Drosophila (phenology and overwintering survival), European grapevine moth, brown marmorated stink bug, and Western flower thrips. Website adoption continues to grow at a rapid rate; over 130,000 model runs were made during 2010.

P093 Partnering with ScoutPro for developing field scouting applications

*Daren S. Mueller, dsmuelle@iastate.edu, and Adam J. Sisson

Integrated Pest Management, Iowa State University, Ames, IA

Iowa State University (ISU) Extension and Outreach has recently partnered with ScoutPro, a company creating scouting applications (apps) for crop growers, in the development of a series of apps based on ISU field guides and diseases publications. ScoutPro, a startup business from the Agricultural

Entrepreneurship Initiative at ISU, developed a soybean scouting app for use on tablets and Smartphones based on the Soybean Field Guide from ISU. ISU Extension and Outreach supplied the information for the scouting app as well as worked with ScoutPro to review and guide the app during the development process. Features include pest information and images, a mapping tool, and a dichotomous key for identifying pests in the field. Pesticide management recommendations will also be available to growers. The mapping software will allow farmers and agricultural practitioners to keep records of their scouting activities to plan for future years. Another app in development is based on the Corn Field Guide from ISU and apps based on other crops are slated for future development. The apps increase access to information and potentially expand the audience of the original publications as well as provide tools not available in print versions.

P094 Popularization of integrated pest and disease management module for onion in India

*D. Dinakaran[1], ddkaranpat@gmail.com, G. Gajendran[1], S. Mohankumar[2], G. Karthikeyan[2], S. Thiruvudainambi[1], E.I. Jonathan[2], R. Samiyappan[2], and V. Jayabal[1]

[1]Anbil Dharmalingam Agricultural College and Research Institute, Tiruchirappalli, Tamil Nadu, India; [2]Tamil Nadu Agricultural University, Coimbatore, India

The basal rot, purple blotch, thrips, cutworm and leaf miner of onion are the major yield limiting factors in India leading to yield losses up to 30%. Different Integrated Pest and Disease Management (IPDM) modules were evaluated at Tamil Nadu Agricultural University, India through a series of experiments during 2008-09. The best module consisted of 1) selection of healthy seed bulbs, 2) bulb treatment with *Trichoderma viride* and *Pseudomonas fluorescens*, 3) soil application of *T. viride* and *P. fluorescens* along with AM fungi, Azophos and neemcake, 4) installation of yellow sticky traps and sex pheromone traps, 5) foliar sprays of *P. fluorescens*, *Beauveria bassiana* and neem formulations and 6) application of insecticides and fungicides on need basis. Module with these practices resulted in the least incidence of basal rot, purple blotch, thrips, cutworm and leaf miner coupled with higher bulb yield. The onion IPDM module was popularized in Tamil Nadu, South India as large scale demonstrations in farmers' holdings in five locations during 2009–11 under the USAID sponsorsed IPM CRSP Project. The bio-intensive IPDM module has registered the reduced mean incidence of basal rot (3.57%), purple blotch (25.17%), thrips population (5.81/plant), cutworm damage (3.80%) and leaf miner damage (13.51%) and resulted in higher bulb yield (13.84 t/ha) and a cost benefit ratio (1: 3.26). This compares to farmers' practice registering higher incidence of basal rot (8.47%), purple blotch (50.03%), thrips population (11.03/plant), cutworm damage (6.23%) and leaf miner damage (20.76%) with reduced bulb yield (10.98 t/ha) and a cost benefit ratio of (1: 2.68). Field days, exhibitions and interactive farmers meetings were organized at all the locations to popularize the technology.

P095 Success of University of Kentucky Wheat IPM Team

*Lloyd Murdock, lmurdock@uky.edu, and Dottie Call

University of Kentucky College of Agriculture, Research & Education Center, Princeton, KY

UK's Wheat Science Group was established in 1997 and consists of 18 members from six departments within the College of Agriculture. The members have varying research, extension and instruction assignments. The group's mission is to plan and implement coordinated wheat research and extension/educational functions. This closely coordinated university research and extension team brought expertise from all needed disciplines for research and educational purposes. A cooperative relationship with county agents, wheat consultants, agribusiness, wheat association and others was established to make the Kentucky producers among the most scientifically knowledgeable producers in the U.S. The group has worked in almost all phases of wheat production with much success. The two greatest successes of this group have been increased yields and increased no-tillage acres. Wheat yields have increased from the 40-bushel per acre range in the mid-1980s to 71 bushels per acre. No-till wheat acres have increased from 15 percent in 1990 to about 70 percent of today's harvested acres which improved soil quality and resulted in a five percent yield increase of corn and soybean crops when planted following no-tilled wheat. The group has received a number of awards, of which two were the Southern U.S. Region IPM "Pulling Together" Award and the National CSREES Partnership Award for Mission Integration. The publication "A Comprehensive Guide to Wheat Management in Kentucky " (ID-125) received the American Society of Agronomy Outstanding Publication Award. The publication "No-Till Small Grain Production in Kentucky" (ID-136) received the American Society of Agronomy Outstanding Publication Award.

P096 Research and extension: Different approach–same objective, monitoring corn lepidopteran pests

*Ed Bynum, Ebynum@ag.tamu.edu, Jerry Michels, and Johnny Bible

Texas AgriLife Research and Extension Center, Amarillo, TX

Fields and corn refuge areas in the Texas High Plains that are planted to non-Bt corn hybrids are vulnerable to heavy damage from southwestern corn borer (SWCB), western bean cutworm (WBC), and fall armyworm (FAW) infestations. The activity of these three corn pests during the summer can occur at different times and at different levels depending on yearly conditions. Therefore, it is difficult for producers and ag-advisers to know when damaging infestations will occur or when timely insecticide applications are needed to minimize economic losses. A research project, beginning in 2008 was initiated to develop temperature-driven predictive logistic models for SWCB and WBC. Data has been collected from

the field for the last four years. We report on the development of the models through 2011. With four years of data, the models are becoming more robust. Results indicate 1st generation Southwestern corn borers reach 50% moth emergence at approximately 716 degree days, 50 % 2nd generation Southwestern corn borer emergence occurs 438 degree days after 50% 1st generation emergence (or 1154 total degree days), and Western bean cutworm reaches the same level at approximately 1031 degree days. Since the models are still in the developmental stage, an extension project was initiated in 2011 to assist producers with management decisions by monitor the weekly activity of SWCB, WBC, and FAW moth flights in 12 Texas High Plains counties. Weekly trap catches were distributed to producers and ag-advisers through different media outlets. Respondents to a survey indicated trapping data was very valuable.

P097 Bird cherry-oat aphid bionomics in the Pacific Northwest

David Bragg, braggd@wsu.edu

Washington State University, Pomeroy, WA

The bird cherry-oat aphid (*Rhophalosiphum padi* Linnaeus) is a major pest of wheat and barley in the PNW region of the USA. The life cycle is complex. The aphid has unrelated plant hosts and vectors virus to some of them. The plant host guild has changed along with farming practices which have increased the population year around. In the fall Sept. through early Dec.) BCOA migrates from corn, especially sweet corn in the Basin to Plateau wheat or barley, the winter hosts. Barley yellow dwarf virus is vectored to the cereal hosts about 12 hours after a late arrival. Subsequent apterous aphids spread the virus from plant to plant increasing the infected population in the field. The virus infects the salivary glands of the aphid. Symptoms from fall vectored virus show in early February with purple yellowing of apex leaf tips, which have a canoe shaped tip. *R padi* migrates to the spring host *Prunus virginianis*– choke cherry the most common host. Migration to corn and sorghum begins in early summer. CRP grasses of many species and wild rye also host this virus. Seed treatment insecticide are very effective in preventing vectoring for at least 30 days.

P098 The NYS IPM Field Crop Weekly Pest Report: Timely news local pest managers can use

Kenneth Wise, klw24@cornell.edu

Cornell University, Albany, NY

The NYS IPM Field Crops Weekly Pest Report (WPR) provides timely pest management information to field crop producers, extension educators, and other agriculture professionals throughout the growing season. This award-winning newsletter is one of the most highly valued resources for field crop extension educators, and ultimately farmers throughout NYS. At least 20 WPR issues have been published annually since 2002 providing stakeholders with weekly summaries of statewide pest and crop observations, detailed pest information and resources to help prepare clientele for potential pest risks. The WPR presents pest identification, scouting techniques and suggested IPM activities in real time. Extension educators and others contribute local pest observations. Pests discussed may also pose risk to other commodities. The WPR is distributed electronically via the Cornell Field Crops list serve and the NYS Field Crop IPM website. WPR articles subsequently appear in many extension newsletters and other publications. Survey respondents indicate WPR articles may reach as many as 15,000 end-users per year. The WPR consistently earns excellent marks for its usefulness, with a large number of readers multiplying impact by using WPR information with clientele. Testimonials include appreciation for the "view from the field", early notification on potential pest problems and web links.

P099 Encouraging adoption of IPM by small-scale farmers: The Western Small Farm-IPM Working Group

*Tessa Grasswitz[1], tgrasswi@nmsu.edu, Edmund Gomez[2], Diane Alston[3], Dan Drost[4], Doug Walsh[5], Marcy Ostrom[6], Ed Bechinski[7], Cinda Williams[8], Gwendolyn Ellen[9], Cheryl Wilen[10], and Ramiro Lobo[11]

[1]Departments of Entomology and Extension Plant Sciences, New Mexico State University, Los Lunas, NM; [2]Extension Economics Department, New Mexico State University, Alcalde, NM; [3]Department of Biology, Utah State University, Logan, UT; [4]Department of Plants, Soils and Climate, Utah State University, Logan, UT; [5]Department of Entomology, Washington State University, Prosser, WA; [6]Department of Community and Rural Sociology, Washington State University, Wenatchee, WA; [7]Division of Entomology, University of Idaho, Moscow, ID; [8]Latah County Extension, University of Idaho, Moscow, Idaho; [9]Integrated Plant Protection Center, Oregon State University, Corvallis OR; [10]University of California Cooperative Extension, San Diego, CA and UC Statewide IPM Program; [11]University of California Cooperative Extension, San Diego, CA

The US small-farm sector is extremely diverse, not only in terms of production systems, but also in relation to the demographics and principal on- and off-farm occupations of the farmers. Many such growers come from 'non-traditional' farming backgrounds, and may be unfamiliar with Extension activities, or hard to reach for various other reasons. Many states have established small-farm research and Extension teams, but the degree to which their programs include IPM is variable. Extension IPM, in turn, is often focused primarily on large-scale agriculture, leaving small-scale producers underserved. The Western Small Farm-IPM Working Group was

formed to redress this balance by focusing on the IPM-related needs of the small-farm sector in six western states. The overall goals of this group are to: (i) identify and prioritize the IPM-related needs of each state's small-scale farmers (and any barriers to adopting IPM) (ii) identify and share existing knowledge/resources for reaching these audiences (iii) implement small-farm IPM pilot projects within each state (iv) develop best practice guidelines in identifying and addressing the IPM needs of small-scale farmers, and (v) produce a prioritized list of future research, extension and policy needs for small-farm IPM. An overview of the first year of the group's activities is presented; these have mainly been focused on conducting needs assessment exercises to better understand the small-farm clientele in member states and to prioritize their IPM-related needs. However, some states have already initiated IPM pilot projects in small-scale fruit and vegetable systems and progress on these projects is discussed.

P100 Thirty years of IPM in Maine

*James F. Dill[1], jdill@umext.maine.edu, David T. Handley[2], James D. Dwyer[3], and Griffin M. Dill[1]

[1]University of Maine, Pest Management Office, Orono, ME; [2]University of Maine, Highmoor Farm, Monmouth, ME; [3]University of Maine, Aroostook Extension Office, Presque Isle, ME

The University of Maine Cooperative Extension's IPM programs started officially in 1981 with the hiring of an IPM coordinator. In that year the early programming in potato and lowbush blueberry IPM was formalized into ongoing programs. Also in 1981 an apple IPM program was added. Since 1981, IPM programs have been developed for sweet corn, strawberries, cranberries, broccoli and home and garden. The programs were started to help farmers better manage the pest complexes associated with the crop and to make pest management practices more "environmentally friendly" through minimized pesticide use. By most states' standards our crops are small with approximately 60,000 acres of potatoes and going down to about 200 acres for cranberries. We monitor for mostly insect and disease problems in these crops, which vary widely from crop to crop with late blight our major potato pest to the earworm/corn borer/fall armyworm complex in sweet corn. The IPM programs introduced various pest monitoring techniques, economic action thresholds and computer models to determine the necessity and timing of sprays. The program has helped growers develop alternative strategies such as pest resistant cultivars, biological control, insect barriers and use of lower hazard pesticides. The program serves hundreds of farms statewide, and works with neighboring states to provide information throughout the region. Depending upon the crop, 4 to 40 sites are monitored weekly during the growing season and regularly updated information is delivered to growers statewide through weekly newsletter, e-mail, and blog updates.

P101 Development and delivery of ecologically-based IPM packages for wheat in Central Asia

*Shahlo Safarzoda[1], shahlos@msu.edu, Nurali Saidov[2], Anvar Jalilov[3], Doug Landis[1], Mustapha El-Bouhssini[4], and Megan Kennelly[5]

[1]Department of Entomology, Michigan State University, East Lansing, MI; [2]IPM CRSP Coordinator/Research Fellow, Dushanbe, Tajikistan; [3]Tajik Research Institute of Farming, Tajikistan; [4]ICARDA, Aleppo, Syria; [5]Department of Plant Pathology, Kansas State University, Manhattan, KS

To meet the challenges of providing local food security and enhanced environmental quality, the countries of Tajikistan, Kyrgyzstan and Uzbekistan are transitioning from centrally-planned monoculture systems focused on export crops (cotton) to more diversified farmer-directed systems. As part of a USAID IPM CRSP project, we are researching and delivering IPM Packages for wheat that address key pests in the region. These include yellow (*Puccinia striiformis*) and brown rust (*Puccinia recondite*) diseases, and insects; the Sunn pest (*Eurygaster integriceps*) and the cereal leaf beetle (*Oulema melanopus*). Our current research is focused on screening wheat varieties for resistance to cereal leaf beetle and has identified three moderately and five highly resistant wheat lines that are part of on-going breeding programs at ICARDA. Our IPM Package demonstrations focus on management of the Sunn pest and wheat rusts with local farmers providing the land, assisting in plot establishment, data collection, and harvest. In 2011, we conducted replicated in-field comparisons featuring "Orman" a variety resistant to wheat rusts, coupled with hand collection of Sunn pest adults to reduce initial infestation and provision of nectar plants to enhance egg parasitoids. In contrast to the "Farmer Practice" plots, the IPM Wheat package plots showed a 41% increase in final yield (from 29.6 to 49.9 kg/plot). In addition to a farmer field day at harvest, results of the demonstration were shared throughout the country by staff of the Tajik Research Institute of Farming and the region as a whole by our project post-docs in each country.

P102 Transitioning apple growers to non-OP spray programs in Kentucky: 4 case studies

Ric Bessin[1], and *Patty Lucas[2], plucas@uky.edu

[1]Department of Entomology, University of Kentucky, Lexington, KY; [2]Department of Entomology, UKREC, Princeton, KY

A project was conducted during 2010 and 2011 with four commercial apple orchards in Kentucky to demonstrate pest management programs free of organophosphate (OP) insecticides. This is in advance of the 2012 azinphos-methyl cancellation. While growers indicated reluctance to use newly registered reduced-risk insecticides due to lack of experience with these products, 2010 end-of-season results demonstrated reduced codling moth captures and damage in portions of the orchards

using the non-OP program. By the start of 2011, two of the 4 orchards had transitioned completely from OP use. While there was a reduction in damage with the non-OP program, the non-OP insecticide program increased insecticide costs by 9.75%.

P103 Utah IPM Program: Outreach and applied research serve thousands in agriculture

*Marion Murray, marion.murray@usu.edu, and Diane Alston

Department of Biology, Utah State University, Logan, UT

The agricultural component of the Utah IPM Program serves the vegetable and fruit industries of Utah. The program offers a wide array of educational components and applied research programs. The IPM pest advisory program serves over 5000 commercial, residential, and private applicators with free, weekly, subscription-based email alerts containing pest biology, monitoring tips, site-specific degree days and treatment timings, threshold recommendations, and control options. An online decision aid tool called Utah TRAPs (Timing Resource and Alert for Pests) provides near real-time degree days, pest phenology, and treatment recommendations for over 50 locations. Other outreach activities include yearly production guides, fact sheets, website, workshops, and grower meetings. Applied research that supports the Utah IPM Program's goals is focused on optimal management of pests. Projects involve the understanding of pest biology, pest management programs that focus on reduced pesticide use and profitability, pest thresholds, and predator/prey interactions. Besides agriculture, the Utah IPM Program also serves the green industry, homeowners, and school IPM.

P104 WSU-DAS—The online pest management support system for tree fruits in Washington

*Ute Chambers, uchambers@wsu.edu, Brad Petit, and Vincent P. Jones

Washington State University, Tree Fruit Research and Extension Center, Wenatchee, WA

The WSU-Decision Aid System (DAS, http://das.wsu.edu) is an online Integrated Pest Management (IPM) decision support system for Washington State tree fruit growers and pest managers. It provides easy-to-use pest management programs and helps to optimize management decisions for certain insects and diseases. DAS collects daily weather data from the WSU AgWeatherNet along with forecast data from the National Weather Service (NOAA) to predict insect and disease phenology. Pest conditions are projected 1 to 10 days into the future giving growers and pest managers time to plan and implement management tactics. Current and projected pest conditions are linked to organic and conventional management and pesticide recommendations, summarized in an integrated pesticide database (WSU Spray Guide). DAS currently provides model output for 10 insect, 4 disease, and 2 horticultural models. The Historic Weather Data Center allows users to view and compare pest conditions using stored weather data. DAS also supports user-entered weather data. The DAS Help Center contains an on-line user manual and short narrated video tutorials that explain step-by-step the various features of DAS. DAS is available on iPhone making it easy to check models and recommendations on the go. Constant efforts are being made to expand the DAS program. In 2011, DAS was translated into Spanish for the growing Hispanic tree fruit grower community. Users are required to register (at no cost). User surveys in 2008 and 2010 showed that users estimated the value of DAS at > $16M/year and used it on the majority of Washington tree fruit acreage.

P105 Global Herbicide Resistance Challenge Conference

*Stephen Powles, stephen.powles@uwa.edu.au

Australian Herbicide Resistance Initiative, School of Plant Biology, UWA Institute of Agriculture, The University of Western Australia, Perth, WA, Australia

Global food production is one of the greatest challenges of the 21st Century. Sustaining world food production requires reliable control of yield reducing crop weeds. Herbicides are the principal tool for crop weed control yet their sustainability is threatened by the evolution of herbicide-resistant weed populations in many parts of the world. The latest chapter in resistance evolution is the widespread appearance of glyphosate-resistant weeds threatening the success of glyphosate-resistant crops. Crops with new herbicide resistance gene traits, new herbicides and non-chemical methods to manage weeds are being introduced to counter the weed/resistance threats. The Global Resistance Challenge 2013 conference offers a multidisciplinary forum focused on all aspects of herbicide resistance in crops and weeds and their impact on global food production. Scientific sessions will range from the molecular basis of herbicide resistance evolution through agroecology and agronomy to on-farm resistance management. The Global Resistance Challenge 2013 conference will provide a stage for young and established private and public sector researchers, crop consultants and others to present their work in front of a welcoming international audience in the beautiful portside city of Fremantle, Perth, Western Australia. The Australian Herbicide Resistance Initiative, based at The University of Western Australia will host this conference. We welcome everyone who wishes to discover the latest advances in herbicide resistance to Perth in February 2013, to experience a magnificent Western Australian late summer.

Outreach—Urban

P106 Integrated pest management in public housing works!

*Allison Taisey, aat25@cornell.edu, and Carrie Koplinka-Loehr

The Northeastern IPM Center, Cornell University, Ithaca, NY

This poster displays resources designed to help educate residents about IPM. All are available for free through www.stoppests.org and have been used by health and housing professionals across the country that are implementing IPM. Resources available include factsheets on 7 common household pests, tenant's Role in IPM DVD, a bed bug poster, and IPM Kit including items residents can use to do their part in IPM. Pests are sources of allergens including those that cause and trigger asthma and are unwelcome in our homes. A healthy home is pest-free and the best way to rid a home of pests and maintain a pest-free environment is through Integrated Pest Management, or IPM. The IPM Training in Public Housing Training program is working with public housing authorities nationwide to implement IPM. An effective IPM program requires the participation of everyone who lives and works in the building including contractors and health and housing professionals. It is critical for residents to participate by inspecting for pests, reporting pest control or maintenance needs, and maintaining a safe and decent household using sustainable, healthy green practices. This poster describes how to get everyone living and working in a building on-board with IPM.

P107 Role of pesticide safety educators in school IPM programs: South Dakota demonstration

*Mark Shour[1], mshour@iastate.edu, Clyde Ogg[2], Erin Bauer[2], and Jim Wilson[3]

[1]Iowa State University, Ames, IA; [2]University of Nebraska, Lincoln, NE; [3]South Dakota State University, Brookings, SD

Role of pesticide safety educators in assisting school integrated pest management program implementation is discussed, based on a recent demonstration program in South Dakota. Pesticide Safety Education Programs do not traditionally serve school districts directly, but indirectly through their contracted pesticide applicators. This poster reports on the collaborative effort of three land-grant university cooperative extension programs in the North Central Region. Types of pesticide products found in two school districts and notable observations are included on the poster.

P108 A growing national effort: progress towards implementing IPM in all US K-12 public schools by 2015

*Thomas A. Green[1], ipmworks@ipminstitute.org, Dawn H. Gouge[2], Janet A. Hurley[3], Lawrence "Fudd" Graham[4], Kathy Murray[5], Lynn Braband[6], Carrie Foss[7], Tim Stock[8], Bob Stoddard[9], Zach Bruns[1], and Matt Anderson[1]

[1]IPM Institute of North America, Inc., Madison, WI; [2]University of Arizona, Department of Entomology, Maricopa, AZ; [3]Texas AgriLife Extension Service, Dallas, TX; [4]Alabama Fire Ant Management Program/Pesticide Safety Education Program/School IPM Program, Auburn University, Auburn, AL; [5]Maine Department of Agriculture, Food and Rural Resources, Augusta, ME; [6]NYS Community IPM Program, Cornell University, Rochester, NY; [7]Extension IPM Program, Washington State University, Puyallup, WA; [8]Integrated Plant Protection Center, Oregon State University, Corvallis, OR; [9]EnviroSafe Inc., Wyoming, MI

The national school IPM steering committee leads the effort to implement high-level IPM in all US K-12 public schools by 2015. The national school IPM working group consists of over 220 members from 49 states including government officials, university scientists and Extension educators, industry experts and representatives from non-governmental organizations. With project support from the US EPA, the USDA NIFA Regional IPM Centers, the USDA Smith-Lever Grant, the Center for Disease Control and Prevention, the National Environmental Health Associations and numerous land-grant universities, our school IPM demonstration and coalition projects have positively impacted over 2 million school children and staff by reducing pesticide use by 69% and pest complaints by 31% over the past three years. Four self-sustaining school IPM working groups leverage funding, create priorities, hold training sessions, host annual meetings and participate in monthly conference calls to advance school IPM in the North Central, Northeastern, Southern and Western regions. With revision of the Pest Management Strategic Plan (PSMP), national school priorities were updated in the areas of management, education, research and regulation. Our current projects include development of school IPM coalition partnerships in 15 states with high asthma rates & six new projects through the 2011 US EPA School IPM grants. Since 2006, our working group has established an active email listserv, developed fact sheets, training materials, manuals and curriculum, created Pest Press newsletters and leveraged over $3 million to support school IPM projects.

P109 The Texas school IPM model: How an EPA seed grant helped build a program

*Janet A. Hurley[1], ja-hurley@tamu.edu, Michael E. Merchant[1], and Don Renchie[2]

[1]Texas AgriLife Research & Extension Center, Department of Entomology, Dallas, TX; [2]Texas AgriLife Extension Service, Ag & Environmental Safety, College Station, TX

Implementation of school IPM in Texas is based on state-mandated requirements for schools, distinguishing it from many other voluntary models of school IPM implementation based on pilot program development. Since 1995 all Texas schools have been required to manage pests in and around public school buildings with integrated pest management (IPM). In addition, each school district is required to have a trained IPM coordinator, a local policy stating that the school will use IPM, and all pesticide applications must be made by licensed applicators. Implementation of IPM, therefore, has been driven by an enforced state law and sustained by cooperative relationships between the enforcement agency (Texas Department of Agriculture), state cooperative extension (Texas AgriLife Extension Service) and private educators (e.g., Texas Association of School Boards). The necessary manpower for cooperative extension was provided in 2001 by a U.S. EPA seed grant ($100,000), awarded to Texas A&M University to establish a technical resource center for school IPM. That grant allowed AgriLife Extension to hire a school IPM program coordinator to develop the center, work with Extension specialists to develop quarterly training classes for new IPM coordinators, and conduct on-site compliance-assistance visits. Education activities are conducted by educators, rather than regulators. Since 2003, funding for this IPM program coordinator position has been supplied by additional grants and by cooperative extension. This multi-agency approach has resulted in significant improvement in IPM implementation in public schools. A survey in 2005 showed that 75% of IPMCs felt that mandatory IPM has resulted in more effective pest management, and 68% felt that implementing IPM had either reduced the long-term cost of pest management, or had no impact on school district costs. State mandated IPM, in combination with educational opportunities for school IPM coordinators, appears to be an economically viable and sustainable model for implementation of IPM in public schools.

P110 Using IPM to improve our children's learning environment: the Northeast School IPM Working Group

*Kathy D. Murray[1], Kathy.murray@maine.gov, and Lynn A. Braband[2]

[1]Maine Department of Agriculture, Food, and Rural Resources, Augusta, ME; [2]New York State Community IPM Program of Cornell University, Rochester, NY

The mission of the Northeast School IPM Working Group is to develop and share tools and resources, and to foster collaboration and networking among a variety of organizations, across the twelve northeastern states plus the District of Columbia. The goal is to promote and support activities that help schools protect children's health, manage costs and provide a productive and comfortable environment for learning. The working group collaborates with other regional school IPM working groups and its co-leaders serve on the National School IPM Steering Committee. Our membership is diverse: currently we have 32 members from 11 states, representing state agencies, small businesses, schools, non-profits and universities. Accomplishments to date include: establishing school IPM demonstrations in four states, organizing and supporting school staff trainings in five states, establishing stakeholder committees in five states, and identifying priority needs and opportunities for school IPM research, management, outreach and regulation. In addition we are engaging with K-12 educators to improve IPM literacy among youth. We surveyed and trained teachers, developed new curricula and a website to make curricula widely available, developed an IPM Literacy Plan, and established K-12 classroom education demonstrations in several states. Since the Working Group's inception in 2008, with financial support from the NE IPM Center, we have leveraged additional grant funding from EPA and other sources enabling us to work directly with schools in our region to support and promote IPM adoption through hands-on demonstration and training.

P111 The Rocky Mountain Consortium– Expanding verifiable integrated pest management in public schools

*Ryan Davis[1], ryan.davis@usu.edu, and Deborah Young[2]

[1]Utah State University Extension, Department of Biology, Utah Plant Pest Diagnostic Lab, Logan, UT; [2]Colorado State University, Center for Integrated Pest Management in Colorado, Fort Collins, CO

In 2011, the EPA Region 8 awarded funding to Colorado and Utah State Universities to implement new, verifiable, School Integrated Pest Management (SIPM) programs in CO and UT public schools. The Rocky Mountain Consortium will increase the number of children attending k-12 schools with verified IPM programs in Colorado and Utah, increase knowledge

and acceptance of IPM, and pilot iPestManager©, which is under development at the Salt Lake City School District. This project achieves the stated goals by: 1. Increasing the probability of SIPM adoption through state surveys, interviews, focus groups, and one-on-one communication to address school community readiness, 2. Demonstrating and implementing customized, verifiable IPM programs in pilot schools based on school audits, instructional workshops and state training, and up-to-date printed and digital IPM educational resources, 3. Evaluating decision-making tools by piloting software (iPestManager©) to track pests, management practices, and costs associated with SIPM and 4. Increasing adoption of SIPM within EPA region 8 and beyond through strengthening state SIPM committees, the Region 8 coalition, and partnerships with stakeholders, including pest management and health professionals.The experience and expertise of CSU, USU, and collaborators such as the Denver and Salt Lake City school districts will allow us to realize positive outcomes, including increased collaboration, support and participation by diverse audiences, the creation of new educational materials and their distribution, improved skills to implement IPM, understanding the costs associated with SIPM programs, and dissemination of knowledge and expertise to foster IPM adoption in new schools and districts throughout the country.

P112 Responsible chemical use: manufacturers taking the lead through stewardship and product development

Kyle K. Jordan, kyle.jordan@basf.com

BASF, Raleigh, NC

IPM is an essential component of a successful urban pest control program. Though it is ultimately up to the technician doing the application, manufacturers have a responsibility to provide guidance, education, and support for those who use their products. BASF is committed to reaching out to its end users through training, relevant label language, and technical support in order to encourage responsible product use as part of an IPM program. Furthermore, BASF is committed to creating products that have a smaller carbon footprint by maximizing the efficiency of manufacturing processes and producing effective formulations that not only save time and resources but reduce callbacks by working more efficiently. In 2012, BASF will focus on product stewardship as part of its regular messaging and will be launching a new termiticide that will significantly reduce the amount of water, fuel, and time required to perform a soil termiticide treatment.

P113 Sustainable Places Information Network (SPIN)

Josh Vincent, jvincent@pesticide.org

Campaigns Associate, Northwest Center for Alternatives to Pesticides (NCAP), Eugene, OR

The Sustainable Places Information Network (SPIN) is a networking site developed specifically for IPM professionals working in urban areas like parks, schools and housing. Through social media tools, Q&A forums, webinars, videos and articles, the site allows people working in different geographic regions to connect and mentor each other in the development of urban IPM strategies. Like a blog, the site also gives members the ability to contribute their own content, making it easy to demonstrate tools or techniques through user-uploaded images and videos. The explosion of social media in recent years has reshaped how people interact online. Internet users now turn to social media for their news often even if they are not interested in networking. This is why, when NCAP saw a need for a fast and interactive means of sharing IPM information, we decided to build a social network for that express purpose. SPIN is free and open for anyone with a working interest in IPM. Current members include landscapers, park managers, pest management professionals, IPM coordinators, school groundskeepers, and extension researchers from all across the country. SPIN was developed by the Northwest Center for Alternatives to Pesticides with support from the Western IPM Center.

P114 The French Quarter Formosan subterranean termite program in New Orleans, Louisiana: 1998-2011

*Dennis R. Ring[1], dring@agctr.lsu.edu, Alan L. Morgan[1], Alan Lax[2], and Frank S. Guillot[2]

[1]Department of Entomology, Louisiana State University AgCenter, Baton Rouge, LA; [2]USDA–ARS, New Orleans, LA

The Formosan subterranean termite, *Coptotermes formosanus*, is a very important structural pest and is a very destructive insect in Louisiana. Very high densities of this termite were found in the French Quarter. A pilot test was begun in 1998 in the French Quarter to reduce densities of termites using area wide IPM. Initially, commercially available baits or non repellent termiticides were used to treat properties in a contiguous 15 block area (Area I) in the French Quarter. The area in the program was expanded to include the blocks immediately surrounding the original 15 blocks (Area II) in 2002, approximately twenty additional blocks (Area III) to the east of Areas I and II in 2004, and twenty two more blocks (Area V) to the north of the other areas in 2006 and 2007. Densities of alates were sampled using glue boards hung on street lamp poles near lights. Alates were sampled once a week in April and two to three times weekly during the flight season (May through

July 15) in 1998 through 2011. Alate numbers were reduced by 50-75 % following treatment, and the lowest numbers of alates were captured in 2011. Funding for the program ended in early 2011. Some property owners are choosing not to renew their termite contracts. Therefore, some treatments are being discontinued. Because of this, the number of termites is expected to increase.

P115 The University of California IPM Program's extension program for retail nurseries and garden centers

*Mary Louise Flint, mlflint@ucdavis.edu, and Karey Windbiel-Rojas

University of California Statewide IPM Program, Davis CA

Based on feedback from a 2010 survey of nearly 100 retail stores in Northern California, UC IPM implemented several tools to help educate retail employees and customers on pest management and less toxic pesticides including a new web site, a newsletter and a train-the-trainer workshop. In early 2011, UC IPM unveiled the "Nursery and Garden Center Portal" web page www.ipm.ucdavis.edu/retail, a one-stop shop for retailers looking for pest management information to answer customer questions. The Portal page contains quick links to the UC IPM pages that retailers frequent most, as well as information on upcoming workshops, online training, seasonal pest topics, and more. The "Retail Nursery and Garden Center IPM News", a new quarterly e-newsletter for retail nursery and garden center employees, managers, and owners was initiated in 2011 to help stores provide customers with the latest pest information from the University of California. We also developed and conducted a series of hands-on train-the-trainer IPM workshops for retailers. Topics included landscape pest identification, finding information using the UC IPM Web site, and pesticides and other products with an emphasis on less toxic pesticides. Each participant was provided with access to online resources to repeat some of the training for other employees back in their stores. Retail stores are a key source of pest management information for many California consumers, and UC IPM will continue building its relationships with retail nursery and garden center staff and managers to help them pass UC science-based IPM information on to their customers.

P116 The IPM Star Process—What it takes to achieve IPM Star status

*Janet A. Hurley[1], ja-hurley@tamu.edu, Lynn A. Braband[2], and Carrie R. Foss[3]

[1]Texas AgriLife Research & Extension Center, Department of Entomology, Dallas, TX; [2]NYS Community IPM Program of Cornell University, Rochester, NY; [3]Washington State University- Puyallup, Puyallup, WA

The School IPM Star Certification Program offered by the IPM Institute of North America recognizes and rewards IPM practitioners who meet a high standard for IPM in schools, childcare centers and other school-age programs. The recognition of the IPM Star Certification assists schools to announce to their communities that they are taking extra steps to protect students and staff. The Star Certification program requires public schools (for the purpose of this poster) to submit to a thorough site inspection and audit of pesticide application use records, campus inspections and interview of school staff about pest/pesticide problems to assess the district's commitment to IPM. Texas, New York, and Washington have used IPM Star to reward or improve the district's IPM status. For each school the process was challenging and time consuming to achieve IPM Star. However each school will agree that the hard work that they placed into becoming IPM Star was well worth it. IPM Star is one way to measure high- performing school IPM; however, at what cost to the district and state Extension can all schools be examined at this level?

P117 Extension entomology and horticulture: A combined approach to teaching IPM

*John D. Hopkins[1], jhopkins@uaex.edu, and Janet Carson[2]

[1]Department of Entomology, University of Arkansas, Little Rock, AR; [2]Department of Horticulture, University of Arkansas, Little Rock, AR

The University of Arkansas, Division of Agriculture has developed a team approach, with the Entomology and Horticulture Departments collaborating, to create Integrated Pest Management (IPM) Training Programs for county extension agents, professional groups, master gardeners and the general public. Extension agent training was conducted across the state of Arkansas where agents were provided with presentation and reference materials on proper pest identification and IPM as the preferred pest control strategy. In addition to agent in-service training, IPM training programs were developed for professional organizations and presented to the AR Green Industry Association and at the Arkansas/Oklahoma Horticultural Industries Show and Conference. IPM trainings have also been conducted for commercial pest control groups, lawn and landscape professionals, at master gardener programs, and events for the general public across the state. The training and reference materials provided will help these groups better present the IPM concept to their clientele. The overall goal of

this project was to introduce or reinforce clientele knowledge of IPM and provide them with the knowledge and tools to implement IPM in their pest control efforts.

P118 Using audience response systems to capture IPM program needs and impacts

*Susan Donaldson, donaldsons@unce.unr.edu, Heidi Kratsch, and JoAnne Skelly

Western Area, University of Nevada Cooperative Extension, Reno, NV

Educators are increasingly challenged to document the outcomes of their programs. Audience response systems are simple and valuable tools for assessing increases in knowledge. They also help educators learn about an audience's background and interests so that presentations can be tailored to specific needs and interests for better learning outcomes. Several commercially available systems consist of similar elements: a small, hand-held wireless response device, or "clicker"; a receiver that collects the radio signals; and software to manage and show responses. Educators can use the system to warm up the audience, collect demographic data, test pre- and post-program knowledge, ask about potentially sensitive issues, and determine whether the audience is satisfied with the event. For example, in a recent pesticide safety training, 89% indicated they were learning more than they would if clickers were not used. Using clickers also allows audiences to provide input in a safe, anonymous setting, so they are more likely to respond honestly to difficult questions. In this training, 100% of the students indicated they participate more because their answers are anonymous. All members of the audience can weigh in, which is difficult in traditional large group settings that are sometimes monopolized by a few people. By displaying the results instantly on the screen, both participants and teacher get a sense of what their fellow students know and believe, opening up topics for discussion and group learning. Examples of the benefits and pitfalls of using clickers in IPM education of landscapers and Master Gardeners will be presented.

Research—Agriculture

P119 Anomalous armyworm infestations in eastern Washington and Oregon wheat implicate *Dargida* spp.

*Diana Roberts[1], robertsd@wsu.edu, Peter Landolt[2], Mary Corp[3], Silvia Rondon[4], Keith Pike[5], and David Bragg[6]

[1]Washington State University Extension, Spokane, WA; [2]USDA-ARS, Yakima, WA; [3]Oregon State University Extension, Pendleton, OR; [4]Oregon State University, Hermiston, OR; [5]Washington State University, Prosser, WA; [6]Washington State University Extension, Pomeroy, WA

Unusual, armyworm-type damage to wheat and barley crops occurred in Lincoln County, WA, and Umatilla County, OR, in 2007 and 2008. Damage was restricted to areas about 20 miles in diameter. Universal Moth Traps baited with the 2-component sex attractant (Z)-11-hexadecenyl acetate plus (Z)-11-hexadecenal, were most effective in trapping male wheat head armyworm moths, *Dargida diffusa* (Walker), which were suspected of causing crop damage. The sex attractant worked better than both the feeding attractant of acetic acid mixed with 3-methyl-1-butanol (AAMB), and light traps. Sex attractant traps located across the cereal-producing counties of eastern Washington in 2009 and 2010, and Umatilla County, OR, in 2010 and 2011, confirmed the presence of the original suspect, the wheat head armyworm. However, the native species *Dargida terrapictalis* (Buckett) was the predominant Noctuid moth captured in the sex attractant traps. Unfortunately, after 2008, the absence of larvae feeding in the field precluded positive identification of the pest. So the utilization of wheat as a host plant by *D. terrapictalis* remains unconfirmed. The seasonal flight pattern of adult males of both *Dargida* spp. was determined and is useful for crop-scouting. Other grass-feeding Noctuids captured included *Apamea devastator* (Brace) the glassy cutworm, *Apamea inficita*, and *Crambus cypridalus* (Crambidae) the snout moth. No-till (high residue) farming practices were implicated in the Washington State pest occurrence, but the correlation did not hold with infestations in Oregon and Idaho. A naturally-occurring but unidentified parasitic wasp likely contributed to the apparent decline of the armyworm as an economic pest.

P120 Evaluation of mustard plants and other products to control sweetpotato whitefly, *Bemisia tabaci*

*Jesusa C. Legaspi, Jesusa.Legaspi@ars.usda.gov, and Neil Miller

U.S. Department of Agriculture, Agricultural Research Service, CMAVE/FAMU-CBC, Tallahassee, FL

A major insect pest of vegetables and horticultural crops in the southeast US is the sweetpotato whitefly, *Bemisia tabaci* (also known as silverleaf whitefly). We evaluated the effect of giant red mustard plants (*Brassica juncea*) and commercial products to control these whiteflies. In laboratory tests, whiteflies were released in potted cantaloupe plants sprayed with mustard oil, garlic oil, horticultural petroleum oil, hot pepper wax and a water control. We found that the plants sprayed with the oils had significantly lower numbers of whiteflies compared to those sprayed with hot pepper wax and water alone. It is possible that whiteflies were repelled by volatiles from the oils. In a separate study, we studied the effect of plant volatiles on whitefly behavior using specialized odor detecting equipment. We found that whiteflies were repelled by giant red mustard plants. Our results indicate that giant red mustard plants and commercial oils such as mustard, garlic and horticultural oils are promising control agents against whiteflies in vegetable plants.

P121 Understanding and managing a key pest in cotton using community based maps of crop assemblages

*Peter B. Goodell[1], pbgoodell@ucanr.edu, Kris Lynn-Patterson[1], Robert J. Johnson[1], and Luis Gallegos[2]

[1]University of California, Statewide IPM Program and Cooperative Extension, Kearney Agricultural Center, Parlier, CA; [2]Sustainable Cotton Project, Winters, CA

Lygus hesperus is a key pest in the cotton Integrated Pest Management system of the San Joaquin Valley of California, USA. By legal regulation, fields must remain free of any cotton plants from December until planting in March which prohibits arthropods from using cotton as an overwinter site. *L. hesperus* is required to annually immigrate and a cotton field must rebuild its entire arthropod food web during the production season, March until September. We propose using community mapping approaches to understand the risk of *L. hesperus* infestation to an individual cotton field based on surrounding crop mosaic. In 2011, we sampled arthropod populations from selected cotton fields and mapped surrounding crops to a distance of 3.2 km. Using spatial tools, we sliced concentric rings of 0.8, 1.2 and 3.2 km around the cotton field and calculated the frequency of crops within each ring. Comparing the abundance of known crops which act as sources or sinks of *L. hesperus* to the maximum infestation in and number of insecticide applications to a field, patterns emerged to indicate relative risk of crop assemblages. Understanding such patterns in the landscape creates the opportunity for a community to develop planned landscapes to mitigate this key pest.

P122 IPM for CLB, *O. melanopus* using new egg parasitoid, *Anaphes nipponicus* from *O. oryzae* on a rice plants

*Shunichi Shibuya, Hymenoptera@s6.dion.ne.jp

Shibata-Machi,Shibata-County,Miyagi-Prefecture, Japan

It is known that *Anaphes nipponicus* parasitizes not only *Oulema oryzae*'s egg, but also the egg of *O.melanopus*'s (Bai 2009). *O.melanopus* resembles *O.oryzae* in appearance and character. Both have similar shape and coloring (adult, egg, larvae). Both species have an adult diapause and one generation per year. The adults crawl out from overwintering sites and then move to food plants in early spring. The differences between these species are body size (*O.melanopus* 4.8mm; *O.oryzae,* 4.5mm) and food plant (wheat or rice). *O.oryzae*, unlike *O. melanopus,* has to fly from the overwintering site to rice in water. Short-term forecasting for *O. melanopus* is difficult to survey due the difficulty of reaching host plants on foot. In addition, to control *O.melanopus* with *Anaphes nipponicus*, we must forecast exactly the flight timing of *O.melanopus*'s adult. If there is a water path between the food plants (oats, wheat) and the overwintering site of *O.melanopus*, we could catch the flight of CLB beetle into the food plants on opposite side to interrupt the invasion of crawling beetles.

P123 Developing new weather-based models to improve management of cereal leaf beetle, *Oulema melanopus* (Coleoptera: Chrysomelidae).

*Christopher R. Philips[1], crp@vt.edu, D. A. Herbert[2], T. P. Kuhar[1], D. D. Reisig[3], and E. A. Roberts[1]

[1]Department of Entomology, Virginia Tech, Blacksburg, VA; [2]Virginia Tech Tidewater Agricultural Research and Extension Center, Suffolk, VA; [3]Department of Entomology, The Vernon James Research & Extension Center, North Carolina State University, Plymouth, NC

Cereal leaf beetle is one of the most important insect pests of wheat in the Southeast with a damage potential of over $20.6 million to Virginia and Carolina wheat growers. To improve scouting efficiency and encourage a more sound IPM approach for wheat production, degree-day models were developed to predict cereal leaf beetle egg and larval peaks. Previously published cereal leaf beetle temperature development data were used to create a predictive degree-day model to estimate the dates of peak egg and larval populations. This model was validated using cereal leaf beetle population data from field populations in Virginia and North Carolina in 2010 and 2011. In addition, historical weather data were used to create a predictive map of when areas of Virginia and North Carolina typically would reach egg peak. Linear regression analysis was then performed using data from all cereal leaf beetle study populations, to determine if the number of eggs at peak could be used to predict larval peak numbers. Our model accurately predicted egg and larval peaks and there was a significant positive linear relationship between egg peak and larval peak density indicating that egg peaks could reliably predict larval infestations levels. If incorporated into cereal leaf beetle management programs, our predictive degree-day model could improve scouting efficiency by limiting the need to scout to only those few critical days at egg peak, rather than over several weeks during larval development allowing for more timely applications of insecticides, if needed.

P124 Development and testing new ways to reduce pesticides on raspberries using IPM tools

A. Nicholas E. Birch, nick.birch@hutton.ac.uk, and Tom Shepherd

James Hutton Institute, Dundee, UK

At the James Hutton Institute (JHI) in Dundee, Scotland, we develop and test new IPM tools for soft fruit, particularly protected raspberries. This research is mainly driven by EU Directives to reduce pesticide residues on fresh fruit and by consumer demand for greener production methods. In addition, the primary crop protection tool, breeding pest-resistant crop varieties, is at a 'tipping point' where virulent

aphid biotypes can overcome resistance faster than we can introgress new pest resistance genes. The shift to protected production in polytunnels has exacerbated this problem, because we now have green bridges across years and microclimates that enable pests to survive for 9+ instead of 3 months each season. At the JHI, we have developed a range of IPM tools such as aphid resistant raspberry varieties, host volatile enhanced precision monitoring traps, floral resource optimization, and banker plants for biocontrol agents including hoverflies and parasitoids. These are being tested in combination on-station and on-farm, so that 'best practice' solutions can be delivered to growers. Based on a recent four year, U.K. wide on-farm collaborative trial with other research groups and commercial companies, we have reduced pesticide use by 40% and still achieved good control of key pests, including raspberry beetle and raspberry aphid. These IPM tools are now included in Horticulture Development Council 'best practice guides for U.K. soft fruit growers' and are being adopted in other countries including Switzerland, France, and Norway.

P125 An early-warning system for viruliferous aphid infestations of pulse crops in the Palouse region

*Diana Roberts[1], robertsd@wsu.edu, Sanford D. Eigenbrode[2], Damon Husebye[2], Bradley Stokes[2], and Ed Bechinski[2]

[1]Washington State University Extension, Spokane, WA; [2]Division of Entomology, University of Idaho, Moscow, ID

The Palouse region of eastern Washington and north Idaho is prime country for dry pea and lentil production. Annual infestations of pea aphid (*Acyrthosiphon pisum*) and the viruses they carry, Pea enation mosaic virus and Bean leaf roll virus, vary considerably among years. Some farmers apply insecticides routinely, but those who defer treatment until aphid numbers are high may incur economic crop loss, especially in aphid and virus "outbreak" years. Since 2007, a network of approximately 30 pan traps has been used to monitor aphid arrival across the region, and their viruliferous status determined by PCR (polymerase chain reaction). The data were provided to farmers and field consultants via an email listserv and a website for use in making decisions regarding aphid management. A weather-based forecasting model for virus infestations is also being developed for pulse growers. Inputs for the model include weather data from the Columbia Basin, WA, and the Willamette Valley, OR, which are presumed sources of the colonizing aphids. Virus risk in specific fields is adjusted based on historic patterns of virus occurrence across the landscape. Both the model and pan trap monitoring of aphids are elements in a virus and aphid management decision system discussed in this poster. Molecular tools and surveys are also being used to confirm the origins of the annual flights of pea aphids into the Palouse region. Full validation awaits an aphid and virus outbreak, which has not occurred since 2005.

P126 An integrated bird (*Psittacula krameri* Scopoli.) management strategy in sunflower

*Thimmaiah Shivashankar[1], shivashankar.ts@gmail.com, Rajegowda[2], and D.K. Siddegowda[2]

[1]College of Agriculture; [2]Zonal Agricultural Research Station, VC Farm, UAS(B) Mandya, Karnataka, India

Sunflower (*Helianthus annus* Linn) is grown in isolated patches (1-2 Ha) and the granivorus bird the Rose ringed parakeet (*Psittacula krameri* Scopoli) causes heavy losses (10-40%) despite following IPM practices like reflective ribbons, bio-acoustics, pyro-techniques, screen crops, botanicals, habitat management, etc. A newer method was employed in Mandya province of Karnataka, India, to protect sunflower from bird damage. With the commencement of feeding by parakeets, colored decorative tencil (blue, red, pink, yellow and silver, each 10cm long) and colored carry bags (white, black, blue, yellow, orange and red of 25 x 50cm size) were tied on the back of the randomly selected sunflower heads (10%). No plants were treated in the check plot (control). The parakeets foraged on the sunflower crop between 07.30 – 09.30 and 03.30 – 05.30 hrs of the day. On the day of treatment and on subsequent three days, no birds were seen on the crop but only sighted on nearby trees. Four days after treatment 19 birds were found foraging in the check plot. No damaged sunflower heads were observed in the treated plots. The presence of the tencil and carry bags, the swaying action, hustling sound created by them and reflective sunlight scared the birds. All these factors acted upon feeding parakeets individually or together in preventing bird damage. In the check plot, most of the plants (94.42%) were damaged by the parakeets with low yield (2.8q/ha) compared to higher yield (10.5 q/ha) in treated blocks.

P127 Isothermal amplification of insect DNA

*Aaron M. Dickey[1], Aaron.Dickey@ars.usda.gov, Lance S. Osborne[2], Robert G. Shatters Jr.[1], and Cindy L. McKenzie[1]

[1]USDA-ARS USHRL, Fort Pierce, FL; [2]University of Florida, Mid-Florida Research & Education Center, Apopka, FL

The loop-mediated isothermal amplification of DNA (LAMP) technique can amplify a target DNA sequence at a constant temperature in about 1 hour. LAMP has broad application in integrated pest management because of the need for rapid and inexpensive diagnoses that can be done in the field without a thermocycler. Several LAMP assays have been developed for use by researchers and clinicians, primarily for human pathogen detection and positive identification, but agricultural applications have been much more limited. In addition to pathogen detection, LAMP should be well suited to the identification of economically and medically important insect pests, particularly for members of cryptic species complexes, which cannot be distinguished morphologically. Here we report the loop-mediated isothermal amplification of insect DNA using sweet potato whitefly Bemisia tabaci Gennadius (Hemiptera: Aleyrodidae) biotypes B and Q.

P128 Biology and infestation of *Nesidiocoris tenuis* Reuter (Hemiptera:Miridae) on tomato in Indonesia

*Dantje T. Sembel[1], sembeldt@yahoo.co.id, Albert Budiman[1], Merlyn Meray[1], Carolus Rante[1], Roy Dien[1], Michael Hammig[2], Merle Shepard[2], and Gerry Carner[2]

[1]Faculty of Agriculture, Sam Ratulangi University, Manado, Indonesia; [2]Clemson University, Clemson, SC

The tomato mirid bug, *Nesidiocoris tenuis*, was first reported by tomato growers in the province of North Sulawesi in 2002. Since then this bug has caused serious damage to tomato crops in this region. Farmers routinely spray with insecticides to control this pest. Tomato seedlings were grown on plastic bags and placed inside screen cages in the greenhouse. Experimental design was a complete randomized block using control (no insect released), one pair, two pairs, three pairs and four pairs of *N. tenuis* per plant. Field experiments involved sampling tomatoes for *N. tenuis* at four centers of vegetable crop production in North Sulawesi. The total life cycle from egg to adult is 21 days. Adult insect is 3.5 cm long, the body is dark green and the dorsal side of the thorax and abdomen has 4 dark parallel lines. Major damage caused by this pest is on the petiole of flowers and small branches forming a yellowish-brown ring and eventually the infested flowers and branches drop. Study shows that the average level of infestation by *N. tenuis* on tomato flower and on the stem grown in the greenhouse increased with age of plant and the number of pairs of insects released on the plant. Field observations show that this insect is an important pest that can cause serious damage to tomato crops. The average level of infestation by *N. tenuis* on tomato in the field at various locations in N. Sulawesi is between 28.4 to 57.6%.

P129 Correlation of resistance to maize weevil and starch arrangement in sectioned kernels of sorghum

*Bonnie B. Pendleton[1],bpendleton@wtamu.edu, Michael W. Pendleton[2], E. A. Ellis[2], Gary C. Peterson[3], Fernando M. Chitio[4], and Suhas Vyavhare[1]

[1]Agricultural Sciences, West Texas A&M University, Canyon, TX; [2]Microscopy & Imaging Center, Texas A&M University, College Station, TX; [3]Texas AgriLife Research, Lubbock, TX; [4]IIAM Nampula Research Center, Nampula, Mozambique

The maize weevil, *Sitophilus zeamais* Motschulsky, is the most important insect pest worldwide of stored grain of sorghum, *Sorghum bicolor* (L.) Moench. Chitio assessed resistance of 20 genotypes of sorghum to maize weevils. He put 5 g of grain of a genotype into a vial with three newly emerged female and two male maize weevils. Damage score and weight loss were determined for grain of each sorghum genotype once every 3 weeks for 105 days. Three of these genotypes were studied to determine whether depth of starch from the seed coat was related to resistance measured by weight loss of sorghum following infestation by maize weevils. Epoxy-embedded kernels of the three genotypes of sorghum were thin sectioned with a Sorvall MT-1 ultra-microtome, and the sections were treated with iodine vapor to locate starch concentrations. A JEOL JSM-6400 scanning electron microscope (15 KeV, 15 mm working distance) was used to show images of maize weevil mouthparts and secondary and backscatter images of the sorghum kernels. Energy dispersive spectrometry (EDS) plots were produced using a PGT (Bruker) detector and PGT (Bruker) Spirit software interface to show the areas of iodine and starch on the sectioned kernels. A correlation was demonstrated for the three genotypes of sorghum so that as the depth of concentrated starch (with iodine as a marker) measured from the seed coat increased, the percentage of weight loss of grain infested with maize weevils increased. Results are preliminary because only three sorghum genotypes have been tested yet by this method.

P130 Defining interactions of agrochemicals to improve integrated pest management in peanut

Gurinderbir Chahal[1], David Jordan[1], Barbara Shew[2], *Rick Brandenburg[3], Rick_Brandenburg@ncsu.edu, Alan C. York[1], James D. Burton[4], and David Danehower[1]

[1]Department of Crop Science, North Carolina State University, Raleigh, NC; [2]Department of Plant Pathology, North Carolina State University, Raleigh, NC; [3]Department of Entomology, North Carolina State University, Raleigh, NC; [4]Department of Horticulture, North Carolina State University, Raleigh, NC

Peanut growers in the United States often implement control measures for numerous pests including disease, insects, and weeds. Growers often make 4 to 6 fungicide, 3 to 5 insecticide, and 3 to 6 herbicide applications annually to manage pests in peanut. Integrated pest management (IPM) strategies are often implemented to control pests, prevent economic loss, reduce production and pest management costs, and minimize environmental impact. Implementing IPM strategies increases risk of greater pest damage if reactive control strategies are not available, are minimally effective, or cannot be implemented rapidly. Growers often implement control strategies simultaneously because pests and their resulting damage often occur at the same time during the season. Co-application of herbicides, insecticides, and fungicides enable growers to control multiple pest complexes. Scientists and practitioners in disciplines of entomology, plant pathology, and weed science often investigate interactions of pesticides within

their respective disciplines. However, a better characterization of pest complexes and pesticide interactions across disciplines is needed. While interactions of two co-applied pesticides or crop protection products are fairly well understood, especially within pest disciplines, many peanut growers apply three or more products simultaneously with varying degrees of success. A series of experiments was conducted to determine weed, insect, and disease control and peanut growth with co-application of up to five agrochemical (pesticide, micronutrient, and plant growth regulator) combinations. The number of interactions and magnitude of changes in response will be provided.

P131 Distribution of *Metarhizium anisopliae* in agroecological soils of Pakistan

*Waheed Anwar, waheeedanwar@hotmail.com, Salik Nawaz Khan, and Muhammad Saleem Haider

Institute of Agricultural Sciences, University of the Punjab, Lahore, Pakistan

The occurrence of entomopathogenic fungi, *Metarhizium anisopliae,* was investigated in the agroecological zones of Pakistan. For this purpose, soils from hot arid zone, central mixed zone, and cotton zone were collected. Entomopathogenic fungi *Metarhizium anisopliae* was isolated using *Galleria* bait method. *Galleria* bait larvae were continuously reared in laboratory and *Galleria* larvae were treated with collected soils. The frequency of occurrence of *Metarhizium anisopliae* varied in different localities within an agroecological zone and with other agro-ecologcal zones due to different soil types and crop pattern. Recent research work aims at the foundations to be laid for future focus on the indigenous populations of insect associated fungi as biological control agents in various regions of Pakistan using conservation biological control strategy. Further studies are necessary to observe the exact behavior of *Metarhizium anisopliae* in different cropping patterns.

P132 Drought tolerant *T. harzianum* isolates promote growth and delay drought responses in *T. aestivum* L.

*Nandani Shukla, nandanishukla@gmail.com, R.P. Awasthi, Laxmi Rawat, and J. Kumar

Govind Ballabh Pant University of Agriculture & Technology, Pantnagar, U.S. Nagar, Uttarakhand, India

Wheat is one of the most important food crops usually grown on arid agricultural fields and drought conditions often cause serious problems in wheat production. The impact of drought tolerant (DT) endophytic fungus *Trichoderma harzianum* isolates (Th 56, Th 69, Th 75, Th 82 and Th 89) applied through seed biopriming on wheat's response to drought was studied. With or without exposure to drought conditions, colonization by DT *Trichoderma* isolates promoted seedling growth, the most consistent effect being an increase in root fresh weight and root dry weight. Colonized seedlings were slower to wilt in response to drought as measured by a decrease in the leaf angle drop. The primary direct effect of colonization was promotion of root growth, regardless of water status, and an increase in water content, which it is proposed caused a delay in many aspects of the drought response of wheat. The impact of the above DT isolates of *Trichoderma* on wheat's response to drought indicated that colonization enhanced drought tolerance of wheat plants as they delayed drought induced changes like stomatal conductance, net photosynthesis, chlorophyll content, greenness of plants and membrane stability index. Drought conditions from 4 to 13 days of withholding water induced an increase in the concentration of many stress induced metabolites in wheat leaves, while DT *Trichoderma* colonization caused a decrease in proline, malondialdehyde and H2O2 contents and an increase in phenolics concentration. Among different DT *Trichoderma* isolates, Th 56 induced maximum drought tolerance as treated plants recorded only 20-40 percent wilting even at 13 days drought stress.

P133 Ecological engineering of rice ecosystem to reduce planthopper outbreak in Thailand

*Patchanee Chaiyawat, patchanee@ricethailand.go.th

Phranakorn Sri Ayutthaya Rice Research Center, Bureau of Rice Research and Development, Rice Department, Phranakorn Sri Ayutthaya Province, Thailand

In 2009-2010, the brown planthopper (BPH), *Nilaparvara lugens* (Stal), outbreak encompassed 387,160 ha of rice fields and 1.1 million tons of rice were lost. Objectives of research were to increase numbers populations of natural enemies to control BPH and reduce use of chemical insecticides by ecological engineering (EE). Twenty ha of EE rice fields were planted with 18 species of vegetable and flowers on rice bunds. Examples of plants included pumpkin (*Cucurbita moschata*), angle gourd (*Luffla acutangula*), okra (*Abelmoschus esculentus*), marigold (*Tagetes erecta*) and sunnhemp (*Crotalaria juncea*). Control rice fields did not have any other plants on the bunds. Direct count, sweep net, and bucket trap were used to evaluate BPH and natural enemies populations in 10 EE and 10 control rice fields. Each field was installed with 30 yellow bucket traps. 60 sample units were taken from each field by direct count, and sweep net samples were collected at 7 day intervals. Results showed that numbers of BPH in EE fields were 4.2 and 2.1 fold less than control areas when examining direct count and bucket traps data, respectively. By sweep net, numbers of BPH also less at all stages of rice growing. The efficient BPH egg predator, *Cyrtorhinus lividipennis*, was 3.5 and 3.4 fold greater than in control areas using direct count and sweep net data, respectively. Other predators and BPH parasitoids also were greater in numbers. Chemical insecticides used in EE fields were also reduced by half. To conclude, ecological engineering could increase natural enemies in the rice ecosystem, resulting in co-exsistance between BPH and natural enemies at an equilibium level that is below the economic threshold.

P134 Effects of microclimate changes in different vegetation types on cattle fever tick larval survival

*Tasha N. Perry[1], niki.kaiser@yahoo.com, Greta L. Schuster[1], David G. Hewitt[2], J. Alfonso Ortega[2], Tyler A. Campbell[3], and Pamela L. Phillips[4]

[1]Department of Agriculture, Agribusiness, and Environmental Science, Kingsville, TX; [2]Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville, Kingsville, TX; [3]USDA APHIS, Wildlife Services, National Wildlife Research Center, Kingsville, TX; [4]USDA-ARS Knipling-Bushland U.S. Livestock Insects Research Laboratory, Kerrville, TX

Cattle Fever Ticks (CFT), *Rhipicephalus annulatus* and *R. microplus*, serve as vectors for *Babesia* spp., which is the cause of cattle fever. Past research on CFT has shown that combinations of temperature and relative humidity are key factors influencing tick larval survival. While macroclimatic conditions are similar for cover types, local microclimates can vary considerably by location. Our objectives were to record temperature and relative humidity data in three different vegetation types in Zapata, TX and determine if vegetative cover affects CFT larval survival through changing seasons. HOBO Data Loggers™ were placed in the field using satellite imagery to identify areas of varying vegetative cover categorized as grass, brush, and dense vegetation. HOBO Data Loggers were programmed to collect temperature and relative humidity within microclimates every 15 minutes. In addition, data are offloaded monthly and field sites are sampled for the presence of CFT larvae by walking transects around the data loggers using flannel panels pinned to jeans. These data will be used to describe daily and monthly microclimate for each vegetation type. Transect sampling will provide data on CFT larvae presence in the study area during seasonal changes in temperature and humidity levels. These data will be used to provide a better understanding of the role microclimate differences play in the survival of CFT larvae in southern Texas.

P135 Establishment of banker plant of *Amblyseius swirskii* for managing multiple pests in vegetable crops

*Yingfang Xiao[1], yfxiao@ufl.edu, Pasco Avery[2], Jianjun Chen[1], Cindy McKenzie[3], and Lance Osborne[1]

[1]Mid-Florida Research and Education Center, Department of Entomology and Nematology, University of Florida, Apopka, FL; [2]University of Florida, Institute of Food and Agricultural Sciences, Indian River Research and Education Center, Fort Pierce, FL; [3]U. S. Horticultural Research Laboratory, USDA-ARS, Fort Pierce, FL

Several key pests, such as Silverleaf whitefly, *Bemisia tabaci* biotype B, western flower thrips, *Frankliniella occidentalis*, and chilli thrips, *Scirtothrips dorsalis*, threaten vegetable production in the US. The present study is the first report of ornamental pepper as bank plants supporting *A. swirskii* against three notorious pests in protected vegetable crops. Specifically, this study (a) evaluated population buildup of *A. swirskii* on three ornamental pepper varieties under laboratory and greenhouses and (b) determined the predation of *A. swirskii* reared on ornamental pepper plants to targeted pests on vegetable crops under greenhouse conditions. The results findings that the three pepper varieties were excellent banker plants and able to sustain~1200 of all stages of *A. swirskii* per plant in greenhouse conditions and support them to complete their life cycle. *A. swirskii* dispersed from the banker plants to other vegetable plants, resulting in significant suppression of the three pests. Only an average of 2.75 of *B. tabaci* and 13.4 of thrips complex (all stages) were found per bean plant, respectively, compared to 379.5 and 235.4 per plant in the control treatments after 14 d post-release. Furthermore, sweet pepper plants protected by bank plants were healthy, whereas those without banker plant protection were heavily infested by chilli thrips; their growth seriously stunted, and died. This established bank plant system could be a new addition to the integrated pest management programs for sustainable control of the three pests in protected vegetable production.

P136 Evaluation of promising rice varieties against panicle mite, *Steneotarsonemus spinki*

Suresh Dasari, *Shashi Vemuri, Sash_3156@yahoo.co.in, Ramgopal Varma

Department of Entomology, ANGR Agricultural University, Rajendranagar Hyderabad, Andhra Pradesh, India

Screening of advanced (promising) rice cultures against panicle mite, *Steneotarsonemus spinki* was carried out at the Rice Section, Agricultural Research Institute, Rajendranagar during Kharif, 2010, utilizing 49 rice cultures. Eight moderately resistant cultures were RNR 898, RNR 9038, RNR 8913, RNR 8860, RNR 2458, Godavari Isukalu, NSN 21184, and NSN 34949. Eleven susceptible cultures were RNR 7781, RNR 8237, RNR 8446, RNR 8912, RNR 8944, RNR 8951, RNR 9024, RNR 2833, RNR 9286, NSN 21114, and NSN 20727. Eight moderately susceptible cultures were RNR 8572, RNR 8852, RNR 8874, RNR 9097, JGL 11470, NSN 20114, NSN 20894, and NSN 20723. Twenty-two highly susceptible cultures were RNR 7669, RNR 7689, RNR 7797, RNR 7995, RNR 8234, RNR 8235, RNR 8055, RNR 8771, RNR 8801, RNR 8806, RNR 8847, RNR 2354, RNR 8933, RNR 9064, RNR 9096, RNR 9278, RNR 883, JGL 11727, MTU 1075, MTU 1064, MTU 1061, and NSN 20601. The incidence of panicle mite was observed to be relatively very low in rice cultures with well exerted panicles (2–4 cm above the boot leaf) in comparison to incompletely exerted panicles. A relationship was also observed between the duration of the crop and incidence of panicle mite indicating that some genotypes escaped from pest infestation. Overall, the panicle mite incidence was observed to be more in early duration cultures than late duration cultures, with few exceptions. The major criteria for panicle mite resistance was observed to be the panicle exertion.

P137 Exploration, identification and pathogenicity tests of entomophatogenic fungi

Betsy Pinaria[1], Saartje J. Lumanauw[1], *Dantje T. Sembel[1], sembeldt@yahoo.co.id, Jotje Warouw[1], Max Tulung[1], Lusye Taulu[2], Gerry Carner[3], Michael Hammig[3], and Merle Shepard[3]

[1]Sam Ratulangi University Manado, N. Sulawesi, Indonesia; [2]Assesment Institute of Agricultural Technology, N. Sulawesi, Indonesia; [3]Clemson University, Clemson, SC

Field observations showed that there are many pests of vegetable crops infected by pathogenic fungi. Exploration and identification of insect pests infected by pathogenic fungi were collected at the centers of vegetable crops in North Sulawesi, Indonesia. Results showed that pathogenic fungi *Nomuraea* sp. and *Metarhizium anisopliae* were the most dominant infecting larvae of *Crocidolomia binotalis*, *Spodoptera* spp. and *Chrysodeixis chalcites*. Other less important pathogenic fungi were *Beauveria* sp. which were isolated from *Spodoptera* spp. and *Hirsutella* sp. from larvae of *Plutella xylostella*. Laboratory examination showed that *Nomuraea* sp. may be a new species because it has different morphological characters and doesn't sporulate on many agar media except on Malt Extract Agar added with crushed larvae of *C. binotalis*. Pathogenicity tests of *Metarhizium anisopliae* under laboratory conditions showed that the average mortality of larvae of *C. binotalis* was 73.75% and on *S.exigua* was 90%. Pathogenicity tests of *Nomuraea* sp. on the same pests were 95%.

P138 Field screening of chilli (*Capsicum annuum* l.) entries against thrips (*Scirtothrips dorsalis*)

*L. Pugalendhi, vegetables@tnau.ac.in, S. Mohan Kumar, B.K. Savitha, and R. Aravintharaj

TamilNadu Agricultural University, Coimbatore, India

Sucking pests are reported to cause over 50 per cent reduction in yield of chilli, of which thrips (*Scirtothrips dorsalis*) alone accounts for about ten per cent. Identification of sources tolerant to thrips may help to evolve tolerant/resistant varieties. With IPM-CRSP support, field screening of 118 entries of chilli was taken up for their field tolerance to thrips at the Department of Vegetable Crops, Horticultural College and Research Institute, Coimbatore, India during 2010-2011. The total number of nymphs and adults of thrips present on five apical leaves were recorded from five randomly selected plants in each plot, while the extent of leaf damage was assessed following a 5-grade score. Grade 0 indicated clear leaves; grade 1: terminal 3-4 leaves showing tiny eruptions in interveinal area of leaf; grade 2: terminal 3-4 leaves showing upward curling along leaf margin; grade 3: severe scarring of terminal and a few basal leaves; grade 4: stunted plants, leaves severely curled and leaf area greatly reduced; and grade 5: plants with no leaves and only stem remaining. The total number of plants and damaged plants were counted in each plot to calculate the percentage of damaged plants. The results showed that five entries viz., CA 6, CA 160, CA 162, CA 53 and CA 46 recorded significantly less thrips infestation. It recorded significantly lower percentage of damaged plants with high yield compared to the susceptible genotypes. These lines will be used as tolerant sources in breeding for resistance to thrips.

P139 Integrated control of spider mites on greenhouse roses in Thailand

*Manita Kongchuensin, manita.k@doa.in.th, Pichate Chaowattanawong, and Ploychompoo Konvipasruang

Plant Protection Research and Development Office, Department of Agriculture, Bangkok, Thailand

Spider mite is a critical pest of roses, causing great damage to this high value ornamental in Thailand. The use of predatory mites, *Neoseiulus longispinosus* (Evans), to control spider mites has been considered an effective method that can compete with the chemical compounds. However, introducing this predatory mite into a large scale pest control system for greenhouse roses has not yet been studied. The integrated control of spider mites was examined by releasing the predatory mite, *N. longispinosus,* and spraying selective acaricides in greenhouse roses at Nakhon Ratchasima province, Thailand. The preliminary results revealed that the release of *N. longispinosus* at the rate of 9-10 mites per plant approximately every 3 weeks plus applying selective acaricide during its establishment phase gave effective control for the Kanzawa spider mite, *Tetranychus kanzawai* Kishida, and two-spotted spider mites, *T. urticae* Koch. The population density of the spider mites on the integrated control plot was significantly lower than the acaricide-sprayed plot. We further investigated the cost reduction by applying predatory mites at the lower rate. The integrated control model was constructed; 1) releasing 3-4 predatory mites per plant every 2 weeks over the first 4-month period, 2) subsequently, releasing predatory mites only once a month, 3) spraying selective acaricides on susceptible stain roses when spider mite outbreaks occurred, and 4) controlling the other pests on roses by spraying 12 recommended pesticides harmless to *N. longispinosus*. Our results showed that this procedure can effectively control spider mites on greenhouse roses all year round.

P140 Grandevo® biopesticide for managing insects and mites

*Timothy Johnson, tjohnson@marronebio.com, Celeste Gilbert, Guy Wilson, Hai Su, Russell Blair, Celeste Gilbert, Lisa Chanbusarakum, Phyllis Himmel, and Pam Marrone

Marrone Bio Innovations, Inc., Davis, CA

Grandevo® is a new microbial-based insecticide based upon the novel bacterium *Chromobacterium subtsugae* strain

PRAA4-1T. Formulated as both liquid and dry flowable formulations, Grandevo® has demonstrated significant biological activity in field and laboratory studies against sucking and chewing insects and against two-spotted spider mite (*Tetranychus urticae*). Key targets include armyworms, peach twig borer, thrips, stink bugs, psyllids, whiteflies, Lygus spp., grubs and leaf-feeding beetles. The EPA granted a registration to the technical-grade active ingredient in August 2011 and to a liquid formulation shortly thereafter with a commercial launch in October 2011 in Florida citrus and vegetable production. EPA registration of a dry flowable formulation is anticipated in the early 2012.

P141 Managing the weed, parthenium (*Parthenium hysterophorus* L.) in eastern and southern Africa

*Wondi Mersie[1], wmersie@vsu.edu, Lorraine Strathie[2], Andrew McConnachie[2], Kassahun Zewdie[3], Lisanework Nigatu[4], Ibrahim Fitiwy[5], Steve Adkins[6], Jenipher Bisikwa[7], Million Abebe[8], Lule Gebrehiwot[8], Mulugeta Negri[9], Keotshephile Kashe[10], Clyde McNamee[1], Emily Wabuyele[11], Krissie Clark[12], and Rangaswamy Muniappan[13]

[1]Agricultural Research Station, Virginia State Univ., Petersburg, VA; [2]ARC-Plant Protection Research Institute, Hilton, South Africa; [3]Ethiopian Institute of Agricultural Research, Addis Ababa, Ethiopia; [4]Haramaya University, Haramaya, Ethiopia; [5]Mekelle University, Mekelle, Ethiopia; [6]The University of Queensland, Brisbane, Australia; [7]Makerere University, Kampala, Uganda; [8]Virginia State University, Addis Ababa, Ethiopia; [9]Ambo University; Ambo, Ethiopia; [10]Department of Agriculture, Ministry of Agriculture, Gaborone, Botswana; [11]National Museums, Nairobi, Kenya; [12]PAMS Foundation, Arusha, Tanzania; [13]IPMCRSP, Virginia Tech, Blacksburg, VA

Parthenium, a native plant of tropical and sub-tropical South and North America adversely affects food security, biodiversity, and human health as well as livestock health in eastern and southern Africa. It competes with preferred species, reducing pasture carrying capacity by up to 90% and taints mutton when sheep feed on parthenium contaminated feed. It caused a sorghum yield loss of 40% in Ethiopia. An international project supported by USAID-IPMCRSP in Africa determined that the distribution of parthenium in Ethiopia, Kenya, Tanzania, South Africa, Swaziland and Uganda was more extensive than previously known. Road-side surveys in these countries showed that infestations of parthenium were mostly high density (>3 plants/m2). Scientists in Ethiopia and South Africa also evaluated the safety of two biological agents; the leaf-feeding beetle, *Z. bicolorata* and the stem-boring weevil, *L. setosipennis* for the control of parthenium. Host range testing done on 27 non-target species in Ethiopia and 41 in South Africa confirmed that *Z. bicolorata* is safe for release against parthenium. An application for a permit to release *Zygogramma* for the control of parthenium in Ethiopia is currently pending. Host specificity tests conducted under quarantine in Ethiopia and South Africa also proved that *L. setosipennis* only feeds on parthenium and does not damage any economical and native plants. A combination of biological and cultural control measures will be implemented to abate the adverse impact of parthenium in eastern and southern Africa.

P142 Integrated weed management in iron-prone soil of Minna, Nigeria

*Adeosun James Olasunkanmi[1], jamadeosun@yahoo.com, I.A. Adewale[2], Hajara Usman[2], and Solomon Taidi[2]

[1]Federal University, Dutsin-ma Nigeria/Ahmadu Bello University, Zaria, Nigeria; [2]Federal University of Technology, Minna, Nigeria

Rice (*Oryza sativa. L*) is the most cultivated cereal crop in Minna, Nigeria. This area is faced with iron toxicity coupled with the problem of weeds especially *Striga hermonthica*. A series of field experiments were carried out between 2008 and 2011 to address these two compelling challenges. These included the identification of iron tolerant variety with good competitiveness, appropriate sowing method, and time and type of weed management. The results showed that rice variety WAB 189 exhibited high level of tolerance to iron toxicity and weed competitiveness. Yield of this variety was better than the newly promoted NERICA variety if drill planted with a low rate (1.0 kg a.i./ha) of pendimethalin and supplemented with hoe weeding 6 WAS (weeks after seeding) or if a high pendimethlin rate (1.5 kg a.i/ha) was used with or without hoe weeding 9 WAS. Furthermore, the results also demonstrated that with adequate management most of the abandoned rice fields, due to aggressiveness of weeds and soil problems, could be salvaged.

P143 Herbicide banding in corn—An improved pest management practice?

*Rakesh Chandran[1], RSChandran@mail.wvu.edu, Rodney Wallbrown[2], Dave Workman[3], and Craig Yohn[4]

[1]West Virginia University Extension, Morgantown, WV; [2]West Virginia University Extension Service, Mason County, Point Pleasant, WV; [3]West Virginia University Extension Service, Hardy County, Moorefield, WV; [4]Retired West Virginia University Extension Service, Jefferson County (retired), Kearneysville, WV

Three grower-scale field experiments were conducted in West Virginia in 2011, to compare banded and broadcast applications of preemergence herbicides in corn. A herbicide pre-mixture containing atrazine, metolachlor, and mesotrione was applied either as broadcast applications or as bands 38 cm wide over corn rows spaced 75 cm apart. While the broadcast applications provided the active ingredients at 0.84, 2.24, and 0.224 kg.ha-1, the banded applications provided the same herbicides at half the rates. All treatments were replicated thrice, and were applied prior to weed emergence when the corn was

10 to 15 cm tall. At one location, experiment was a repetition of one carried out in 2010, and the treatments were superimposed on the same plots as the previous year. At all three locations, corn yields recorded were statistically similar between banded and broadcast applications. The weed pressure was significantly higher in the first location, compared to 2010. Some untreated plots suffered total crop loss due to weed competition. Banded application may not only reduce the application rate of certain preemergence herbicides such as atrazine by 50% but may also provide other services to the ecosystem such as reduced soil erosion and nutrient runoff, provide habitat for beneficial insects, reduce the buildup of resistant weed biotypes from lower selection pressure, and increase the levels of carbon sequestration. If determined to be a grower-friendly practice upon further testing, this approach may have the potential to provide more sustainability-, and IPM-oriented solutions to otherwise industrialized cropping systems.

P144 Improving biological control on equestrian farms

*Erika T. Machtinger[1], irishtangerine@ufl.edu, Chris J. Geden[2], Norman C. Leppla[1], and Jerome A. Hogsette[2]

[1]University of Florida, Entomology and Nematology Department, Gainesville, FL; [2]United States Department of Agriculture, Agricultural Research Service–Center for Medical, Agricultural and Veterinary Entomology, Gainesville, FL

House flies, *Musca domestica* L., and stable flies, *Stomoxys calcitrans* L., (Diptera: Muscidae), are common pests on horse farms in Florida. Historically, insecticides have been the primary method of fly control in most livestock facilities but increasing fly resistance to chemicals has prompted the need for alternative control options. The use of pupal parasitoids in augmentative release programs has become popular with horse owners. However, releases have not been tested on horse farms and the success of a program is dependent on whether filth fly breeding is occurring on-site and the associated microhabitat preferences of the released species. In January 2010, a series of laboratory and field experiments were conducted with the goal of improving biological control methods for filth fly control on equestrian facilities in Florida. Weekly surveillance in the field suggested fly breeding was influenced by farm management. The greatest numbers of natural parasitoids collected were of the genus *Spalangia*. Parasitism by Spalangia cameroni of house flies and stable fly pupae was assessed at two different host:parasitoid ratios. Six field collected substrates commonly found in equestrian facilities were used to determine if substrate had an effect on the attraction of parasitoids and pupal mortality. There were no effects on host species but substrate and host: parasitoid ratio did affect progeny production and total mortality. There was no difference in parasitoid progeny production between host: parasitoid ratios. These results suggest the genus *Spalangia*, and primarily *S. cameroni*, is a suitable candidate for augmentative releases on equestrian farms in Florida.

P145 Implications of gender relations for the introduction of IPM among tomato farmers in Ghana

*Laura Zseleczky[1], lauraz@vt.edu, Maria Elisa Christie[2], Joyce Haleegoah[3], and Awere Dankyi[3]

[1]School of Public and International Affairs, Virginia Tech, Blacksburg, VA; [2]Office of International Research, Education, and Development, Virginia Tech, Blacksburg, VA; [3]Crops Research Institute, Kumasi, Ghana

The purpose of this research was to explore gender relations in the Brong-Ahafo region of Ghana to identify gender-based constraints and opportunities for the introduction of an IPM intervention for tomato crops. This research is part of the Gender Global Theme of the IPM Collaborative Research Support Program (IPM CRSP) funded by the US Agency for International Development. Data was collected through focus group discussions, household visits, field visits, participant observation, and interviews with key informants. All respondents reported using pesticides as their primary form of pest management for tomatoes and 16 of 30 farmers reported losses of more than 50% due to pests and diseases. Findings revealed that most farmers receive information about pest management from other farmers or agrochemical vendors. There are gender differences in knowledge of IPM or alternatives to pesticides. Findings also demonstrate farmers' interest in IPM and the need for trainings on safe pest management and tomato production for both men and women. Women may face more constraints than men in tomato production because they have to find or hire male labor to carry out gendered tasks like land preparation and pesticide application but may have little access to the resources to do so. Women may be less likely than men to adopt labor-intensive IPM technologies but may be particularly interested in strategies that would not require male labor or high costs. A survey is currently underway in Ghana and will supplement these findings.

P146 Not presented

P147 A decision support system for the integrated management of potato and tomato late blight

*Ian M. Small, ims56@cornell.edu, Laura Joseph, and William E. Fry

Department of Plant Pathology and Plant-Microbe Biology, Cornell University, NY

A web-based decision support system (DSS) for tomato and potato late blight, caused by *Phytophthora infestans*, has been developed which links several models into a system that can be used to predict disease dynamics based on weather conditions and management tactics. The system was initially developed for late blight of potato but extension of the system is underway to enable its use for late blight of tomato. Location

specific, observed and forecast, weather data are used by the DSS to drive disease forecast models, including Blitecast and Simcast. Additionally, the DSS utilizes a simulation model, LATEBLIGHT (LB2004 version), to provide a prediction of disease development up to seven days into the future as a function of future weather and future fungicide selected by the user. This simulator provides producers, consultants, researchers and educators with a tool to evaluate disease management scenarios, explore comparative epidemiology, develop forecasting models, or function as a teaching aid. The DSS provides an interactive system that helps users maximize the efficiency of their crop protection strategy by enabling well-informed decisions.

P148 Elucidating disease epidemiology for management of a complex virus pathosystem in wine grapes

*Naidu Rayapati[1], naidu@wsu.edu, Alabi Olufemi[1], Brian Bahder[2], Sudarsana Poojari[1], Andrew Schultz[1], and Doug Walsh[2]

[1]Department of Plant Pathology and [2]Department of Entomology, Washington State University, Irrigated Agriculture Research and Extension Center, Prosser, WA

Grapevine leafroll disease (GLRD), a unique and highly complex virus pathosystem, is the greatest biotic constraint effecting vine health, fruit quality, and economic prospects for the grape and wine industry in Washington State. A broad range of GLRD symptoms have been observed in virus infected grapevines (*Vitis vinifera*) indicating substantial variability in disease symptoms among different wine grape cultivars. Some symptoms mimic those caused by mechanical injury or nutritional disorders, underscoring the need for accurate diagnosis of GLRD using reliable and accurate detection methods instead of visual observations alone. Disease surveys for grapevine viruses over the past 5 years has revealed the presence of six grapevine leafroll-associated viruses (GLRaV-1, -2, -3, -4, -5, and -9) and their genetic variants in several wine grape cultivars. Viruses have been found occurring as single or mixed infections in individual grapevines. Among them, GLRaV-3 was found to be the most widespread in several vineyard blocks. GLRaV-3 was also detected in juice grapes (*Vitis labruscana* 'Concord'), although no symptoms of GLRD were observed in this cultivar. Data on spatial distribution of GLRD indicates clustering of infected vines along rows in vineyard blocks planted with different cultivars. Studies on spatio-temporal spread of GLRD document spread of the disease from heavily infested older blocks to neighboring healthy plantings. Using commercially available pheromones and diagnostic methods, only the grape mealybug (*Pseudococcus maritimus*) has been implicated as a vector in Washington vineyards. These epidemiologically relevant data is offering avenues to develop management guidelines for growers to mitigate the spread of GLRD.

P149 "DNA barcoding" of plant viruses using FTA Classic Card Technology

*Naidu Rayapati[1], naidu@wsu.edu, Poojari Sudarsana[1], Alabi Olufemi[1], Gandhi Karthikeyan[2], Karuppannan Manoranjitham[2], Tri Damayanti[3], and Sri Hidayat[3]

[1]Washington State University, Prosser, WA; [2]Center for Plant Protection Studies, Tamil Nadu Agricultural University, Coimbatore, India; [3]Faculty of Agriculture, Bogor Agricultural University, Bogor, Indonesia

Accurate identification of a virus is the first critical step for implementation of management strategies against virus diseases. Due to the lack of adequate facilities in many developing countries for diagnosis of viruses, we sought alternative methods whereby plant samples can be easily and inexpensively processed and transported from farmers' fields to laboratories capable of conducting diagnostic analysis for reliable and accurate detection of viruses. For this purpose, we evaluated FTA Classic Card technology for the collection, shipment and identification of viruses in different crops. Plant samples suspected for virus infections, based on visual symptoms, were collected from a variety of vegetable crops grown in farmers' fields from India, Bangladesh, Nepal, Cambodia, Tajikistan, and Indonesia, directly pressed gently on FTA cards, allowed to air dry and brought to a central location for virus testing. A simplified method was optimized for eluting the captured nucleic acids from FTA cards. Total nucleic acids recovered were subsequently used in RT-PCR or PCR for the detection of viruses using group- and species-specific primers. The amplified DNA fragments were subsequently cloned and nucleotide sequence determined. The derived sequences were compared with corresponding sequences available in GenBank to confirm identity of virus(es) present in individual samples. The results showed presence of distinct virus species belonging to the genera Begomovirus, Potyvirus, Tospovirus and Cucumovirus in several samples. These results have illustrated the practical value of FTA cards in virus disease surveys, multi-location varietal evaluations against viruses and other downstream applications for molecular characterization of plant viruses.

P150 Host-specific differences in pathogenicity of *Erwinia tracheiphila* from different cucurbit crops

*Erika Saalau Rojas, esaalau@iastate.edu, and Mark L. Gleason

Department of Plant Pathology and Microbiology, Iowa State University, Ames, IA

Bacterial wilt of cucurbits, caused by *Erwinia tracheiphila*, can cause yield losses of up to 80%. Very little is known about the biology of *E. tracheiphila*. Recent studies using a genetic fingerprinting technique called rep-PCR indicated that *E. tracheiphila* strains were distinct according to the cucurbit-crop host from which they were isolated. Twelve strains isolated from

muskmelon (*Cucumis melo* L.), cucumber (*Cucumis sativus*), or squash (*Cucurbita pepo*) were wound-inoculated onto leaves of 2-week-old muskmelon and cucumber seedlings. Wilt symptoms were assessed over a 2-week period and strains were re-isolated. Muskmelon plants expressed wilt symptoms 4 to 5 days sooner when inoculated with strains that originated from muskmelon than when inoculated with strains that originated from cucumber. Similarly, cucumber plants inoculated with cucumber-derived strains expressed symptoms 4 to 5 days sooner than when inoculated with strains derived from muskmelon. Our results suggest that host specificity observed for *E. tracheiphila* is associated with differences in pathogenicity to genera of cucurbit crops. This new insight into pathogen behavior should ultimately lead to development of more effective management tactics for bacterial wilt.

P151 Preliminary assessment of differences in Christmas tree species to root rot

*Brian Eshenaur[1], bce1@cornell.edu, and Shawn Kenaley[2]

[1]New York State Integrated Pest Management Cornell University Extension, Geneva, NY; [2]Department of Plant Pathology and Plant Microbe-Biology, Cornell University, Ithaca, NY

There are approximately 700 Christmas tree farms with at least 3 acres planted in trees in New York State – at least one in nearly every county. (Darling, Christmas Tree Farmers of New York, personal communication). The USDA Nursery Crops Survey 2006 states that the NYS growers they surveyed farmed approximately 8,000 acres, and sold 245,000 trees. Among the Christmas tree species grown, Fraser fir has become increasingly popular and is now considered a premium tree for consumers and Christmas tree growers in NY State. Unfortunately, recurrent episodes of dead or dying Fraser fir has become common in NY tree farms. Tree mortality appears to be associated with poorly drained soils in low-lying portions of affected fields. In other states, *Phytophthora* species have been associated with root rot of Fraser fir. This field project was conducted in a one-year old Fraser fir planting affected by *Phytophthora* root rot. A control planting of replacement Fraser firs, Cannan, Concolor and Turkish firs were planted in replicated blocks to determine and compare their susceptibility to *Phytophthora*. Initial results indicated a that the alternate species are less susceptible to *Phytophthora*-related dieback compared to Fraser fir. Samples from infected Fraser fir, either roots or at the root collar, revealed at least two species of *Phytophthora* were causing disease. Characterizing the role of *Phytophthora* spp. in the etiology of root rot in Fraser and the identification of resistant fir species/varieties will be important in the future management of this problem in NY State.

P152 Biocontrol potential of salinity tolerant isolates of *Trichoderma harzianum* against *Fusarium* wilt disease of chickpea (*Cicer arietinum* L.) under salt stress

*Laxmi Rawat, lakku_joshi@rediffmail.com, Y. Singh, and J. Kumar

Department of Plant Pathology, College of Agriculture, G.B. Pant University of Agriculture & Technology, Uttarakhand, India

This study was conducted to test the impact of salinity on antagonistic ability of five salinity tolerant (ST) *Trichoderma harzianum* (Th) isolates viz.: Th-13, Th-14, Th-19, Th-33, Th-50 and one salinity sensitive (SS) isolate, Th-25, against *Fusarium oxysporum* f.sp *ciceri* (FOC), in order to use them as biological agents in controlling fusarium wilt of chickpea in saline soils. *Trichoderma* spp. tolerated the salinity for their mycelial growth but their sporulation was significantly reduced. Under saline conditions, ST *Trichoderma* isolates greatly surpassed Th-25 in growth rate, sporulation and biological proficiency against FOC. ST *Trichoderma* isolates retained capability to grow and sporulate in growth medium containing up to 240 mM NaCl. Out of five ST isolates that retained their tolerance to different salt stress concentrations, Th-14 and Th-19 showed maximum antagonism against FOC. Plants obtained from seeds bioprimed with Th-14 and Th-19 performed well both at germination and seedling stage in comparison to control in moderately (6.6 dSm-1) saline soil. In comparison with the untreated plants, characterization of *Trichoderma* treated plants confirmed that they had reinforced contents of proline and relatively higher levels of total phenols while lower accumulation of malondealdehyde content. Th-14 and Th-19 significantly reduced the wilt disease incidence of chickpea plants. Simultaneously, the population density of both the Th isolates in rhizosphere far exceeded that of FOC under both saline and non-saline soil conditions. However, Th-14 was more efficient in increasing relative salt tolerance in chickpea and reducing the FOC growth in rhizosphere under present materials and conditions.

P153 Control of soil-borne potato diseases using *Brassica* spp. mediated Biofumigation

*Fiona I. Taylor[1,2], fiona.taylor@sasa.gsi.gov.uk, David M. Kenyon[1], and Susan J. Rosser[2]

[1]Diagnostics and Molecular Biology, Science and Advice for Scottish Agriculture, Edinburgh, United Kingdom; [2]Institute of Molecular Cell and Systems Biology, University of Glasgow, Glasgow, United Kingdom

Potatoes are particularly susceptible to becoming infected by a range of different soil borne pests and pathogens. Infection can lead to blemish diseases which may reduce the market value of the crop, or even lead to the loss of plants or the

whole potato crop. However with mounting legislation leading to restrictions on traditional control methods, attention has turned to more natural methods of control – such as biofumigation. In *Brassica* cells there are both glucosinolates and myrosinases, when the tissue cells are disrupted they come into contact with each other, causing glucosinolate hydrolysis to occur. This results in one of several products being formed, including isothiocyanates (ITCs). Previous studies have shown that ITCs possess a high level of toxicity towards a range of soil microorganisms. It is thought that by encouraging the release of isothiocyanates into the soil, there is the potential to control a large range of soil borne pathogens. This process has been termed biofumigation. This study used a range of techniques to investigate all major aspects of the biofumigation, work using in vitro bioassay, pot trials, and field trials have concentrated on looking at the effects biofumigation has upon the potato fungal pathogens *Rhizoctonia solani* and *Colletotricum coccodes*. An assay using Gas Chromatography–Mass Spectrometry has also been developed to determine levels of isothiocyanates within a range of brassica plants at different developmental stages. Work has also been carried out to determine the effects that biofumigation has upon soil microorganism communites.

P154 Identification of resistant donors for tomato leaf curl virus in Coimbatore, India

*L. Pugalendhi, vegetables@tnau.ac.in, G. Karthikeyan, B.K. Savitha and R. Aravintharaj

TamilNadu Agricultural University, Coimbatore, India

Tomato (*Solanum lycopersicum* L.) is one of the popular vegetable crops in India. Tomato leaf curl virus disease (ToLCV, genus *Begomovirus*, family Geminiviridae), transmitted by *Bemisia tabaci* Genn. is one of the most destructive diseases of tomato crop. With IPM-CRSP support, field trials were conducted during 2010-2011 at the Department of Vegetable Crops, Horticultural College and Research Institute, Coimbatore, India to screen tomato accessions against Tomato leaf curl virus. Response of cultivars to disease incidence and severity was highly significant among the accessions. Among 113 tomato germplasms, 12 lines (LE 812, CLN 2123A, L2, RGF, WFF, WFM, LE 150, LE 709, LE 350, LOT, RGM and HN2) were identified as a field-tolerant source to Tomato leaf curl virus. Among the 12 field-tolerant lines, five accessions viz., HN2, CLN 2123A, WFF, WFM and RGM showed complete resistance to the Tomato leaf curl virus. The accessions RGM recorded the highest yield of fruits (70 t/ha), followed by CLN 2123A (65 t/ha) and WFF (65 t/ha). These identified ToLCV resistant accessions are being utilized in a hybridization programme as donor parents.

P155 Incidence of YVMV in okra entries (*Abelmoschus esculentus* l.) under tropical condition

*L. Pugalendhi, vegetables@tnau.ac.in, N. Ragupathi, B.K. Savitha, and G. Karthikeyan

TamilNadu Agricultural University, Coimbatore, India

The degree of Yellow vein mosaic virus (YVMV) at different growth stages of okra plants was studied in eleven *Abelmoschus esculentus* entries in naturally infested fields for two seasons (Late Rabi, 2010 and Kharif, 2011) at Department of Vegetable Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, India with IPM-CRSP support. The results of screening for two seasons revealed that the lines AE 63, AE 64, AE 65, AE 66, AE 67, AE 15 and AE 18 were found to be free from YVMV incidence. The other accessions viz., USO 7109, AE 61, AE 62 and AE 17 recorded an incidence ranging from 2.00% to 19.56% at 90 days after sowing. Among these YVMV-free genotypes, AE 64 recorded the highest yield of 17.00 t ha-1 followed by AE 65 (16.5 t ha-1). The above two accessions are utilized in a hybridization programme as donor parents. The progeny evaluation is in progress.

P156 Influence of different intercrops of sugarcane on nematode population dynamics in Kenya

*Alexander Chirchir[1], alkchirchir@yahoo.com, John Kimenju[2], and Florence Olubayo[2]

[1]Department of Crop Development, Kenya Sugar Research Foundation, Kisumu, Kenya; [2]Department of Plant Science and Crop Protection, University of Nairobi, Nairobi, Kenya

A study was conducted to determine the prevalence and distribution of plant parasitic nematodes associated with sugarcane in western Kenya and the influence of their population by different intercropping regimes. Soil samples were collected from randomly selected farms in each zone. Fifteen genera of plant parasitic nematodes were recovered from the sugarcane rhizosphere. The most predominant were *Pratylenchus*, *Scutellonema* and *Meloidogyne* species with densities of 21%, 18% and 13% respectively whereas *Belonolaimus, Trichodorus* and *Longidorus* were the least prevalent, all at <1%. Greenhouse tests were conducted to determine relative host resistance status of sugarcane varieties grown in Kenya. Seven varieties, namely Co421, Co617, Co945, EAK70-97, KEN83-737, KEN82-808 and KEN82-216, were selected for evaluation. All the varieties tested were susceptible to nematode damage but showed a higher level of resistance compared to the standard, N14. To determine the influence of different intercrops of sugarcane on the nematode population dynamics, five food crops were selected, namely bean, soybean, pigeon pea, maize, and cowpea. Nematode numbers were 81% lower in a Co421/bean mixture compared to N14/bean. Significant differences ($P \leq 0.05$) were also observed in different sugarcane/soybean

mixtures. *Pratylenchus* and *Aphelenchoides* species were significantly (P≤0.05) influenced by different types of intercrop with their numbers highest in Co617 and least in KEN83-737. Overall intercropping resulted in reduction of numbers of nematodes except *Scutellonema* species whose numbers increased in sugarcane/bean mixtures.

P157 Effectiveness of selected fungicides for control of white powdery mildew of apples in Uganda

*Arinaitwe, A.B., abelarinaitwe@yahoo.com, Turyamureba Gard, and Imelda. N. Kashaija

Kachwekano Zonal Agricultural Research and Development Institute (KAZARDI), Kabale, Uganda

Powdery mildew of apples caused by *Podosphaera leucotricha* (Ell. & Ev.) is the most important disease of apples and pears in Uganda. It attacks apple tree stems, leaves, flowers, and fruits, simultaneously, or at different times and intensities in orchards. Control of powdery mildew of apple in Uganda requires application of appropriate fungicides. A study to identify the most effective fungicides that can control the disease was conducted from 2009 to 2011. A randomized complete block design with two replications and nine selected candidate fungicides as treatments was used. The treatments included protectant fungicides, Thiovit (Wettable suphur), Agrozeb, and Antracol (propineb), and semi-systemic or systemic fungicides, Milraz (propineb and cymoxanil), Equation Pro (famoxadone + cymoxanil) and Ridomil Gold, Rodazim, cobox and Nimrod. For each fungicide, the industrial recommended rate was used. The first fungicide treatment was applied immediately after defoliation in two susceptible cultivars of Golden dosert and Apple Anna. The trees were 4 years old and monitored weekly for disease severity following inoculation with white powdery mildew. Results from the study showed that Agrozeb, Thiovit, and Atracol reduced disease severity by 10% and were more effective in controlling white powdery mildew of apples compared to other fungicides. The results of disease severity computed using relative area under disease progress curve (rAUDPC) for powdery mildew on apple plants were; Orius (32.92%), Agrozeb (36.05%), nimrod (36.76%), Thiovit (37.93), Atracol (40.19%), Cobox (42.40%), Equation pro(43.6%), Milraz (45.30%), Ridomil(46.27%), control (No spray) (46.40%). and Rodazin (50.2%) respectively.

P158 Pruning techniques for managing bacterial canker of sweet cherry

*Juliet Carroll[1], jec3@cornell.edu, Thomas Burr[2], Terence Robinson[3], Stephen Hoying[4], Kerik Cox[2], and Marion Zeufle[1]

[1]NYS IPM Program, Cornell University, Geneva, NY; [2]Department of Plant Pathology and Plant Microbe Biology, Cornell University, Geneva, NY; [3]Department of Horticulture, Cornell University, Geneva, NY; [4]Department of Horticulture, Cornell University, Highland, NY

Bacterial canker of sweet cherry occurs worldwide, causing bud mortality, twig cankers, leaf spots, flower and fruit lesions, and severe collapse and death of trees. In New York, the pathogen *Pseudomonas syringae* pv. syringae (Pss) is most commonly isolated from infected tissues. Given that the pathogen may enter through pruning wounds, our objectives were to determine if, by leaving pruning stubs, trunk and scaffold cankers could be reduced, and if pruning time or bactericides reduce stub infection severity. Pruning techniques and bactericides (copper and phosphorous acid, applied at March and April pruning times) were evaluated in replicate orchard blocks in Geneva and Highland, NY. Stub pruning (avg 20-cm-long x 3.5 cm diam) and inoculation were done in March, April, May and post-harvest. Cut surfaces were inoculated with Cu-sensitive Pss (10^8 cfu/ml). Canker progression down stubs (severity) was assessed during the growing season. Stub infections rarely progressed into scaffolds or trunks. Cankers progressed furthest in stubs pruned in March and least when pruning was done post-harvest. Bactericide treatments failed to prevent infections and provided less than 19% reduction in canker severity. Our results suggest that bactericide applications at pruning provide little benefit and that post-harvest stub pruning can be used effectively to lessen canker infection. Reducing copper applications in orchards will slow the emergence of Cu-resistant bacterial strains and reduce copper build-up in soils.

P159 Regalia® biopesticide in plant disease management

*Hai Su, hsu@marronebio.com, Russell Blair, Tim Johnson, Celeste Gilbert, Phyllis Himmel, and Pam Marrone

Marrone Bio Innovations, Inc., Davis, CA

Regalia® is formulated from an extract of giant knotweed (*Reynoutria sachalinensis*) and is registered as a biopesticide with EPA in the US and with COFEPRIS in Mexico. It induces treated plants to produce phytoalexins and simple phenolics and increases the activity of pathogenesis-related proteins such as chitinase and beta-1,3-glucanase. Results of field trials and three years of commercial use show that Regalia® is effective in controlling powdery mildew in cucurbits, grape, and strawberry, downy mildew diseases on lettuce and onion, Botrytis rot on grape and onions, bacterial diseases on citrus, tomato, walnut, etc.. Regalia® can be integrated in disease management programs. Regalia® is synergistic with other commonly used fungicides such as sulfur, copper, azoxystrobin (Quadris®, Syngenta), myclobutanil (Rally®, Dow AgroSciences), mefenoxam (Ridomil®, Syngenta) etc., and can be used in tank mix or rotation for managing fungicide resistance. When used as seed treatment or for drench, Regalia® increased emergence of soybean and cotton in soil infested with *Rhizoctonia solani* and *Pythium ultimum*. Integration of Regalia® in disease management programs also increased crop yield and economic return.

P160 IPM strategies for the management of Peanut bud necrosis virus disease in tomato

*Karthikeyan Gandhi[1], agrikarthi2003@yahoo.com, S.K. Manoranjitham[1], S. Mohankumar[1], R. Samiyappan[1], E.I. Jonathan[1], G. Chandrasekar[1], and Naidu A. Rayapati[2]

[1]Centre for Plant Protection Studies, Tamil Nadu Agricultural University, Tamil Nadu, Coimbatore, India; [2]Department of Plant Pathology, Irrigated Agriculture Research and Extension Center, Washington State University, Prosser, WA

Bud necrosis disease in tomato is caused by Peanut bud necrosis virus (PBNV, genus-Tospovirus, family-Bunyaviridae). In recent years, the disease has emerged as a serious threat to sustainable production of tomatoes in subsistence agriculture in India. Management of the disease has become a challenge due to a broad host-range of the virus and its thrips vector (*Thrips palmi*), the lack of sources of resistance and overlapping cropping seasons. Indiscriminate use of pesticides is resulting in pesticide resistance in thrips. Consequently, we sought IPM strategies as an alternative to pesticide-based tactics for the management of bud necrosis. Through a project funded by the Integrated Pest Management-Collaborative Research Support Program (IPM-CRSP) of the USAID, we conducted farmer-participatory field trials to evaluate the efficacy of IPM tactics for mitigating negative impacts of the disease to tomato production. A combination of the following management practices were evaluated: seed treatment with plant growth promoting biocontrol agents (*Pseudomonas fluorescens* at 10g/kg and *Trichoderma viride* at 4g/kg of seeds), soil application of neem cake at 250kg/ha, soil application of *P. fluorescens* at 2.5kg/ha, selection of healthy seedlings for planting, roguing virus-infected transplants within 45 days of transplanting, installing yellow sticky traps and need-based neem formulations. The data obtained over three seasons in three locations indicated that deployment of these IPM practices were effective in reducing the disease incidence under field conditions. Harvesting data showed 43 per cent yield increase in plots managed with IPM practices when compared to control plots, suggesting economic benefits of adopting IPM to resource poor farmers.

P161 Integrated management of the *Cyperus rotundus*, *C. esculentus*, *Meloidogyne incognita* complex in irrigated crops

*Jill Schroeder[1], jischroe@nmsu.edu, Stephen H. Thomas[1], Leigh Murray[2], Cheryl Fiore[1], Jacqueline Trojan[1], and Naomi Schmidt[3]

[1]Department of Entomology, Plant Pathology and Weed Science, New Mexico State University, Las Cruces, NM; [2]Department of Statistics, Kansas State University, Manhattan, KS; [3]Department of Economics and Applied Statistics, New Mexico State University, Las Cruces, NM

Sustainable crop production in the arid southwestern USA is affected by pest complexes that limit profitability. Persistent interactions among weeds, nematodes, and diseases impact producers who must intensively manage limited irrigated acreage without nonselective biocides. Research has identified mutually beneficial pest relationships between *Cyperus esculentus* L. and *C. rotundus* L. [yellow and purple nutsedge] and *Meloidogyne incognita* [southern root-knot nematode = SRKN] in sandy southwestern soils. These pests do not disseminate readily and are well adapted to coexist and enhance this damaging complex. *Cyperus* species host SRKN with little effect on vegetative growth, their tubers protect SRKN from fumigant nematicides, and nematode infection enhances nutsedge tuber production. A 3-year rotation with a nondormant, *M. incognita*-resistant alfalfa suppressed the pest complex and doubled subsequent chile pepper [*Capsicum annuum*] yield compared to standard cotton rotations; however, all three pests resurged to damaging levels by the end of the season. A 2-year alfalfa rotation followed by targeted herbicide treatment in the next crop slowed resurgence of the pest complex and demonstrated that nutsedge counts can predict SRKN juvenile counts in the field. Two rather than three seasons of alfalfa did not effectively suppress the weed population. Results indicate that herbicide treatment in the alfalfa or three seasons of a *Cyperus* spp./*M. incognita* suppressing crop are needed to obtain initial suppression of the pest complex, and that additional in-crop management is needed to sustain pest suppression. Rotation schemes must be chosen based on economic return, efficient water use, and effective suppression of the weed-nematode complex.

P162 Efficacy of soil amendments with neem cake and with bio-control agent on the incidence of *Macrophomina* stem and root rot of sesame

T.S. Rajpurohit, rajpurohitts@rediffmail.com

Agricultural Research Station, S. K. Rajasthan Agricultural University, Mandor, Rajasthan, India

Stem and root rot of sesame caused by *Macrophomina phaseolina* infects a high percentage of plants and consequently leads to great yield losses in rainfed crops especially in Rajasthan. The continuous use of chemicals has deleterious effecs on the beneficial microorganisms in soil, in addition to the residual problem and development of resistance by the pathogen. An experiment was conducted in a randomized block design with eight treatments and four replications with plot size of 4x2.4m on sesame during kharif 2006–2007 at Agricultural Research Station, Mandor-Jodhpur (Rajasthan), India to find out the efficacy of soil amendments with neem cakes and with bio-control agents on the incidence of *Macrophomina* stem and root rot. The cakes were incorporated in the soil and mixed thoroughly before sowing. Bio agent *Trichoderma viride* was added in FYM 15 days prior to its application and kept in shed. The incidence of *Macrophomina* stem and root rot was recorded before

harvesting. Minimum incidence of *Macrophomina* stem and root rot (3.32%) and highest seed yield (924 kg/ha) was recorded in soil application of Neem cake (250 kg/ha) + seed treatment with *T. viride* (0.4%) + soil application of *T. viride* at 2.5 kg/ha, This treatment gave 82.27% disease control and 43.92% yield increase with B:C ratio of 2.88. This was followed by seed treatment with *T. viride* (0.4%) + soil application of *T. viride* at 2.5 kg/ha (PDI 6.08%, seed yield 816 kg/ha). Highest disease incidence (13.03%) was recorded in the control.

P163 Investigating a tomato virus on Guam

*Robert L. Schlub, rlschlub@uguam.uog.edu, Jesse Bamba, and Roger Brown

College of Agriculture and Applied Sciences, University of Guam, UOG Station, Mangilao, Guam

In the spring of 2007, leaf curling and yellowing were observed in a mature field of Solar Set tomatoes in Yigo, Guam. Yield loss was estimated to be 10%. Two samples were sent to Agdia Diagnostics for evaluation. Their sequencing produced 89-90% matches to both Papaya leaf curl virus and Malvastrum leaf curl virus. In the spring of 2011, on the same Yigo Guam farm and in another farm in the adjacent village of Dededo, severe leaf curling and stunting of young plants was observed in the cherry tomato variety Season Red. By October, the disease was so severe on the Yigo farm that some tomato fields were a total loss. Leaves with leaf curl virus type symptoms were collected, from a 2-foot tall mature plant (S1) and an 8-inch tall seedling (S2), and sent to Agdia for evaluation. The Tomato leaf samples S1 and S2 tested positive for the presence of Begomoviruses according to the Begomovirus Group PCR test. The forward sequence of sample S1 had an 87% identity to Ageratum yellow vein virus. The reverse sequence of S1 had a 90% identity to both Papaya leaf curl virus and Soybean crinkle leaf virus and an 89% identity to Ageratum yellow vein virus. Both the forward and reverse sequences of sample S2 had a 93% identity to Ageratum yellow vein virus. Current control strategies include rotating out of tomatoes for 120 days with hosts that do not promote build-up of white fly populations of Bemisia tabaci or Begomoviruses.

P164 Managing powdery mildew in cucurbit crops with biopesticides and resistant varieties

Margaret T. McGrath, mtm3@cornell.edu

Department of Plant Pathology and Plant-Microbe Biology, Cornell University, LIHREC, Riverhead, NY

Integrated management programs consisting of biopesticides applied to resistant varieties beginning after disease detection were evaluated for powdery mildew in three parallel experiments conducted under field conditions with different cucurbit crop types in 2007 and 2009. Two biopesticides, Organocide (5% sesame oil) and Milstop (85% potassium bicarbonate), were tested alone or combined with conventional, mobile fungicides (Quintec, Procure, and/or Pristine) in various programs with these fungicides applied in alternation on a 7- or 14-day schedule a total of 2 to 6 times using a tractor-sprayer. Applications were made on a 14-day schedule to resistant varieties in 2007. More effective control was achieved with the integrated program than with biopesticides applied to a susceptible variety for pumpkin in 2009: 59% and 88% control with Organocide and Milstop, respectively, based on severity on upper leaf surfaces at the last assessment in 2009. Control was not significantly improved by adding mobile fungicides. Similar results were obtained in 2009 with Milstop applied to butternut squash (95% control) and in 2007 with both biopesticides applied to cantaloupe (100% control). Applying biopesticides on a 14-day schedule to a resistant variety resulted in similar control to that achieved by applying them on a 7-day schedule to a susceptible variety for pumpkin in 2007 but less effective control for butternut squash. Only Organocide was effective on pumpkin in 2007, providing 52% and 70% control on upper leaf surfaces of the susceptible and resistant variety, respectively. Control was 89% and 59%, respectively, for squash.

P165 Interaction of bee pollination and seed feeding insect damage on sunflower (*Helianthus annuus* L.) seed traits

*Kentaro Miwa, kmiwa@huskers.unl.edu, and Gary J. Brewer

Department of Entomology, University of Nebraska–Lincoln, Lincoln, NE

Flowering sunflower (*Helianthus annuus* L.) is attractive to insect pollinators and herbivores that affect yield and seed quality traits. Insecticide applications made during anthesis can reduce insect damage to seeds but may also decrease the benefits of bee pollination. Our objective was to measure the interaction of bee pollination and seed feeding insect damage on sunflower seed traits. In four North Dakota and Nebraska trials, bee exclosures were placed on individual sunflower heads during anthesis to prevent pollination by bees. Other plants were open to insects. Plants exposed to bees generally had more seeds, higher yields, and larger heads. Seed oil percentage was increased in some hybrids. In 2008 in Nebraska, four insect exposure groups were tested by applying combinations of two treatments, mesh bags to exclude bees and insecticides to remove pests. Plants in the Bees & No Pests group produced the highest yield; those in the No Bees & Pests group generally produced the lowest yield. Plants in the No Bees & No Pests and the Bees & Pests groups were intermediate in seed production. The results indicate that bees can increase yield and that the use of an insecticide to manage pest insects may not result in maximized seed production if bee pollination is reduced. Insect management in sunflower should consider impacts on both wild and domesticated bee populations. Managing sunflower to maximize bee activity may be more valuable than controlling pest insects in some environments.

P166 Lethal and sublethal effects of insecticides on *Chrysoperla carnea* (Neuroptera: Chrysopidae)

Kaushalya G. Amarasekare, *Peter W. Shearer, peter.shearer@oregonstate.edu, Nicole Allum, and Amanda A. Borel

Oregon State University, Mid-Columbia Agricultural Research and Extension Center, Hood River, OR

Our laboratory bioassay focused on lethal and sublethal effects of cyazypyr, rynaxypyr (Altacor®), spinetoram (Delegate®), novaluron (Rimon®), lambda-cyhalothrin (Warrior II®) tested against adults and second-instars of the green lacewing *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae). Products were tested using concentrations that were equivalent to the high label rate (1x) and 1/10th of that amount (0.1x) dissolved in 100 gallons of water. High rates of rynaxypyr, spinetoram and lambda-cyhalothrin and both rates of cyazypyr were highly toxic to adults. Both rates of novaluron appeared to be toxic to larvae with no larva to adult survival. Larva to adult survival was lower for high rates of rynaxypyr and spinetoram and both rates of cyazypyr and lambda-cyhalothrin. Viability of eggs was low when females were treated with either rates of novaluron.

P167 Management of major pests of small Cardamom in Karnataka

*D. Jemla Naik, djn97@rediffmail.com, S.D. Rangaswamy, D. Thippesha, and K.M. Devaraju

Zonal Horticultural Research Station, Karnataka,India

An experiment was conducted at Zonal Horticultural Research Station, Mudigere, Karnataka during 2008-09 and 2009-10 to identify ecofriendly insecticides to manage the major pests of Cardamom. Results of seasonal incidence of thrips indicated that the maximum thrips population was recorded during February to April while October to December compared to minimum populations during June to August. The thrips population exhibited a significant positive correlation with maximum temperature (r = 0.474) and sunshine hours (r = 0.229). A significantly negative correlation was recorded between thrips population with rainfall (r = –0.313), relative humidity (r = –0.231) and minimum temperature (r = –0.278). The quality analysis of different graded capsules indicated the lowest oil content (4.5%) in maximum thrips-damaged capsules compared to healthy (5.1%) capsules. The percent Oleoresin 1.8 – cineole (39.95%) content was high in damaged capsules compared to healthy capsules (35.85%) whereas the reverse trend was observed in the case of α – Terpenyl Acetate. More than 33% loss in weight of different graded capsules was recorded in damaged capsules compared to healthy capsules indicating that as damage increases the capsules weight decreases drastically. The efficacy of insecticides in a spray schedule indicated that sprays of Methomyl 1gm/lit and Poneem 3ml/lit resulted in low thrips damage (10.83% and 10.56%) and high capsule yield (138 kg/Ac & 136 kg/Ac), respectively, compared to standard check of Carbosulfan 2ml/lit and other treatments. Methomyl 20SP and Poneem can be utilized as an alternative to the standard check in spray schedule of management of major pests of Cardamom.

P168 Not presented

P169 Organic soil fertility amendments as an IPM tool against Lepidopteran pests of cabbage

*Jeninah Karungi[1], jkarungi@agric.mak.ac.ug, J. Kateregga[1], K. Byamugisha[1], B. Ekbom[2], and S. Kyamanywa[1]

[1]School of Agricultural Sciences, Makerere University, Kampala, Uganda; [2]Department of Entomology, Swedish University of Agricultural Sciences, Uppsala, Sweden

A study was conducted to evaluate the effects of different organic soil fertility amendments on population dynamics of the lepidopteran insect pest complex and associated natural enemies on cabbage. A RCBD experiment with six treatments: i) cattle manure incorporated in the soil, ii) crop compost incorporated in the soil, iii) poultry manure incorporated in the soil, iv) grass straw surface mulch, v) NPK fertilizer incorporated in the soil, and vi) the un-amended control, each replicated three times, was conducted for two consecutive seasons. The organic manures were each applied at a rate of 12 tonnes/ha; NPK was applied at a rate of 50 Kg/ha. Data were collected on occurrence of lepidopteran pests and insect predators, plant growth attributes, and yield. The diamond back moth, cabbage head caterpillar, web worm, cutworm, and boll worm were the pests recorded on the crop. The diamondback moth was the predominant pest and was highest on cattle manure and crop compost amended plants and lowest on mulched plants. Predator occurrence varied with type of amendment, spiders were highest in cattle manure plots; ground beetles were highest in mulched plots; whereas ladybird beetles were highest in poultry manure plots. Poultry and cattle manure amended plots had the highest collective number of natural enemies whereas NPK and mulched plots had the lowest. Mulch and NPK amended plants had the lowest pest incidences but brought no yield advantage; however, crop compost amended plants with relatively higher pest incidences had superior yield scores.

P170 Plant bioregulators enhance aphid control in pecan orchards

*Ted E. Cottrell[1], ted.cottrell@ars.usda.gov, Bruce W. Wood[1], Xinzhi Ni[2], Christian M. Paulsen[3], and John R. Ruberson[3]

[1]USDA-ARS, Southeastern Fruit and Tree Nut Research Laboratory, Byron, GA; [2]USDA-ARS, Crop Genetics and Breeding

Research Unit, Tifton, GA; [3]Department of Entomology, University of Georgia Tifton Campus, Tifton, GA

Pecan [*Carya illinoinensis* (Wangenh.) K. Koch] foliage is attacked by three aphid species, with the black pecan aphid [*Melanocallis caryaefoliae* (Davis) (Hemiptera: Aphididae)] being the most serious pest of the three. Feeding by *M. caryaefoliae*, but not the other two (i.e. *Monellia caryella* and *Monelliopsis pecanis*), elicits zones of chlorotic injury leading to premature defoliation. Chlorotic zone elicitation is essential for normal *M. caryaefoliae* development. First instars require ≈2 d to elicit chlorosis; with nymphs remaining stationary at a single chlorotic feeding site throughout their development. Stationary nymphs are exposed to a greater predation threat, except that nymphs distribute about equally on upper and lower leaf surfaces. *M. caryaefoliae* nymphs on the upper leaf surface suffer less predation from predators that spend more time searching the lower leaf surface where the vast majority of *M. caryella* and *M. pecanis* reside. Application of certain plant bioregulators to pecan foliage can mitigate chlorotic feeding injury by *M. caryaefoliae* and not harm beneficial insects. It has been shown that mortality of *M. caryaefoliae* nymphs is high when feeding on foliage treated with certain plant bioregulators. If nymphs survive, however, resultant adults are smaller and take longer to complete development; likely, the result of aphids being severely restricted in the degree of chlorosis elicited. Thus, pre-treatment of pecan foliage with certain senescence-retarding plant bioregulators enables management *M. caryaefoliae* while facilitating regulation of *M. caryella* and *M. pecanis* by natural enemies.

P171 Evaluation of a trap cropping strategy for control of harlequin bug in collard

*Anna K. Wallingford, awalling@vt.edu, T.P. Kuhar, and P.B. Schultz

Virginia Tech, Blacksburg, VA

Six plant species were evaluated for host plant preference of harlequin bug, *Murgantia histrionica* (Hahn) in field cage choice tests in 2010 and 2011. Potential trap crop species, mustard (*Brassica juncea* 'Southern Giant Curled'), rapeseed (*B. napus* 'Athena'), rapini (*B. rapa*), and arugula (*Eruca sativa*), were compared to collard (*B. oleracea* 'Champion') and bean (*Phaseolus vulgaris* 'Bronco'), a typical cash crop and a non-brassica control, respectively. Mustard was the most consistently preferred over collard. In only one experiment was mustard found to be equally preferred for oviposition; in all other oviposition choice tests rapeseed was the most consistently preferred. Mustard was found to be an effective trap crop for reducing feeding injury on collard at three experimental sites in 2010 and 2011. Augmentation of the mustard trap crop with a systemic, neonicotinoid insecticide provided no added control of harlequin bug for the duration the spring season, but contributes to reducing the on-farm population of the pest for subsequent plantings.

P172 The incidence of gall wasp (*Quadrasticus erythrinae*) on *Erythrina* spp.

Thimmaiah Shivashankar and *Chinnaiah Doreswamy, drdoreswamy@gmail.com

University of Agricultural Sciences (Bengaluru) Mandya, Karnataka, India

The invasion of *Quadrasticus erythrinae* (gall wasp) during 2003, has become responsible for the death of >99% the standard plant *Erythrina indica* used in the cultivation of betel vine (*Piper betle*) in southern India. This invasive pest has threatened the very survival of *E indica*. A study (2005-2010) was carried out to record the incidence of gall wasp on 8 *Erythrina* sp from the Indian subcontinent (9 states). The pest incidence was recorded on 20 plants per location (n=27). From each plant galls were recorded on 10 shoots and 100 leaves and the intensity was grouped into 1–4 categories viz., 1) No incidence on leaves and shoots, 2) 5 galls per leaf and shoot (no malformation or death) and 4) >25 galls per leaf and shoot (death of plants was noted at a few sites by collecting information from locals). *E. mysoorensis* (99%), *E. indica alba* (57%), *E. indica orientalis* (98%), and *E. variegata* (49%) recorded highest incidence (category 4) & (mortality). *E. suberosa*, *E. lysistomom* and *E. blackei* had moderate incidence (category 2). No incidence was observed on *E. cristagalli* and *E. subumbrans* (category 1). The results indicate that it would be useful to include the least gall wasp-affected species as alternative IPM practice (as standard) in the betel vine gardens in south India.

P173 Insect and disease management in multi-use landscapes: Conventional, bioenergy, and non-crop hosts

*Thomas E. Reagan[1], treagan@agcenter.lsu.edu, Julien M. Beuzelin[1], Jeffrey W. Hoy[2], Michael O. Way[3], Lloyd T. Wilson[3], Yubin Yang[3], Allan T. Showler[4], Matthew T. VanWeelden[1], and Blake E. Wilson[1]

[1]Department of Entomology, LSU AgCenter, Baton Rouge, LA: [2]Department of Plant Pathology and Crop Physiology, LSU AgCenter, Baton Rouge, LA, [3]Research and Extension Center at Beaumont, Texas A&M AgriLife, Beaumont, TX, [4]Formerly Kika de la Garza Subtropical Agricultural Research Center, USDA-ARS, Weslaco, TX

This work reports the first year of research for USDA NIFA Sustainable Bioenergy grant 2011-67009-30132. The goal of this project is to build a landscape-wide IPM program that will mitigate insect pest and disease damage to energy crops in interaction with conventional crops in the U.S. Gulf Coast region. A portion of the first year of our research documented susceptibility of sugarcane and energycane cultivars to the Mexican rice borer, *Eoreuma loftini*, and the sugarcane borer, *Diatraea saccharalis*. Energycane L 79-1002 sustained >2-fold greater *E. loftini* injury (% bored internodes) compared to the

resistant sugarcane HoCP 85-845. Energycane Ho 08-9003 was identified as being highly susceptible to *E. loftini* with a 3-fold increase in injury over the susceptible commercial sugarcane HoCP 04-838. Additionally, recorded secondary insect pests and diseases of potential bioenergy crops included the sugarcane aphid (*Melanaphis sacchari*), the yellow sugarcane aphid (*Sipha flava*), the Banks grass mite (*Oligonychus pratensis*), and sugarcane smut (*Sporisorium scitamineum*). L 79-1002 is more vulnerable to these secondary pests than any of the other crops examined, including two high biomass sorghums and a sweet sorghum. Research on the effect of crop rotation systems including fallow fields and soybean production on nematode populations has also been initiated. The results of this research will be integrated into an analysis and forecast system providing the capability to identify optimal pest management strategies. Our results already suggest that bioenergy crops, especially if targeted for marginal land, may sustain pest problems more severe than those of conventional crops.

P174 Synergistic interactions within and across insect sensory modalities: Applications for IPM

*Jaime C. Pinero[1], pineroj@lincolnu.edu, Silvia Dorn[2], Roger I. Vargas[3], Giovanni Galizia[4], and Ronald F.L. Mau[5]

[1]Lincoln University of Missouri, Jefferson City, MO; [2]Institute of Agricultural Sciences/Applied Entomology, ETH Zurich, Switzerland; [3]USDA-ARS Pacific Basin Agricultural Research Center, Hilo, HI; [4]University of Konstanz, Department of Biology, Konstanz, Germany; [5]University of Hawaii at Manoa, Honolulu, HI

Vision and olfaction are two key sensory modalities used by insect herbivores to locate and exploit host plants. A comprehensive understanding of the orientation and movement of the herbivore species as well as the factors that influence host selection are crucial for the development of behaviorally-based IPM systems. Three examples of synergisms documented within (olfaction) and across (olfaction and vision) sensory modalities involving three species of insect pests at the level of behavior and neurophysiology will be provided in a succinct way. For plum curculio (*Conotrachelus nenuphar* [Coleoptera: Curculionidae]), a key pest of apple, peach and related fruits in eastern North America, the focus will be on synergisms documented between aggregation pheromones and plant volatiles. For oriental fruit moth (*Grapholita molesta* [Lepidoptera: Tortricidae]), an important pest of apple and peach in various regions of the world, synergisms were demonstrated at the level of behavior and neurophysiology (using optical imaging) among five constituents of plant odors. For the melon fly (*Bactrocera cucurbitae* [Diptera: Tephritidae]), synergistic interactions in response to host- and food-associated stimuli were demonstrated across two sensory modalities (vision and olfaction). These findings have resulted in novel monitoring and control approaches for insect pests using, for example, lures and visually-attractive bait stations. Combined findings emphasize the need to identify and exploit synergistic interactions among insect sensory modalities for the benefit of IPM in order to develop tools that do not unilaterally rely on one cue so that they are more likely to work more reliably under rapidly changing environmental conditions.

P175 Microbial control in strawberry IPM

Surendra Dara, skdara@ucdavis.edu

University of California Cooperative Extension, San Luis Obispo, CA

Microbial control is an underexplored area in strawberry IPM in California. Mild climatic conditions in the strawberry growing areas of California Central Coast are favorable for entomopathogenic fungi such as *Beauveria bassiana* which is pathogenic to most of the arthropod pests such as aphid, lygus bug, spider mite, thrips, and whitefly on strawberries. Commercial formulations of this fungus are available for both organic and conventional operations. Preliminary laboratory, greenhouse and field studies indicated the potential of microbial control as an important component of strawberry IPM. Reduced rates of certain chemical pesticides along with *B. bassiana* resulted in higher and faster mortality of adult western tarnished plant bug, *Lygus hesperus* in laboratory bioassays. Such combinations can reduce chemical pesticide usage while increasing the efficacy of the biopesticide. A preliminary field study and a greenhouse study indicated the potential of managing lygus bug, aphids, and whiteflies with *B. bassiana*. Endophytic colonization of *B. bassiana* in some host plants is known to provide protection against herbivore damage. A greenhouse study demonstrated successful colonization of *B. bassiana* in strawberry plants and persistence in various parts for up to 9 weeks post inoculation. Influence of colonized fungus on herbivore damage is yet to be determined. A successful strategy for incorporating microbial control into strawberry IPM can provide environmentally sustainable management options with reduced chemical usage as well as help extend the life of effective chemical pesticides.

P176 Effect of methyl salicylate-based lures on lady beetle populations in Central Kentucky blackberries

*John D. Sedlacek, john.sedlacek@kysu.edu, Karen L. Friley, Justina Riddick, and Joy Birike

College of Agriculture, Food Science and Sustainable Systems, Kentucky State University, Frankfort, KY

Kentucky annually produces approximately 45 ha of blackberries for a total value of $1,000,000. Demand for locally grown, damage-free blackberries usually exceeds the supply. Developing more sustainable production methods, including the use of beneficial insect attractants, such as a methyl

salicylate-based lure is important for the success of small and limited resource farmers. Eight blackberry sites, including six grower collaborators, were located in Franklin, Fayette, Scott and Shelby counties Kentucky. Three sites were certified organic and the other five sites had no pesticides applied. Four sticky traps and posts were placed in all sites and two PredaLure® lures were placed in each of the PredaLure baited sites. Sticky traps were collected weekly, placed in labeled Ziploc® bags and taken to the laboratory where lady beetles were identified using an illuminated magnifier. Pink lady beetle, *Coleomegilla maculata*; multicolored Asian lady beetle, *Harmonia axyridis*; spotless lady beetle, *Cycloneda munda*; seven-spotted lady beetle, *Coccinella septempunctata*; parenthesis lady beetle, *Hippodamia parenthesis*; mildew-eating lady beetle, *Psyllobora vigintimaculata*; twice-stabbed lady beetle, *Chilocoris stigma*; and orange-spotted lady beetle, *Brachiacantha ursine* were identified in the PredaLure baited sites. Seven-spotted lady beetle and parenthesis lady beetle were not found in the non-baited sites. PredaLure baited sites had more pink lady beetles, while non-baited plots had more multicolored Asian, spotless, mildew-eating and orange-spotted lady beetles. Results will be discussed with respect to previous laboratory attractancy studies and location of each sampling site, as well as the surrounding landscape.

P177 Populations of beneficial insects in methyl salicylate-baited sweet corn in Central Kentucky

*Karen L. Friley[1], karen.friley@kysu.edu, John D. Sedlacek[1], Michael K. Bomford[1], Leslye S. Brent[1], and Darrell Slone[2]

[1]College of Agriculture, Food Science and Sustainable Systems, Kentucky State University, Frankfort, KY; [2]Department of Horticulture, University of Kentucky, Lexington, KY

Sweet corn, *Zea mays* ('Garrison'), was grown in replicated plots using conventional and organic production practices. Plots were baited with PredaLure® lures or were left as non-baited controls. Lures were placed in the center of the plot and in the center of each plot quadrant and stapled to tobacco sticks at tassle height. Beneficial insects were sampled weekly during silking using 15 cm x 15 cm yellow sticky traps stapled to a tobacco stick at ear height. Seven species of lady beetles, one species of big-eyed bug and two species of lacewings were caught in conventionally grown sweet corn plots, while five species of lady beetles, one species of big-eyed bug and one species of lacewing were caught in organically produced sweet corn. Pink lady beetle, *Coleomegilla maculata*; multicolored Asian lady beetle, *Harmonia axyridis*; big-eyed bug, *Geocoris* sp.; and green lacewing, *Chrysoperla carnea*, were the primary predatory insects collected. Pink lady beetle was the most abundant predator caught followed by the big-eyed bug. PredaLure baited plots in conventionally grown sweet corn attracted more pink lady beetle, multicolored Asian lady beetle, big-eyed bug and green lacewing than non-baited plots in 2009. However, during 2010 more pink lady beetle, multicolored Asian lady beetle and big-eyed bug were caught in non-baited plots. No differences were observed in organically grown sweet corn during either year of the study. Separation between baited and non-baited plots could be issues due to potential saturation of the study areas with methyl salicylate.

Research—Natural Resources

P178 Acaricidal effects of four hypocrealean fungi against citrus red mites *Panonychus citri* (Mcgregor) (Acarina: Tetranychidae)

Ronliange Jiang and *Liande Wang, wangliande@yahoo.com

Key Laboratory of Biopesticide and Biochemistry, MOE./ Faculty of Plant Protection, Fujian Agriculture and Forestry University, Fuzhou, P. R. China

Bioassay of eight isolates of four fungi *Lecaniicillium lecanii*, *Metarhizium anisopliae*, *Beauveria bassiana* and *Aschersonia aerlodidae* with different host insect origins were evaluated for their acaricidal effects against female adults of citrus red mite, *Panonychus citri* in the laboratory. A lamp-chimney-caged seedling mite bioassay system was used. It provided a habitat for free activity of the highly mobile mite adults and prohibited the test mites from escaping to give more accurate background mortalities. Each seedling of 40 adults (≤2-day-old) was exposed to a spray of each isolate at the concentration of 104~107 conidia ml-1 plus a blank control (sprayed with 0.02% Tween-80), maintained in a top-meshed lamp-chimney cage at 25° and 12:12 L:D and observed daily for 9-day mortality records. Each of the bioassays was repeated 5 times. The four fungal concentrations resulted in mite mortalities of 40.8 to 70.0% for *L. lecanii*, 40.8 to 71.4% for *B. bassiana*, 45.8 to 63.3% for *M. anisopliae* and 44.6 to 63.2% for *A. aerlodidae*. These results were analyzed by a complementary log-log (CLL) time-concentration-mortality model based on the Hosmer-Lemeshow test. The LC50s of the tested isolates determined by the fitted time-concentration-mortality relationships declined over days after spray while their LT50s shortened with the increase of concentration. The two domestic isolates of *L. lecanii* (V3450) and *B. bassiana* (BFZ0409) are promising candidates for use in spider mite control among the eight tested fungal isolates.

P179 Not presented

P180 Developing a sustainable IPM approach for management of herbicide resistant hydrilla in the U.S.

*James Cuda[1], jcuda@ufl.edu, Jennifer Gillett-Kaufman[1], Joan Bradshaw[2], Kenneth Gioeli[3], Stacia Hetirick[4], Raymond Hix[5], William Overholt[6], and Judith Shearer[7]

[1]Entomology and Nematology Department, University of Florida, Gainesville, FL; [2]Citrus County Extension, Lecanto, FL; [3]St. Lucie County Extension, Ft. Pierce, FL; [4]Osceola County Extension, Kissimmee, FL; [5]Center for Biological Control, Florida A&M University, Tallahassee, FL; [6]Biological Control Research and Containment Laboratory, University of Florida, Ft. Pierce, FL; [7]US Army Engineer Research and Development Center, Vicksburg, MS

Hydrilla verticillata (L.f.) Royle, Hydrocharitaceae (hereafter hydrilla) is one of the worst invasive aquatic weeds in the U.S., with millions of dollars spent annually to control large infestations in all types of water bodies. Various chemical, mechanical and biological methods have been investigated for managing hydrilla infestations in an attempt to control the explosive growth of the weed. However, none were as effective as fluridone, a systemic herbicide used to manage this submersed aquatic weed for the past 20 years. In Florida, it was discovered that hydrilla has developed resistance to fluridone. The resistance problem is cause for concern because the spread of resistant hydrilla is inevitable, and the higher fluridone concentrations required to control it will adversely affect the environment. New tools and tactics to cope with this problem need to be developed. Our novel approach involves integrating herbivory by a naturalized meristem mining midge *Cricotopus lebetis* Sublette (Diptera: Chironomidae) with the native fungal pathogen *Mycoleptodiscus terrestris* and low doses of imazamox, a new acetolactate synthase (ALS) inhibiting herbicide. We anticipate that these different control tactics are compatible with each other, and that by integrating them, we can achieve safe and cost-effective control of both susceptible and resistant hydrilla. This IPM strategy will be initially field tested in Florida, and if successful, will be implemented in other locations in the US where the resistant biotypes are expected to become established. Extension faculty will be instrumental in transferring this new IPM approach to clientele groups.

P181 Increasing herbicide product options in vegetated, non-crop areas: The Natural Areas Herbicide Working Group

*John Vickery[1], jvickery@mcg.net, Jim Broatch[2], Art Gover[3], Roger Hybner[4], and Mark Renz[5]

[1]Denver, CO; [2]Pest Surveillance Branch, ARD, Alberta, Canada; [3]Department of Crop and Soil Sciences, Pennsylvania State University, State College, PA; [4]Bridger Plant Materials Center, USDA-NRCS, Bridger, MT; [5]Department of Agronomy, University of Wisconsin, Madison, WI

Only a small portion of the herbicide products on the market are labeled for use in non-crop areas and rangeland. In part, this is because these markets are small and offer limited return on investment for registrants. Furthermore, the use settings are more varied and use patterns within them are less predictable than in plant agriculture contexts. Thus, product stewardship is more challenging and liabilities potentially greater. As there is a public benefit in controlling noxious and invasive plants in a variety of non-agricultural and non-turf settings, there is a public interest in securing the use of the herbicide products with the best available combination of characteristics for each scenario. The USDA-funded, IR-4 Project is designed to improve the pesticide selection available in the production of minor agricultural and specialty crops—markets that otherwise would have relatively limited chemical options. IR-4 prioritizes suitable prospects, develops data necessary for the registration package, and provides coordination among the parties involved. Although IR-4's mandate is broad enough to include rangeland and non-crop areas, dedicated sources of funding are necessary to expand their work to a new application context. A working group has been established to collaborate with IR-4 to secure new product registrations for natural areas. We present the rationale for the Natural Areas Herbicide Working Group, provide background information on the IR-4 Project, discuss similar issues in Canada and collaboration with colleagues there, and elaborate examples of research and development needs and potential product candidates for label expansion or amendment.

P182 Effectiveness of control treatments on saltcedar (*Tamarix* spp.) seedlings

*Michelle K. Ohrtman, michelle.ohrtman@sdstate.edu, Sharon A. Clay, Shauna Waughtel, and Janet Moriles Miller

South Dakota State University, Department of Plant Science, Brookings, SD

Preventing new saltcedar (*Tamarix* spp.) infestations from seed requires plant identification and removal before they become well-established. However, it is unclear which treatments are most successful for controlling saltcedar seedlings and when plants develop resistant belowground tissues. We examined the effectiveness of chemical, mechanical, and fire control on 4-, 8-, and 12-week-old saltcedar grown in a greenhouse. Seedlings were clipped to 2 cm height, sprayed with herbicide (0.75 mg and 1.5 mg imazapyr per plant) or a combination of these treatments. Clipped and unclipped seedlings were treated with fire for 30-, 60-, and 120-s durations. There were 9 replicates for each age per treatment including untreated controls. Six weeks after treatment, seedling survival was recorded and roots and shoots were dried and weighed for biomass comparisons. Fire following clipping was the most effective treatment with only 20% of 12-week-old plants surviving the shortest duration. Between 20 and 35% of clipped 8- and 12-week-old seedlings survived exposure to the 2X herbicide rate whereas survival ranged from 30 to 55% for the 1X rate. Fire alone

resulted in complete control at 120 s but shorter exposures were less effective on the oldest plants (>45% survival). Herbicide and clipping alone had less influence on survival but reduced plant biomass. No 4-week-old seedlings survived fire or chemical treatments but plant survival was unaffected by clipping. Results indicate that saltcedar seedlings developed belowground reproductive tissues sometime between 4 and 8 weeks after germination and more destructive control practices were required to kill older seedlings.

Research—Urban

P183 A demonstration project using IPM principles for subterranean termite management

Brian T. Forschler, bfor@uga.edu

University of Georgia, Department of Entomology, Athens, GA

The Household and Structural Entomology Research Program (HSERP) in cooperation with the Physical Plant Division (PPD) at the University of Georgia have conducted a termite IPM program for the past 12 years. The program includes notification, inspection, communication, action plan development, implementation and verification. The HSERP has developed and implemented over 65 action plans involving a variety of interventions including landscape and structural alterations, insecticide applications at low volumes and concentrations, and baits. Program effectiveness was evaluated using two measures: the methodological and ideological. The client, PPD, has been 100% satisfied because of the communication of every step of all action plans. The amount of pesticide used was reduced by more than 95% less than required by the Georgia Structural Pest Control Commission Rules. The determination of a 'success' rate depended on the metric. The methodological success rate (no termite activity at areas identified during first inspection) has been 100% while the ideological rate varied from 72% (return of termites to the same building), 90% (using original action plan) to 95% (remediation of infestation using revised action plan, includes action plans not implemented). Important lessons for regulators, clients and practitioners toward developing a new model for termite management include the importance of communication and client cooperation in addition to validation of successful remediation using a targeted treatment approach versus whole house treatments.

P184 Sound landscaping forestall termite invasion to homes

Xing Ping Hu, huxingp@auburn.edu

Department of Entomology and Plant Pathology, Auburn University, Auburn AL

Subterranean termites attached home, structure and even plant in seek of cellulosic food and moisture. They count food and moisture for survival, development, and reproduce, and have the propensity to forage for new sources and territories. Any landscape mulch and water source that contributes to a favorable environment for trees and ornamentals is also good for termites and other insects. Our 10-y study indicates that landscape has profound impact on arthropod pressure, insecticide use, and landscaping plants in urban system. Sound landscaping practices on 10 sites in AL successfully forestalls termite invasion to homes and enhances pest management. We found a positive relationship between the proportion of frequently watered flowerbed/garden and termite abundance, particularly in drought seasons and years.

P185 Integrated pest management in child care: A mixed methods examination of the implementation process

*Evie Kalmar[1], evie.kalmar@ucsf.edu, Abbey Alkon[2], Asa Bradman[3], and Vickie Leonard[2]

[1]University of California, Berkeley–University of California, San Francisco Joint Medical Program, Berkeley, CA; [2]School of Nursing, University of California, San Francisco, San Francisco, CA; [3]Center for Environmental Research and Children's Health, School of Public Health, University of California, Berkeley, Berkeley, CA

Child care providers receive little-to-no training on integrated pest management (IPM) thus implementation rates of IPM are low, despite legislative efforts to increase its use. The objective of this mixed methods study is to: (1) employ a convergent mixed methods design to develop a more complete understanding of the process of IPM implementation in child care, (2) describe the facilitators and barriers to implementing IPM in child care, and (3) examine congruence between IPM practices identified on an IPM Checklist with practices reported in manager interviews. A 7-month pilot study was conducted with 9 California child care centers, serving 854 low-income children. The intervention included an educational workshop and IPM assessment with feedback on the IPM practices and building structure. We employed a convergent parallel design, separately collecting and analyzing qualitative interviews with center managers and quantitative pre- and post-intervention observational IPM Checklists and self-report survey interviews, ultimately converging the results.The qualitative analyses of the implementation process revealed a 4-stage progression, from awareness, recognizing the importance of IPM and

learning how to practice it, the decision to adopt IPM, to implementation of IPM. A wide range of facilitators and barriers were identified. There was general congruence between the manager interviews and IPM Checklist findings on IPM policies, practices, and management. Understanding a model of how IPM is implemented in child care centers, and the facilitators and barriers involved in the process, can aid in planning future health interventions in child care.

P186 IPM alternatives for stored-product insects

Rizana M. Mahroof, rmahroof@scsu.edu

Department of Biological and Physical Sciences, South Carolina State University, Orangeburg, SC

Stored-product insects are comprised of mostly beetles and moths that are adapted to feeding and reproducing on durable stored food and agricultural products. Methyl bromide, a fumigant traditionally used in mills for insect management, is an ozone depleter and phased out in the United States. The use of elevated temperatures, or heat treatment, is gaining popularity as a methyl bromide alternative. Heat treatment involves raising the ambient temperature of a flour mill to 50 to 60°C and holding these temperatures for 24 to 36 h. This study describes stage-specific susceptibility of the red flour beetle, *Tribolium castaneum* (Herbst) and Indianmeal moth, *Plodia interpunctella* (Hubner) two economic pests commonly associated with flour mills in the United States. Further, the cigarette beetle, *Lasioderma serricorne*, thrives on dried plants that contain natural defensive chemicals, such as tobacco, coffee or red pepper and numerous other spices and herbs used in cooking. A non-chemical alternative in managing cigarette beetle is the application of mating disruption, in which an unnaturally high level of synthetic sex pheromone is released in an area that results in males failing to locate females with an ensuing population crash. Preliminary field studies in the U.S. suggest that release of the synthetic sex pheromone serricornin can significantly inhibit proper orientation of male cigarette beetles to females and result in reduced reproduction. The work reported suggests that effective IPM alternatives for controlling key stored products pests can be developed from non-chemical approaches.

author index

Note: *Numbers preceded by a "P" indicate a poster; other numbers refer to oral sessions.*