Western IPM Center
Fostering responsible pest management for a sustainable future.

The Western Front

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Highlights of IPM Activities in the West: Accomplishments, Outcomes, Impacts, and Plans—Part II

This is the second in a two-part series of articles highlighting state IPM activities in the West. These activities were reported by state Extension IPM Coordinators at the WERA-069 annual meeting in April. WERA-069 (now called WERA-1017) is a multistate extension, education, and research committee focusing on IPM in the West. Part one of the series, which highlighted reports for six western states and Guam, was published in the June edition of *The Western Front* and can be viewed at ***http://www.wripmc.org/newsletter/index.html***. Below are reports for an additional five western states.

ARIZONA

Peter Ellsworth, Extension IPM Coordinator and Director of the University of Arizona's Arizona Pest Management Center (APMC), and Al Fournier, Assistant IPM Coordinator, reported on the state and multistate accomplishments and impacts of Arizona's Extension IPM program.

Increased Organizational Capacity for IPM Research and Outreach

The APMC recently concluded a cluster hire to enhance their Extension IPM programs. Three new full-time Assistants in Extension will work with IPM Leadership Teams to develop and deliver science-based IPM programs to end-users. Leveraging of Extension IPM funding with competitive grants and funds from UA's College of Agriculture and Life Sciences made these positions possible.

Peter Ellsworth

APMC staff and Coordinating Committee members (left to right): **Top:** *Lin Evans (PCA, stakeholder), Wayne Dixon (Assistant in Extension, IPM Assessment), John Palumbo (Vegetable IPM Specialist), Marco Peña (Assistant in Extension, Vegetable IPM).* **Middle:** *Bryan Stevens (Assistant in Extension, Community IPM), Ed Martin (Associate Director of Programs, Cooperative Extension), Pat Clay (Valent USA, stakeholder), Bill McCloskey (Weed Science Specialist), Ayman Mostafa (Area Extension Agent, IPM).* **Bottom:** *Shawna Loper (Area Extension Agent, Agronomy), Lydia Brown (Assistant in Extension, Field Crops IPM), Al Fournier (IPM Program Manager).*

- Ms. Lydia Brown will work with the Agronomic Crops IPM Leadership Team.
- Mr. Bryan Stevens will work with the Community IPM Leadership Team.
- Mr. Wayne Dixon will work with the IPM Assessment Leadership Team.
- These new assets join Mr. Marco Peña, Assistant in Extension, Vegetable IPM, who has been working with the Vegetable IPM Team since November 2009.
- Dr. Ayman Mostafa has been hired as the APMC's first-ever IPM Area Agent in Arizona.

Community IPM Team

The Community IPM Team combines expertise from four previously separate program areas: school IPM, residential IPM, turf IPM, and horticultural IPM. This diverse team is in the planning stages for a comprehensive "School IPM—Inside and Out" program that will address the IPM needs of school buildings, grounds, and recreational areas. This pilot program will serve as a model for other types of sites in the future, potentially including assisted living centers, child care facilities, and golf course resorts and grounds.

Vegetable IPM Team

The Vegetable IPM Team has been active for more than a year and has some impressive outputs.

The team implemented new "Veg IPM Updates," delivering timely information to end-users via Web, email, and smart phone. They have delivered 32 biweekly updates since January 2010 on insect, disease, and weed management topics. These reached more than 450 Arizona and California stakeholders via email list and at least 300 stakeholders via the Arizona Crop Information site, ***http://ag.arizona.edu/crops/vegetables/advisories/advisories.html***. (Past updates are archived at ***http://ag.arizona.edu/crops/vegetables/advisories/archive.html***.) Some updates have been distributed by Western Farm Press and the Western Agri-Radio Network, reaching more than 1,000 subscribers.

In addition, the team has produced and posted 14 vegetable IPM videos (four on insects, eight on weed control, and two on diseases) and created a video archive Web page, ***http://ag.arizona.edu/crops/vegetables/videos.html***.

Finally, the team organized on-farm research demonstrations with grower cooperators,

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What's Inside

Jeff Vanuga, USDA-Natural Resources Conservation Service

Director's Comments

We are beginning what could be the last year of funding for the Western IPM Center. In the final continuing resolution last March, Congress funded the Regional IPM Centers for another year. An RFA was released by USDA-NIFA for Regional IPM Centers in July. Kassim Al-Khatib, Director, University of California Statewide IPM Program, Tom Holtzer, Professor of Entomology and Department Head, Colorado State University, and I applied to continue the management of the program in the West. Kassim will take over the Director's responsibilities upon my retirement on July 1, 2012. Tom has agreed to stay on as a Co-Director.

The Regional IPM Centers RFA called for significant programmatic changes. In particular, we will create three new signature programs: "Developing a Water Quality Best Management Practices Curriculum," "Pollinator Protection and Conservation of Beneficials in the Pacific Islands," and "Coordinating Responses to Invasive Species in the West." The invasive species program will create pest-specific work groups to provide leadership, communication, and coordination of responses to the identified high priority invasive species. The overall goal of these work groups will be to develop a process to ensure good regional communication and collaboration for earlier detection and rapid response to manage, control, and/or eradicate the identified high priority invasive species. All three signature programs will be led by Western IPM Center staff and have been identified by stakeholders as priority issues in the West..

It was clear to me when Congress granted another year's funding that there is strong support for the activities of the Regional IPM Centers. The House Appropriations Subcommittee has proposed keeping the Regional IPM Centers in an early markup of the 2012 budget, as has the Senate in early September. It will be important for stakeholders to continue their support if we are to make it through the next budget cycle.

The Western IPM Center released a new RFA for IPM Work Groups, Outreach and/or Publications, Surveys/Crop Profiles, and Pest Management Strategic Plans, with proposals due November 18, 2011. Given that we only have 1 year's funding and 18 months to spend it, we cannot fund research projects. However, the Regional IPM Grants Program RFA will continue to fund Research, Research and Extension, and Extension-only projects.

The four Regional IPM Center Directors, along with several other U.S. IPM delegates, have been invited to the Organization for Economic Cooperation and Development (OECD) "Workshop on IPM Strategies for the Adoption and Implementation of IPM in Agriculture Contributing to the Sustainable Use of Pesticides and to Pesticide Risk Reduction" in Berlin, Germany, October 17–19, 2011. This meeting will address the adoption and implementation of IPM as one of the most important strategies for pesticide risk reduction in agriculture and will focus on practical implementation tools and policies. The overall goal of the workshop is to draw conclusions and make recommendations for OECD, governments, and identified stakeholders to overcome existing barriers and to facilitate further progress in IPM adoption and implementation that will lead to greater pesticide risk reduction.

The WIPMC will, once again, be a proud supporter of the 7th International IPM Symposium, next March, in Memphis, Tennessee. We will participate in various sessions and look forward to great interactions.

—Rick Melnicoe

Seven Regional IPM Grants Awarded in Western Region, Totaling $658,066

The Regional IPM Competitive Grants Program (RIPM) is administered by the land-grant university system's four regions in partnership with USDA-NIFA. In fiscal year 2011, the Western Region RIPM program is supporting three types of projects: Research, Extension, and Joint Research-Extension. The following 2011 proposals have received grant awards:

Research Grants:

Development of an IPM Program for the Invasive Bagrada Bug in Southwest Desert Vegetable Production Systems
Award Amount: $179,463
Principal Investigator: Thomas Perring, University of California, Riverside

Minimizing Impacts to Urban, Agricultural, and Natural Water Systems: Evaluating Biocontrol Agents for Invasive Eurasian Mussels
Award Amount: $99,447
PI: Carolynn Culver, University of California, Santa Barbara

Life History and Refined Management of Cucumber Beetles in Central California Melons
Award Amount: $99,447
PI: Larry Godfrey, University of California, Davis

Development of Integrated Approaches for Clover Crown Borer Management
Award Amount: $31,639
PI: Sujaya Rao, Oregon State University

Research and Extension Grants:

Integrating Biological Control of White Mold into Conventional and Organic Vegetable Rotations
Award Amount: $87,594
PI: Alexandra Stone, Oregon State University

An Integrated Disease Management Program for Banana Industries in the Pacific Islands
Award Amount: $100,000
PI: Koon-Hui Wang, University of Hawaii

Extension Grant:

Developing a Statewide Invasive Plant Early Detection and Rapid Response (EDRR) Program: The Foundation of Effective Integrated Pest Management
Award Amount: $59,976
PI: Jane Mangold, Montana State University

Jeff Vanuga, USDA-Natural Resources Conservation Service

IPM Activities in the West—*from page 1*

including four herbicide trial demonstrations for melons and broccoli and two large translational research projects on aphid control and on monitoring the use of reduced risk insecticides.

Impacts. Program staff have seen a steady increase in attendance at educational meetings and a 220 percent increase in email list membership for "Veg IPM Updates" (from 172 in December 2009 to 385 in December 2010). Stakeholders have offered many positive comments about the quality and relevancy of the team's outputs.

Agronomic Crops IPM Team

The Agronomic Crops IPM Team conducted a statewide IPM needs assessment for field crops (excluding cotton) in 2010, identifying stakeholder priorities for IPM research and outreach. The new Assistant in Extension, Lydia Brown, will work with the leadership team to develop research, grower demonstrations, publications, and other outputs to help address these needs. This position is leveraged by grants from the USDA-Animal and Plant Health Inspection Service (APHIS) Cooperative Agricultural Pest Survey (CAPS) program and the Arizona Department of Agriculture Reduced Risk Pest Management Program. Brown and Peter Ellsworth are developing a national reference document for potential exotic pests of cotton.

IPM Assessment Team

The IPM Assessment Team focuses on the development of data and resources to help measure the adoption and impact of the APMC's IPM programs. Two major projects are the Crop Pest Losses and Impact Assessment Working Group and the APMC "1080" Pesticide Use Database. Data from these two sources have been used to respond to federal pesticide information requests and to document extension program outcomes and impacts, including adoption of reduced risk pesticides. Reduction of economic, environmental, and human health risks can be inferred from these data.

Crop Pest Losses and Impact Assessment Working Group. This group has been funded continuously by the Western IPM Center since 2004. The group's goal is to develop "real-world" data on crop pest losses, control costs, yields, and pesticide use in key crops for Arizona and the low desert region of California. The group conducts annual workshops with pest control advisors and guides them through a survey process. The data that are developed provide a broad view of pest management practices and needs in three key crops: cotton, head lettuce, and melons. This started as a process focused on insects, but now the group also collects data on weeds and diseases. In 2010 they conducted six workshops (four for cotton and one each for melons and head lettuce) and also mailed surveys to respondents. Data, reports, and presentations related to these efforts are available online for cotton at ***http://ag.arizona.edu/crops/cotton/insects/cil/cil.html*** and for melons and lettuce at ***http://ag.arizona.edu/crops/vegetables/insects/vegiloss.html***.

Pesticide Use Database. In 2010 the APMC made great advancements on a 20-year statewide pesticide use database (1991 through 2010). This involved 1) key partnerships with the Arizona Department of Agriculture and an industry stakeholder advisory committee and 2) integrating, evaluating, and correcting data from diverse sources.

Soil Fumigation Education

In 2010 the APMC received special funding from EPA to address a critical need for applicator training related to new label requirements for soil fumigant products. An interdisciplinary team, including university faculty, the Arizona Department of Agriculture, and industry partners, developed education resources and delivered six workshops to meet the needs of Arizona agricultural soil fumigation, turf fumigation, and bin fumigant applicators. Program staff trained more than 100 private and commercial applicators and other participants at workshops around the state and provided health certification and respirator fit testing (a U.S. Department of Labor-Occupational Safety and Health Administration [OSHA] requirement). The trainings were extremely well received by participants statewide, who are struggling to keep up with the extensive label changes implemented in 2010 and 2011. An industry specialist dedicated to training pesticide applicators indicated to organizers that this was the best set of pesticide education trainings he had been involved in.

Contact Peter Ellsworth at ***peterell@cals.arizona.edu*** and Al Fournier at ***fournier@cals.arizona.edu***.

CALIFORNIA

Extension IPM Coordinator Kassim Al-Khatib reported that the University of California Statewide Integrated Pest Management Program (UC IPM) was quite productive in 2010 in spite of receiving a significant state-budget cut. By making choices and attracting new external funds, the program maintained its capacity to serve California's IPM community effectively through research, extension, and preparation of online and print resources. UC IPM's work supports audiences in agriculture, communities, and natural resources. The UC IPM urban program continued to expand, adding new programs and products. In agriculture, several new products were released, and a new program for pesticide safety training is being established. Below are highlights of UC IPM's program activities in 2010.

Urban IPM

- Completed a study to survey 92 retail stores in California to determine 1) their resource and education needs related to pests and IPM, and 2) how UC IPM could help them improve delivery of IPM information to consumers.
- Established an advisory committee of stakeholders for UC IPM's retail nursery and garden center education and outreach program.
- Worked with BASMAA (Bay Area Stormwater Management Agency Association) and the California Department of Pesticide Regulation (CDPR) to implement a year-long training/mentoring program. (See related article, page 12.) This program trains paraprofessional consultants to work with retail stores to help them promote less-toxic pest management products and solve customer questions with IPM solutions. This "IPM Advocates" program is a new idea, never tried anywhere else, but it has met with great enthusiasm from potential IPM Advocates, stores, and local stormwater agencies. Training was initiated in June, and mentoring in stores began in August.
- All content (including videos, printouts, and pest management information) on the UC IPM touch-screen computer kiosks has been translated into Spanish, so UC IPM can now serve a greater audience with this popular tool. The program's 16 kiosk units are rotated to about 100 locations throughout California annually. They are used in retail stores and by UC Master Gardeners and others.
- Developed new consumer tools related to beneficial insects, including a 24-minute narrated presentation, "Biological Control in Gardens and Landscapes," which has been posted on the UC IPM Web site (***http://stream.ucanr.org/biocontrol_final/index.htm***). Developed "Quick Tips," in English and Spanish, on Common Predators, Parasites of Insect Pests, Common Garden Spiders, and Less Toxic Insecticides. UC IPM is promoting these materials as outreach tools that UC Master Gardeners can use to help people in their communities become more aware of biological control.
- Developed and posted online training courses for landscape and structural pest control professionals on IPM, Pesticide Properties, Impact of Pesticides, Mitigating Urban Pesticide Runoff, and Water Quality: Bifenthrin and Fipronil. These free courses were approved for continuing education (CE) credit by CDPR and fulfill CE requirements for licensed or certified pesticide applicators who take them.
- Published seven issues of the *Green Bulletin*, a newsletter with practical information for pest management professionals and pesticide applicators who work in urban areas.
- Unveiled a pesticide hazards database for pesticides that are included in UC IPM's *Pest Notes* publications, which are targeted to consumers and landscape professionals. The database currently includes information for 99 active ingredients and is linked to 25 *Pest Notes*.
- Worked with the University of California San Francisco School of Nursing and UC Berkeley's

Lynn Betts, USDA-Natural Resources Conservation Service

Center for Children's Environmental Research to produce an IPM Curriculum for Childcare Centers to meet requirements of California's Healthy Schools Act, which has now been extended to childcare centers.
- Developed IPM training and technical support for Orange County Urban Parks to increase use of IPM at all parks and facilities.
- Developed alternative materials for weed management in landscapes, including plant-based herbicides for pre- and postemergence control of liverwort in greenhouses. Special consideration was given to include alternatives that have little impact on water quality and management.
- Released new guidelines for spotted wing drosophila in backyards, added six new *Pest Notes* titles, and revised 20 others. UC IPM now has more than 150 *Pest Notes*, at least 10 of which get more than 40,000 Web views annually.

Agriculture IPM

- European grapevine moth (EGVM) is a new invasive pest that was detected in 2009 in several counties across California. The insect had never before been detected in the United States, but it is the primary pest on grapevines in Europe and can be expected to cause significant economic harm to California's diverse grape industries if it becomes established. UC IPM is engaged in an all-out effort to combat the EGVM and contributed to a dramatic reduction of EGVM populations in 2010. For example, in Napa Valley the EGVM population declined from about 100,000 moths caught in the first generation to only about 1,000 moths in the second. The decline in the EGVM population was achieved by conducting research to 1) develop and validate an EGVM degree-day model, 2) determine the most effective insecticides and best timing to control EGVM that are least disruptive to the established IPM program in grapes, 3) develop an effective EGVM monitoring system in vineyards with and without mating disruption, 4) evaluate if winery waste is a pathway for spreading EGVM, and 5) determine winter mortality factors of the overwintering pupal stage. In addition, UC IPM has provided technical advice to government agencies, the grape industry, and growers. Furthermore, UC IPM has worked closely with USDA's Natural Resources Conservation Service (NRCS) to utilize the Environmental Quality Incentives Program (EQIP) for helping growers affected by the EGVM quarantine. With funding from NRCS, UC IPM has developed several outreach materials on EGVM, including bilingual publications.
- UC IPM continues its efforts to respond rapidly to new pests that disrupt IPM programs, such as spotted wing drosophila. UC IPM is helping growers identify and manage spotted wing drosophila, which was identified in 2009 and recently has been found in many California counties infesting soft-flesh fruits, particularly ripening cherries and caneberries. Spotted wing drosophila has the potential to become an important pest, because—unlike other *Drosophila* species that is resembles—it attacks ripe, undamaged fruit as well as damaged or rotting fruit. UC IPM is collaborating with Oregon State University and Washington State University by incorporating research results on the UC IPM Web site and posting information for University of California Cooperative Extension and UC researchers on the UC IPM Web site.

Lynn Betts, USDA-Natural Resources Conservation Service

- UC IPM helps walnut and almond growers to use pheromone mating disruptors to control codling moth and navel orangeworm moth. The program reduces grower reliance on broad-spectrum pesticides to manage codling moth and navel orangeworm in these crops. One of the more economical techniques for delivering pheromones in orchards is aerosol puffers. These are easily managed and organized in an orchard in a grid pattern of one puffer for every 2 acres. UC IPM works with growers, training them to increase adoption of pheromone puffer technology.
- Oriental fruit moth, peach twig borer, and obliquebanded leaf roller are serious pest problems in peaches. UC IPM helps growers to develop IPM programs using reduced-risk pest management methods. Field demonstrations were conducted to illustrate these programs to San Joaquin Valley growers who were willing to use newer, more environmentally friendly ways to manage important pests in their peach orchards. IPM methods—including mating disruption and use of reduced-risk insecticides as needed, plus augmentation of oriental fruit moth parasites—successfully prevented these three pests from causing damage in demonstration orchards. The reduced-risk methods were compared to growers' commonly used programs, which involved spraying pyrethroid insecticides for the same pests. Regulators have targeted organophosphate and pyrethroid insecticides for elimination or severe reduction because of their harmful effects on water quality and nontarget organisms. The project also demonstrated a way to augment biological control of peach pests to further reduce pesticide use.
- UC IPM helped organize a workshop on IPM tools and methods to manage almond pests. The workshop helped more than 280 Pest Control Advisors pull together the wide range of IPM tools and methods for managing these pests. Almost all of the participants said they intended to use the methods during the following growing season. The training session was focused on the almond Year-Round IPM Program. For the dormant, bloom, fruit development, and harvest periods, experts presented the latest about monitoring procedures and tools, degree-day pest models, pesticide selection and timing, biological control, and new technologies such as puffers for dispensing pheromones. Speakers also presented information about economic and environmental risks associated with pest control practices. This information included how to meet pest and pesticide residue requirements that foreign markets place on growers who export this important U.S. crop. The evaluation, which used an electronic audience-response system and a brief written survey, indicated that 90 percent of those who answered were interested in using the methods they had learned.
- UC IPM developed a new Web tool that is making it easier for growers and pest control consultants to assess the risk of fire blight in apples and pears. This is an important disease in California. The online program presents the potential for fire blight infection using two science-based models and weather data stored in the UC IPM database. The degree-hour model helps growers know whether they need to treat, and if so, how to time fungicide sprays effectively. The model assesses whether recent temperature and rainfall conditions are right for growth of and infection by *Erwinia amylovora*, the bacterium that causes the disease. The mean air temperature model uses daily air temperatures to predict colonization of blossoms by the bacterium. It also gives information about whether—and when—to treat, based on biology of the bacterium and weather data.
- IPM extension collaboration between UC IPM and the Arizona and Oregon Extension IPM programs continued during 2010. The purposes of this collaboration are 1) to enable a deeper level of coordination among these state IPM programs, 2) to enable specialized tools and services to be exchanged, and 3) to enable high quality outreach to be jointly delivered in shared commodities.
- UC IPM is currently working to develop five new Year-Round IPM Programs, including for eggplant, cucurbits, peppers, corn, and asparagus, bringing the total number to 24.
- UC IPM cooperated with the Oregon IPM program and others at UC Davis on projects to increase use of weather-driven tools for decision making, particularly in grapes.

Natural Resources IPM

- UC IPM, NRCS, and CDPR personnel meet quarterly to apprise each other on IPM issues, progress, and common interests. These partnerships have improved communication and facilitated common IPM goals among agencies.
- The new wildlife IPM program continues to expand, covering several needs related to conflict with wildlife in agriculture. Some of the activities included developing an IPM program for controlling California voles in artichokes, developing monitoring and management methods for Norway and roof rats, and evaluating several attractants for potentially increasing the capture success of pocket gophers.

UC IPM Web Site and Communication

- Program staff continued to update and add new products and tools to the UC IPM Web site, which receives more than 50,100 hits a day. This large number of hits clearly shows the relevance of UC IPM. UC IPM sold approximately 10,000 copies of UC IPM books, identification cards, and leaflets in 2010.

Contact Kassim Al-Khatib at ***kalkhatib@ucdavis.edu***.

COLORADO

The Center for Sustainable Integrated Pest Management in Colorado (CSIPM) was established at Colorado State University to provide a focal point for, and coordination of, pest management research and education. Extension IPM Coordinator Ned Tisserat reported the following highlights of IPM activities in Colorado in 2010.

Legume ipmPIPE

The Legume *ipmPIPE* is a national program to monitor the outbreak and movement of diseases in western, southeastern, and, now, midwestern states. Timely reporting in the West allowed pest management specialists to advise crop consultants and growers regarding disease status and threat. Legume *ipmPIPE* helped growers avoid needless preventive fungicide spraying on 225,000 acres of common bean grown in Colorado (75,000 acres), Idaho (75,000 acres), Oregon (10,000 acres), Washington (30,000 acres), and other western states (35,000 acres). This provided economic benefits to growers and reduced chemical exposure to the environment and food supply. This savings is estimated to total $6.75 million, based on a conservative average cost of $30 per acre for a fungicide and its application.

Onion IPM

The Colorado Onion IPM Network, with a focus on onion thrips and iris yellow spot virus (IYSV), was initiated. *IpmPIPE* and innovative disease diagnostic tools for growers are being developed to provide 1) enhanced pest and disease scouting protocols, 2) more rapid diagnostic confirmation, and 3) more timely pest management strategies that can be implemented by growers throughout the United States.

Wheat IPM

The areawide IPM program in the Great Plains includes:

- the role of diversified crop rotations and host plant resistance in managing Russian wheat aphid and green bug
- tools to enhance the grower's ability to manage Russian wheat aphids and green bugs economically
- research on native predators and parasitoids for Russian wheat aphid
- the benefits of diversification for weed management and crop profitability

Recreational Lands—Invasive Weeds

An intensive extension education program on the problems associated with invasive weeds and how to manage them using an IPM approach began in 2010. Additional training was set, and evaluation planned, for 2011.

Gary Kramer, USDA-Natural Resources Conservation Service

Recreational Lands—Thousand Cankers Disease

Juglans and *Carya* are being screened for resistance to thousand cankers disease. Ongoing research is being done to identify sources of intra- and inter-specific genetic resistance in *Juglans nigra*, *J. hindsii*, and *J. californica*. Inoculation trials demonstrate that black walnut is highly susceptible to canker formation following inoculation with *Geosmithia morbida*. Other walnut species appear to be less affected by the fungus. Based on these trials, interspecific hybrids among *J. nigra*, *J. microcarpa*, and *J. hindsii* are now being considered for resistance to thousand cankers disease. Disease and assess detection methods for the walnut twig beetle, *Pityophthorus juglandis*, are being monitored. The distribution of the walnut twig beetle and *Geosmithia morbida* in the western United States is being documented. Thousand cankers disease was confirmed in black walnut in Tennessee in July 2010. The impact of this finding is enormous, because the disease is considered a serious threat to the survival of black walnut in its native range.

Consumer/Urban Environments—Advanced Plant Pest Training

Advanced training was provided and educational materials developed on urban landscape and home pests (funded by a Colorado IPM Coordination grant). Five advanced training courses were offered to master gardeners, with more than 100 participants. These courses are continuing, and some of the training is being transferred to modules that will be Web-based. To document increased awareness and implementation of IPM practices, CSIPM will begin measuring the technical skills of those receiving the training and evaluate how clientele have implemented IPM practices.

Consumer/Urban Environments—Healthy Housing

Diagnostic aids for identification of bed bugs have been developed, including posters, fact sheets, and presentations. These were distributed to facility managers, nurses, and schools and to university campuses and Extension offices state wide. The evaluation of trapping methods for bed bug detection is in process.

Analysis and outreach for public policy discussion is ongoing regarding state and local policies and regulations on pests and control measures. Community engagement with scientists and decision makers, as shown by increased literacy about potential risks from pests and pest management strategies, will be assessed.

IPM in Schools

In 2010, CSIPM did the following to implement and expand verifiable school IPM programs:

- increased the number of school districts
- made presentations to principals, teachers, staff, and facility managers
- expanded the active advisory committee
- produced newsletters, fact sheets, and articles and created a new Web site

These outputs will be measured by increased awareness and skills regarding pest identification and strategies.

Contact Ned Tisserat at ***ned.tisserat@colostate.edu***.

HAWAI'I

Arnold Hara, Extension IPM Coordinator, and Ruth Niino-DuPonte, Assistant IPM Coordinator, shared the following highlights of the University of Hawai'i at Mānoa's Extension IPM Program.

IPM Implementation in Specialty Crops

Macadamia Nuts

- Macadamia nut producers were trained (through workshops and published materials) to recognize damage caused by the tropical nut borer (TNB) (*Hypothenemus obscurus*) and three of the most common nutrient deficiencies encountered in macadamia nut trees (nitrogen, magnesium, and iron deficiencies). Once the causal agents for these two types of damage were recognized, producers were able to implement effective management strategies.
- Through collaborative research with a plant pathologist at the USDA-Pacific Basin Agricultural Research Center, the primary causal agent of macadamia quick decline (MQD) was identified as *Phytophthora tropicalis*. MQD is responsible for the death of a large number of mature trees in Hawai'i. A pressurized injection system (Arborjet) was developed to deliver phosphorous acid fungicide into the tree trunk at or near infection sites and prolong the life of trees with MQD.
- Use of spirotetramat (Movento) was found to provide better control of the macadamia felted coccid (*Eriococcus ironsidei*) than spray oil emulsions. Long-term control is due to the systemic activity (phloem and xylem movement) of spirotetramat.
- Minor adjustments to harvesting protocol can greatly preserve nut and kernel quality. Clearing the orchard floor prior to the start of the harvest season eliminates old and poor-quality nuts. Harvesting intervals of 4 weeks or less during high infestations of TNB can decrease kernel damage. Likewise, 4-week or shorter harvesting intervals during wet weather reduce damage by mold growth and seed germination, both of which accelerate with increased rain and humidity.
- Adjustments to post-harvest handling can also maximize nut quality. De-husking and delivery of nuts to the processor for drying should be done immediately after harvesting to maintain highest quality. If de-husked nuts need to be held for any length of time (up to 2 to 3 weeks) before delivery to the processor for drying, in-shell nuts should be placed on open-air wire racks (no more than 2 or 3 nuts deep) and kept in a shaded area (not in direct sun) with good air circulation.
- Orchard nutrient management decisions based upon leaf tissue and soil sample analyses continue to minimize over-application of fertilizers, reducing nutrient runoff and leaching.

Impacts for Macadamia Nut Production in Hawai'i

- Identification of the primary causal agent of MQD and an effective injected fungicide finally provided a solution to a problem that has plagued the industry for 25 years.
- Management of disease and insect pests during harvest and post-harvest handling, as well as availability of more effective pesticides and

application methods, have reduced crop losses and increased delivery of higher quality nuts to processors.
- Adoption of these IPM practices allows producers to better predict production estimates and optimize their business profitability.

Saponaceous Fruits

Saponaceous fruits are fruits of the Sapindaceae, or soapberry, family. This is a family of mostly trees and shrubs (not many herbaceous species) whose native distributions are in the warm tropics and subtropics. In addition to longan and rambutan, important saponaceous fruits are the ackee, litchi, and pulsan.

- Nutrient requirements of longan production were determined for a commercial cultivar, "Biew Kiew," based on tissue analysis during fruit development. For every 100 pounds of fresh fruit harvested, a minimum of 0.89 pounds of nutrients, removed by the crop, must be replaced. Application of fertilizer with an approximate ratio of 2-1-4 (N-P-K, 0.74 pounds per 100 pounds of harvested fruit) is recommended during fruit development. Calcium and magnesium (0.10 pounds and 0.05 pounds per 100 pounds of harvested fruit, respectively) can be supplied as dolomite if soil pH is low, or provided in the form of calcium sulfate (gypsum) and magnesium sulfate.
- For both longan and rambutan, adequate moisture is critical during fruit set. Longan trees must receive adequate irrigation and/or rainfall between 12 and 24 weeks after flowering to ensure optimum fruit size at maturity. Rambutan trees should be irrigated at 80 to 85 percent of pan evaporation rate (equivalent to 1.09 to 1.16 inches of rainfall per week) under Hawai'i growing conditions, from fruit set to harvest.
- Growers were encouraged to monitor fruit development. Longan "Biew Kiew" fruit should be harvested between 23 and 24 weeks after flowering, at peak maturity, when weight and soluble solids content are at their highest. Thereafter, sugar content progressively drops, and the seeds begin to germinate, negatively impacting fruit quality.

Impacts for Saponaceous Fruit Production in Hawai'i

- Growers of longan "Biew Kiew" now have effective nutrient management recommendations based on nutrients removed in harvested fruit, which minimizes over-application of fertilizers and risk to the environment through runoff and leaching.
- Production of higher-quality fruits is possible through 1) monitoring rainfall and providing irrigation when necessary to ensure adequate moisture during fruit set and 2) harvesting at peak maturity.

Ornamental Crops

Integrated Crop and Livestock Management Workshop. This workshop, co-sponsored by the University of Hawai'i Extension IPM program and the Western Region Sustainable Agriculture Research and Education (SARE) Professional Development Program was held on June 7 and 8, 2010, at the Komohana Extension and Research Center, in Hilo. The workshop, which had 42 participants, was held

Rick Melnicoe

Potted orchids.

for University of Hawai'i extension faculty and staff as well as personnel from the Hawai'i Soil and Water Conservation Districts, the USDA Natural Resources Conservation Service, the USDA Resource Conservation and Development Council, and the USDA Hawai'i Association of Conservation Districts. Seventeen IPM practices were covered in presentations, demonstrations, and field tours, and participants were surveyed after the workshop on whether they would encourage appropriate adoption of each practice by their respective clientele. Survey results indicated that 89 percent of the state and federal agents would encourage adoption of the IPM practices presented, which included:

- heat treatment of potted plants for quarantine pests
- steam sterilization of potting media and use of cover crops for nematode control
- "natural farming" for livestock
- varroa mite management in honey bee production
- optimizing insecticide spray coverage with nozzle technology
- use of compost extracts and teas in organic farming, and efficacious herbicide application methods

Pest Management Strategic Plan (PMSP) for Potted Orchid Production in Hawai'i. An orchid PMSP workshop was held on September 30, 2010, in Hilo. Pest management strategies for blossom midge, mealybugs, scale insects, false spider mites, snails, and coqui frogs were provided for the strategic plan document authored by personnel at the University of Hawai'i at Mānoa's College of Tropical Agriculture and Human Resources.

Distribution of Insect Identification Poster. A poster was designed and published to assist agricultural producers, state and federal inspectors, extension faculty and staff, personnel at facilities involved with plant shipments, landscape workers, and the general public with identification of the 16 "Most Unwanted Pests in the United States," as designated by the USDA-Animal and Plant Health Inspection Service (APHIS) Cooperative Agricultural Pest Survey (CAPS) project. Six of the 16 featured insects are already present in one or more states, but diligence and early detection can impede their spread and damage. In Hawai'i, new discoveries of these insects can be reported to the Hawai'i Department of Agriculture Pest Hotline at (808) 643-PEST (7378).

Heat as Quarantine Treatments. A commercial-scale hot water shower system to treat potted plants prior to transport is in constant use by six plant export nurseries. University of Hawai'i Extension IPM personnel advised nurseries in the construction of permanent (versus portable) on-site facilities in East Hawai'i County. Volcanic cinder potting media used by plant nurseries continues to be steam sterilized for reniform nematodes.

Impacts for Ornamental Crops

Approximately 63,223 potted plants were treated on the island of Hawai'i during a recent 9-month period, resulting in elimination of more than 1,200 potential causes of rejection, including 1,171 coqui frogs. Rejections of potted ornamental plants exported from Hawai'i to California have been reduced since export nurseries adopted heat as a quarantine treatment. A hot water shower (103° to 120°F for 5 to 15 minutes, depending on target pest) is effective against all life stages of the coqui frog, as well as many arthropods. Steam (160° to 200°F for 30 minutes) effectively sterilizes volcanic cinder media and eliminates reniform nematodes.

IPM Implementation for Animal Agriculture

The "natural farming" waste management concept from Korea incorporates indigenous microorganisms (IMO), use of natural ventilation, and solar positioning for cooling and drying within livestock housing. A maintenance-free green waste bedding system, mitigating nuisance flies and odors, eliminates the need for manure handling. Within a year, five piggeries implementing these concepts have been constructed in Hawai'i. The natural farming concepts have also been adapted to poultry production. Twenty-one stand-alone poultry housing structures (called "Hubbell Bubbles," after their designer, Mike Hubbell) have been constructed in East Hawai'i Island, five of which are being monitored as part of a demonstration project. Nuisance fly and odor levels and egg and chick predation by mongoose and rodents have been significantly reduced in backyard and small-scale commercial poultry operations.

Three workshops covered construction, microbe collection, waste management, and mongoose control. The workshops were held at the demonstration farms, and 50 people participated. More workshops were planned for later in the year.

Impacts of IPM Implementation for Animal Agriculture

The use of IMOs and natural ventilation from Korea provides much-needed options to swine and poultry producers in addressing waste management and environmental protection issues. While the current implementation is for backyard and small-scale production, at least two commercial farms are in the process of adapting the plans for large-scale operations, which will support efforts for increasing food sustainability for the state without contributing to waste accumulation and nutrient runoff liabilities.

Contact Arnold Hara at ***arnold@hawaii.edu*** and Ruth Niino-DuPonte at ***duponte@hawaii.edu.***

MONTANA

IPM Coordinator Barry Jacobsen reported on the Montana State University Extension IPM Program's areas of emphasis and new or rejuvenated programs.

Agronomic Crops

This is a major area of emphasis in Montana, and the whole MSU Extension IPM Program team cooperates on it. Ten 4-hour IPM workshops for agronomic crop producers were held in 2010, with 278 people receiving IPM training that focused on plant pathogen, weed, and insect management. Program staff developed 68 "AgAlerts" dealing with IPM issues. The High Plains IPM Web site has been continuously updated for all crops and has had formatting help from the Bugwood Network.

Sugarbeet, Dry Bean, and Potato

Sugarbeet Seed Selection/IPM workshops were held in conjunction with the Western Sugar Cooperative in December, 2010, with 93 percent of growers attending. In January, 2011, the 12th Montana/Wyoming Sugarbeet and Barley Symposium was held, with 398 growers and agribusiness personnel attending the 2-day symposium.

During 2010 MSU Extension IPM Program staff worked with Oregon State University Integrated Plant Protection Center (IPPC) programmer Len Coop and the uspest.org group to get 12 Montana potato IPM weather stations incorporated into the uspest.org database. Uspest.org provides online IPM pest and plant disease models and forecasting for agricultural, pest management, and plant biosecurity decision support in the United States. In January, 2011, program staff held a full-day workshop with Montana potato growers (with nearly 100 percent attendance by the 52 certified seed producers) on potato IPM and how to use the disease prediction tools found at uspest.org. Growers worked with the potato late blight, early blight, and growing degree day tools on their laptop computers.

Cutworm Prediction

Entomologists on the MSU Extension IPM Program team coordinate a cutworm monitoring program each year in collaboration with Montana growers and county agents. The army cutworm (*Euxoa auxiliaris*) and the pale western cutworm (*Agrotis orthogonia*) are perennial pests of several crops grown in Montana, including wheat, barley, alfalfa, canola, peas, and sugarbeets.

Photo by Bob Nichols, USDA-Natural Resources Conservation Service

Montana alfalfa field.

Damage by dingy cutworm (*Feltia jaculifera*), which is infesting Montana crops, has been increasing, particularly in eastern Montana. In annual collaborative research efforts with county agents, program staff use pheromone lures for the three cutworms that are in most counties state wide. These data are incorporated into the cutworm.org Web site with data from other states and provinces in the region. The MSU Extension IPM Program purchases and then distributes pheromone lures and traps to collaborating growers and county agents across Montana. Recipients install the traps during the first week of August and monitor the number of insects caught weekly through the end of September. Training is provided to cooperators. Collaborators enter trap catch numbers online into the Western Region Cutworm Risk Warning System, maintained by MSU (***http://cutworm.org***). These data are linked to ***http://uspest.org/wea***, where degree day models can predict emergence and growth. This system provides regional risk warnings for the following year that are also used by other western region states. An annual summary is circulated as an "AgAlert" through the Great Plains Diagnostic Network.

Plant Diagnostic Services

MSU Extension's Schutter Diagnostic Lab processed a record 2,151 samples (1,022 disease, 482 plant/weed identification, and 647 arthropod) in 2010. Two Montana first-find pathogens were identified: pine wilt nematode and coin canker of green ash. Four new Montana first-find weeds were identified: white bryony, yellow starthistle, and Bohemian and Japanese knotweed. No new arthropod pests were identified. Primary users of diagnostic services were county agents, crop consultants, landscape managers, service industry personnel, and homeowners. As a baseline for evaluation, a survey was conducted among diagnostic service users. Seventy-eight percent of users indicated they used the services for specialized testing and verification of initial diagnosis. Ninety-four-and-a-half percent of users were completely satisfied.

Honey Bee and Leaf Cutter Bee IPM

Two workshops were conducted for apiarists in 2011, with 67 people attending the 6-hour events. MSU Extension IPM Program staff cooperated with the Montana Department of Agriculture on this project.

IPM Training for Consumer and Urban Environments

This project began in 2008, and the first 20 landscape professionals completed the certification process in 2011 to become Certified Urban IPM Practitioners. Certification is done in cooperation with industry and the Montana Department of Agriculture. An online training program is under development, and a Web site has been developed (***http://www.msuextension.org/urbanipm/certification.cfm***). Two statewide training programs, with 170 attendees, were conducted, and a survey of clientele has been completed regarding services, barriers to IPM use, training needs and types, and what information sources are used by IPM practitioners. A clear message from the survey was that user education is critical to drive demand.

Master Gardner Levels I, II, and III Training

Level III trainees will work with community demonstration gardens and assist with diagnosis of homeowner problems at the county level. IPM training is being done at all three levels, with more than 1,200 individuals receiving 10 or more hours of IPM training.

IPM Training and Implementation in Schools

This project is in cooperation with the Montana Department of Agriculture and EPA Region 8. The first school IPM training took place in 2010 in Bozeman, with Dawn Gouge, University of Arizona, and Ricardo Zubiate, Salt Lake City School District IPM coordinator, as the featured speakers. Pilot training programs in three schools were conducted over the last year. MSU Extension IPM Program staff are currently surveying Montana K–12 schools about their perceptions of pest occurrence and pesticide use. This is a baseline survey for the project. The survey can be found at ***http://msuextension.org/schoolpestsurvey***. Based on the schools in the pilot survey, it appears that pest pressures are lower in Montana than they are in the more southerly states (e.g., no cockroaches have been found to date).

Pesticide Applicator Training

Approximately 5,000 Montana applicators received IPM training during the recertification process. The MSU Extension IPM Program has developed a pesticide newsletter that is published in hard copy and online. Depending on the issue, this information source reaches 400 to 500 people each quarter. This program involves the whole MSU Extension IPM Program staff and the Montana Department of Agriculture.

Contact Barry Jacobsen at ***uplbj@montana.edu***.

PMSP Update

Ongoing:

- **Cucurbit Crops (Hawaii, Guam)**
- **Desert Turf (Arizona, Nevada, and Southeastern California)**
- **Grass Seed (Idaho, Oregon, and Washington)**
- **Low Desert Cotton (Arizona and Southeastern California)**
- **Orchid (Hawaii):** Currently being reviewed
- **Seed Potato (Alaska, California, Colorado, Idaho, Montana, Oregon, Washington):** Currently being reviewed
- **Turf (Hawaii):** Currently being reviewed

Completed:

- **Blueberry (Oregon, Washington)**

Tim McCabe, USDA-Natural Resources Conservation Service

PROFILE

By Diane Clarke

Paul Jepson

Director, Integrated Plant Protection Center, Oregon State University, and Extension IPM Coordinator for Oregon

Paul Jepson, who serves in a number of IPM- and crop production-related administrative, research, extension, and teaching capacities at Oregon State University, has been a member of the Western IPM Center's Advisory Committee since 2005 and the Center's state contact for Oregon since 2003. Paul came to the United States from England in 1995 to be head of OSU's Department of Entomology. Currently, Paul is Director of the Integrated Plant Protection Center (IPPC) at OSU and the Extension IPM Coordinator for Oregon. He also directs the USDA-funded Western Specialty Crops IPM PIPE (Pest Information Platform for Extension and Education) and is a professor in both the Department of Environmental and Molecular Toxicology and the Entomology Graduate Program. Paul's far-reaching expertise in IPM-related work has equipped him to provide unique and invaluable input to the WIPMC. In addition to his support for the Center, Paul has secured WIPMC competitive funding as the principal investigator or co-principal investigator on numerous projects. Paul's Center-funded projects have leveraged almost $2.5 million—more than anyone else funded through the WIPMC.

Associate Director Linda Herbst said, "Paul was a huge supporter of the Regional IPM Center concept from the beginning. He has been a loyal, energetic, and dynamic promoter of the Western IPM Center and has helped mold who we are today." Center Director Rick Melnicoe added, "Paul has provided a lot of guidance and excellent suggestions for the direction of the Center. He has a great vision for local, regional, and national IPM programming and has been adept, in tough budget times, at pulling together funding from all over. He's an excellent ideas person and one of the best grant writers I've ever seen." Overall, Paul has been the PI or co-PI on research and extension grants totaling more than $8.6 million since 2002. Rick went on, "Paul is committed to taking a big-picture, landscape view of things, attending to all of the different factors that influence a pest management decision." Paul's work with the Center-funded weather systems work group is an example of this. The group has made weather-related pest management data more user-friendly to IPM practitioners by advancing the predictability of weather in spatial and temporal scales that are useful to precision agricultural applications.

Importance and Strengths of the IPM Centers

Paul said, "The Centers were a brilliant idea and became a key part of U.S. agricultural infrastructure for 10 years. USDA needs to recognize that." He cited what he considers the three key strengths of the Centers:

1. **Enabling Multistate Cooperation.** "From the beginning, the Centers fostered the idea that there were incentives and benefits for cooperation. It got us thinking about cooperating regionally across political and other boundaries," Paul said. And it was about more than IPM. Paul said, "I developed relationships with people involved with water quality, with pesticides, etc. Right away, it really united us into a series of effective work groups." The IPPC was instrumental in setting up three regional work groups: school IPM, weather, and functional agricultural biodiversity. These have all been successful at leveraging funding, and according to Paul they have helped farmers throughout Oregon and the West.
2. **Facilitating Agency Engagement.** Paul said the WIPMC enabled the West to have a voice with U.S. EPA, the National IPM Committee, and other agencies. "Key here is that we were able to implement the *National Roadmap for IPM*, which I think is really remarkable," he said.
3. **Developing Successful IPM-Supporting Mechanisms.** Paul cited PMSPs as an example. "They were a great idea: they brought stakeholders in who did not previously have a voice, and agencies and programs took notice of the priorities they identified," he said. He pointed out that when the CAR and RAMP programs were still around, PMSPs played a critical role in documenting needs and stakeholder involvement. "That connection is broken now that these grant programs have been cut from the federal budget," he said.

R.G. Jepson

Paul Jepson discussing habitat IPM and natural enemy identification with a hop farmer.

Paul summarized, "Why is the Western IPM Center important? Because it met an unmet need for multistate coordination. A lot of industry and agency programs quickly participated because there was nothing like this before. I travel round the world and see agricultural systems that have failed or aren't as efficient as ours, and it's messy. Leadership, feedback, and coordination are critical to success at all levels. The Centers were a clever idea, but their successes have not been fully built upon yet. I detect changes that indicate we are going back to the way we were before, and this isn't a healthy situation: the mechanisms are not there to substitute for what the Centers provide."

Paul's Work at Oregon State University

About 30 percent of Paul's time goes to directing the IPPC, and another 30 percent is devoted to research and extension work in his role as Extension IPM Coordinator. The rest of his time is devoted to the Western Specialty Crops PIPE, writing and publications, teaching and mentoring, and international work connected with food security.

As IPPC director, Paul provides grant program leadership and coordination, personnel management, and liaison with the university, agencies, farmers, and the legislature. Since becoming director, Paul has developed and implemented the IPPC's strategic vision and managed an approximately $15 million budget, leveraging state funds nine-fold.

The overall goal of the IPPC is to improve agricultural sustainability and food security in Oregon, the Pacific Northwest, and beyond. To do this they develop and deliver state-of-the-science integrated pest and production management (IPPM) systems in collaboration with their stakeholders. IPPM, Paul explained, is a little broader than IPM overall, encompassing, for example, things like crop choices and nutrient and rotation management. "IPM involves combining complementary practices to achieve a goal, and this approach works very well in other areas of crop management. Globally, we have the goal of increasing agricultural production by 50 percent in the next 40 years. IPPM is a

key element of intensified production," he said. To advance the IPPC's goals, Paul has worked to establish a broad set of partnerships with OSU departments and external stakeholder groups, including state and federal agencies, commodity groups, agribusiness and advocacy organizations, and civil society groups.

As Oregon's Extension IPM Coordinator, Paul developed and implemented a new statewide Extension IPM Program and has personally led more than 140 participatory and workshop-based programs since 2002, when he began in this role. With IPPC colleagues, he has succeeded in building a statewide needs-based Extension program for small and organic farmers and large-scale commercial agriculture that blends participatory extension approaches with outcomes-based, context-specific workshops. The IPPC has implemented a platform of decision-support tools based on state-of-the-art climate and weather-based epidemiological and risk modeling that has now been implemented in all 50 states. And, along with a number of his colleagues, he contributed to development of a novel, pesticide risk assessment tool (called PRiME) that represents the current state-of-the-science. PRiME allows producers, advisors, and regulatory professionals to compare different pest management scenarios for any commodity and select options with the fewest potential environmental and health hazards, and to identify mitigation options for the products and uses selected.

Paul oversees research and extension projects in:

- **Biological Control and Biologically-Based Pest Management.** Current projects include caneberry IPM and development of on-farm habitats for beneficial insects and pollinators.
- **Enhanced Diagnostic and Forecasting Tools.** These include pest models and climate and weather models that are also being deployed in the new IPM PIPE program.
- **Pest Management, Rational Pesticide Use, and Risk Mitigation.** This includes research and outreach in pesticide application technology, development of Pest Management Strategic Plans, pesticide safety education, School IPM, and a pesticide monitoring and risk assessment project in West Africa (in the Senegal and Niger river basins).
- **Information Delivery, Decision Support, and Outreach.** The IPPC delivers three online IPM handbooks (insect, weed, and disease). Center staff have also developed an integrated outreach program in soil nutrient and pest management (called iSNAP) that addresses ways to minimize impacts on water quality. In addition, they distribute IPM news and information to the more than 200 public employees with IPM responsibilities in Oregon, and an email and Web-based IPM newsletter to more than 4,000 subscribers in 142 countries eight times a year.

Securing and maintaining funding for all of this work has been far from straightforward. Paul reported that Oregon now has a state Extension IPM program that is more than 90 percent externally funded. "I don't think that's a good thing," he said. "The system has changed. It's been a very big adjustment in the last 10 years, and this in part reflects a lack of appreciation for the importance of extension by federal agencies and within the appropriations process."

Much of Paul's approach to program development involves capacity building. One of the places Paul has seen the benefits of this approach over time is West Africa, where he is involved in a broad partnership addressing pesticide risks, IPM, and food security. He said, "When we go to West Africa, we are working with local professionals and assisting in the development of much-needed capacities." Paul works with colleagues in the United Nations Food and Agriculture Organization (FAO) and local nongovernmental organizations. He said it's very much a partnership, analyzing the contributions that others have made and working out how to build upon them. Paul said, "My approach to professional life is to facilitate development of responsive and productive networks. You should never view your own success as the goal—success, fleeting though it is, comes from helping others to be successful."

Paul's West African work began in England when he was involved with international students in undergraduate and graduate programs. Starting in the mid-1980s, this gave him the opportunity to work with locust and mosquito management in Africa. In the course of this work, he was introduced to the FAO and developed the professional partnerships that have continued to the present day.

Goals, Challenges, Dreams

Paul said the most important professional goal in his work is related to sustainable production intensification. "The goal is that our work reaches enough people and is valuable enough that they can advance their practices and adapt to changing circumstances," he said. "All our work involves partnerships, and we want people to gain skills and reduce critical uncertainties that affect their farming operations." He said this goes back to his time at Cambridge University. "The mantra was to be the best at what you do, but, if no one adopts or applies your work, the work is meaningless. The aim is to secure adoption, and for the benefits of productive research and education partnerships to resonate throughout the production system. And it's key that we actually have a beneficial impact that's measurable," he said.

"My approach to professional life is to facilitate development of responsive and productive networks. You should never view your own success as the goal—success, fleeting though it is, comes from helping others to be successful."

Asked what he sees as the biggest challenges facing the advancement of IPM adoption, Paul answered, "First, the reduction in capacities of Extension programs to truly act as a channel to communicate research needs back to the university and then convey research findings to farmers. Secondly, climate change and all the uncertainties that brings." He added, "The context of IPM is changing rapidly—with accelerated globalized movement of pests, a changing climate, and far greater inter-dependency in the international food system."

If he had limitless time and money, Paul said he would develop a completely integrated decision support system that would combine the power of weather-based epidemiological models with economic risk assessment and IPM decision support. "Growers should be able to zoom out to explore longer time frames across the farm, and zoom in to see what may happen in the next week in an individual field," Paul said. "This is achievable, but there are some critical conceptual pieces and challenges that need to be overcome first, and that requires money, time, and people!"

Personal

Paul cited two chief reasons he chose his line of work. First, he had two lecturers at Imperial College, in London, whom he described as "incredible." One, Graham Matthews, was a world authority in IPM, pesticide application systems, and pesticide droplet physics, and the other, Michael Way, was one of the originators of the IPM concept in Europe. Paul said, "These guys took us out to farms and government research stations to see what they were doing, and that inspired me."

The second thing was the fact that Paul was 10 years old before seeing a farm. "My father worked in the coal mining industry. We got our excitement from the smell of sulfur and sparks while visiting a nearby foundry that cast the axles for the railway engines," Paul said. "Seeing a farm for the first time made a big impression on me."

Paul and his wife, Sue, have a daughter, Rose, who works in Salt Lake City, and a son, Hugh, who works in Corvallis. In the 1850s, Paul's family came to America, but all except one of them died of diphtheria in their journey westwards. Besides his work, Paul said his other great pastime is music. He plays the fiddle and viola, and this was a major passion back in England, where he played semi-professionally for a time. Playing has lapsed recently, but this is something he really wants to get back to.

The Coffee Berry Borer (CBB) Invades Kona, Hawai'i: How Can Growers Live With CBB?

Mike Kawate and Cathy Tarutani, University of Hawai'i, College of Tropical Agriculture and Human Resources, Department of Plant and Environmental Protection Sciences

The coffee berry borer (CBB), *Hypothenemus hampei* Ferrari (Coleoptera: Curculionidae, Scolytinae), is considered the world's most economically important pest of coffee (Damon, 2000). This beetle is endemic to central Africa.

CBB Look-Alikes

Two CBB-look-alikes have become well-established in Hawai`i: the black twig borer, *Xylosandrus compactus,* and the tropical nut borer, *Hypothenemus obscurus.* The latter is known to infest coffee berries, but this occurs only rarely or at a very low frequency. Therefore, tropical nut borer is not considered an important pest of coffee. The black twig borer does not directly infest the coffee berry. CBB was positively identified in Hawai'i in August 2010, and shortly thereafter it was determined that CBB was widely distributed over the entire western coffee growing area of Hawai'i Island (the area that includes Kona). Therefore, it is thought that CBB has been in the area for several years and that samples previously submitted for identification might have been misidentified as either of the two look-alike species.

Living with CBB and Preventing its Spread

Theories explaining how CBB may have invaded the Kona coffee growing area are controversial. Since CBB is so widely distributed, instead of trying to pinpoint the cause of the invasion researchers are concentrating on 1) solutions to allow the coffee industry to "live" with CBB and 2) education for growers, the local public, and tourists to prevent the spread of CBB.

Why CBB is Difficult to Control

CBB is very difficult to control because it spends the majority of its life within the coffee berry. This characteristic might seem like an advantage for its control (i.e., the solution would be simply to remove and destroy all of the fallen and infested coffee berries). However, coffee is grown on a variety of terrains, including on lava rock in some locations, where collecting all the infested berries is impossible. Also, there is a considerable amount of feral coffee (abandoned coffee fields or wild coffee) in the area, and these berries cannot be collected for disposal.

CBB Biology

CBB adults are relatively small—1.4 to 1.7 millimeters in length—and attack green to mature coffee berries (Garcia, 2011). The founder female lives her entire life in the coffee berry she infests, and the berry provides excellent protection from the environment (including chemicals). Females can lay between 31 and 119 eggs (Damon, 2000), and there is a 10-to-1 female-to-male sex ratio (Bittenbender et al., 2010). Males do not fly, so their sole purpose is mating. Sibling mating occurs, and adult females leaving the coffee berry are already inseminated. Reproduction and development of CBB can continue in "raisins" (dried-up berries) that have fallen to the ground. The life cycle from egg to adult is approximately 28 to 34 days, and females can live up to 157 days (Damon, 2000). Males can live from 20 to 87 days. All stages—eggs, larvae, pupae, and adults—can be found in the coffee berry at the same time. There are alternative hosts of CBB in Hawai'i, but CBB has not yet been found to reproduce on them.

How Are Coffee Growers in Kona Going to Control the CBB?

Chemical Control. Currently, chemical control is not known to be an effective option, since CBB is so well protected within the coffee berry for most of its life. No currently-registered insecticide is effective at killing any stage of CBB while it is in the coffee berry. A few contact and translaminar insecticides are labeled for use in coffee, but their efficacy has not yet been fully elucidated. (Translaminar insecticides penetrate the leaf and form a reservoir of active ingredient within the leaf.) If a grower wants to spray an insecticide, he or she must monitor for and spray adult females as they fly in search of coffee berries to infest. Growers can monitor for CBB in their fields using traps baited with a solution of ethanol and methanol in a 3-to-1 ratio.

Biological Control. The biological control fungus *Beauveria bassiana* occurs naturally in Hawai'i. Some control of CBB might be occurring with natural infections of *B. bassiana,* as local strains have been isolated from dead CBB. It is hypothesized that CBB might have been under some biological control initially, but that extreme drought in the area more recently has made conditions less favorable for adequate control of CBB by the local strain of *B. bassiana.* Three commercial formulations of *B. bassiana* have recently been licensed in Hawai'i and are available for use by coffee growers. The efficacy of these products against CBB is not known. The proportion of coffee growers using these products is also unknown.

Courtesy Hawaii Department of Agriculture

Coffee berry borer entrance holes and damage to the coffee berry.

Cultural Control. Cultural control currently plays the most important role in controlling CBB in Hawai'i. At all phases of coffee production and processing, growers and processors need to prevent CBB from escaping and spreading. Such preventive measures include:

- removing and destroying all coffee berries from an infested orchard by manual or mechanical means
- destroying all coffee berries that are not processed
- destroying and/or treating (chemically or with high temperature) all by-products (such as the pulp)
- cleaning all equipment, especially the burlap shipping bags

Drying areas should be screened in to prevent CBB females from escaping from infested parchment coffee.

Research on Control Strategies. Research into strategies to control CBB is ongoing in several areas. These include:

- postharvest treatments (heat, irradiation, hypobaric [i.e., low pressure], CO_2, and others)
- trapping
- synchronizing flowering and fruit development to reduce CBB reservoirs
- screening insecticides (both labeled and unregistered products, as well as natural products such as essential oils)
- studying predator complexes

Natural biocontrol of CBB by local strains of *B. bassiana* may be enhanced by rain and humidity. It is hoped that conditions of more rain and higher humidity will prevail in the Kona area. With strong emphasis on implementing cultural controls, growers may be able to live with CBB until additional control tactics and strategies can be developed.

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Protecting Pollinators: How the Small Hive Beetle is Impacting Producers in Hawai'i and What Can Be Done to Safeguard Honeybees

By Ethel Villalobos, University of Hawai'i Honeybee Project

Kin Hubbard, an American humorist of the early 1900s, wrote, "Nobody can be as agreeable as an uninvited guest." Although I am quite certain he never intended this quote to be used in reference to an insect, it seems to work very well to describe the invasive behavior of *Aethina tumida*, the small hive beetle. This beetle is, by all accounts, an unwelcome guest to the Hawaiian Islands, but it is certainly a very flexible and agreeable one.

How the Beetle Locates and Colonizes Hives

The small hive beetle can find hives by scent from miles away. Since the beetle invades colonies that have built their comb inside tree trunks, in small cavities underground, and in commercial hive boxes, it seems the location of the guest-home does not matter. The beetle's colonization strategies include avoiding detection, minimizing bee aggression, and "patience." It enters the hive using chemical trickery and sly behavior: because it has evolved closely with bees, it can reduce the level of aggression it encounters. The beetle lives a long time for a small insect, so once inside the hive, it can afford to wait for a suitable moment to reproduce. While it waits, it discreetly feeds on honey and hides in a corner of the hive, out of reach of the bees. Then, when the host colony is weakened by environmental factors such as

Ethel Villalobos

The small hive beetle has a high reproductive potential. Eggs are laid in clumps within the hive, sometimes exposed, as in this picture.

drought, or by other pests, the once-agreeable guest becomes an already established threat. A female beetle can lay 2,000 eggs in her lifetime. The eggs hatch within a day or two, and the voracious beetle larvae consume bee brood and pollen resources. The feeding activities of the beetles also contaminate and ferment the honey stores, causing a liquefying effect called a "slime-out," which is commonly associated with dying colonies.

Impacts on the Beekeeping Industry and Agriculture

This honeybee pest arrived just as the beekeeping community had begun rebuilding their industry after the introduction of the Varroa mite in 2007. It quickly spread to four of the main Hawaiian Islands, and is now causing large losses among managed hives. The beetle's invasion has affected a wide range of beekeepers, from backyard hobbyists to large-scale honey producers. Along the Kona coast of the Big Island, where some of the largest concentrations of managed hives in Hawai'i can be found, the arrival of the beetle coincided with a strong drought and resulted in catastrophic losses.

An example of the economic impact is the situation experienced by Whendi Grad and Garnett Puett, an experienced husband-and-wife team of beekeepers. (Garnett is a fourth-generation beekeeper.) Together they own Captain Cook Honey and Big Island Bees and are among the leading, most successful honey producers for the state. However, in 2010, shortly after an explosive small hive beetle infestation, they lost approximately 1,800 colonies, which represented about half of their managed bees. This year, after a large investment in beetle control, they have so far lost 400 colonies, or one-fifth of the remainder of their colonies.

This dramatic decline in honeybee abundance has also had a direct impact on the agricultural sector. Many of the colonies lost in Kona had previously been transported yearly to the macadamia nut fields to provide pollination services for that crop. Understandably, there is much interest from the farmers in the development of IPM strategies to reduce such colony losses. Unfortunately for the local beekeepers and growers, knowledge of the small hive beetle's behavior and population dynamics outside its native range remains limited.

Influence of Climate on Beetle Success

The beetle's success appears to be related to climatic conditions. In the continental United States, regions with marked seasonality experience relatively little beetle damage during the winter months, when beetle reproduction is greatly reduced. However, the subtropical climate of Hawai'i allows bees to raise brood year-round, thus providing continuous resources for the beetle. The warm, humid weather is likely to make pupation possible in most of the Hawaiian landscape and to shorten the duration of immature stages. This release from climatic constraints, typical of temperate regions, may contribute to the explosive beetle population levels recorded on the Hawaiian Islands.

Current Management Options and Research Needs

The existing management options can be divided into chemical controls (synthetic pesticides) and cultural/mechanical controls (traps and colony management strategies). For beekeepers wishing to reduce chemical use in their hives, beetle traps filled with oil are the only option. However, the high beetle densities are forcing local beekeepers to utilize more traps per hive and to check and service these traps more frequently than their mainland counterparts. There is undoubtedly great need for basic research on bee-beetle

Ethel Villalobos

Small hive beetles feeding on a Hawaiian colony that collapsed due to beetle attack.

population dynamics and for applied research aimed at improving the efficacy and reducing the cost of beetle control tools. Management of this invasive species will protect the future of the most important agricultural pollinator, the honeybee, thus fostering the economic viability of small and medium farms in Hawai'i and the rest of the United States.

For more information on the University of Hawai'i College of Tropical Agriculture and Human Resources' work on honeybees, please visit ***http://www.ctahr.hawaii.edu/wrightm/Honey_Bee_Home.html***. Ethel Villalobos can be contacted at ***emv@hawaii.edu***.

Editor's note: *The Western IPM Center, in a new signature program, "Pollinator Protection and Conservation of Beneficials," will work with University of Hawai'i researchers and Extension personnel and other pertinent experts in the western region to develop a workshop curriculum on protecting native pollinators and native beneficial organisms in Hawai'i and the Pacific Island Territories. The project will also include development of a field guide to identify beneficial organisms and pollinators in these unique environments, and workshop participants will be trained on how to use the guide.*

Ethel Villalobos

Honeybee worker attempting to remove a small hive beetle adult. This defensive behavior is uncommon among European honeybees.

IPM Advocates Program for Retail Nurseries and Garden Centers Launched in California

By Mary Louise Flint

The University of California Statewide IPM Program is partnering with the San Francisco Bay Area Stormwater Management Agencies Association (BASMAA) in a new training and outreach program. The program's purpose is to develop a corps of professionals with IPM expertise who can help retail nurseries and garden centers promote less toxic alternatives for managing home and garden pests. This novel program is being funded through a Pest Management Alliance grant from the California Department of Pesticide Regulation.

As more traditional pesticides have been phased out or abandoned by an increasingly "green" consumer base, the demand for accurate information on alternative practices and products has grown. However, store employees, who are a primary source of pest management information for consumers, tend to be ill-equipped to respond to these questions. Safer, effective products are in stores now, but most stores lack knowledgeable employees to direct interested consumers to the appropriate products.

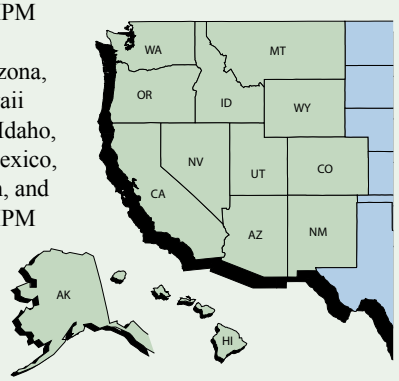
Over the last decade BASMAA's successful Our Water, Our World program demonstrated that there is strong interest among retail nurseries and garden centers in northern California to participate in programs that educate store employees and consumers about less toxic management methods. However, there have not been enough professionals or consultants with IPM expertise to meet the demand for in-store training.

The IPM Advocates Program was created to address this need. We have developed a curriculum to prepare individuals with horticulture/pest management/retail experience to work with stores to improve dissemination of information about less toxic products and safe use of pesticides. The program involves an intensive 7-week, hands-on training course, which is now under way. After training, each advocate will be paired with three stores for a 9-month mentoring period, and after successful completion, each will be certified as an IPM Advocate. IPM Advocates will assist stores with inventory selection, in-store displays, marketing, customer outreach, and employee training workshops. It is expected that certified IPM Advocates will continue this work as consultants to stores or public agencies after the mentoring period has ended. A Web page will also be created, and ways will be identified to maintain the program and IPM Advocate network once the funding period has ended.

Mary Louise Flint is Associate Director for Urban and Community IPM, UC Statewide IPM Program. She can be contacted at ***mlflint@ucdavis.edu***.

Center Scope

The Western IPM Center enhances communication between federal and state IPM programs in the western United States: Alaska, Arizona, California, Colorado, Hawaii and the Pacific territories, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. It serves as an IPM information network, designed to quickly respond to information needs of the public and private sectors.



Mark Your Calendar

2011

- PestWorld 2011, October 19–22, New Orleans, Louisiana. ***https://www.npmapestworld.org/pestworld2011/index.cfm***
- 2011 Bean Improvement Cooperative Conference, October 30–November 2, San Juan, Puerto Rico. ***http://2011bic.com/Home_Page.html***
- National Plant Diagnostic Network Third National Meeting, November 6–8, (field trip November 9), Berkeley, California. ***http://ucanr.org/sites/NPDN_/***
- Entomological Society of America 59th Annual Meeting, November 13–16, Reno-Sparks Convention Center, Reno, Nevada. ***http://www.entsoc.org/am/fm/index.htm***
- 2011 Field Crops Rust Symposium, December 14–16, San Antonio, Texas. ***http://www.apsnet.org/meetings/topicalmeetings/fcrs2011/Pages/default.aspx***

2012

- 64th Annual Conference of the California Weed Science Society, January 23–25, Santa Barbara, California. ***http://www.cwss.org/***
- 25th Vertebrate Pest Conference, March 5–8, Portola Hotel and Spa at Monterey Bay, Monterey, California. ***http:// www.vpconference.org***
- 7th International IPM Symposium, March 27–29, Memphis, Tennessee.
- Western Society of Weed Science Annual Meeting, March 12–15, Peppermill Resort, Reno, Nevada. ***http://www.wsweedscience.org/default.asp***
- Entomological Society of America 60th Annual Meeting, November 11–14, Knoxville, Tennessee. ***http://www.entsoc.org/am/fm/index.htm***

2013

- Western Society of Weed Science Annual Meeting, March 11–14, Catamaran Resort Hotel, San Diego, California. ***http://www.wsweedscience.org/default.asp***
- Entomological Society of America 61st Annual Meeting, November 17–20, Austin, Texas. ***http://www.entsoc.org/am/fm/index.htm***

Gary Kramer, USDA-Natural Resources Conservation Service

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USDA United States Department of Agriculture National Institute of Food and Agriculture