

Symposium program and presentation abstracts

Monday, March 23, 2009

The World Forestry Center

4033 S.W. Canyon Road
Portland, OR

5:00–6:00 pm Reception, World Forestry Center Museum

6:00 pm Move to Miller Hall

6:30 pm

Welcome: Norman C. Leppla, ncleppla@ifas.ufl.edu, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL

Presentation: Fostering IPM and International Understanding in the Middle East

Dan Gerling, dange@tauex.tau.ac.il, Department of Zoology, Tel Aviv University, Israel

Additional Authors: Einat Zchori Fein, Department of Entomology, Agricultural Research Organization, and Yael Argov, The Israel Cohen Institute of Biological Control, Plants Production and Marketing Board, Citrus Division, Beit Dagan, Israel

Pests do not respect international boundaries; neither does the validity of proper IPM practices. Therefore, cooperation can be the road to improved pest management, and replace antagonism with better understanding among peoples. With this double goal in mind, The Peres Center for Peace launched an ICM program, which includes IPM initiatives. Others, like the USAID MERC (Middle East Regional Cooperation) program, finance similarly aimed cooperative projects.

The Red Palm Weevil, *Rhynchophorus ferrugineus* Olivier, (RPW) is of Indo-Malayan origin where it attacks *Arecaceae*. The boring larvae cause extreme damage and since the 1980s when the pest entered the Middle East, hundreds of thousands of trees were lost. The Peres Center for Peace assisted by Novartis, executed an IPM program in Egypt the Palestinian region, Jordan and Israel. Laboratories were constructed, thousands of pheromone traps were distributed, an insecticide treatment program based on trappings was established and early discovery of infested trees was undertaken. Presently, pheromone trap-based monitoring is maintained and recommendations are issued accordingly. Concurrently, other date-culture associated developments are raised, training in pollination technology and pest management take place.

An IPM program to manage the olive fly, financed by MERC, aiming to improve the yield, quality and farm income of table and oil olive varieties while reducing insecticide use, is under way. Goals include 1) trap

improvement; 2) better biological control; and 3) Strengthening professional ties and furthering cooperation of experts and olive farmers in Israel, Jordan and Palestine. So far, local parasitoid species were found, their seasonal dynamics determined and additional species have been introduced. New trap models are tested and meeting and cooperative work is conducted. We found that both projects greatly improved cooperation and understanding at all levels of interaction while bringing about better management prospects of these pests.

7:00 pm Dinner

Tuesday, March 24, 2009

8:00–11:45 am

Opening Plenary Session

Portland Ballroom 254-255

8:00 Welcome, Robert Hedlund, rhedlund@usaid.gov, Integrated Pest Management/Pesticides Management, United States Agency for International Development/Bureau for Economic Growth Agriculture and Trade/Agriculture, Washington, DC

8:15 Transcending International Boundaries: IPM for Pests of Regional or Global Importance, Abdelaziz Lagnaoui, alagnaoui@worldbank.org, Environment Department, Sustainable Development Network, The World Bank, Washington, DC

Integrated Pest Management (IPM) is increasingly becoming accepted as best practice in developed and developing countries. National and international research, extension, and development agencies have long been calling for greater development, implementation, and adoption of IPM not only for its immediate crop protection aim but for its contribution to the millennium development goals. IPM is critical to sustainable production systems for human health, economic efficiency, and environmental sustainability. Over the years the IPM approach has increasingly transcended its disciplinary boundaries and has achieved substantial progress. However, there still remain considerable constraints and challenges to the development and implementation of IPM in resource-poor countries. These challenges are more pronounced in the case of trans-boundary pest and diseases problems. The Desert Locust, for example, is considered a serious threat to agricultural production in Africa on a large scale because of its frequent swarm migrations across international borders, and often requiring large-scale regional control operations. This paper uses examples of such pest problems to illustrate the constraints limiting the development and implementation of IPM and the prevailing trends to favor increased stockpiling and use of chemical pesticides.

9:00 Integrated Crop Protection as a Part of Farming System Design, Janjo de Haan, janjo.dehaan@wur.nl, Wijnand Sukkel, and Jan Eelco Jansma, Applied Plant Research, The Netherlands

Over the last century, crop productivity has been raised dramatically because of mechanization, artificial fertilizers, pesticide use and improved varieties. However, this raise in productivity has lead to an unsustainable farming systems with e.g. large emissions of pesticides and nutrients and deterioration of soil quality. The unsustainability is for a large part caused by a one dimensional solution of problems in crop production: e.g. a pest is occurring, thus a pesticide has to be applied. No thorough analysis is done

of the cause of the problem and alternative control measures. To improve environmental quality and agricultural production in the long-term, new visions on farming are necessary, leading to new sustainable farming systems. In the Netherlands, the prototyping methodology was developed over the last 25 years to design and test sustainable arable and horticultural farming systems. The methodology consists of a 1) thorough analysis of the current and the desired situation; 2) translation of the analysis into a limited set of manipulable parameters and target values on all themes (e.g. crop production, nutrient emissions, pesticide emissions, soil and farm economics); 3) the design of farming methods, coherent strategies on the major aspects of farming, e.g. multifunctional crop rotation or integrated crop protection. 4) Combining the farming methods into a theoretical prototype. 5) Testing and improving the prototype in practice on experimental or commercial farms. Integrated crop protection (ICP) is in this methodology defined as the prevention or minimisation of economical damage to crops caused by harmful species with a minimum of negative effects on the environment. ICP consists of three steps: 1) optimising prevention, 2) establishing the need of control and 3) choosing the actual control measures. Crop rotation design is the basis for ICP in optimising prevention besides farm hygiene and the agro-ecological layout of the farm (field size, ecological infrastructure, crop rotation layout). Results of applying the prototyping methodology on experimental farms as well as on commercial farms will be presented in this paper. The results indicate that by application of the methodology, large steps can be made in making farming systems more sustainable and ambitious environmental targets can be reached without economic consequences. Working with this methodology asks a different attitude of researchers, advisors and farmers. Whereas current practices are often the development and dissemination of recipes, the prototyping methodology asks for situational assessment of problems. The problem has to be seen taking the whole farm into perspective and from there the problems should be solved.

9:45 Break

10:00 IPM Strategies in Eco-agriculture Landscapes:
The Challenge and Opportunities of Coordinated
Pest Management for Products and Ecosystem
Services, Sara J. Scherr, sscherr@ecoagriculture.org,
Ecoagriculture Partners, Washington, DC

Integrated Pest Management for decades has led the shift by agriculturalists from a focus on plot and farm-scale analysis and action to one embracing landscape scale, and in understanding the functional linkages between agriculture and the ecosystem services underpinning production. This landscape frame is now taking on increasing importance as we consider more seriously the impacts of agricultural production systems on other ecosystem services. Biodiversity conservation strategies are extending to production landscapes; management of agriculture-dominated watersheds is becoming more important to water security; environmental health issues (including vector-borne disease) are evolving with climate change; land use options are becoming an increasingly important part of national and international climate change mitigation and adaptation strategies. This presentation will describe those shifts and highlight some of the opportunities and challenges for the IPM community to consider in engaging with these issues. Examples include: evolution of pest complexes and management systems with climate change and in mosaics mixing production and conservation areas; the impacts of landscape diversification and increasing perennial components on pest populations and management in the field and across the value chain; the development of IPM for newly domesticated crops. These may call for different types of training and field partnerships.

10:45 Master Planned Community Developments and
IPM, Pierce Jones, piercejones@ufl.edu, Program
for Resource Efficient Communities, Institute
of Food and Agricultural Sciences, University of
Florida, Gainesville, FL

The Program for Resource Efficient Communities (PREC) promotes adoption of best design and management practices that measurably reduce energy and water consumption and environmental degradation in new master-planned mixed-use communities. The program's focus extends from the lot

level through the site to surrounding lands and ecological systems. PREC consults directly on development projects identifying and evaluating implementation of innovative resource efficient design, construction and operational practices. We are especially interested in projects with the potential to serve as case studies and demonstrations of successfully applied low impact development practices. In Florida standard land development practices involve complete site clearing and mass grading for storm water management. Once homes are constructed, lots are “graded out” creating highly compacted soils with completely disrupted profiles. Individual lots are landscaped predominantly with turf to quickly create a finished appearance. Essentially, the turf is maintained hydroponically within ground irrigation systems and regular fertilization. To maintain property values, homeowner associations enforce community covenants that preserve these standard, landscapes. And these un-natural landscapes require protection from opportunistic predators. Similar thinking drives decisions about construction methods—pest management isn’t a significant design consideration, it’s a post-occupancy management issue. There are many stages in the permitting process for large developments and many opportunities to define the characteristics of a project’s site planning, landscaping and housing. These characteristics are codified in various legally binding documents such as, Development Orders (DO); Site Mitigation and Management Plans; and Conditions, Covenants and Restrictions (CCRs). As problems related to water supply, water quality and energy become critical; developers have shown a willingness to plan their projects more strategically. IPM practices are part of that conversation. The tools needed to leverage IPM practices into developments include: competent integration of IPM into certification programs (such as LEED-ND); specifically targeted IPM field guides for residential communities and training for professionals.

11:30 Closing Remarks, Robert Hedlund, rhedlund@usaid.gov, Integrated Pest Management/Pesticides Management, United States Agency for International Development/Bureau for Economic Growth Agriculture and Trade/Agriculture, Washington, DC

11:45 Adjourn for Luncheon and Integrated Pest Management Achievement Awards Presentation (Portland Ballroom 252-253)
Presiding: Sherry Glick, glick.sherry@epa.gov, Office of Pesticide Programs, United States Environmental Protection Agency, Las Vegas, NV

The goal of this year’s awards program is to recognize efforts that have led to the implementation of IPM practices aimed at reducing risks and costs while minimizing negative impacts on people and the environment. The award recipients were chosen because they displayed notable contributions to 1) improving economic benefits related to IPM adoption, 2) reducing potential human health risks, and/or 3) minimizing adverse environmental effects. IPM users, promoters, service providers and others who demonstrated outstanding contributions to IPM implementation, promotion, or service, especially those having a direct and positive impact, were sought through nominations. These awards recognize outstanding examples of effective IPM implementation, demonstrating a positive impact on end-users.

The following individuals and/or teams will be awarded the **International IPM Excellence Awards:**

- ***IPM CRSP funded by USAID at Virginia Tech***
- ***SYSCO Corporation and Participating Branded Suppliers and Growers***
- ***GREEN SHIELD CERTIFIED Program of The IPM Institute of North America***
- ***Dr. Zeyaur R. Khan, Nairobi, Kenya***
- ***Salt Lake City School District, Utah***

These award winners were ranked highest for exceptional accomplishments relating to economic benefits of IPM adoption, reducing potential human health risks, and demonstrating minimal adverse

environmental effects. Their nomination packages were exemplary and reflected true champion recognition.

Bio-Integral Resource Center of California will be awarded the **Lifetime International IPM Achievement Award**. Their work includes years of accomplishments with IPM and reflects many publications, demonstrations, and real valued outcomes.

Three other organizations will be presented the **International Award of Recognition** because they were well deserving, but did not rank as high as the other awardees. These award winners are:

Santa Clara County, California

Grower Incentives for IPM Team Project

International Team for Sustainable Adoption of Eggplant IPM in South Asia

Tuesday, March 24, 2009

1:30–3:30 pm

1. Global Food Shortages: Role of IPM

Room D133

Global food shortages, high food prices and food riots are news in the papers today. According to the UN World Food Program, 19 out of 53 countries in Africa face serious hunger problems and the number of hunger related deaths is 3 million according to FAO. The New York Times April 3, 2008 reported that, “fearing shortages some major rice producers- including Vietnam, India, Egypt Cambodia have sharply limited their rice exports so they can be sure to feed their own people.” The World Bank estimates that 33 countries face potential political and social unrest because of the acute hike in food and energy prices. What role do IPM scientists play in this crisis? How do biofuels, GMOs and global warming fit into the IPM picture? What is the role of global IPM in confronting the current crisis? This workshop will explore that issue on a global basis by discussing the current status of IPM, current research and proposed directions for future IPM studies in IPM in the world’s major food and feed crops: rice, maize, wheat, sorghum, soybeans, and vegetables. Presentations will cover the global status of IPM in these crops and will discuss where we are today, what are the current major issues and how do we plan to confront the future. It is evident that the role of the IPM scientist has significantly increased. Are we up to the challenge?

Organizers: E.A. Heinrichs, eheinric@vt.edu, International Association for the Plant Protection Sciences (IAPPS), Blacksburg, VA; John Foster, jfoster1@unl.edu, University of Nebraska, Lincoln, NE; Muni Muniappan, ipm-dir@vt.edu, IPM CRSP, Virginia Tech University, Blacksburg, VA

1.1 Maize, Jaime Molina-Ochoa, jmolina18@hotmail.com, Biológicas y Agropecuarias, Universidad de Colima in Tecomán, Colima, México

1.2 Sorghum, Bonnie B. Pendleton, bpendleton@wtamu.edu, Department of Agricultural Sciences, West Texas A&M University, Canyon, TX

1.3 Sorghum, Chris Little, crlittle@ksu.edu, Department of Plant Pathology, Kansas State University,

Manhattan, KS

1.4 Vegetables, Gregory C. Luther, greg.luther@worldveg.org, AVRDC–The World Vegetable Center, Shanhua, Tainan, Taiwan, R.O.C.

1.5 Vegetables, Peter Aun-Chuan Ooi, peter.ooi@worldveg.org, Asian Regional Center, AVRDC–The World Vegetable Center, Kasetsart University, Bangkhen, Bangkok, Thailand

1.6 Soybean, Antonio R. Panizzi, panizzi@cnpso.embrapa.br, Embrapa (Empresa Brasileira de Pesquisa Agropecuaria) Soja Caixa, Londrina, Brazil

1.7 Rice, M. O. Way, moway@aesrg.tamu.edu, Texas AgrLife Research and Extension Center, Beaumont, TX

2. Utilizing Communications and Technology to Deliver your IPM Message

Room D134

Technology offers a changing array of tools for delivering IPM information to users: podcasts, DVDs, Web Sites, RSS feeds, YouTube and blogs to name a few. With shrinking budgets and fewer people to generate information, which technology will improve IPM information delivery and be welcomed by our audiences? In this interactive workshop, we will introduce you to some of the latest methods of information delivery and talk about resources to use in working with these newer tools. The latter half of the workshop will encourage discussion and sharing of experiences with new technologies. Faye Cragin will identify sources for creating interactive web-based media including Captivate, Flash, and Photoshop as well as inexpensive or free resources for individuals with little or no experience with design and code including Constant Contact for creating online newsletters. She will discuss software options for shared resources including blogs (blogger.com), wikis (PB Wiki), podcasts and drop.io. Joy Landis will share free sources for images and explain Creative Commons, a means for identifying non-copyright images/video. She'll offer examples of ways to get multiple uses out of communications pieces and show how her state's crop/pest newsletter is being updated. Participants are invited to bring communication examples and discuss the best ways to update traditional sources and integrate them with the new.

Facilitator and Organizer: Joy N. Landis, landisj@msu.edu, Michigan State University IPM Program, East Lansing, MI

Faye E. Cragin, faye.cragin@unh.edu, New Hampshire Cooperative Extension, University of New Hampshire, Durham, NH

Joy N. Landis, landisj@msu.edu, Michigan State University IPM Program, East Lansing, MI

3. International Cooperation: Researchers and Regulators Working Together to Build Management Strategies for Growers

Room D135

The face of agriculture is changing, moving toward sustainable crop production systems which will meet the needs of today without compromising the ability of future generations to meet their own needs. To achieve sustainability, production practices must meet society's needs for human health protection, food and fibre production, as well as resource utilization; must conserve or enhance natural resources and the quality of the environment for future generations; and must be economically viable. Although strides have been made toward this end, sustainable crop production will be realized only through the development and introduction of new products and new innovations in farming practices. These innovations include creating, adopting or applying new methods, ideas or devices in on-farm situations. An important aspect of sustainable crop production is sustainable crop protection, which makes use of integrated pest management (IPM), biopesticides and other reduced risk products. The move toward sustainability worldwide has resulted in a large number of new innovations and pest control products becoming available which support sustainable crop protection. However, many of these innovations and products are only available in limited geographic areas. There is a need to share information internationally in order that many more farmers can benefit from these new tools.

This session will include presentations from representatives of programs which focus on supporting sustainable agriculture crop protection in Canada and other countries. Presentations will be followed by discussion of how we can work together as researchers, regulators and program administrators in different countries to increase the development and adoption of sustainable crop protection practices in agriculture.

Moderators and Organizers: Debby LeBlanc, debby_leblanc@hc-sc.gc.ca, Pest Management Regulatory Agency, Health Canada, and Leslie Cass, Leslie.Cass@agr.gc.ca, Agriculture and Agri-Food Canada, Ottawa, ON, Canada

1:30 3.1 International Regulatory Activities of the IR-4 Project and Their Impact on Pesticide Risk Reduction, Michael Braverman, braverman@aesop.rutgers.edu, Daniel Kunkel and Jerry Baron, Interregional Research Project Number 4 (IR-4), Rutgers University, Princeton, NJ

The IR-4 Projects Food Use Program and the Biopesticide and Organic Support Program are involved in obtaining Reduced Risk and Biopesticide registrations, primarily on specialty crops. There have also been educational programs, international workshops, field demonstrations, crop grouping and other regulatory activities resulting in risk reduction. The IR-4 Project is strongly involved in NAFTA, OECD, JMPR and other organizations relating to pesticide regulation. The IR-4 Project has registered biopesticides in the US that were developed in the US and several other countries. Examples of specific programs and how they impacted national and international risk reduction issues will be presented.

1:45 3.2 EPA's Pesticide Environmental Stewardship Program, Sherry Glick, glick.sherry@epa.gov, and Thomas Brennan, US EPA Pesticide Environmental Stewardship Program, Washington, DC

The US EPA's Pesticide Environmental Stewardship Program (PESP) is a voluntary program that forms partnerships with pesticide users and influencers to reduce the potential health and environmental risks associated with pesticide use and implement pollution prevention strategies. While government regulation can reduce pesticide risk, PESP is guided by the principle that, even in the absence of additional regulatory mandates, the informed actions of pesticide users reduce risk even further. EPA recognizes the need to protect public health and the food supply with efficient, cost-effective pest control. In its role as a partner, the Agency promotes the adoption of innovative, alternative pest control practices that reduce potential pesticide risk. Representatives of PESP will present an overview of their approach to partnering within the program, some of the notable successes since the program inception in 1994, and will discuss opportunities to work with international partners to develop and promote the use of strategies to reduce risks associated with pesticide use.

2:00 3.3 The Pesticide Risk Reduction Program, Debby LeBlanc, debby_leblanc@hc-sc.gc.ca, Pest Management Regulatory Agency, Health Canada and Leslie Cass, Agriculture and Agri-Food Canada, Ottawa, ON, Canada

The Pesticide Risk Reduction Program is jointly administered by Agriculture and Agri-Food Canada's Pest Management Centre (PMC) and Health Canada's Pest Management Regulatory Agency (PMRA). The goal of this program is to help reduce the risks associated with pesticide use in agriculture through the development of integrated pest management tools and practices and the registration of low risk pesticides. PMC and PMRA work with stakeholders to build strategies to reduce pesticide risk in agriculture. The implemented strategies have encouraged the registration and use of low risk or biopesticide products to reduce the reliance on traditional pesticide use, and through research, have promoted the development of new integrated pest management tools and practices. Examples of strategies and their implementation will be presented.

2:15 Presentations from Other Countries That Have Programs Which Focus on Supporting Sustainable Agriculture Crop Protection

4. Innovative Food Industry Programs Are Accelerating Adoption of IPM and Other Best Management Practices

Room D136

Fifteen years ago, IPM professionals working at Campbell Soup published a carefully documented 50% reduction in pesticide use on processed vegetables. Ten years ago, US EPA reviewed more than 40 food company IPM and other best practice initiatives designed to protect health, environment and profits. Now Sysco, General Mills, Unilever, Wal-Mart and other industry giants are swinging the IPM and best practices bat harder than ever. Broad, aggressive initiatives led by high-level executives charged with corporate social responsibility are literally changing the landscape. Sustainable agriculture has joined food safety, animal welfare and good agricultural practice as commonly audited performance measures. Information technology systems are aiding performance and impact measurement. Federal agency, land-grant university and non-governmental agency partners are diving in to partner in both traditional and novel ways including producer-friendly evaluation tools and compiled national outcome measurement. Perspectives will be offered from growers, food processors, distributors, retailers, buyers, agency and non-governmental organizations on what this new wave of continuous improvement means to their business and to health and environment.

Organizers: Brenna Wanous, bwanous@ipminstitute.org, and Thomas Green, ipmworks@ipminstitute.org, IPM Institute of North America, Inc., Madison, WI

1:30 4.1 Introduction, Thomas A. Green, ipmworks@ipminstitute.org, IPM Institute of North America, Inc., Madison, WI

1:40 4.2 Sysco's Sustainable Agriculture/Pest Management Initiative, Craig Watson, watson.craig@corp.sysco.com, Sysco Corporation, Houston, TX

Sysco's Sustainable Agriculture/Pest Management program aims to protect environmental and human health by targeting key opportunities for improvement including pesticide and nutrient use and impact reduction and resource conservation. Criterion for the program includes identification and protection of environmentally sensitive areas, documenting water and energy conservation and recycling, and IPM including reducing pesticide use and toxicity. Suppliers adhere to a self-written and third-party evaluated

program, undergo an annual audit and report annual performance. More than 70 suppliers, representing 160 producer processing facilities, 4,179 growers and more than 600,000 acres, participated in the program in 2008.

1:55 4.3 Shepherd's Grain Program, Karl Kupers, karl@shepherdsgrain.com, Shepherd's Grain, Harrington, WA

Shepherd's Grain is a farmer co-operative which uses sustainable practices and Food Alliance standards to produce wheat in Washington. With a strong focus on IPM and no-till and direct-seeding, Shepherd's Grain's mission is to use farming methods that produce high-quality and safe grain while also protecting natural resources and providing a sustainable livelihood for its 33 growers, all of which are Food Alliance Association certified for their sustainability practices. This project started with a WSARE farmer research grant and has now grown into a value added marketing business. The marketing emphasis is the "story" of local and sustainable food production.

2:10 4.4 Guide to Guidelines: IPM Elements and Guidelines, Thomas Green, ipmworks@ipminstitute.org, IPM Institute of North America, Madison, WI, and Curt Petzoldt, cp13@cornell.edu, Cornell University, Ithaca, NY

Conservation program managers and crop advisors face a common question when creating a pest management plan for their growers: "I know my grower wants to adopt IPM, but where do I go from here?" IPM Elements and Guidelines are valuable documents that address this question by listing and prioritizing basic and advanced IPM practices for a specific crop and region. However, not all IPM Elements and Guidelines are the same. The *Guide to IPM Elements and Guidelines* shares with those drafting, editing and distributing these documents various methods, tips and resources to ensure an effective resource.

2:25 4.5 Field to Market Initiative, Julie Shapiro, jshapiro@keystone.org, the Keystone Center, Denver, CO

Field to Market, The Keystone Alliance for Sustainable Agriculture, is a diverse, collaborative initiative involving producers, agribusinesses, food companies, retailers, and conservation organizations. The Alliance is working to facilitate quantification and identification of key environmental and socioeconomic sustainability outcomes and metrics, foster industry-wide dialogue, and generate processes for continued improvement in sustainable agricultural production. The initiative is organized and facilitated by The Keystone Center, a non-profit dedicated to developing collaborative solutions to societal issues.

2:40 4.6 The Stewardship Index for Specialty Crops, Jonathan Kaplan, jkaplan@nrdc.org, Natural Resources Defense Council, San Francisco, CA

The Stewardship Index for Specialty Crops project is a multi stakeholder initiative to develop a system for measuring sustainable performance throughout the specialty crop supply chain—at farm, processor, distributor, food service provider and retailer levels. The project will address the unique needs of specialty crop stakeholders while demonstrably improving environmental and social impacts. "Specialty crops" are defined as fruits, vegetables, nuts and horticulture. Unlike other sustainability initiatives, the Stewardship Index will not prescribe standards or define a specific level of performance as "sustainable." Rather, it aims to provide a system for measuring stewardship performance by focusing on desired outcomes.

2:55 4.7 American National Standards Institute, Ann Sorensen, asorensen@niu.edu, American Farmland Trust Center for Agriculture in the Environment, DeKalb, IL

The American National Standards Institute (ANSI), launched in 2008, works to develop a national consensus standard for sustainable agriculture in the United States. The Standards Committee, comprised of 50 representatives from a diverse stakeholder group including agriculture, retail and

government, identify related sensitive issues, such as the relationship between organic, mainstream and sustainable agriculture, the role of genetically engineered crops in this arena, sequestration of carbon in soils and the role of agriculture in the global fight against climate change, and more. The on-going project is housed at the Leonardo Academy, a non-profit Think and Do Tank in Madison, Wisconsin.

3:10 Speaker Panel: Question and Answer Session

5. Integrating Strategies for Invasive Species Management: Capacity, Compatibility, and Operational Challenges

Room D137

Problems posed by invasive species are becoming increasingly important in both managed and natural systems. Biological control is an important approach to the management of invasive species. A more rapid development of biological control programs would be desirable. The advent of invasive species also, often poses challenges to established IPM systems. Adopted approaches for the management of invasive species may lead to disruption of existing biological control and IPM programs. For example, attempts to manage the glassy winged sharp shooter invasion of California grapes disrupted a citrus pest management system that had been in place for most of a century. Similarly, spraying for Mediterranean fruit fly in Florida often disrupts biological control of citrus pests. Changing attitudes by stakeholders are also likely to impinge on which strategies may be applicable in different systems. This mini-symposium which has been organized by the southern and western regional biological control projects (S-1034 and W-2185) will explore some of the critical issues from a context of capacity, compatibility and operational challenges.

Moderators and Organizers: Moses T.K. Kairo, Moses.Kairo@famu.edu, Center for Biological Control, Florida A&M University, Tallahassee, FL; Norm Leppla, ncleppla@ifas.ufl.edu, IPM Florida, Institute of Food and Agricultural Sciences Department of Entomology and Nematology, University of Florida, Gainesville, FL; Peter McEvoy, mcevoyp@science.oregonstate.edu, Department of Botany and Plant Pathology, Oregon State University, Corvallis, OR

1.30 Introduction

1:36 5.1 IPM for Preventing and Managing Alien Invasive Species, Norm Leppla, ncleppla@ifas.ufl.edu, IPM Florida, Institute of Food and Agricultural Sciences Department of Entomology and Nematology, University of Florida, Gainesville, FL

Sustainable IPM systems are needed for preventing and managing alien invasive species (AIS). These pests expand their distributions along pathways and establish in habitats with available ecological niches. These habitats lack natural resistance mechanisms, such as competitors and natural enemies that could prevent the establishment of AIS. Addition of natural enemies to a habitat is an attempt to provide a mechanism of ecological resistance. Biological control has been highly successful for minimizing the detrimental effects of insect AIS, e.g., cottony cushion scale, citrus black fly, cassava mealybug, pink hibiscus mealybug, mole crickets, whiteflies, and so forth. In managed ecological situations, such as agricultural crops, biological control typically is practiced in the context of IPM, part of a system based on cultural practices and conservation of natural controls. Over or miss use of pesticides in response to AIS has disrupted well-established, effective IPM programs in citrus, tomato and other crops. High quality IPM education and Extension programs are required to institute and maintain sustainable IPM systems for preventing and managing AIS.

1:55 5.2 Emerald Ash Borer: The Case of the Unexpected Guest and the Empty Pantry, Kenneth Bloem, Kenneth.Bloem@aphis.usda.gov, Center for Plant Health Science and Technology, Plant Protection and Quarantine, Animal and Plant Health Inspection Service, United States Department of Agriculture, Raleigh, NC

2:14 5.3 Soybean Aphid: From Thresholds to Biocontrol, David W. Ragsdale, ragsd001@umn.edu, Department of Entomology, College of Food, Agricultural and Natural Resource Sciences, University of Minnesota, St Paul, MN

Soybean aphid IPM is struggling how to integrate three broad, but essentially separate, management tools: insecticides (economic thresholds), host plant resistance (*RAG1* and other genes), and classical biological control, into a seamless IPM program applicable across diverse landscapes and production systems. While we have made considerable progress on each of these strategies separately, several fundamental questions remain as we attempt to optimize all the available tactics. We have developed a robust economic injury level and a widely accepted economic threshold which is used across the US and Canada. But 2009 ushers in a new era in soybean aphid IPM. There will be aphid resistant varieties grown on a commercial scale for the first time in 2009 and the extent to which this germ plasm is incorporated into new high yielding improved varieties is yet unknown. Aphid resistant varieties are also being developed for the organic (or at least non-transgenic) market as well. Finally, aphid parasitoids are being released and ultimately we believe this will result in a much lower aphid density as is observed in Asia, where soybean aphid is a rare pest. But questions remain as how to integrate host plant resistance and will aphid resistant varieties allow us to rely more heavily on native and naturalized aphid predators and parasitoids? Our goal is to integrate all currently available management tactics into a seamless soybean aphid management program. Fundamentally, soybean aphid IPM in the Northern Great Plains will rely on a network of collaborating entomologists, plant breeders, and extension specialists to conduct the research and communicate those findings with soybean producers with regard to soybean aphid IPM.

2:33 5.4 How to Avoid Potential Conflicts between Insect and Weed Biological Control Agents, Harriet L. Hinz, H.Hinz@CABI.ORG, Tim Haye, T.Haye@CABI.ORG, and Ulli Kuhlmann, U.Kuhlmann@CABI.ORG, CABI Europe Switzerland, Delémont, Switzerland; Peter Mason, MasonP@AGR.GC.CA, Agriculture and Agri-Food Canada, Ottawa, ON, Canada

Classical biological control of insect pests may lead to conflicts with classical biological control of weeds in cases where insect pests are closely related to weed biocontrol agents. Although only few documented cases exist, it is still surprising that such potential negative impacts of “pest agents” on “weed agents” have never been considered before initiating a biological control program. We present the case of the biocontrol program against the cabbage seedpod weevil (CSPW), *Ceutorhynchus obstrictus*, in North America, which belongs to the same subfamily, Ceutorhynchinae, as a number of introduced or potential agents against exotic weed species. The most likely non-target “weed agents” were selected based on potential overlap with the target pest (i.e. CSPW). Systematic long-term field samples were conducted as well as host-finding and host-choice studies in the lab with five selected non-target “weed agents” and two potential “insect agents” for CSPW control. Results will be presented and discussed in relation to future release strategies.

2:52 5.5 Whitefly Management in Cotton: Anatomy of an IPM Success Story, Steven E. Naranjo,

Steve.Naranjo@ARS.USDA.GOV, Arid-Land
Agricultural Research Center, Agricultural
Research Service, United States Department of
Agriculture, Maricopa, AZ, and Peter C. Ellsworth,
peterell@ag.arizona.edu, Department
of Entomology, Maricopa Agricultural Center,
University of Arizona, Maricopa, AZ

The whitefly, *Bemisia tabaci* biotype B, invaded the southwestern US in the late 1980s and precipitated outbreak populations in cotton and other crops during the first half of the 1990s, a pattern that has played out in other parts of the world. The cotton system is affected by a multitude of pests and the whitefly is one of three key pests in the Arizona system. A concentrated and organized multi-institutional program led to the development of a successful IPM program for this pest in Arizona cotton that has served as a model in other regions of the world. Biological control plays a key role in the management of this pest and many of the component tactics for managing both the whitefly and other key pests in the system serve to conserve natural enemies and enhance natural control. This presentation will summarize the history of this IPM success story for an invasive pest.

3:11 5.6 Invasion of Southern California by the Glassy-
Wing Sharpshooter: Its Population Dynamics
and Consequences, Robert F. Luck, rluck@ucr.
edu, Department of Entomology, University of
California, Riverside, CA

The glassy-winged sharpshooter (GWSS) was first detected in Southern California's Orange County in 1989 and in Ventura County in 1990. By 1997 it had spread throughout most of southern California, including the desert agricultural regions of the Coachella Valley and Imperial County and into the southern San Joaquin Valley with scattered "populations" as far north as Sacramento. Its initial threat to California agriculture, was its ability to vector and spread Pierce's disease, a bacterial disease fatal to both table and wine grapes. Its population densities in southern California were driven by alternative perennial plant hosts such as citrus because of the latter's seasonal phenology. Citrus was briefly affected by GWSS' invasion because of the rapid increase of GWSS' population that range from 1.2 million adults per ha in Kern County and 2.2 million adults per ha in Riverside Co. The danger GWSS poses is its ability to vector Pierce's Disease, a bacterial disease fatal to wine and table grapes. Its initial spread into Riverside County's Temecula Valley (southern California) in 1998 destroyed a third of the Valley's wine industry, causing 10 million dollars worth of damage. Although GWSS in much reduced in density it has become an important vector in the spread of other strains of the bacteria which infects a variety of other perennial crops and ornamentals. Moreover, there is clear evidence that the bacteria, *Xylella fastidiosa*, is broadening its range of host plants as the bacterial disease appears to be evolving.

6. Urban Pest Ant Management

Room D138

In recent years ants have become one of the most important urban pests encountered by Pest Management Professionals (PMPs). A survey in southern California by a PMP indicated that 85% of their accounts reported ant problems. Strategies to control urban pests on residential accounts must take into account ants and their control. Unlike some ubiquitous urban pests such as cockroaches or fleas, the species of ants around structures are greatly influenced by the urban environment. Consequently, identification and recognition of their habits and biology are extremely important. It has been suggested that conventional pest control methods to control ants have contributed to the amount of pesticides in urban water runoff. The workshop will explore these issues and propose potential avenues for developing more effective and environmentally friendly approaches to ant control and extending them to the industry and public.

Organizer and Moderator: Michael. K. Rust, michael.rust@ucr.edu, Department of Entomology, University of California, Riverside, CA

1:30 6.1 Overview and Identifying Urban Ant Problems, Michael K. Rust, michael.rust@ucr.edu, Department of Entomology, University of California, Riverside, CA

1:45 6.2 Role of Regulatory Agencies in Stimulating IPM Programs, Mark Robertson, mrobertson@cdpr.ca.gov, Pest Management and Licensing, Department of Pesticide Regulation/Cal EPA, Sacramento, CA

The California Department of Pesticide Regulation is mandated to see that pesticides are used safely in order to protect both human health and the environment. Regulatory agencies directly influence pest management options primarily through registration and labeling of pesticides, licensing of pesticide users, and direct regulation of pesticide applications. It is perhaps less generally recognized that regulatory agencies can also improve pest management options through promotion of practices that integrate reduced risk pesticides and nonpesticide control methods in IPM programs. IPM programs are promoted through identification of effective and economical alternative practices, identification of research needs, and support of IPM outreach and demonstration projects. Specific IPM elements relevant to ant management and promotion strategies will be discussed.

2:00 6.3 Developing Low Impact Approaches to Controlling Ants, John Klotz, john.klotz@ucr.edu, and Michael Rust, michael.rust@ucr.edu, Department of Entomology, University of California, Riverside, CA

Conventional approaches to controlling ants in and around structures have been the extensive application of insecticide sprays. With the loss of organophosphates such as chlorpyrifos and diazinon, pyrethroids have become the primary group of insecticides applied as barriers to control ants. In recent years, fipronil has been shown to be very effective and has replaced many pyrethroid applications. Our research has shown that targeted and more selective applications can reduce the total amount of insecticide applied around structures and still provide control. In certain cases, liquid baits have been successfully incorporated in to programs further reducing the need for perimeter sprays. An essential element in developing these low impact approaches is demonstrating that they are efficacious and cost effective for the Pest Management Professional.

2:30 6.4 Can We Reduce Insecticide Runoff and Maintain Effective Ant Control around Residences? Les Greenberg, les.greenberg@ucr.edu, Department of Entomology, University of California, Riverside, CA

We have measured insecticide runoff from individual residences resulting from treatments against ants using fipronil and bifenthrin. Both materials gave significant runoff within a couple of weeks of application when applied as fan sprays. However, we saw a significant reduction in runoff when the insecticides were applied using a pin-stream applicator. Other strategies for reducing runoff should emerge now that we can monitor the runoff efficiently.

2:45 6.5 Industry Perspectives on Urban Pest Ant Control: Cost Analysis of Baiting Verses Spraying

Programs, Herb Field, entomologyservices@
yahoo.com, Lloyd Pest Control, San Diego, CA

Urban Pest Management (UPM) programs must be shown to be effective and economical before they will be adopted by industry. One important aspect of this in regard to structural pest control is the efficacy and cost-effectiveness of various strategies to control ants. This presentation will summarize the results of a study conducted by Pest Management Professionals, which compared the efficacy and cost-effectiveness of a baiting program versus a combination treatment (spraying + broadcasting granules) in order to control Argentine ants around homes in San Diego County.

3:00 6.6 Urban Pest Ant Outreach to Professionals and
Consumers: Getting to a Common Goal, Cheryl
Wilén, cawilen@ucdavis.edu, University of
California Statewide IPM Program (UCIPM) and
University of California Cooperative Extension,
San Diego, CA

Extension of pest ant management research to consumers and professionals presents numerous opportunities as well as obstacles. The consumer primarily wants long-term control but when presented with a choice will often prefer low-toxicity methods. Professionals are willing to modify their methods if some of their risk of callbacks or cost of service is mitigated. Environmental agencies would like to reduce the use of pesticides that could impair air and water quality. We are coordinating an alliance of professionals and researchers who develop and demonstrate technology to alleviate those risks. The information is made available to consumers and professionals via a number of outreach avenues to help them adopt strategies that meet the needs and goals of all involved.

3:15 Panel and Audience Discussion

7. IPM Strategies for the Management of Insect-

Transmitted Plant Virus Diseases

Room D139

Viruses causing economically important plant diseases are often transmitted by specific insect vectors that may also be pests of the crop. Invasions of new insect vector species and biotypes, shifting agricultural practices, and globalization of agricultural and horticultural products are contributing to the emergence and/or re-emergence of numerous viral diseases. Because there are no chemicals that affect viruses in infected plants, reduction in vectors by insecticides is often attempted by growers. However, this single strategy is incompatible with IPM practices, and has had limited success. Broader knowledge of virus and vector biology and epidemiology, and of interactions of viruses with their vectors and ecosystems, are needed to design and implement successful management strategies. Vectors and viruses transcend geographic and national boundaries, necessitating multi-disciplinary, system-wide, and holistic approaches to eco-friendly, sustainable management strategies for plant diseases caused by insect-transmitted viruses. Invited speakers will present overviews of the principles of vector and virus disease management and emergence of new problems. Case studies with different perspectives and experiences in designing and implementing management strategies will give insight into IPM for management of insect-transmitted virus diseases globally.

Moderator and Organizers: Naidu A. Rayapati, naidu@wsu.
edu, Department of Plant Pathology, Washington State University,
IAREC, Prosser, WA, and Sue A. Tolin, stolin@vt.edu,
Department of Plant Pathology, Physiology, and Weed Science,
Virginia Tech, Blacksburg, VA

1:30 7.1 IPM in the Management of Insect-Transmitted Virus Diseases—Present and Future, Mike Irwin, meirwin@illinois.edu, University of Illinois, Urbana, IL

1:55 7.2 Invasion Biology of Thysanoptera—Vectors of Tospoviruses, Joseph Morse, joseph.morse@ucr.edu, University of California, Riverside, CA

2:20 7.3 The Role of Epidemiology in the Management of Insect-Transmitted Viruses—An Australian Perspective, Roger Jones, rjones@agric.wa.gov.au, University of Western Australia, Australia

2:45 7.4 Management of Whitefly-Transmitted Virus Diseases in a Developing Country—A Case Study, Margarita Palmieri, palmieri@uvg.edu.gt, Universidad del Valle de Guatemala, Guatemala

3:10 7.5 Success Stories:

- Management of Tomato Leaf Curl Disease in West Africa, Robert Gilbertson, rgilbertson@ucdavis.edu, University of California, Davis, CA
- Management of Groundnut Rosette Disease Virus Complex in Southern Africa, Naidu A. Rayapati, naidu@wsu.edu, Department of Plant Pathology, Washington State University, IAREC, Prosser, WA
- Contributions of USAID and IPM CRSP to the Management of Virus Diseases in Developing Countries, Sue A. Tolin, stolin@vt.edu, Department of Plant Pathology, Physiology, and Weed Science, Virginia Tech, Blacksburg, VA

8. Evaluating Impacts of IPM: Methods and Examples

Room D140

This workshop illustrates IPM impact assessment methods and results from the United States and abroad, with an emphasis on economic assessment. The presentations cover methods for measuring IPM adoption trends and individual impacts, as well as methods for extrapolating across time and populations. The methods range from low-cost to expensive, with applications ranging from single pest in single crop to broad international programs. Rapidly implemented IPM of the invasive soybean aphid shows a large and rapid payoff to in *ex ante* economic surplus analysis in US over 2003–17. A national scale environmental impact analysis explores how IPM programs have affected overall pesticide use in US agriculture. Internationally, disease resistant bean varieties in Ecuador during 1982–2006 have generated a strong rate of return to a small program in a survey-based economic surplus analysis. A final presentation summarizes methods and results of IPM impact assessments across an international program, the IPM Collaborative Research Support Program.

Moderator and Organizer: Scott M. Swinton, swintons@msu.edu, Department of Agricultural, Food and Resource Economics, Michigan State University, East Lansing, MI. Co-organizer: George Norton, gnorton@vt.edu, Department of Agricultural and Applied Economics, Virginia Tech, Blacksburg, VA

1:30 8.1 Returns to Integrated Pest Management Research and Outreach for US Soybean Aphid, Feng Song, songfeng@msu.edu, and Scott Swinton, swintons@msu.edu, Department of Agricultural, Food and Resource Economics, Michigan State University, East Lansing, MI

1:55 8.2 Impacts of IPM on Agricultural Pesticide Use in the United States, Jason Maupin, jdmaupin@vt.edu, George Norton, gnorton@vt.edu, and Jeff Alwang, alwangj@vt.edu, Department of Agricultural and Applied Economics, Virginia Tech, Blacksburg, VA

2:15 8.3 Economic Impact Evaluation of Disease-Resistant Bean Research in Northern Ecuador, Daniel Mooney, dmooney1@utk.edu, Department of Agricultural Economics, University of Tennessee, Knoxville, TN; Scott Swinton, swintons@msu.edu, Department of Agricultural, Food and Resource Economics, Michigan State University, East Lansing, MI; Cristian Subía, crisubiag@hotmail.com, and Eduardo Peralta, legumin@pi.pro.ec, National Institute of Agricultural Research (INIAP), Ecuador

2:35 8.4 Economic Impacts of IPM CRSP Research around the World, George Norton, gnorton@vt.edu, Jeff Alwang, alwangj@vt.edu, and Tatjana Hristovska, tatjana@vt.edu, Department of Agricultural and Applied Economics, Virginia Tech, Blacksburg, VA

2:55 General Discussion

9. Implementation of IPM in the Corn and Soybean Transgenic Landscape: A Lost Cause?

Room E141

The speakers within this symposium will address the current state of IPM implementation within the commercial corn and soybean production landscape of the United States. According to the USDA Economic Research Service, 80% of all corn and 92% of all soybeans planted in 2008 were genetically modified (transgenic). In recent years, the prophylactic use of corn and soybean seed treated with an insecticide and/ or fungicide also has become a more common approach by producers. Not surprisingly, overall production input costs have risen sharply. Projected non-land costs (2009) to produce corn and soybeans are \$579 and \$331 per acre, respectively, for northern Illinois. Seed cost increases account for 9% and 10% of overall projected (2009) production expenses for corn and soybeans, respectively, for northern Illinois. Most of these input increases were attributed to rising fertilizer prices. These projections were provided by Gary Schnitkey, a Professor of Agricultural and Consumer Economics at the University of Illinois. Against this backdrop of escalating production costs and risk aversion, is the deployment of traditional IPM tactics in the large-scale commercial production of corn and soybeans relevant? Are producers integrating management tactics for pests in this landscape? Are the widespread use of transgenic crops and the pyramiding of genes in modern corn hybrids the new integration strategy? These and other questions will be explored by the panel of speakers.
Organizer: Michael E. Gray, megray@illinois.edu, Department

of Crop Sciences, University of Illinois, Urbana, IL

1:30 9.1 Introduction and Perspectives, Michael E. Gray, megray@illinois.edu, Department of Crop Sciences, University of Illinois, Urbana, IL

1:50 9.2 A Grower's Conundrum: Implementing Integrated Weed Management in a HRC World, Chris Boerboom, boerboom@wisc.edu, Department of Agronomy, University of Wisconsin, Madison, WI; Christy Sprague, Department of Crop and Soil Sciences, Michigan State University, East Lansing, MI; Mike Owen, Department of Agronomy, Iowa State University, Ames, IA

Integrated weed management (IWM) is the use of all available strategies to manage weed populations in a manner that is economically and environmentally sound. IWM strategies are based on knowledge of weed species, their life cycles, thresholds, and exploiting their weaknesses. However, corn and soybean grower's adoption of herbicide-resistant crops (HRC) over the past decade has greatly reduced the diversity of weed management practices in use. In soybean, glyphosate is the sole herbicide used to control weeds on most acres in the Midwest and adoption of glyphosate-resistant corn hybrids also allows most acres to be treated glyphosate. The simplicity and economic incentives associated with HRC have driven grower adoption to such a level that the existence of IWM on most Midwest farms could be questioned. However, the risk of employing a single control practice is the evolution of resistance or weed species shifts and as anticipated, glyphosateresistant weeds have developed in most states in the Midwest and South where HRC have frequently been grown. While Extension weed scientists agree that a greater diversity of weed management practices is needed to sustain the full value of HRC technologies, identifying IWM practices that corn and soybean growers are willing to adopt is a challenge. Needed research and IWM practices that are recommended by Extension weed scientists will be presented.

2:10 9.3 Corn and Soybean Disease Management: Does IPM Play a Role?, Carl A. Bradley, carlbrad@illinois.edu, Department of Crop Sciences, University of Illinois, Urbana, IL; Paul D. Esker, Department of Plant Pathology, University of Wisconsin, Madison, WI; Pierce A. Paul, Department of Plant Pathology, The Ohio State University, Columbus, OH; Alison E. Robertson and Daren S. Mueller, Department of Plant Pathology, Iowa State University, Ames, IA

Historically, foliar fungicide use in corn and soybean production systems in the Midwestern U.S. has been rare up until the mid- to late- 2000s. In late 2004, soybean rust was found in the continental U.S. for the first time. Because of the risk of soybean rust to producers in the U.S., increased marketing of foliar fungicides for use on soybean occurred. In 2007, foliar fungicides were applied to more corn acres than ever before, with estimates of 10 to 12 million acres of corn being applied in the Midwest that season. This observed increased use of foliar fungicides on corn can be attributed to many factors such as: an increase in corn acreage (meaning that more corn would be planted back into fields that were planted to corn the previous year), higher marketing prices and input costs for corn (which translated into a greater-than-ever economic investment for a corn field), and companies increasing their focus on marketing foliar fungicides for use on corn. Due to the lack of disease forecasting models for corn and soybean diseases, the preventative (rather than curative) nature of the fungicides being used, and the possibility that decisions have to be made earlier in the season (due to scheduling an aerial applicator and potential fungicide shortages), using IPM to help make fungicide decisions on corn and soybean can be difficult.

Despite the difficulties, some programs, such as the soybean rust sentinel plot monitoring program and IPM PIPE, can help growers make informed decisions about fungicide use.

2:30 9.4 Transgenic Maize and the Theory of IPM: Perspectives and Realities from the Heart of the Corn Belt, Marlin E. Rice, merice@iastate.edu, Department of Entomology, Iowa State University, Ames, IA

Transgenic maize has been widely adopted in Iowa for management of European corn borer and corn rootworms. One thousand maize producers were surveyed for their perspectives on Bt maize technology. Questions were asked that focused on whether corn rootworm Bt maize was more economical, sustainable and environmentally safer than a soil-applied insecticide when applied to a non-Bt maize hybrid; which cultural, chemical and transgenic methods provided the best rootworm control; would they plant a corn rootworm Bt hybrid if field scouting indicated a low probability of damage the following year; did they scout or trap for beetles before deciding to plant a corn rootworm Bt hybrid the following year; are they concerned about corn rootworms developing resistance to Bt maize; would they plant more Bt maize if there was no refuge requirement; and if European corn borers populations had declined substantially from historically high populations, would they continue to plant a European corn borer Bt hybrid? Responses to these questions will be interpreted in the context of IPM theory.

2:50 9.5 Mass Migration to Preventive Control Tactics in Corn: IPM-Driven or Defiant?, Scott Hutchins, shhutchins@dow.com, Dow AgroSciences, Indianapolis, IN

The core principle of pest management since the landmark publication of “The Integrated Control Concept” by Stern et al. 50 years ago has been rational and quantitative vs. emotional and qualitative decision making with regard to crop protection. Others have extended this core philosophy based on the economic-injury level and developed a range of theoretical and practical tools that have effectively framed host-pest ecosystem research and bioeconomics for five decades. Indeed, for curative control decisions where cost:benefit tradeoffs are easily calculated and related to action thresholds, the notion of IPM is well recognized as a best practice that incorporates key considerations for a rational and balanced decision as Stern et al. originally envisioned. Preventive control, however, is far more complex within a traditional IPM decision framework due to uncertainty and personal attitudes about risk:reward. Moreover, the strengthening demand (and hence commodity price) for corn has pushed for acceptance of even less yield risk such that, when combined with the overwhelming convenience of seed-delivered control solutions, the on-farm decision has defaulted toward widespread use of the preventive technologies. Does this overwhelming behavioral shift to preventive control invalidate our longstanding principles for IPM or does it actually reinforce them? Indifference analysis, a means to assess the economic consequence of making incorrect decisions within a payoff matrix, suggest that widespread adoption of preventive technologies is both rational and quantitative, just as Stern et al. had advocated in 1959.

3:10 9.6 Attitudes: Outside Our Fields of Interest, Jerry DeWitt, jdewitt@iastate.edu, Leopold Center, Iowa State University, Ames, IA

Attitudes and forces prevail across both the agricultural landscape and beyond the farm gate that impinge more and more on decision-making and adoption of emerging IPM strategies. What are the subtle roles and influence of neighbors and the implications of the economic environment on IPM adoption? Appropriate roles and responsibilities are called for beyond the farm gate for the farming community, individuals, the Land Grants, and commodity and farm organizations for IPM strategy adoption.

10. Diversity in IPM Education and Delivery Systems: Strengths, Weaknesses,

Opportunities, and Threats

Room E142

IPM is knowledge-intensive and requires locally informed decision-making based on an ecosystem perspective that touches upon a range of subjects within agronomy, ecology and economics. IPM programs must provide effective training and delivery systems that match farmer educational and technical needs if they are to deliver the benefits that IPM can provide. Various IPM education and delivery systems have been developed historically, but thorough evaluation of these programs in terms of longer-term adoption rates, expansion (scaling up) and the full range of impacts of IPM is time-consuming, expensive and methodologically complex. There is a continuing need to establish indicators that better reflect the outcomes of IPM education and delivery systems, particularly indicators that measure longer-term benefits to the environment, human health and well-being.

Technology Transfer, Training & Visit, and Farmer Field Schools are just some of the approaches that have been employed to deliver IPM. This session will describe a range of approaches to IPM delivery via a “case study” framework. Experts will share their experiences related to the opportunities and constraints associated with various IPM training methods. They will discuss issues of up-scaling, sustainability, what conditions/ settings are best suited for various approaches (industrialized or non-industrialized agriculture, resource-poor or resource rich farmers, mono-crop or multi-crop, weak or strong local & regional infrastructure, etc.), long-term adoption/expansion and monitoring & evaluation.

The presentations will be followed by a moderated discussion on key points brought up during the presentations.

Moderator and Organizer: Tim Stock, stockt@science.oregonstate.edu, Oregon State University, Corvallis, OR

1:30 10.1 Farmer Field Schools in the Social Wild: The Andean Experience, Stephen Sherwood, ssherwood@wnandes.org, Andes Area Representative, World Neighbors, Quito, Ecuador

Farmer Field School (FFS) methodology requires a fundamental shift in underlying norms and values surrounding agricultural science and development practice that can be at odds with dominant ways of thinking, doing, and ordering. Drawing on six years of reflective practice, diverse academic studies, and on-going interactions with FFS graduates, facilitators, and Master Trainers, I explore the introduction of FFS to Ecuador and its subsequent transformations. I examine spontaneous appropriations of FFS in the hands of farmers, development practitioners, researchers, and their organizations in light of present calls for “scaling-up” of FFS.

2:00 10.2 Challenges of a Large-Scale IPM Education and Delivery System in West Africa, William Settle, william.settle@fao.org, Biodiversity and Ecosystem Officer, Food and Agriculture Organization of the United Nations, Rome, Italy

Using a Strengths/Weaknesses/Opportunities/Threats (SWOT) format, this case study will describe an ongoing, multi-year, multi-country IPM education and delivery system in West Africa. The case study will illustrate the need for locally informed decision making, the relevance of an ecosystem perspective, and the challenges of monitoring and evaluation over a longer time scale (including longer-term adoption rates, upscaling, and the full range of IPM impacts).

2:30 10.3 Origins, Evolution, and Future of IPM Extension in the United States, Paul Jepson, jepson@science.oregonstate.edu, Director, Integrated Plant Protection Center, Oregon State University, Corvallis, OR

Extension IPM will be placed in a historical perspective that spans the era of modern synthetic pesticide use that triggered the elaboration of IPM as a concept. Examples of current IPM extension programs will be provided that illustrate the need for, and ability of these programs to address both production and protection goals. We are entering an era when greater ecological insight must be incorporated within extension IPM programs. Each program must evolve according to stakeholder needs and local circumstances, but we have an opportunity to review global experiences, and adopt practices proven to be successful in more challenging systems.

3:00 Moderated Group Discussion (with audience participation) on two or three of the following: 1) Educating for Locally-informed Decision Making, 2) Relevance of an Ecosystem Perspective in Education and Delivery, 3) Conditions/ Settings Best Suited for Various Approaches, and 4) Long-term Evaluation of Full Range of IPM Impacts.

Tuesday, March 24, 2009

3:45–5:30 pm

11. Economics of IPM in Developing Countries

Room D133

This workshop illustrates IPM impact and livelihood assessment in a developing country context, drawing on assessments conducted on the IPM CRSP and other projects. Examples are provided from Asia, Africa, and Latin America. The workshop should be of interest to IPM scientists and practitioners. There will be an introduction, five presentations, and 30 minutes of general discussion. Impacts of fruit fly control on cucurbits using pheromone traps in Bangladesh is covered, including efforts to change import regulations on pheromones. An assessment is provided of an IPM program to manage tomato viruses in Mali. The determinants of household livelihood strategies among farmers facing different pests and diseases in Ecuador are presented. Strategies used to manage pests and diseases include integrated management techniques, and the presentation examines how these techniques affect household well-being. Another presentation focuses on potato producers in Bolivia and the attributes that influence their varietal selection, including yield, tastes, and disease and pest resistance. The fifth presentation summarizes an impact assessment of molecular-assisted breeding to develop cassava varieties resistant to cassava mosaic disease and green mites.

Moderators and Organizers: Jeffrey Alwang, alwangj@vt.edu, Department of Agricultural and Applied Economics, Virginia Tech, Blacksburg, VA; George W. Norton, gnorton@vt.edu, Department of Agricultural and Applied Economics, Virginia Tech, Blacksburg, VA

11.1 Economic Assessment of Adoption of Pheromone

Products by Cucurbits Farmers in Bangladesh, arakshit@vt.edu, Atanu Rakshit, Virginia Tech, Blacksburg, VA

11.2 Livelihood Strategies, Pest Management, and Well-Being in the Chimbo Watershed, Ecuador,

Robert Andrade, andrader@vt.edu, and Jeffrey Alwang, alwangj@vt.edu, Virginia Tech, Blacksburg, VA; Victor Barrera, vbarrera70@hotmail.com, National Institute of Agricultural Research (INIAP), Ecuador

11.3 Determinants of Variety Choice and the Role of Pest Risk Management among Potato Planters in

the Bolivian Highlands, Michael Castelhana, mcastelh@vt.edu, Jeffrey Alwang, alwangj@vt.edu, Nic Kuminoff, kuminoff@vt.edu, Virginia Tech, Blacksburg, VA; Ruben Botello, r.botello@proinpa.org, PROINPA, Cochabamba, Bolivia

11.4 Economic Impacts of Tomato Virus Management in Mali, Theodore Nouhoheflin, tnouhoheflin@vt.edu, and George Norton, gnorton@vt.edu, Virginia Tech, Blacksburg, VA, and Ousmane Coulibaly, o.coulibaly@cgiar.org, International Institute of Tropical Agriculture, Ibadan, Nigeria

11.5 Impacts of Molecular Assisted Breeding for Pest Control in Cassava, Nderim Rudi, nderimr@vt.edu, and George Norton, gnorton@vt.edu, Virginia Tech, Blacksburg, VA

12. Distance Education in IPM by the IPM₃ Training Consortium

Room D134

The workshop will demonstrate distance IPM education provided by the IPM₃ Training Consortium. The IPM₃ Program is a web-based, distance delivery education opportunity for individuals interested in IPM to become proficient in the principles and application of IPM as taught by leading IPM authorities in diverse disciplines from various U.S. universities. The initial target audience is federal agencies but the longer-term training audience includes: state/local government officials tasked with IPM, Extension Educators, Master Gardeners, 4-H staff, Crop Consultants, Pest Management Professionals, and a wide array of Green Industry Professionals.

Content was developed in collaboration with federal agencies, and university academic and extension educators. Courses are structured into modules. The modules are arranged into a hierarchical progression starting with an *IPM Core Concepts Module*, *Pest Biology Modules*, and *Specialty Topic Modules*. The 3-tiered program avoids duplication or repetition of content with each tier providing the information needed to understand the more specific content in the next tier. Pest Biology Modules *consist of* introductions to: entomology, plant pathology, weed science, and vertebrate pests. Various specialty modules are available currently including structural pest management and invasive species.

The workshop will highlight the IPM₃ Core Module and Structural Pest Management for Managers Modules. The workshop will be conducted online within WebVista, the University of Minnesota's web-based education system. WebVista encapsulates content and has full course management features such as grade book, assessments, discussion group capability, and internal email for communications between students and instructors.

Moderators and Organizers: Mark E. Ascerno, mascerno@umn.edu, Department of Entomology, University of Minnesota, St. Paul, MN; Stephen Kells, kells002@umn.edu, Department of Entomology, University of Minnesota, St. Paul, MN; Michael J. McDonough, mcdon091@umn.edu, Department of Entomology, University of Minnesota, St. Paul, MN

3:45–5:30 Interactive Workshop

13. Biofumigation in the Pacific North West— Their Effect on Plant Pathogens and Plant Pests

Room D135

In the PNW farmers and researchers are investigating several types of Brassica crops that produce biologically active compounds, and organisms that produce volatile organic compounds that are biocidal (biofumigants) to control a range of organisms including insects and nematodes. Biofumigation is becoming adopted by growers using sustainable means to control diseases and pest and improve soil health. The workshop consists of both scientists and growers and will provide information about the different biofumigation approaches using green manures and *Muscodor albus* against insects and plant parasitic nematodes. Both positive and negative aspects of biofumigation will be covered.

Moderator and Organizer: Ekaterini Riga, riga@wsu.edu,
IAREC and Department of Plant Pathology, Washington State
University, Prosser, WA

3:45 13.1 The Biofumigant Effects of *Muscodor albus* on Potato Tuber moth, *Phthorimaea operculella*, and Codling Moth, *Cydia pomonella*, Clive Kaiser, Clive.Kaiser@oregonstate.edu; Lawrence Lacey, lerry.lacey@ars.usda.gov, Yakima Agricultural Research Laboratory, USDA-ARS, Wapato, WA

The endophytic fungus, *Muscodor albus*, produces several volatile organic compounds (VOCs: alcohols, esters, ketones, acids and lipids) that are biocidal for a range of organisms. We conducted research on the insecticidal activity of *M. albus* VOCs on potato tuber moth (PTM) (*Phthorimaea operculella*) and codling moth (CM) (*Cydia pomonella*). The insecticidal activity of the fungus for control of PTM adults and neonate larvae was demonstrated after 78 hours of exposure under different temperature regimes and dosages of fungus. Adult PTM were very susceptible (91% mortality) to 30 g of hydrated fungal mycelium on rye seeds in a 28 liter chamber at 24°C. Neonate larvae under the same conditions responded with 73% mortality. Three day-old larvae within tubers were also susceptible but after longer exposures. A 7 day exposure to VOCs produced 96% mortality. VOCs were also tested against CM adults, neonate larvae, larvae in infested apples, and diapausing cocooned larvae. Fumigation of adult CM with VOCs for 78 hours resulted in 81% mortality. Exposure of neonate larvae to VOCs for 78 hours on apples and incubating for 7 days in fresh air resulted in 86% mortality. Exposure of apples that had been infested for 5 days, fumigated with VOCs for 78 hours, and incubated as above produced 71% mortality. Diapausing cocooned CM larvae that were exposed to VOCs for 7 or 14 days resulted in 31 and 100% mortality, respectively. Treating several stages of PTM and CM with VOCs indicate that *M. albus* could be an alternative to broad spectrum chemical fumigants.

4:05 13.2 *Muscodor albus* against Plant Parasitic Nematodes of Economically Important Vegetable Crops in Washington State, Ekaterini Riga, riga@wsu.edu, IAREC and Department of Plant Pathology, Washington State University, Prosser, WA

The endophytic fungus, *Muscodor albus*, was tested for potential nematicidal and nematostatic properties against four plant parasitic nematode species representing three different feeding modes on economically important vegetable crops in the Pacific Northwest. *Meloidogyne chitwoodi*, *M. hapla*, *Paratrichodorus allius* and *Pratylenchus penetrans* were exposed for 72 h to volatiles generated by *M. albus* grown on a rye grain culture in hermetically sealed chambers at 24 °C in the laboratory, and under greenhouse conditions using soil inoculated with nematodes, fumigated with *M. albus*, and incubated for 7 days prior to the introduction of a host plants. The mean percent mortality of nematode juveniles exposed to *M. albus* in the chamber was 82.9% for *P. allius*, 82.1% for *P. penetrans*, and 95% for *M. chitwoodi*; mortality in the nontreated controls was 9%, 7%, and 3.9% respectively. Only 21.6% of *M. hapla* juveniles died due to *M. albus* exposure in comparison to 8.9% in controls in the chambers; 69.5% of the treated *M. hapla* juveniles displayed reduced motility and reduced response to physical stimulus by probing, in comparison to the nontreated juveniles, evidence of nematostasis due to *M. albus* exposure. Nematostatic effect was not observed on the other three nematodes. The greenhouse study showed that *M. albus* applied at 0.5% and 1.0% w/w significantly reduced all nematode species in host plant roots and in rhizosphere soil; with similar results as the chamber assay. In this study, *M. albus* has shown both nematostatic and nematicidal potential.

4:20 13.3 Mustard Green Manures in Washington State, Andy McGuire, amcguire@wsu.edu, Grant Country Extension, Washington State University, Ephrata, WA

Mustard green manures could be an important alternative to the fumigant metam sodium, especially in situations where it will be difficult to implement EPA's new risk mitigation measures. This practice has been shown to be as effective as metam sodium in some farming systems. Since 2002, it has been used annually on an average of 21,000 acres in the Columbia Basin of Washington state, mainly before potatoes. Besides soilborne pest suppression, its benefits include increased water infiltration, improved soil tilth, and increased resistance to wind erosion. It is also economically competitive with metam sodium

fumigation. However, the mechanism behind its effects on soil pests is not known. Although several possible mechanisms have been identified, not knowing the actual mechanism hinders efforts to improve the practice. Research has been started to do this over the next few years.

4:40 13.4 The Effect of Biofumigation on Beneficial Organisms, William Snyder, wesnyder@wsu.edu, Department of Entomology, Washington State University, Pullman, WA

Entomopathogenic nematodes (EPNs) are important natural enemies of many soil-dwelling insect species. Entomopathogens fill unique ecological roles that can complement the impacts of predators or other biological control agents. Thus, non-target toxicity of mustard biofumigants to EPNs is a concern. In a series of laboratory and field experiments we have shown that a broad range of EPN species are harmed by mustard biofumigants, although species do vary in their susceptibility. Our results suggest that the many environmental benefits of mustard biofumigants may come at a cost to biological control by beneficial nematodes.

5:00 13.5 Developing “Designer Biopesticides” from *Brassicaceae* Species, Jack Brown, jbrown@uidaho.edu, PSES, University of Idaho, Moscow, ID

It has been known for quite some time that *Brassicaceae* glucosinolate breakdown products (mainly isothiocyanates and ionothiocyanates) have pesticidal properties that has led to many considering either green manure or seed meal soil incorporation from *Brassicaceae* crops as viable biopesticides in organic fruit and vegetable production systems and other horticultural situations. More recently it has been discovered that different glucosinolates breakdown into compounds that are more or less toxic to different soil borne pests. The breeding group at the University of Idaho have been examining pesticidal effects of different *Brassicaceae* species on a range of soil borne pests. Interspecific hybridization techniques have been developed to combine large quantities of different glucosinolate types into plant and seed meal tissues. The potential impact of the novel “designer biopesticides” is discussed.

5:20 13.6 The Washington Grower’s Perspective of Using Green Manures, Dale Gies, djgies@atnet.net, Gies Farms, Moses Lake, WA

Twenty-five per cent of farmland in Washington State uses mustard crop in rotation, to treat pests and diseases. Dale Gies is a potato and wheat grower, and has a seed company that markets green manure crops. He sows the mustard directly into the wheat stubble, using fertilizer and irrigation to grow it fast. Then by late October, when it’s about six-feet tall, he cuts it up and ploughs it into the soil, where he can plant potatoes. Before he started using biofumigation his farm had many problems with wind erosion and water penetration 15 years ago. However, the use of green manure has reduced but not eliminated his use of fertilizers and herbicides. He does find that mustard helps to keep his nitrogen inputs low and he is able to grow higher value crops with less money.

14. IPM Evolution to Green Revolution

Room D136

The purpose of this workshop is to address the rise in green pest management, the “how to’s” behind products and techniques, and the pros and cons of certification. While this workshop will cover general ideas and practices of green pest management, it will focus on the Green Shield Certification program, a national IPM certification program available to pest management providers and facilities that meet a high standard for structural IPM.

The workshop will be divided into three parts. First, we will outline a brief history of the evolution of structural IPM to green pest management (GPM) and the criteria non-governmental organizations (NGOs) use to evaluate green pest management programs. Next, we will cover green pest management practices for common pests. Green Shield Certified participants will detail how to inspect for, identify and address

pest-conducive conditions for ants, cockroaches and bed bugs, including products and techniques. Methods for structural repairs of pest-conducive conditions and pests damage will also be addressed. We will finish the workshop with the challenges and payoffs of the Green Shield Certified program, including the time commitment, results and marketing edge. A ten minute Q&A session at the end will allow attendees to ask questions and provide panelists the opportunity to comment on their Green Shield Certified experience.

Organizers: Thomas A. Green, ipmworks@ipminstitute.org, and Katie Mulholland, kmulholland@ipminstitute.org, IPM Institute of North America, Inc., Madison, WI

3:45 14.1 Introduction, Evolution of IPM to Green Pest Management (GPM) and the Beginnings of IPM Certification Programs, Thomas A. Green, ipmworks@ipminstitute.org, IPM Institute of North America, Inc., Madison, WI

Since the late 1980s, IPM has slowly evolved and gained acceptance by structural pest management providers. Today, with green building certification programs, such as LEED's Existing Building (EB) standard, identifying IPM as a component of healthy and environmentally friendly buildings, pest management providers across the country have begun to offer green pest control services. However, without a definition of green pest management, practices have varied widely. As a result, a number of organizations have developed green pest management certification programs to define standards. One such program, Green Shield Certified, was launched in June 2007 to help facility managers by identifying pest management providers that offer effective, prevention-based pest control. To date, Green Shield Certified has 17 certified services offered across the country with more companies involved in the certification process.

4:00 14.2 Differentiating Green Pest Management from "Greenwashing," an NGO Perspective, Jonathan Kaplan, jkaplan@nrdc.org, Natural Resource Defense Council (NRDC), San Francisco, CA

For concerned customers, the variety of definitions and practices of green pest management may not be confusing or simply unapparent. While certification programs have provided some guidance, the differences between programs can be just as great the differences between practices. Weigh in from experts such as non-governmental organizations (NGOs), can assist consumers when choosing pest management services. When evaluating structural IPM certification services, NGOs, like the Natural Resource Defense Council (NRDC), review to what degree pest management providers practice inspection, identification, monitoring and non-chemical approaches. They also evaluate how practitioners reduce toxicity and risk of exposure if chemical approaches are used. Because one "can't manage what isn't measured," documentation and notification procedures are also examined. For certification programs, NGOs also look at how stringent and transparent the standards are, how the program verifies compliance, and the motivations of the stakeholder group who developed the program. Through their support or rejection of green pest management services and certifications, NGOs can help consumers make more informed decisions.

4:10 14.3 Green Pest Management Procedures for Structural Repairs, Ted St. Amand, ted@atlanticpestsolutions.net, Atlantic Pest Solutions Companies, Kennebunkport, ME

Structural repairs are an important part to any green pest management program and provide an opportunity for additional revenue. With the right training, detailed and seasonal inspections and proper identification, pest management providers can address pest damage and pest-conducive conditions quickly and competently for long term solutions. Effective, green pest control requires not only addressing current issues, but more importantly, foreseeing potential future problems. Pest and rodent exclusion, carpenter ant and termite damage repair, landscape modification, including vegetation trimming, and gutter cleaning and roof repair will be covered. Because proper training is key to offering these services, techniques and products will be make up the majority of this presentation.

4:25 14.4 Green Pest Management Procedures for Ants and Cockroaches, Luis Agurto, Jr., lafourth@yahoo.com, PESTEC, San Francisco, CA

Knowing how to inspect and properly identify pests and pest conducive conditions is half the work when battling ants and cockroaches. This session will focus on non-chemical procedures for addressing Argentine ants and German cockroaches as well as address specific products and application techniques.

4:45 14.5 Green Pest Management Procedures for Bed Bugs, Lynn Frank, BCE, lfrank@suburbanexterminating.com, Suburban and Magic Exterminating, Smithtown, NY and Flushing, NY

Detailed inspections, proper training and customer cooperation are key to addressing and preventing the spread of bed bugs. This presentation will focus on inspection, procedures for gaining customer cooperation and new and effective methods, including heat treatments, to address one of nature's best hitchhikers.

5:00 14.6 Challenges and Payoffs of Green Shield Certified Program, Corey Arnold, carnold@peachtreepestcontrol.com, Peachtree Pest Control, Norcross, GA

This presentation will cover details on the challenges and benefits of the Green Shield Certified program. Topics include the time commitment, amount of paperwork, restrictions on products and practices, and required trainings as well as how certification works to protect health and the environment, to improve organization, and to focus marketing language to promote services and acquire new customers.

5:15 Question & Answer

15. Soil Quality Management as an Approach to Pest Management: Examples from Organic Research

Room D137

Proponents of organic farming have long promoted the view that the likelihood of pest outbreaks is reduced with organic farming practices, including establishment and maintenance of "healthy" soil (Howard 1940, Oelhaf 1978, Merrill 1983). Recent studies have shown that plant resistance to insect and disease pests is linked to optimal physical, chemical and, perhaps most importantly, biological properties of soil (Altieri and Nicholls 2003, Zehnder et al 2007). Other researchers have reported evidence of various types of signaling between soil and plants mediated by soil organic matter (Phelan 2004, 2006; Stone 2004 and others) that could be enhanced by management. This workshop will investigate recent research suggesting strong linkages between soil quality and plant resistance to disease and insect pests, and that soil quality management should be an important consideration in pest management.

Organizers: Geoff Zehnder, zehnder@clemson.edu, Department of Entomology, Soils and Plant Science, Clemson University, Clemson, SC; Jane Sooby, jane@offr.org, Organic Farming Research Foundation, Santa Cruz, CA

Moderator: Geoff Zehnder, zehnder@clemson.edu, Department of Entomology, Soils and Plant Science, Clemson University, Clemson, SC

3:45 15.1 Introduction, Geoff Zehnder, zehnder@clemson.edu, Department of Entomology, Soils and Plant Science, Clemson University, Clemson, SC

3:50 15.2 Organic Research in the United States: The Leading Edge of Agricultural Science, Jane Sooby, jane@offr.org, Organic Farming Research Foundation, Santa Cruz, CA

4:10 15.3 Soil Quality Management as an Approach to Insect Pest Management: Field Crops during Transition to Organic Certification, Eileen Cullen, cullen@entomology.wisc.edu, Department of Entomology, University of Wisconsin, Madison, WI

4:30 15.4 Functional Genomic Analysis of Biological Buffering: How Soil Communities Modulate Above-Ground Herbivory, P. Larry Phelan, phelan.2@osu.edu, Department of Entomology, OARDC, The Ohio State University, Wooster, OH

4:50 15.5 Plant Disease Management: Unearthing Links Between Soil, Plants, and Microbes, Frank J. Louws, frank_louws@ncsu.edu, Department of Plant Pathology, North Carolina State University, Raleigh, NC

5: 10 15.6 From Soil Health to Crop Health: How to Establish and Measure Health of Soil and Crops, Gary Zimmer, maryp@midwesternbioag.com, Midwestern Bio-Ag, Blue Mounds, WI

16. Applied Research in Urban IPM

Room D138

Pest problems in urban areas, especially in housing, have a widespread and persistent impact on public health. Cockroaches trigger asthma attacks and may cause asthma in young children. Rodents are also connected to asthma and illness. In addition, bedbugs are making a resurgence. Leading researchers have responded to this challenge with ground-breaking applied researches built on integrated pest management. Only through integrated pest management can the residents, staff and pest management professional work cooperatively to address the problems.

This research has assessed the prevalence of pests in affordable housing. It has tested various means to control pests, especially cockroaches. Some of these methods rely heavily on the PMP. Others require leadership from the property manager. Two studies have compared commercial pest control to university-based researchers to identify disconnects between the science and the application.

This session highlights the work of the leading researchers. It will focus on how they have transcended the boundaries by engaging residents and property managers in successful IPM efforts, especially in the challenging and complicated area of affordable housing.

Organizer: Tom Neltner, National Center for Healthy Housing, tneltnr@nchh.org, Columbia, MD

16.1 Achieving Effective Cockroach Control and Cockroach Allergen Reduction through Integrated Pest Management, Changlu Wang, cwang@aesop.rutgers.edu, Department of Entomology, Rutgers University, New Brunswick, NJ

The lack of adoption of effective cockroach IPM programs has led to chronic cockroach infestations in multi-family buildings. Through comparison of researcher and contractor-delivered IPM programs, we demonstrated 74% reduction in cockroach infestations and significant cockroach allergen and pesticide use reduction by both IPM programs after one year. Most importantly, the first year costs of the programs were only slightly higher to existing pest control contracts. A self-sustainable cockroach IPM program can be achieved by engaging the participation of pest control contractor, residents, and the property manager.

16.2 Cockroach Allergen (Bla g 1) in Public Schools in North Carolina: Comparison of Integrated Pest Management (IPM) and Conventional Pest Control Programs, Godfrey W. Nalyanya, Godfrey_nalyanya@ncsu.edu, J. Chad Gore, H. Michael Linker, and Coby Schal, Department of Entomology, North Carolina State University, Raleigh, NC

Cockroach suppression is fundamental to cockroach allergen mitigation in infested homes. The effects of various cockroach control strategies on cockroaches and allergens have not been examined in schools. This study was conducted to compare the effectiveness of integrated pest management (IPM) and conventional pest control in controlling German cockroach (*Blattella germanica* L.) infestations, and concentrations of the cockroach allergen Bla g 1 in public school buildings. Both cockroach counts and Bla g 1 concentrations were dependent on the pest control approach, with highly significant differences between IPM-treated schools and conventionally-treated schools in both the cockroach mean trap counts and in the amount of Bla g 1 in dust samples. Cockroaches and Bla g 1 were primarily associated with food preparation and food service areas, and much less with classrooms and offices. Our data extend recent findings from studies in homes, showing that cockroach allergens can be reduced by cockroach elimination alone or by integrating several tactics including education, cleaning and pest control. IPM is

not only effective at controlling cockroaches, but can also lead to long-term reductions in cockroach allergen concentrations

16.3 Case Study Examining the Effects on Pesticide Loadings and Resident Pest Control Practices following IPM Interventions, Rhona Julien, Julien. rhona@epa.gov, US Environmental Protection Agency and Harvard School of Public Health, Boston, MA

Studies evaluating the effectiveness of integrated pest management (IPM) have not routinely examined its impact on pesticide reductions indoors. In this study, IPM interventions, which included resident education, were evaluated by comparing pre- and post- intervention measurements of pesticide loadings (e.g., chlorpyrifos, diazinon, permethrin, and cyfluthrin) in 42 apartments in Boston public housing developments. With the exception of diazinon (p -value=0.04), mean concentration changes for the other pesticides were not significantly different from zero at the 0.05 level. Families reported reductions in the use of chemical pesticides including sprays (38% to 0%) and smoke bombs (27% to 0%) as well as cockroach infestation (52% to 21%).

16.4 Assessing the Value That Residents of Public Housing Place on IPM for German Cockroach Control, Dini Miller, dinim@vt.edu, Department of Entomology, Virginia Tech, Blacksburg, VA

Valuation surveys were conducted in Virginia public housing to determine how much additional rent residents would be willing to pay for IPM. Of the 816 residents surveyed, 56% indicated that they would be willing an average of \$11.32 per month for IPM. Other respondents (42%) indicated that they only pay \$0 dollars for IPM. Of those that would not pay, 88% indicated that HUD should pay for IPM. Sixty-four percent of the households contained someone in the "sensitive" age group (65+ years or <13). Fifty-three percent of the households indicated that someone in the home had a breathing illness. Twenty-four percent of the households indicated that someone in the home had visited the emergency room visit for breathing problems within the last two years.

17. Transcending Geographic and Institutional Boundaries to Address a Migratory Pest: The Corn Earworm Story

Room D139

The corn earworm (CEW), *Helicoverpa zea* (Boddie), is a polyphagous pest that feeds on over 100 wild and cultivated host plants including field and sweet corn, cotton, soybean, grain sorghum, and vegetables. Pyrethroids are economical and effective components of chemical control strategies used on numerous crops that are infested annually by the corn earworm. Changes in pyrethroid susceptibility for populations of the corn earworm remain a critical issue for U.S. agricultural industry and the loss of these products would be devastating for many cropping systems. During the 1990s, several pyrethroid insecticides provided cost-effective control of CEW in sweet corn, and for most crops affected in the Midwestern U.S. However, beginning in 2000, researchers in Minnesota and Wisconsin began to notice significant reductions in pyrethroid efficacy for larval control (e.g., 35 to 45% control) as measured by small-plot studies in sweet corn. Although there have been limited reports of CEW control problems in commercial sweet corn (southern Minnesota and Ontario, Canada), pyrethroid efficacy in small-plot trials has remained low, in most years since 2000. Because of the recent challenges in managing CEW, in both fresh-market and processing sweet corn in the Northern U.S., a renewed effort was made during the past 5 years to develop an area-wide IPM program, via funding from an IPM Implementation grant from the North Central IPM Region (USDA-CSREES). These events led to additional matching and in-kind funds from various industry groups, including IRAC, FMC Corp., Del Monte Foods, and Monsanto, to create a multi-state network for CEW moth flight monitoring (PestWatch), resistance monitoring, and extension outreach (ZEA-MAP). Data collected during the past 5 years are being used to revise risk-based models for CEW migration forecasts, and IPM in the Midwest Region. The status of the program and future challenges will be discussed.

Moderators and Organizers: Bill Hutchison, hutch002@umn.edu, University of Minnesota, St. Paul, MN; Brian Flood, Brian.R.Flood@delmonte.com, Del Monte Foods, Rochelle, IL

17.1 Potential Impact of Pyrethroid Resistance in *H. zea* to the Midwest Processing Sweet Corn and Snap Bean Industry, Brian R. Flood, Brian.R.Flood@delmonte.com, Del Monte Foods, Rochelle, IL; Mike Sandstrom and Dave Changnon, Northern Illinois University, DeKalb, IL; Tom Rabaey, General Mills, Le Sueur, MN; W.D. Hutchison, University of Minnesota, St. Paul, MN

The Midwest U.S. food processors are well positioned to avoid major crop losses and product contamination resulting from the corn earworm (CEW), due to a range of harvest periods, from July to October. However, the potential loss of effective pyrethroid materials will have a significant impact and cost to the industry. Pyrethroid insecticides are currently the commercial standard and alternative chemistries are being evaluated; however, the new products are in excess of \$25/application, over current pyrethroid materials. The CEW treatment window for sweet corn is from early silk to dark brown silk. Field trials indicate higher pyrethroid rates are more effective than the former lower rates used. If left untreated, or if we experience insecticide failure, we anticipate losses of ca. 1 or more square inches of kernels per ear on 80% of the ears per acre. This is equivalent to two or more cases per ton of sweet corn destroyed by CEW. Larval consumption of kernels and the creation of black kernels, associated with larval feeding result in market losses in excess of \$115 per acre. To manage CEW we have relied on higher pyrethroid rates, shorter intervals and additional treatments during the treatment windows. In sweet corn we also maximize *Process Out* methods to husk out, wash out and vision sort the contamination and damaged kernels. If problems with CEW control persist long-term, the production of sweet corn and green beans may require expansion to new geographic locations, with less CEW pressure, or changes in production time. Currently, GMO Bt traits are not utilized in the processing industry for green beans or sweet corn.

17.2 Pyrethroid Resistance in Corn Earworm: Historical Perspective, Southern Cropping Patterns, New Active Ingredients, and Prospects for the Future, B. Rogers Leonard, rleonard@agcenter.lsu.edu, and J. Temple, jtemple@agcenter.lsu.edu, Department of Entomology, Louisiana State University AgCenter, Baton Rouge, LA

The corn earworm, *Helicoverpa zea* (Boddie), is a polyphagous pest that feeds on over 100 wild and cultivated host plants including field and sweet corn, cotton, soybean, grain sorghum, and vegetables. Pyrethroids are economical and effective components of chemical control strategies used on numerous crops that are infested annually by the corn earworm. Changes in pyrethroid susceptibility for populations of the corn earworm remain a critical issue for U.S. agricultural industry and the loss of these products would be devastating for many cropping systems. Novel insecticidal molecules such as spinosad, indoxacarb, flubendiamide, and rynaxypyr may offer an alternative to the pyrethroids for control of corn earworm.

17.3 Tracking and Mapping Corn Earworm Migratory Flights at Semi-Continental Scales—Expansion of PestWatch, S.J. Fleischer, sjf4@psu.edu, M. Saunders, A. Bachmann, S. Isard, D. Miller, S. Crawford, Departments of Entomology, Plant Pathology, Geography, Penn State University, University Park, PA; W. Hutchison, Department of Entomology, University of Minnesota, St. Paul, MN; R. Nagoshi and R. Meagher, USDA-ARS, Gainesville, FL

Management decisions require knowledge of local densities, but due to its migratory nature, corn earworm densities can increase dramatically and rapidly, with little warning and independent of local conditions. Public-private collaborations, supported through information technologies, have developed to monitor these and related migratory lepidopterans. Results are being coupled to risk forecasts driven by synoptic meteorology, and could inform process-driven aerobiology models. The collaborations are also enabling improved understanding of lepidopteran migration measured through molecular markers. Discussion will focus on the history and future needs of this infrastructure for IPM of migratory noctuids.

17.4 The IRAC International Diamide (Group 28) Working Group, Aims and Scope: Focus on Stewardship of the Novel Mode of Action Insecticides, the Ryanodine Receptor Activators, Paula G. Marçon, paula.c.marcon@usa.dupont.com, DuPont Crop Protection, Newark, DE; Andrea Bassi, DuPont Crop Protection, Cernusco sul Naviglio, Italy; Glyn Jones, Nichino Europe, Cambridge, UK; John Andaloro, DuPont Crop Protection, Newark, DE; Ken Chisholm, Nichino America Inc., Wilmington, DE; Ralf Nauen, Bayer Crop Science Ag., Monheim, Germany; Robert Senn, Syngenta Crop Protection AG, Basel,

Switzerland; Russell Slater, Syngenta Crop Protection AG, Stein, Switzerland; Shane Hand, Bayer Crop Science Ag., Monheim, Germany; Takashi Hirooka, Nihon Nohyaku Co. Ltd., Tokyo, Japan; Alan Porter, IRAC International, UK

The IRAC International Diamide Working Group (WG) is leading efforts aimed at the sustainability of Group 28 Insecticides (ryanodine receptor activators), currently extending to chlorantraniliprole- and flubendiamide-containing products. There is a common interest to effectively manage field use and prevent or delay the development of resistance to one or more of these insecticides. The global team is working to provide country groups with guidance and tools to implement locally tailored Insecticide Resistance Management (IRM) programs. This is an unprecedented industry effort of global reach and magnitude to proactively manage resistance development to a new class of insecticides with a novel mode of action.

17.5 Obtaining the Coragen® Section 18 for Corn Earworm: Considerations for Emergency Exemptions for New Active Ingredients, Richard A. Carver, Richard.A.Carver@usa.dupont.com, DuPont Crop Protection, Newark, DE, and Keith Dorschner, IR-4 Program, Rutgers University, NJ

Specific criteria are required to obtain approval under Section 18 of the Federal Insecticide Fungicide and Rodenticide Act (FIFRA), for emergency use of pesticides in the United States. These criteria include establishing that the emergency meets certain standards and that data have been submitted and reviewed which allow the US Environmental Protection Agency (EPA) to ensure that the risks to humans and the environment are low. This is particularly challenging for new pesticides such as DuPont™ Coragen® insect control. These criteria, the process for establishing an emergency exemption, and other significant issues encountered in the Coragen® approval will be reviewed.

17.6 Putting it all Together: Benefits of a Multi-state, Public-Private Sector Partnership for Enhancing Corn Earworm IPM, William D. Hutchison, hutch002@umn.edu, University of Minnesota, St. Paul, MN; R. Weinzierl, University of Illinois, Urbana, IL; R. Foster, Purdue University, West Lafayette, IN; B. Jensen, University of Wisconsin, Madison, WI; M. Sandstrom and D. Changnon, Northern Illinois University, DeKalb, IL; S. Fleischer, Pennsylvania State University, University Park, PA; R. Leonard, Louisiana State University, Baton Rouge, LA; Gregory Payne, Department of Biology, University of West Georgia, Carrollton, GA; C. Welty and J. Jasinski, The Ohio State University, Columbus, OH; L. Dobbins, FMC Corp., Indianapolis, IN; Brian Flood, DelMonte Corporation, Rochelle, IL; Thomas Rabaey, General Mills Corporation, LeSueur, MN

The impetus for a renewed focus on area-wide management of the corn earworm, *Helicoverpa zea*, was the need to respond to growing concerns of reduced efficacy by the synthetic pyrethroids, combined with the funding of an IPM Implementation grant from the North Central IPM Region (USDA-CSREES). These events led to additional matching and in-kind funds from various industry groups, including IRAC, FMC Corp., Del Monte Foods, General Mills, and Monsanto, to create a multistate network for CEW moth flight monitoring (PestWatch), resistance monitoring, and extension outreach (ZEA-MAP). Data collected during the past 5 years are being used to revise risk-based models for CEW migration forecasts, and IPM in the Midwest Region. The status of the program and future challenges will be discussed.

18. Potential Revision of the IPM Road Map

Room D140

Pest management systems are subject to constant change, and must respond to a variety of pressures. Environmental concerns, consumer demands, and public opinion are significant influences in the marketplace related to pest management practices. IPM Practitioners must now, more than ever, strive to implement best management practices and tools to incorporate a pest management regime where strategies work in concert with each other to achieve the desired effects while posing the least risks. Current and evolving conditions clearly signal the need for the increased development and adoption of

IPM practices. The justification for a national IPM Road Map, which serves to make these transitions as efficient as possible, has never been greater.

The Road Map for the National Integrated Pest Management (IPM) Program identifies strategic directions for IPM research, implementation, and measurement for all pests, in all settings, throughout the nation. This includes pest management for agricultural, structural, ornamental, turf, public and wildlife health pests, and encompasses terrestrial and aquatic invasive species.

The goal of the IPM Road Map is to increase communication and efficiency through information exchanges among federal and non-federal IPM practitioners and service providers including land managers, growers, structural pest managers, and public and wildlife health officials. Development of this document began in February 2002. Continuous input from numerous IPM experts, practitioners, and stakeholders resulted in the current IPM Road Map published in 2004. The IPM Road Map was intended to be a "living document" from its inception. Thus it is time to take a look at the document to determine if revisions are in order. Interested participants should access the current Road Map at <http://www.ipmcenters.org/Docs/IPMRoadMap.pdf> prior to attending this session. Moderator and Organizer: Harold D. Coble, Harold.coble@ars.usda.gov, Office of Pest Management Policy, United States Department of Agriculture, Raleigh, NC

3:45-5:30 Interactive Workshop

19. Transcending Farm Boundaries: Improving Our Understanding of Insect Relationships within and between Cropping Systems Using Protein Marking Techniques

Room E141

Area wide pest management requires the transcendence of management from fields to wider landscapes. Area wide management requires thinking at landscape levels and understanding how insects move within and between crops. Relationships between predators and prey and consideration of factors that influence the movement of insect, pest, natural enemy and pollinator populations can be explored using a novel technique involving protein markers. This mini-symposium proposes to bring together a group of research entomologists utilizing marking techniques to improve the understanding of the movement of insects, the predators that feed upon them and the spatial requirements of pollinators. The session will focus on protein marking of insects, with a discussion of strengths, weaknesses and hands-on experience using large-scale application of proteins to mark and then recapture insects. Recommended approaches for handling analysis of the data will also be suggested. Cropping systems will include orchard and field crops.

Organizers: Peter B. Goodell, ipmpbg@uckac.edu, University of California Cooperative Extension Statewide IPM Program, Parlier, CA, and Shannon Mueller, scmueller@ucdavis.edu, University of California Cooperative Extension, Fresno County, Fresno, CA

Moderator: Peter B. Goodell, ipmpbg@uckac.edu, University of California Cooperative Extension Statewide IPM Program, Parlier, CA

3:45 19.1 Introduction, Peter B. Goodell, ipmpbg@uckac.edu, University of California Cooperative Extension Statewide IPM Program, Parlier, CA

3:50 19.2 Marking Insects in Orchard Systems, Vincent P. Jones, vpjones@wsu.edu, Tawnee Melton, Callie C. Baker, Department of Entomology, Washington State University, Wenatchee, WA; Steve Naranjo, Agricultural Research Service, USDA, Maricopa, AZ

Studies using immunomarkers in orchard systems for the past five years shows that movement patterns are much more complex than we previously thought. Our studies with codling moth show that dispersal is highly dependent on wind patterns, edge effects, and border treatments. Age of the moths also play a factor, with older moths being less likely to disperse as far as younger moths. By themselves, the immunomarker data are insufficient to understand movement patterns and wind tunnel and flight mill studies are important to determine scale for plot set up and interpretation of the resulting patterns.

4:10 19.3 Spatiotemporal Distribution and Movement of Glassy-Winged Sharpshooters in a Citrus Orchard, Rodrigo Krugner, Rodrigo.Krugner@ars.usda.gov, USDA-ARS, San Joaquin Valley Agricultural Sciences Center, Parlier, CA; Marshall W. Johnson, Department of Entomology, University of California, Riverside, CA; James Hagler, USDA-ARS, Arid Land Agricultural Research Center, Maricopa, AZ; Russell L. Groves, Department of Entomology, University of Wisconsin, Madison, WI; Joseph G. Morse, Department of Entomology, University of California, Riverside, CA

A two-year field study was conducted in a citrus orchard to evaluate the influence of plant water stress on *Homalodisca vitripennis* dispersal and movement. Experimental treatments included irrigation at 100%, 80%, and 60% of the crop evapotranspiration (ET_c). Movement of *H. vitripennis* among treatment plots was quantified through a mark and capture technique using protein markers (soy milk, whole milk, and egg white) and yellow sticky traps. Presence of protein markers on 5795 and 8612 insects captured on sticky traps in 2005 and 2006, respectively, was determined using ELISA. About 22 and 33% of the insects tested positive for at least one protein marker in 2005 and 2006, respectively. In 2006, 75, 78 and 63% of *H. vitripennis* captured in the 60, 80, and 100% ET_c treatments, respectively, were insects that immigrated from the other two irrigation treatment plots. Based on estimates of population densities observed in visual and beat sampling, we hypothesize that in mature orchards *H. vitripennis* is unable to use visual or olfactory cues to search for a suitable host plant and thus, plant selection is determined after contact with the plant by chemosensory or mechanosensory stimulus after probing. Spatiotemporal distribution and movement *H. vitripennis* in the orchard will be discussed with emphasis on the host selection process.

4:30 19.4 The Use of Protein Markers to Pinpoint Predation Events, James R. Hagler, James.Hagler@ars.usda.gov, USDA-ARS, Arid Land Agricultural Research Center, Maricopa, AZ

Identifying the feeding choices and amount of prey consumed by generalist predators is difficult. Often the only evidence of arthropod predation is in the stomach contents of predators. Currently, the state-of-the-art predator stomach content assays include prey-specific ELISAs for the detection of prey-specific proteins and PCR assays for the detection of prey-specific DNA. However, pest-specific antibody development for the ELISA is too difficult, costly, and time consuming for wide scale use. PCR assays are less expensive, easier, and faster to develop than MAb-based ELISAs, but the assays are technically demanding, tedious, and time consuming. Finally, neither type of assay is quantifiable. These shortcomings were the impetus to develop a new technique for predator gut analysis, applying the protein marking technique used to mark insects for dispersal studies. Specifically, prey items can be marked with foreign proteins. Predators exposed to marked prey can be assayed by a series of protein-specific ELISAs to detect individual predation events. The prey marking technique can be employed to quantify three aspects of arthropod predation that are impossible to study using prey-specific gut content assays. Specifically, prey marking can quantify predation and identify cannibalism and scavenging events. Prey marking for studies of predation is an untapped resource. The advantages and disadvantages of immunomarking (a.k.a. protein or prey marking) prey over prey-specific gut assays will be discussed.

4:50 19.5 Tracking Pollinator Movement with Protein

Markers to Enhance Gene Flow Evaluations,
Shannon C. Mueller, scmueller@ucdavis.edu,
University of California Cooperative Extension,
Fresno County, Fresno, CA; James Hagler, James.
Hagler@ars.usda.gov, USDA-ARS, US Arid Land
Agricultural Research Center, Maricopa, AZ;
Larry Teuber, lteuber@ucdavis.edu, University
of California, Davis, CA

Tracking pollinator movement is an important component of gene flow evaluation. In recent years, understanding pollen-mediated gene flow has received much attention in the development of strategies to manage gene flow between transgenic and conventional crops. Using a modified Mark-Release-Recapture technique, foraging honey bees were marked with various colored DayGlo dusts, powdered milk protein, powdered egg protein, or a combination of dusts and proteins. In a commercial production setting encompassing approximately nine square miles, individual apiary locations (9) were equipped with devices that marked the honey bees as they exited the hive. Bees were collected near the hive entrance and in the bee yard to determine marking efficiency. Foraging honey bees were also captured several times over two pollination seasons at 19 different predetermined study sites systematically located in surrounding alfalfa fields. Distances among the study sites ranged from 165 feet to over 3 miles. Captured bees were first examined under UV light to detect the presence of various colored DayGlo dusts and then by protein-specific ELISAs to detect the presence of milk and egg proteins. Marked bees were identified and could be traced back to one of the nine apiaries. Information regarding honey bee movement among commercial seed production fields can be used in combination with estimates of gene flow resulting from analysis of seed samples collected as part of this study from conventional and transgenic (marker source) cultivars to develop new protocols for crop production and establish stewardship programs to preserve existing markets. The combination of pollinator marking and associated gene flow provides powerful technology in developing and managing new traits for the future.

5:10 19.6 The Problem of False Positives in Protein Marking
Techniques, Frances J. Sheller, fjsheller@ucdavis.edu, University of California, Davis, CA; Jay A.
Rosenheim, jarosenheim@ucdavis.edu, University
of California, Davis, CA; James R. Hagler, James.
Hagler@ars.usda.gov, USDA-ARS, Arid Land
Agricultural Research Center, Maricopa, AZ

Protein marking is a valuable technique in the study of insect movement in agriculture. It can be implemented on a large scale and is relatively inexpensive to use. Unlike other marking techniques, protein marking is a quantitative method. Whether an individual is considered marked or not is dependent on threshold that is chosen by the experimenter. The traditionally employed method of choosing a threshold for considering a sampled individual 'marked' accepts some risk of false positives, where an unmarked individual is misclassified as marked. In dispersal studies where the recapture rate of marked individuals is low, false positives can significantly affect estimates of dispersal rates. Using simulations, we demonstrate the interpretational problems potentially produced by false positives. We introduce two possible approaches that can minimize this problem. First, populations can be doubly marked as a means of reducing the incidence of false positives. Second, we introduce new algorithms for choosing a threshold that will decrease the incidence of false positives and allow data to be corrected for anticipated rates of false positives. Together, these methodologies should enhance researcher confidence in the data generated from dispersal studies using protein marking techniques.

5:30 Discussion

20. Tools for Fostering IPM Success in Residential Environments

Room E142

Increasing the adoption of IPM practices in residential environments is critical to sustaining healthy citizens, communities and ecosystems. This workshop will focus on identifying essential elements for success in IPM public education and adoption of IPM practices in and around homes. We will begin with a number of voices from the field where we will hear details of innovative approaches to reaching citizens, influencing attitudes and actions, and measuring impacts from programs working with an array of citizen audiences from public housing residents to public garden visitors. A synthesis led by social scientist Dr. Eisenhower will follow to further highlight factors critical to success in changing people's attitudes and behavior. The information shared and discussed in this session will be the foundation for creating a toolbox for program planners and educators working to increasing the adoption of IPM practices in home environments.

Moderator and Organizer: Lori Bushway, bushway@cornell.edu, Department of Horticulture, Cornell University, Ithaca, NY

3:45 20.1 Voices from the Field

4:45 20.2 Synthesis and Discussion, Brian W. Eisenhauer, bweisenhauer@plymouth.edu, Department of Sociology and Center for the Environment, Plymouth State University, Plymouth, NH

21. The Eco-labeling Explosion—Keeping Up in a Rapidly Changing Marketplace

Room E143

Many eco-labels, such as the Protected Harvest program administered by SureHarvest, have historically grown out of IPM and pesticide reductions. Over the years these labels have grown to address other environmental issues. A new world of sustainability concern has exploded onto the scene in recent months and corporate America is rapidly discovering and redefining what sustainability looks like. How are existing labels adapting? Dr. Deana Knuteson was instrumental in the development of the Health Grown potato eco-label program, a pioneer in IPM and eco-labeling. Dr. Knuteson will present on the original ideas of IPM and pesticide reduction components to develop an eco-labeled program, as well as the addition of an eco-system restoration standards to the program in recent years and new components to be added in the future including social components of sustainability. Dr. Cliff Ohmart of the Lodi Winegrape Commission developed an internationally recognized self-assessment program for winegrape growers to track their progress along a sustainability continuum. A certification program, the Lodi-Rules for Sustainable Winegrowing developed out of this program. Dr. Ohmart will report on the expansion of the *Lodi Rules* program, the emergence of labeled wines in the marketplace, and the work beginning on adding additional quantitative performance metrics to the program. Drs. Jeff Dlott and Daniel Sonke of SureHarvest will discuss the history of eco-labeling, current and emerging eco-labels, how agriculture can benefit by defining the next generation of sustainability metrics in the food chain rather than waiting for it to be defined for it.

Moderator and Organizer: Daniel J. Sonke, dsonke@sureharvest.com, SureHarvest Inc., Modesto, CA

3:45 21.1 The Growth of the *Lodi Rules for Sustainable Winegrowing* Program, Clifford P. Ohmart, cliff@lodiwine.com, Lodi Winegrape Commission, Lodi, CA

The *Lodi Rules for Sustainable Winegrowing* program has expanded from six initial growers certifying 1,455 acres in 2005 to 27 growers certifying 10,000 acres in 2008. Six wineries have put the *Lodi Rules* logo on 19 different wines from the 2005 and 2006 vintages. Additional wineries will be using the logo on wines from the 2007 and 2008 vintages resulting in a significant expansion in the use of the logo on wines in the marketplace. It is likely the *Lodi Rules* program will incorporate performance-based farming standards as it matures and this approach becomes refined in the agriculture community.

4:10 21.2 The Healthy Grown Brand of Potatoes: Success in Eco-labeling, Deana Knuteson, dknuteson@wisc.edu, Nutrient and Pest Management Program, University of Wisconsin, Madison, WI

The Wisconsin eco-potato project worked with researchers, industry representatives, and environmentalists to develop a fresh market potato eco-standard to develop a value-added market to the WI potato growers who were willing to grow in this environmentally sensitive manner. These potatoes are marketed under the brand Healthy Grown. The Healthy Grown brand evolved in response to growing consumer demand for environmentally responsible production methods and to provide consumers more food choices. The “Protected Harvest”/Healthy Grown labels, which are now in place, are rewarding the achievements the growers have already made in regards to pesticide reduction, IPM adoption, and ecological conservation efforts.

4:35 21.3 The Eco-label Landscape—History and Present Developments in Agriculture Eco-labeling, Daniel J. Sonke, dsonke@sureharvest.com, SureHarvest Inc., Modesto, CA

The concept of “sustainability” has been around agriculture for decades but recently has penetrated the American consumer market as never before. Organic agriculture can be considered the “mother” of food certification, but several other nonorganic third-party certification programs are in existence or are being actively considered by growers, retailers, food service companies, government agencies, and environmental organizations. Some of the names are familiar to many in the industry, others less so—EurepGAP, Wal-Mart, SYSCO, Food Alliance, Protected Harvest, and the American National Standards Institute. Select past and current sustainable agriculture certification systems will be reviewed along with some recent developments.

5:00 21.4 The metrics-Based Approach to sustainability-The Stewardship Index, Jeff Dlott, jdlott@sureharvest.com, Professional Services, SureHarvest Inc., Soquel, CA

The historical approach to eco-labeling and sustainability programs for agriculture has generally fallen into two categories— best management practice based programs or process-based programs. Each of these has advantages and limitations. In particular, stakeholders are questioning how to measure the impact of both types of programs in terms of real environmental and social impact. In addition, the emergence of many different programs is of concern to agriculture companies already experiencing “audit fatigue” from multiple food safety programs. Dr. Dlott will present on metrics-based sustainability programs and an “open source” effort in development to address some of these concerns.

22. Promoting Implementation of IPM in Schools

Room D144

Many effective programs have been developed throughout the country to encourage and assist schools with implementation of IPM. This mini-symposium will present a combination of these programs from five areas of the U.S., including programs at the multi-state, statewide, and district-wide levels, each program unique in scope and approach. The purpose is to share information on the successful strategies and resources employed, and to stimulate innovative solutions for the major obstacles as we work together to transcend boundaries and promote nationwide implementation of IPM. The successes and challenges of each will be valuable to other organizations involved in, or planning, programs similar in scope. Order of presentations will move from multi-state to statewide to district-wide. The symposium will begin with a New England effort to evaluate adoption of school IPM and the challenges faced with the assessment process. We will then present a multi-state school IPM workshop conducted in Iowa to assist implementation in several Midwestern states, and serve as a model for expansion in Iowa schools and neighboring states. The symposium will examine the impact on public schools in Texas, where 1991 legislation mandated statewide adoption of school IPM. We will then highlight California's state-wide program to facilitate voluntary adoption of IPM policies and programs in schools and child care facilities. We will conclude with a comparison of the impacts and IPM program sustainability of Florida schools in a "voluntary state" with in-house and outsourced programs.

Moderators and Organizers: Candace Bartholomew, Candace.
Bartholomew@uconn.edu, Pesticide Safety Education, Department
of Extension, University of Connecticut, West Hartford,
CT; Sewell Simmons, ssimmons@cdpr.ca.gov, Pest Management
and Licensing, Department of Pesticide Regulation,
Sacramento, CA

3:50 22.1 Discoveries from a New England Wide School
IPM Survey, Candace Bartholomew, Candace.
bartholomew@uconn.edu, Pesticide Safety Education,
Department of Extension, University of
Connecticut, West Hartford, CT

A School IPM survey was conducted in 2007 in the New England states using the Dillman survey method. The purpose of the survey was to assess pest management priorities and practices in schools, to determine what notification requirements are in place in each state, what the rate of IPM adoption is, to determine the best outreach methods to use to deliver IPM implementation information and to assess future needs. Five-hundred-forty-four useable surveys of 1477 were returned representing 8% of all schools in New England. The project was funded through the Northeast IPM Center and awarded to the PRO New England Pest Management Network collaborators.

4:10 22.2 Implementing IPM in Midwestern States Schools,
Mark Shour, Iowa State University, mshour@
iastate.edu, Ames, IA

The Midwest School Integrated Pest Management Workshop was held March 23-25, 2004, in Ames, Iowa. Thirty-four persons from 10 states and 2 Environmental Protection Agency regions were in attendance. "Instructors" were those who had conducted school IPM training in their states, while "Students" were change agents interested in school IPM. This workshop provided face-to-face interactions and hands-on activities, a school site visit, and electronic and hard copy toolbox of current IPM educational materials. Impacts occurring the first year following the workshop include: 1) landscape audit/IPM program started for KS district; 2) IPM Institute of NA STAR certification for IA school district; 3) beginning of IPM program in MO; 4) new school IPM presentations in KS, MO and SD; and 5) strengthening of networking between workshop participants.

4:30 22.3 The Success and Challenges of Mandating School
IPM in Texas—10 Years Later, Janet Hurley,
ja-hurley@tamu.edu, Texas AgriLife Extension

Service, Dallas, TX

In 1991, the Texas Legislature passed one of the first laws in the U.S. requiring all schools to implement integrated pest management as part of their school maintenance programs. The law required all Texas public schools to use less toxic pesticides and to require licensing of all pesticide applicators on school district property. In addition, the law required all schools in Texas to adopt a school board-approved integrated pest management (IPM) policy and to appoint and train a school district IPM coordinator. In 2006, Texas AgriLife Extension conducted a statewide survey to see how this unfunded mandate has influenced Texas public schools.

4:50 22.4 California's Statewide Programs to Promote Implementation of IPM in Schools and Child Care Facilities, Sewell Simmons, ssimmons@cdpr.ca.gov, Pest Management and Licensing, Department of Pesticide Regulation, Sacramento, CA

The California Department of Pesticide Regulation is committed to facilitating voluntary adoption of IPM policies and programs in schools and child care facilities throughout California, and assists with their implementation of the Healthy Schools Act. Program elements include IPM training workshops; a model school IPM program guidebook; a comprehensive Web Site that provides information on pest, IPM, pesticides, and other resources; extensive technical outreach materials; statewide surveys to evaluate progress; and collection of pesticide use data. Surveys show significant increases in Healthy Schools Act compliance and in adoption of IPM programs and practices.

5:10 22.5 Impacts and IPM Program Sustainability in Florida Schools, Faith Oi, foi@ufl.edu, Entomology and Nematology Department, University of Florida, Gainesville, FL

The State of Florida does not have any laws regulating IPM in Schools. The impacts and sustainability of schools in a "voluntary state" with in-house and outsourced programs will be compared. These school districts are mid-sized, containing more than 50 but less than 130 schools. We will also discuss the function of the Florida School IPM Working Group and interfacing with the Southern Region School IPM Working Group and Extension in the context of program sustainability.

Tuesday, March 24, 2009

6:30–9:00 pm

23. Hands-On Introduction to Integrated Pest Management Tools: eXtension

Room D134

Organizer: Fudd Graham, fgraham@acesag.auburn.edu, Auburn University, Department of Entomology and Plant Pathology, Auburn, AL

The eXtension Web Site is an internet-based collaborative environment that allows for the exchange of objective, research-based knowledge. A branch site dedicated to urban IPM is in progress and scheduled for a December 2009 launch date. Content needed for the site includes but is not limited to Extension-quality articles on pest management, verifiable IPM, monitoring, tools for the school IPM toolbox, thresholds and pest vulnerable areas. Experts in the field of urban IPM are encouraged to contribute their

material to the site. Members of the Southern Region School IPM Working Group will lead this interactive session on entering and editing content for the up-coming urban and school IPM “how to” site.

7:00–9:30 pm

24. 2008 National Extension IPM Special Projects Program (EIPM) Reporting Workshop

Room D133

In 2008, the National Extension IPM Special Projects Program was funded for the second round. In the RFA for that program, the successful applicants were required to report their progress at the IPM Symposium. Projects funded include various databasing efforts for IPM materials, IPM collaborations on tribal lands, IPM for the eOrganic community of practice on eXtension, school IPM, IPM collaborations with Habitat for Humanity, urban IPM certification, IPM and environmental risk assessment, and traditional field guides for IPM in the mid- Atlantic region. The program directors from these successful grant applications will share their progress and early successes on their projects.

Organizer: Marty Draper, mdraper@csrees.usda.gov, Plant Pathology, USDA, Washington, DC

7:00 24.1 Welcome and Process, Marty Draper, mdraper@csrees.usda.gov, Plant Pathology, USDA, Washington, DC

7:05 24.2 Marketing IPM as Green School Technology for Southern Schools, Faith Oi, foi@ufl.edu, Entomology and Nematology Department, University of Florida, Gainesville, FL

7:20 24.3 A Web and Database-Enabled Grower Guidebook to Assess Environmental Risk and Facilitate IPM Adoption, Michael J. Brewer, brewerm@msu.edu, IPM Program, Department of Entomology, Michigan State University, East Lansing, MI

7:35 24.4 eOrganic: Collaborative Development of Ecologically Based Pest Management Information for eXtension, Geoff Zehnder, zehnder@clermson.edu, Department of Entomology, Soils and Plant Science, Clemson University, Clemson, SC

7:50 24.5 An Extension IPM Library and Search Engine, Yulu Xia, yulu_xia@ncsu.edu, Center for Integrated Pest Management, North Carolina State University, Raleigh, NC

8:05 24.6 A Pest Management Strategic Plan Database: Completion, Analyses, and Publication, Russ Mizell, rfmizell@ufl.edu, North Florida Research & Education Center, University of Florida, Quincy, FL

8:20 24.7 1994 and 1862 Land Grant Institutions Working Together to Address IPM Issues on Tribal

Lands, Susan Ratcliffe, sratclif@illinois.edu,
North Central IPM Center, University of Illinois,
Urbana, IL

8:35 24.8 Implementing IPM Certification for Urban Landscape
Professionals and Enhancing Awareness of
IPM in the High Plains and Intermountain West,
Jim Knight, jknight@montana.edu, MSU Extension,
Montana State University, Bozeman, MT,
and Mary Burrows, mburrows@montana.edu,
Department of Plant Sciences and Plant Pathology,
MSU Extension, Montana State University,
Bozeman, MT

8:50 24.9 Home Pest Management Program with Habitat
for Humanity New Homeowners, Molly Keck,
MEKeck@ag.tamu.edu, Department of Entomology,
Texas A&M University, San Antonio, TX

9:05 24.10 Development of Three IPM Field Guides for
Broadleafed Woodies, Needled Evergreens,
and Herbaceous Ornamentals, David Clement,
clement@umd.edu, Home and Garden Information
Center, University of Maryland, Ellicott City,
MD

Wednesday, March 25, 2009

9:00–11:00 am

25. Integrated Crop Management: Transcending IPM Boundaries

Room D133

Integrated Crop Management (ICM) is a crop-centered, holistic, strategic approach for formulating decisions that have the greatest net benefit on agricultural and other ecosystems. It is broader in scope than IPM in that crop production and crop protection are *evaluated together*, resulting in the most efficient, productive, economical and environmentally safe crop/commodity. Information is integrated across all levels and disciplines with the potential benefits of identifying and making rational decisions about actions and practices that have offsetting advantages and disadvantages, and in revealing unique opportunities for synergistic outcomes that increase efficiency and have other benefits. A main tenet of the ICM philosophy is that any action imposed on an ecosystem will likely have multiple “ripple effects” on other factors/components of the system. With respect to the focal crop, these outcomes may be positive, negative or, often, result in a mixture of positive and negative outcomes (trade-offs). By acknowledging, and then understanding, what those effects are, it becomes possible to exert some control over outcomes. Ultimately, decisions can be made that have the net greatest positive effect. To maximize this approach requires good interdisciplinary teamwork. Success is based on coordinated research efforts and communication to exchange knowledge and to analyze if/how procedures and other actions implemented by each discipline impacts others. The goals of this mini-symposium are to communicate, discuss and promote the concept of ICM, and to show by examples of ICM currently in use the benefits of taking this comprehensive approach.

Moderator and Organizer: Jim Nechols, jnechols@ksu.edu,

Department of Entomology, Kansas State University, Manhattan, KS

9:00 25.1 Integrated Crop Management Overview: Novel Approach to Interdisciplinary Research with Unique Benefits for Producers and Other End-Users, Jim Nechols, jnechols@ksu.edu, Department of Entomology, Kansas State University, Manhattan, KS

Integrated crop management (ICM) uses an interdisciplinary approach that is broader than IPM. Because the focus of ICM is the crop/commodity rather than the pest, inputs typically are evaluated in terms of net outcomes for crop production. An underlying assumption is that any action will have multiple effects on other factors in the agroecosystem. By adopting an interdisciplinary approach and understanding what those effects are, decisions can be made that have the greatest net benefit. Tradeoffs between agriculture and environment/ human safety are also considered. Finally, taking an ICM approach may reveal unique opportunities for improving agricultural efficiency and productivity.

9:30 25.2 Integrated Crop Management for Western Flower Thrips, *Frankliniella occidentalis*, Joe Funderburk, jef@ufl.edu, Department of Entomology, University of Florida, Quincy, FL

The spread of the western flower thrips has resulted in the destabilization of integrated pest management programs on a global scale. Growers have typically attempted to control populations by the repeated use of broad-spectrum insecticides; yet populations are largely resistant to most major classes of insecticides. The killing of natural enemies and competing native thrips species results in the flaring of populations. Population attributes include high vagility, short generation time, and polyphagy. The importance of taking an ICM approach for effectively managing pest populations in space and time will be discussed.

10:00 25.3 Integrated Crop Load Management in Native Pecan, William Reid, wreid@ksu.edu, Pecan Experiment Field, Kansas State University, Chetopa, KS

Extensive IPM programs have been developed for native pecan groves. However, these strategies all work under the assumption that crop loss must be prevented. Only by taking a wider view of the native pecan agroecosystem do we find that, under high crop loads, insect frugivory early in the growing season can have the beneficial effect of reducing alternate bearing. I will describe an Integrated Crop Management approach to native pecan management that utilizes IPM tools developed for pecan nut casebearer and integrates them with methods for crop load assessment to determine an action plan for early season insect control.

10:30 Discussion

26. Scaling Up Regional Food Systems: Implications for IPM Education and Research

Room D134

There are multiple multi-institutional projects working on food systems issues, asking the question “what will it take to scale up a sustainable food system to meet wholesale market demand?”. In many parts of the country, there are efforts to revive flagging horticultural industries associated with vegetable and fruit production. IPM is clearly part of the mix required for sustainable food production. What does a regional

sustainable food sector mean for horticultural expertise in the field, in federal conservation program administration, and aggregation, distribution and logistics?

Organizer: Michelle Miller, mmmille6@wisc.edu, Center for Integrated Agricultural Systems, University of Wisconsin, Madison, WI

9:00 26.1 Efforts to Build a Regional Food Economy in the Midwest, Michelle Miller, mmmille6@wisc.edu, Center for Integrated Agricultural Systems, University of Wisconsin, Madison, WI

9:30 26.2 Embracing Sustainability through the Entire Production, Packing and Distribution Process, Fred Wescott, Fred@wescottorchard.com, Wescott Agriproducts and Mississippi Valley Fruit Company, Elgin, MN

10:00 26.3 Efforts to Embed IPM into Conservation Programs, Jim Jasinski, jasinski.4@osu.edu, Integrated Pest Management Program, Ohio State University Extension, Urbana, OH

10:30 Discussion

27. Biorational Control: Mechanism, Selectivity and Importance in IPM Program

Room D135

Our session deals with novel approaches for biorational insect pest control aiming at developing selective insect control agents acting on specific biochemical sites such as neuropeptides, ecdysone and juvenile hormones, GABA, ACh and ryanodine receptors, and natural products such as plant lectins and others originating from tropical plants. All of which are important components in IPM programs. Countermeasures for resistance to biorational control agents using advanced biological and biochemical approaches are discussed.

Organizers: Isaac Ishaaya, vpisha@volcani.agri.gov.il, Agricultural Research Organization, The Volcani Center, Bet Dagan, Israel, and A. Rami Horowitz, hrami@volcani.agri.gov.il, Department of Entomology, Agricultural Research Organization, Gilat Research Center, MP Negev, Israel

27.1 Biorational Control: An Overview, A. Rami Horowitz, hrami@volcani.agri.gov.il, and Isaac Ishaaya, Department of Entomology, Agricultural Research Organization, Israel

For nearly 50 years, pest control has been mostly based on broad-spectrum conventional-insecticides. However, the severe adverse effects of pesticides on the environment, problems of resistance reaching crisis proportions and public protests led to stricter regulations and legislation aimed at reducing their use. This overview briefly summarizes various new environmentally friendly approaches to pest management. One such approach is based on disrupting the activity of specific biochemical sites such as neuropeptides, ecdysone and juvenile hormones and other insect's receptors. Another is the use of natural products obtained from tropical plants for pest control. Some ideas for utilization of

semiochemicals and of insect signaling are described too. Novel biotechnology control strategies (“the genetic approach”) exploit genetically modified-plants, -insect and -symbionts in the combat against insect pests and disease-borne vectors are discussed.

27.2 Insect Neuropeptide Agonists/Antagonists as Tools for Rational Pest Control, Ronald J. Nachman, Nachman@tamu.edu, Areawide Pest Management Research Unit, Southern Plains Agricultural Research Center, US Department of Agriculture, College Station, TX

Insect neuropeptides regulate critical processes and behaviors in insects, though they are unsuitable as tools to arthropod endocrinologists and/or as pest management agents due to unsuitable biostability and/or bioavailability characteristics. Peptidomimetic, and non-peptide, analogs can overcome these limitations and either over-activate or block critical neuropeptide-regulated functions. Stereochemical and conformational aspects critical for the successful interaction of several broad classes of arthropod neuropeptides with their respective receptors is discussed, and exploited to design/discover mimetic analogs with enhanced biostability, bioavailability and selectivity. Mimetic analogs of neuropeptides may offer promising leads in the development of selective, environmentally friendly insect control agents in the future.

27.3 Novaluron: An Important IGR for Controlling Field Crop Pests, Isaac Ishaaya, vpisha@volcani.agri.gov.il, Galina Levdev, Svetlana Kontsedalov, Murad Ghanim, and A. Rami Horowitz, Department of Entomology, Agricultural Research Organization, The Volcani Center, Bet Dagan, Israel

Novaluron (Rimon) is a novel benzoylphenyl urea which acts by both ingestion and contact. It is a powerful suppressor of lepidopteran larvae such as *Spodoptera littoralis*, *S. exigua*, *S. frugiperda* and *Helicoverpa armigera*. It also efficiently affects the whiteflies *Bemisia tabaci* and *Trialeurodes vaporariorum* and the leafminer *Liriomyza huidobrensis*. The LC₅₀ value of Rimon on *S. littoralis* larvae fed on treated leaves is approximately 0.1 mg a.i./liter. Novaluron affects larvae of *B. tabaci* to a much greater extent than does either chlorfluazuron or teflubenzuron resulting in total mortality at a concentration of 1 mg a.i./liter. Artificial rain at a rate of 40 mm/h applied 5 and 24 h after treatment in a cotton field had no appreciable effect on the potency of novaluron on *S. littoralis* larvae. Hence, novaluron can be used in tropical areas and in rainy seasons. Novaluron is considered to have a mild effect on natural enemies and has no cross resistance with conventional insecticides, the juvenile hormone mimic pyriproxyfen and the neonicotinoids. As such it is considered an important compound in IPM programs.

27.4 Development and Uses of a Spruce Budworm Microarray Platform for Studying Ecdysone-Controlled Gene Expression and Tebufenozide Effects, Daniel Doucet, dan.doucet@nrca.gc.ca, D. Zhang, S. Bowman, P.J. Krell, H. Mossalanejad, G. Smagghe, Canadian Forest Service, Sault Ste. Marie, Canada

Microarrays, also known as DNA chips, are extremely useful tools for the high throughput study of gene expression in many organisms. We have constructed a microarray for the moth *Choristoneura fumiferana* (the spruce budworm, sbw), an important pest of fir and spruce in North America. The array contains over 3000 unique sbw DNA sequences, obtained by spotting PCR products from a sbw EST clone collection. The sbw array has been used to support two projects: i) an analysis of gene expression profiles in larvae molting from 5th to 6th instar stages and ii) a study on the impact of tebufenozide (a diacylhydrazine insecticide) on a spruce budworm cell line. Results from both projects will be presented. Genes represented by over 300 ESTs showed at least three-fold difference in the expression level between

molting and intermolting larvae. These genes are involved in several biological processes such as cuticle synthesis and degradation, chitin synthesis and degradation, cuticle pigmentation, myogenesis, transcription and translation regulation and catabolic pathways.

27.5 Plant Lectins as Tools for Controlling Pest Insects, Guy Smagghe, guy.smagghe@ugent.be, Gianni Vandenborre, Amin Sadeghi, Shahnaz Shadidi-Noghabi, Mohamad Hamshou, Nagender Rao, Katrien Michiels, Anita Kabera, Leni Vaeyens and Els J.M. Van Damme, Ghent University, Ghent, Belgium

In recent years the exploitation of defense proteins that confer resistance towards insect pests has received great attention as these may help to develop a balanced IPM strategy reducing pesticide use. Until now, the successful development of *Bacillus thuringiensis* (*Bt*) has revolutionized the field, but another interesting group comprises lectins that are a large, heterogeneous group of carbohydrate-binding proteins. This paper will give an overview of the recent progress that has been made in the study of the insecticidal properties of different classes of plant lectins and their potential use as tools in controlling pest insects. Interestingly, lectins show toxicity against biting-chewing insects like caterpillars and piercing-sucking insects like aphids. Also the combined use with beneficial organisms/ natural enemies and *Bt* will be discussed. Finally, possible target sites inside the insect and the mode of action for ingested lectins are presented.

27.6 Flufenimer, a Novel Insecticide for Controlling Whiteflies and Aphids—Biological and Biochemical Aspects, Murad Ghanim, ghanim@agri.gov.il, Svetlana Kontsedalov, Galina Levdiv, A. Rami Horowitz, and Isaac Ishaaya, The Volcani Center, Bet Dagan, Israel

Flufenimer is a new pyrimidinamine insecticide which is under developmental stage by Makhteshim-Agan for controlling sap-sucking pests such as aphids and whiteflies with unknown mode of action. Flufenimer showed exceptional potency against the whitefly *Bemisia tabaci*, the green peach aphid *Myzus persicae*, and the melon aphid *Aphis gossypii* with LC₅₀ values lower than 1 mg a.i./litre. After 24 generation selection with flufenimer, no decrease in susceptibility of *B. tabaci* was found. Flufenimer showed no cross resistance with selected *B. tabaci* resistant strains against *neonicotinoids*.

28. Transcending Boundaries with Innovations in IPM for School and Childcare Facilities: Cost-Benefit Case for IPM in Schools

Room D136

Transcending geographic and traditional role boundaries can help make IPM happen in all of our schools and childcare facilities. We know how to manage pests primarily with sanitation and exclusion, reducing both pesticide use and pest complaints substantially. We also know how to enlist all of those in the school community with a role to play including pest management staff and contractors; custodial, maintenance, food service, school health and administrative staff; and students, parents and others. Our challenge is to multiply our successes by more effectively coordinating efforts across state and international boundaries, making the most efficient use of resources to reach all school districts and regularly measuring and reporting progress towards high level IPM in all schools. In this mini-symposium, we will address the cost-benefit case for IPM in schools, drawing both on new tools that help determine cost-effectiveness and tested models for successful, affordable IPM. We will report on international school and childcare IPM efforts in the US, Mexico, Japan and South Korea. We'll also hear about four new regional school IPM working groups, a new school IPM "toolbox", the national school IPM strategic plan, updates on laws and

regulations, and verification and certification for schools and service providers. The session will provide valuable "how-to" information on adoption of IPM in schools.

Organizers: Kelly Adams, kadams@ipminstitute.org, and Thomas Green, ipmworks@ipminstitute.org, IPM Institute of North America, Inc., Madison, WI

9:00 28.1 New Tool to Help Schools Calculate the Costs of IPM, Janet A. Hurley, MPA, ja-hurley@tamu.edu or hurley_janet@yahoo.com, Texas AgriLife Extension Service, Entomology, Dallas, TX

IPM is frequently promoted as an effective means of reducing risks of both pests and pesticides in public school settings. Nevertheless, due to lack of standards, policies, or regulations requiring the use of IPM in most states, implementation of IPM among school districts has been slow. A heuristic decision tool was developed by Texas AgriLife Extension to project the probable costs of IPM. The IPM Cost-calculator provides users with an estimate of overall pest risk of the school being evaluated, a facilities maintenance pest management budget, and a prioritized list of suggested facility improvements and behavioral modifications. Interest in the calculator as a budgeting and planning tool has been high. Even more importantly, the cost calculator has proven to be another valuable tool for teaching IPM.

9:24 28.2 Cost-Benefit Brochure, Sherry L. Glick, glick.sherry@epa.gov, US Environmental Protection Agency, Office of Pesticide Programs, Environmental Stewardship Branch National Pesticides and Schools Coordinator, Washington, DC

We all know that School IPM is environmentally friendly and the right thing to do, but is it cost effective? Compared to the dollars saved using less or no pesticides in a school versus the maintenance costs for window screen replacements and door sweeps; what will the school district budget look like? This session will involve an interactive discussion on a new brochure that addresses these issues and more about the cost-benefits of IPM and why schools need to make that initial investment to protecting their children and staff.

9:48 28.3 Metrics and How They Are Developed: Pesticide Applications and Cost and Complaint Rates, Marc L. Lame, mlame@indiana.edu, Indiana University, School of Public and Environmental Affairs, Bloomington, IN

The metrics of IPM models are designed to confirm the decision to diffuse IPM by the school district community. Measures used are: Annual number of pesticide applications; pest management costs; number of complaints by school inhabitants regarding pests; and recognition. Metrics regarding the reduction of pesticide use are developed from pre-program and post-program invoices and work orders for pesticide applications. Pest Control Cost data are developed through analysis of the pest management annual contract, work-orders and monthly invoice statements. Pest complaints are measured via "observed" and "perceived" pest infestations using numeric/percentage reduction benchmarks during the initial, midterm and final evaluations of the school district. Recognition is considered an observable attribute of IPM as news media attention, plaques/awards/certification and invitations to present successful management are tangible benefits in the school community with regard to performance review.

10:12 28.4 Innovative Model on Delivering Cost Effective IPM, Bob Stoddard, bob@envirosafeipm.com, EnviroSafe Inc., Grand Rapids, MI

Learn about a school Integrated Pest Management (IPM) program that began as a response to a state mandate and was developed through grassroots community efforts. The EnviroSafe Model evolved from an in-house program at Michigan's second largest school district to become the nation's first Green Shield Certified program. Currently implemented in 72 school districts (480 buildings) in Michigan, components of the EnviroSafe program are also being used by the nation's largest school district and a number of districts in Pennsylvania. This session offers an introduction to the program and will explore how a cost-effective model has been scaled to serve school districts of all sizes and needs

10:36 28.5 The Cost-Benefits of IPM from a Facility Director's

Perspective, Gregg Smith, gregg.smith@slc.

k12.ut.us, Salt Lake City School District, Salt Lake City, UT

Safe and healthy school environments are a national priority and the health benefits from IPM are immeasurable. Because IPM is unfamiliar to many school officials, they often view the associated costs and benefits from a different perspective and unfortunately impede IPM implementation. This session will identify and compare the costs incurred to implement a successful IPM program in a mid-sized urban school district to the costs that were previously expended for traditional pest management practices. The analyses presented will address IPM training and monitoring costs as well as other costs for exclusion and prevention and will explore whether these are new budgetary expenditures or existing dollars spent for different reasons. The discussion will also consider the influence of facility age, construction, sanitation and maintenance on IPM costs.

29. Mitigating or Eliminating Pesticide Risks in Surface Waters in the Pacific Northwest and West Africa with Targeted Research, Extension, and Education Programs

Room D137

The session will draw attention to increasing risks posed by pesticide surface water contamination internationally. It will review the role of IPM and pesticide risk reduction and mitigation practices in addressing these challenges. Contributors will deliver reports from ongoing programs and demonstrate how a common set of tools can be applied in the very different settings of the Pacific Northwest and six West African countries to achieve common goals.

This session will draw upon two groups of contributors:

1) Participants in partnerships in the Pacific Northwest that have successfully addressed pesticide issues in surface waters, including 1) a program in Hood River, Oregon that has developed effective BMP's for tree fruit producers in collaboration with the State Department of Environmental Quality, Oregon State University, the Hood River Grower Shippers Organization, the Hood River Watershed Group and the Confederated Tribes of the Warm Springs; and 2) participants in the multistate iSNAP program, based in the IPPC at OSU, who have developed and delivered targeted IPM education programs that explicitly address pesticide occurrence in local surface waters, the risks associated with these, and a combination of IPM and BMP practices that reduce or mitigate potential impacts.

2) Participants in an international program, coordinated by the FAO (UN) that aims to reduce pesticide inputs to the Senegal and Niger rivers in West Africa. Contributors will include team members from the USA and West Africa responsible for development of surface water monitoring, human health and ecological risk assessment, risk communication and large scale farmer field school programs across the region.

Organizer: Paul C. Jepson, jepsonp@science.oregonstate.edu,
Integrated Plant Protection Center, Oregon State University,
Corvallis, OR

9:00 29.1 IPM and Pesticide Challenges in West Africa and the Pacific Northwest with Water as a Common Thread, Paul Jepson, jepsonp@science.oregonstate.edu, Integrated Plant Protection Center, Oregon State University, Corvallis, OR; William Settle, william.settle@fao.org, FAO (UN) AGPP, Rome, Italy; Hama Garba, mohamed.hamagarba@fao.org, FAO (UN), Dakar, Senegal

Pesticides used in agriculture contaminate surface waters and present challenges to ecological function, food supply and human health. Contaminant burdens may infringe international conventions and national laws and there are significant pressures to reduce chemical inputs to water in both continents. Pesticide regulation and producer education can both play important roles in the amelioration of impacts, but both require feedback from chemical monitoring. We will review pathways for progress through implementation of IPM and contrast the ways in which this can be achieved in US and West African systems.

9:20 29.2 Status, Trends and Importance of Pesticide Risks in Surface Waters in West Africa and the Pacific Northwest, Jeffrey Jenkins, jeffrey.jenkins@oregonstate.edu, Environmental and Molecular Toxicology, Oregon State University, Corvallis, OR; Makhfousse Sarr, sarrmakh12@yahoo.fr, National GIPD/GEF, Dakar, Senegal

Pesticide surface water contamination data from the USA and West Africa will be evaluated, and the potential for risks of adverse impacts on human health and the environment outlined. Data from both sources are limited, and this generates uncertainties in the assessment of possible risks. We will outline approaches to the analysis and interpretation of these uncertainties with reference to the ecological risks posed by pesticides to Salmonidae in the Pacific Northwest and to human health in West Africa.

9:40 29.3 The Role of Community Based Participatory Education in Reducing Risks to Agro-Chemicals while Meeting Food Security Goals, William Settle, william.settle@fao.org, FAO (UN) AGPP, Rome, Italy; Hama Garba, mohamed.hamagarba@fao.org, FAO (UN), Dakar, Senegal; Makhfousse Sarr, sarrmakh12@yahoo.fr, National GIPD/GEF, Dakar, Senegal; Paul Jepson, jepsonp@science.oregonstate.edu, IPPC, Oregon State University, Corvallis, OR; Jeffrey Jenkins, jeffrey.jenkins@oregonstate.edu, Environmental and Molecular Toxicology, Oregon State University, Corvallis, OR

A large body of evidence points to the importance of participatory education programs in the establishment and implementation of locally-tuned and sustainable IPM programs. We will report programs in farmer education in West Africa and the Pacific Northwest that quantitatively demonstrate the association between participatory programs and reductions in pesticide inputs and surface water chemical burdens. Off-site losses may reveal modes of pesticide use that threaten food security, and we argue that knowledge of the pathways and levels of losses and their consequences are an important component of IPM education.

10:00 29.4 The Use and Value of Environmental Monitoring in the Assessment and Analysis of Risks, Kim Anderson, kim.anderson@oregonstate.edu, Food Safety and Environmental Safety Laboratory

(FSES), Oregon State University, Corvallis, OR; Greg Sower, gsower@g.mail.com, FSES, Oregon State University, Corvallis, OR; Makhfousse Sarr, sarmakh12@yahoo.fr, National GIPD/GEF, Dakar, Senegal; Lucas Quarles, quarlesl@onid.orst.edu, FSES, Oregon State University, Corvallis, OR; Wendy Hillwalker, walkerwe@onid.orst.edu, FSES, Oregon State University, Corvallis, OR

Effective chemical monitoring requires advanced capacities in the deployment and use of sampling technology, chemical extraction and analysis, all of which are subject to strictly managed procedures governing the reliability and quality of data. We outline programs in the Pacific Northwest and West Africa that are building the capacity for monitoring and analysis of surface water contamination by pesticides and outline the conceptual framework for a collaborative network of laboratories that will build quality and resilience into these activities.

10:20 29.5 Risk Assessment Tools that Contribute to Effective Risk Management and Risk Communication, Jeffrey Jenkins, jeffrey.jenkins@oregonstate.edu, Environmental and Molecular Toxicology, Oregon State University, Corvallis, OR; Kathy Blaustein, blaustek@science.oregonstate.edu, Integrated Plant Protection Center, Oregon State University, Corvallis, OR; Paul Jepson, jepsonp@science.oregonstate.edu, Integrated Plant Protection Center, Oregon State University, Corvallis, OR; Makhfousse Sarr, sarmakh12@yahoo.fr, National GIPD/GEF, Dakar, Senegal

Experience in the development and use of sophisticated risk assessment instruments that inform education programs for farmers and other stakeholders is increasing. We will outline development of human health risk assessment procedures for surface waters in West Africa, illustrating the ways in which these exploit data from environmental monitoring, surveys of pesticide use and analyses of behaviors and activities that affect chemical exposure and impacts. We will also briefly outline the scope for establishing ecological risk assessment procedures in the same West African study locations.

10:40 29.6 The Role of Modeling in Effective Decision Support for Pesticide Management at Multiple Scales, Michael Guzy, guzym@enr.orst.edu, Biological and Ecological Engineering, Oregon State University, Corvallis, OR; Paul Jepson, jepsonp@science.oregonstate.edu, Integrated Plant Protection Center, Oregon State University, Corvallis, OR

Environmental monitoring and risk assessment procedures that support IPM and food security are usually limited in scope, and address the specific locations and times when measurements are made. Modeling in a variety of forms may enable the temporal and spatial scope of these data and associated analyses to be expanded, but only where care is taken to determine the validity of these steps and the uncertainties associated with model output. We explore current activities and opportunities for exploiting models in analysis and reduction of risks associated with pesticides in surface waters in West Africa and the Pacific Northwest.

30. Sustainable Subterranean Termite

Management

Room D138

Where eradication is not feasible, sustainable pest management is the goal of large-scale IPM programs. This is an ambitious goal in the urban environment, particularly with respect to structural pests. This workshop builds upon the successful workshop on subterranean termite IPM at the 5th National IPM Symposium to address the issues involved in implementing sustainable community-wide programs for termite prevention and control.

Organizers and Moderators: J. Kenneth Grace, kennethg@hawaii.edu, Department of Plant and Environmental Protection Sciences, University of Hawaii at Manoa, Honolulu, HI, and Frank S. Guillot, frank.guillot@ars.usda.gov, Southern Regional Research Center, USDA-ARS, New Orleans, LA

9:00 30.1 The Goal of Sustainable Termite Management, J. Kenneth Grace, kennethg@hawaii.edu, Department of Plant and Environmental Protection Sciences, University of Hawaii at Manoa, Honolulu, HI, and Frank S. Guillot, frank.guillot@ars.usda.gov, Southern Regional Research Center, USDA-ARS, New Orleans, LA

9:15 30.2 New Paradigms in Termite Control, Michael K. Rust, michael.rust@ucr.edu, Department of Entomology, University of California, Riverside, CA

9:30 30.3 Technological Needs for Sustainable Termite Management, Nan-Yao Su, nysu@ufl.edu, Department of Entomology and Nematology, Ft. Lauderdale Research and Education Center, University of Florida, Ft. Lauderdale, FL

9:45 30.4 Sustainable Termite Management in Multi-species Environments, Chow-Yang Lee, chowyang@mac.com, School of Biological Sciences, Universiti Sains Malaysia, Penang, Malaysia

10:00 30.5 The Role of Extension in Implementation of Sustainable Management Efforts, Eric P. Benson, ebenson@clermson.edu, Department of Entomology, Soils and Plant Sciences, Clemson University, Clemson, SC

10:15 Panel and Audience Discussion

31. Indoor IPM and Green Buildings: Is There a Connection?

Room D139

Interest in green buildings has grown tremendously in recent years. Certification standards based on energy and water conservation, site selection and use of recycled materials are among the criteria frequently used to designate buildings as "green". We propose that building architects and engineers (and

IPM specialists) need to look beyond traditional boundaries when it comes to “green” or environmental design. Currently, pest-proofing is rarely, if ever, considered in the design of new buildings. We propose that IPM should become an integral part of green architecture. Experts from the fields of building maintenance, architecture, engineering and pest control will be invited to discuss how pest management considerations can be integrated into the design and construction of green buildings. If adopted, features such as sanitary dumpsters, pigeon-resistant building ledges, pest-resistant doors and non-pest-attracting outdoor lighting could reduce long-term maintenance costs and significantly reduce the need for pesticides.

Organizer: Mike Merchant, m-merchant@tamu.edu, Texas AgriLife Extension, Dallas, TX

31.1 Introduction to IPM and Green Buildings, Mike Merchant, m-merchant@tamu.edu, Texas AgriLife Extension, Dallas, TX

Green building certification programs are built around criteria such as environmentally friendly site location, use of recycled materials, energy and water use efficiency. Ideally green design should reduce the need for non-renewable resources, minimize the introduction of toxic materials, and the need for expensive, ongoing maintenance. Buildings designed with basic principles of pest management in mind have the potential for improving indoor air quality by reducing the need for pesticides and expensive pest control interventions over the life of the building. In addition, pest resistant buildings can increase the life of buildings by minimizing, for example, the risk of termite and rodent damage. This presentation will introduce the idea of IPM-based design, provide examples of good pest resistant design, and outline some of the challenges in securing wider adoption of IPM-design considerations in new buildings.

31.2 Implementing IPM in Commercial Food Service Facilities: Integrating Process, Relationship, Recommendations, and Challenges, Judy Black, judy.black@steritech.com, The Steritech Group, Denver, CO

Steritech's extensive experience providing pest control services to commercial food handling facilities supports the idea that customer cooperation, sanitation, and pest resistant design can aid pest control while reducing the need for pesticide use. Recommendations for new construction and landscape design, and steps that can be taken during facility renovations, will be presented, with the goal of making the facility as hostile to pests as possible. IPM in commercial food service facilities works best when both the service provider and the client are equally interested in and invested in achieving a sound program with minimal pesticide applications.

31.3 Proactive Pest Exclusion Considerations for Green Buildings, Bobby Corrigan, cityrats@mac.com, RMC Consulting, Richmond, IN

What biological and non-biological factors are associated with pest entry and thereafter with pest concealment, survivability and proliferation within urban structures? How can green design considerations be meshed with innovative pest exclusion technology? This session considers these questions and analyzes the pest vulnerable areas (PVAs) of buildings with the goal of shedding light for architects and building contractors for proactively (i.e., prior to design and construction) excluding or minimizing pest issues as an integral part of green architecture. It also addresses the long overdue necessity for proactive collaboration among architects, contractors and IPM specialists on a broad scale.

31.4 Green Building Rating Systems and How to Get Involved, Alisa Kane, akane@ci.portland.or.us, Green Building Program, City of Portland, OR

Green building rating systems, such as LEED, have created an increased demand for efficient, healthy and attractive spaces for people to live work and play. Since many of the principles of green building reflect and incorporate natural elements into the built environment, anticipating unintended pest consequences is essential to the long term performance of the building. Alisa will provide an overview of several rating systems with suggestions on how an IPM specialist can get more involved in the green building industry.

31.5 Role of the Engineer in School Design and Construction,
James D. McClure, jmccclure@
estesmcclure.com, Estes, McClure and Associates,
Tyler, TX

The role of an engineer will be discussed within the context of a team approach to designing and constructing schools. Examples of good and poor building designs for pest management will be covered. Practical tips will be offered on how IPM can be more effectively incorporated into the building design and construction process. Specific topics addressed will include the team approach for integrated school design and construction, the role of the team after construction, energy issues, and communicating with engineers about IPM.

32. History, Causes, and Challenges of Insecticide and Herbicide Resistance

Room E141

Pest management has relied heavily on synthetic pesticides to prevent economic losses in food and fiber crops worldwide. As a result, the remarkable adaptability of insect, weed, and plant pathogen pests has resulted in the development of resistance to nearly all classes of pesticides. This symposium will attempt to give a broad overview of some of the key developments in insecticide and herbicide resistance across a broad range of crops. The presenters will briefly cover the causes of resistance in many pests and present information relevant to managing resistance before it becomes widespread. Additionally, topics covered will include various IPM strategies to manage pests that have developed widespread resistance to multiple classes of pesticides, the impact of resistance on the agricultural industry, and new technologies on the horizon to manage agricultural pests.

Organizers: Jeff Gore, JGore@drec.msstate.edu, and Trey Koger, tkoger@drec.msstate.edu, Delta Research and Extension Center, Mississippi State University, Stoneville, MS, and John Adamczyk, John.Adamczyk@ars.usda.gov, USDA-ARS, Weslaco, TX

9:00 32.1 Insecticide Resistance in Vegetable Crops,
Anthony Shelton, ams5@cornell.edu, Department
of Entomology, Cornell University, New
York State Agricultural Experiment Station,
Geneva, NY

Because of their high economic value, strict cosmetic standards and lack of insect-resistant germplasm in most cases, vegetables are subjected to more intense use of insecticides than many other crops. This has led to many instances of insecticide resistance. Examples of insecticide resistance have occurred in most major vegetable crops and against most major classes of insecticides, including *Bacillus thuringiensis* and several of the newest classes. Good pest management practices can reduce the intensity of spraying and hence the evolution of resistance.

9:20 32.2 Insecticide Resistance and IPM in Row Crops,
Roger Leonard, rleonard@agctr.lsu.edu, Department

of Entomology, Louisiana State University,
Northeast Research Station, Winnsboro, LA

Many U.S. row crops including field corn, soybean, wheat, cotton and rice experience annual yield-limiting problems with insect pests. Chemical control strategies represent an essential IPM tool for managing these insect pests. Unfortunately, this reliance on insecticides has resulted in the development of resistant populations of insect pests in many production systems. Registration costs and a strict regulatory environment have slowed the registration of new insecticidal molecules. This trend has further increased selection pressure on insect populations with fewer effective products being used on a variety of crops that share common pests across entire regions. History demonstrates that resistance will likely continue to be an issue for row crop IPM and the present challenge is to delay the occurrence of widespread chemical control failures using combinations of science-based insect pest management strategies across the “farmscape.”

9:40 32.3 Insect Resistance Management Challenges:
An Industry Perspective, Graham Head,
graham.p.head@monsanto.com, Monsanto
Company/IRAC, St. Louis, MO

Insect Resistance Management (IRM) poses significant technical, logistical and economic challenges. From a technical perspective, the design of IRM programs requires knowledge of pest biology, pest-product interactions, and resistance mechanisms that may not be readily available. In addition, IRM programs can only be successful if they provide practical and economic solutions that will be supported and implemented by a range of stakeholders. These challenges are discussed in the context of industry-wide efforts to manage insect resistance.

10:00 32.4 The History and Challenges of Herbicide Resistance
in Weeds, Phil Westra, Philip.Westra@
ColoState.edu, Department of Bioagricultural
Sciences and Pest Management, Colorado State
University, Ft. Collins, CO

Since the discovery of triazine herbicide resistant common groundsel in nurseries in Washington state in 1968, the discipline of weed science has increasingly had to turn its attention to the biology, ecology, and molecular aspects of herbicide resistant weeds. Most herbicides exhibit high level lethal effects on target plants while causing no damage to tolerant crops or trees. This very high level of biological activity for most herbicides has created equally high selection pressure for individuals exhibiting resistance to these herbicides. If a given herbicide kills 99.9% of a weed population, resistant survivors can quickly build up to very high populations, especially if the same herbicide is used every year. In the 40 years since the common groundsel discovery, many weeds globally have developed resistance to many modes of action for herbicides. These resistant weed often force growers to utilize more costly alternative herbicides, or tank mix partners to help control the resistant species. Herbicide resistant weeds have added to the cost of global food and fiber production. The herbicide families with the largest number of resistant weed species are the ALS inhibitors, the triazines, and the ACCase inhibitors. However, virtually all herbicide modes of action now have examples of herbicide resistant weeds. Not surprisingly, most of these resistant weeds occur in developed countries where herbicides are heavily relied on for weed management. Some believe that greatly increased use of glyphosate in rapidly adopted Roundup Ready crops accelerated the global development of glyphosate resistant weeds, a phenomenon once thought to be highly unlikely. To be sure, herbicide resistant weeds have provided the weed science and its many colleagues with excellent opportunities to conduct basic, fundamental research on plant physiology, plant biochemistry, plant metabolism, plant genetics, and plant molecular genetics. In some cases, a herbicide resistance trait provides a powerful marker for studying photosynthesis, plant enzyme activity, or the dispersion of trait at a landscape level. More recently, weed scientists have been using the powerful tools of biotechnology and molecular genetics to study herbicide resistance in weeds, including glyphosate resistance in selected species. New evidence suggests that a novel molecular basis for glyphosate

resistance may once again force the weed science community to closely examine possible mechanisms of herbicide resistant weeds.

10:20 32.5 Impact of the Evolution of Glyphosate Weed Resistance on Syngenta, Chuck Foresman, chuck.foresman@syngenta.com, Syngenta Crop Protection, Greensboro, NC

Glyphosate and glyphosate tolerant crops have had a major impact on American agriculture and crop protection organization strategies. Syngenta's focus is crop protection chemicals, seeds, and professional products. The selection of weeds with the ability to resist glyphosate in row crop agriculture has had a significant impact on herbicide strategy. Herbicide discovery, development and marketing efforts have been greatly influenced by the acceptance, success and challenges of glyphosate tolerant cropping system. Syngenta invests in herbicide discovery and development as a part of the long term strategy while developing pre-mixtures of registered products in the near term.

10:40 32.6 Present and Coming Herbicide-Resistant Crops: Impacts on IPM, Stephen Duke, sduke@olemiss.edu, USDA-ARS, Natural Products Utilization Research Unit, Oxford, MS

Over the past twelve years, transgenic, glyphosate-resistant crops have been widely adopted and have had more impact on weed management than any other method since the introduction of synthetic herbicides. Managing weeds with this powerful technology has had significant but poorly studied influences on plant disease and insect pressure. Weeds are evolving resistance to glyphosate rapidly, causing a need for more thoughtful strategies to prevent and mitigate the problem. New herbicide-resistant crops are on the verge of being introduced which will provide new tools for managing present and emerging issues with evolved herbicide resistance and weed species shifts.

33. Reaching Out to the Public: Developing and Delivering Residential IPM Messages

Room E142

The Community IPM Working Group of the Northeastern IPM Center developed two educational outreach poster displays based on messages from the 2007 "Green-Blue Summit". The goal was to highlight poor gardening/lawn care practices and help consumers make decisions that benefit them and the environment. The "Landscape Bloopers" display illustrates common landscaping mistakes, and the "Growing Green Lawns" display utilizes best management practices to solve common lawn problems. Content development was the result of a multi-regional collaborative effort to build consensus among land grant universities, environmental groups, government, and private industry. Both of these displays were part of the "One Planet—Ours! Sustainability for the 22nd Century" exhibit at the United States Botanic Garden in Washington, D.C. which ran from Memorial Day through Columbus Day, 2008. The event attracted 750,000 visitors. Additional educational efforts include a "GrowingGreenLawns.org" Web Site, a regional lawn care fact sheet, magnet, and a pilot transit project. The initial transit project included placement of a banner on 250 buses and ran from mid-August through mid- October in Montgomery County Maryland. Daily ridership averaged 140,000 people. Based on the success of these projects they will be expanded in 2009 through grant funds and partnering with the North Central IPM Region to additional cities, zoos, parks, arboreta, etc. The transit project will also be expanded to Providence, RI, and Pennsylvania. Community IPM is a new focus area for the national office of the Environmental Protection Agency (EPA) and they have invited us to partner with their Community IPM Working Group. Speakers will address challenges and outcomes from this outreach effort and educational materials will be shared with the audience.

Organizers: Mary Kay Malinoski, mkmal@umd.edu, University

of Maryland, Home and Garden Information Center, Ellicott City, MD; Rick Johnson, rhj3@psu.edu, Pesticide Education Program, Penn State University, University Park, PA; David L. Clement, clement@umd.edu, University of Maryland, Home and Garden Information Center, Ellicott City, MD

Moderator: Rick Johnson, rhj3@psu.edu, Pesticide Education, Penn State University, University Park, PA

9:00 33.1 The Process of Message Development, Rick Johnson, rhj3@psu.edu, Pesticide Education, Penn State University, University Park, PA

9:30 33.2 Delivering the Messages: Outreach Materials and Projects, Mary Kay Malinoski, mkmal@umd.edu, University of Maryland, Home and Garden Information Center, Ellicott City, MD

10:00 33.3 Evaluation and Future Project Goals, David L. Clement, clement@umd.edu, University of Maryland, Home and Garden Information Center, Ellicott City, MD

10:30 Exchange of Ideas and Open Discussion (New Partnerships)

34. Branding IPM in the Marketplace

Room E143

IPM success depends in part on consumers understanding and valuing products and services that incorporate IPM practices. Environment, energy, health, safety, local and organic all weigh increasingly in consumer choices. Because IPM intersects with all of these, the opportunity for IPM in the marketplace has never been better.

Yet, telling an IPM story that is quick, clear and appealing is a tremendous challenge. Conventional and organic producers alike may see IPM as undermining their market position. Consumers are often just confused by IPM—and confusion can lead to mistrust and misplaced expectations.

This session will look at current IPM marketing efforts in food and fiber, consumer attitudes toward eco-messages, and the challenging questions that face marketers in all segments of the IPM spectrum. What makes successful programs economically viable and what limits the success of other efforts? Will educating the end consumer increase the demand for IPM produced food and fiber? Is a national certification program needed to assist consumers in their product selection? How can we differentiate between advanced (and advancing) IPM and entry/basic level practices? How do we motivate steady progression toward the advanced end of the spectrum and to promote IPM more effectively in the marketplace?

Moderators and Organizers: Susan Futrell, sfutrell@mchsi.com, Red Tomato, Canton, MA, and Susan Ratcliffe, sratclif@illinois.edu, North Central IPM Center, University of Illinois, Urbana, IL

Panelists:

Scott Exo, scott@foodalliance.org, Food Alliance, Portland, OR

Susan Futrell, sfutrell@mchsi.com, Red Tomato, Canton, MA
Curt Petzoldt, cp13@cornell.edu, Cornell University,

Ithaca, NY

Susan Ratcliffe, sratclif@illinois.edu, North Central IPM Center, University of Illinois, Urbana, IL

35. IPM at the Landscape Level: Prospects and Challenges

Room E144

This symposium is designed to generate an international dialogue on the current knowledge and future direction of the landscape level integrated pest management. Symposium speakers representing diverse crop production regions are selected to review their research and scope of landscape level IPM across multiple cropping systems. Role of natural enemies in natural biological suppression of arthropod pests at the landscape level will also be discussed. Discussion will also focus on bridging the gap between research and practice of landscape level IPM.

Organizer: Megha Parajulee, m-parajulee@tamu.edu, Texas AgriLife Research and Extension Center, Lubbock, TX

9:00 35.1 Introductory Remarks—Megha Parajulee, m-parajulee@tamu.edu, Texas AgriLife Research and Extension Center, Lubbock, TX

9:05 35.2 Understanding Pest and Beneficial Insect Movements: Source-Sink Relationships Affecting Arizona Cotton, Peter C. Ellsworth, peterell@cal.arizona.edu, and Yves Carriere, ycarrier@ag.arizona.edu, Arizona Pest Management Center, Department of Entomology, University of Arizona, Maricopa, AZ; Steve Naranjo, steve.naranjo@ars.usda.gov, Arizona Pest Management Center, Department of Entomology, University of Arizona, and USDA-ARS, Arid Lands Agricultural Research Center, Maricopa, AZ

For over a decade, cotton IPM in Arizona has followed a model that depends on key elements of “Avoidance”. One major aspect of this is the development of tactics with “Areawide Impact”. Things such as crop placement, alternate host management, inter-crop movement, and cross-commodity cooperation are each considerations in the management of insect pests, especially polyphagous, mobile ones such as *Lygus hesperus* and *Bemisia tabaci*. Management therefore can be improved by an understanding of landscape level population processes including source-sink relationships for pest and beneficial insects among crop and non-crop hosts. This presentation will update progress made in testing the extent of influence of cotton and non-cotton hosts on the movement of *Lygus* bugs and key natural enemies in the Arizona agroecosystem.

9:30 35.3 Transcending Spatial and Temporal Boundaries:

What Happens to IPM in Cotton when Landscapes

Radically Change?, Peter B. Goodell,

ipmpbg@uckac.edu, University of California

Statewide IPM Program and Cooperative Extension,

Kearney Agricultural Center, Parlier, CA

Cotton IPM is well established in California’s San Joaquin Valley having been under development and honed for almost 50 years. This presentation will explore the question: if an IPM program is developed within the context of a landscape, what are the implications to the IPM program when the landscape radically under goes change? Using historic data from pesticide use reports, area wide crop mapping and

current studies on movement of key pests and natural enemies, we will describe changes and suggest approaches to dealing with the change.

9:50 35.4 Spatiotemporally Distinct Natural Enemies Have Synergistic Effects on Shared Prey, William E. Snyder, wesnyder@wsu.edu, and Ricardo A. Ramirez, ricarrami@neo.tamu.edu, Washington State University, Pullman, WA; Michael R. Strand, mrstrand@uga.edu, University of Georgia, Athens, GA

Biocontrol improves when natural enemies occupy unique feeding niches, and thus complement one another. These issues are more complex when pest species move among habitats during development. For example, Colorado potato beetles feed in the plant canopy during most stages, but pupate underground. This life cycle exposes the beetles to two distinct natural enemy communities, insect generalist predators in the foliage and nematode and fungal entomopathogens in the soil. In a series of field experiments we found that predators facilitated resource capture by pathogens, with potato beetles exposed to predators earlier in development more likely to later succumb to pathogen infection. This may reflect an inherent conflict for the herbivore in allocating energetic resources towards anti-predator versus anti-pathogen defenses. Thus, natural enemies entirely separate in space and time exerted complementary impacts on shared prey/hosts.

10:15 35.5 Cotton IPM Tactics at the Farmscape Level, Michael D. Toews, mtoews@uga.edu, Department of Entomology, University of Georgia, Tifton, GA

A complex of phytophagous stink bugs (Hemiptera: Pentatomidae) have recently become serious insect pests in southeastern US cotton production. While these pest populations can be effectively mitigated with insecticide applications, there are no available chemistries for selectively removing stink bugs without disrupting natural enemies. Therefore, growers are challenged to manage these polyphagous insect populations at the farmscape level as opposed to the crop specific level. Five acre replicated trials with cotton fields located adjacent to corn, peanut, and soybean fields were investigated in 2007- 2008. Cotton and the adjacent crops were sampled weekly through 4 wk of bloom and then representative cotton plots at varying distances from the common borders were mechanically harvested, ginned, and classed. Results show that boll damage, gin turnout, fiber color, and lint value were negatively affected when the cotton plots were located adjacent to peanut and soybean. However, yield and fiber quality parameters harvested 20-rows from the edge of the shared borders were statistically similar to cotton plots harvested in the center of the field. These data strongly suggest that integrated pest management of the stink bug complex in cotton should include management tactics at the farmscape level.

10:35 35.6 Landscape Level Understanding of *Lygus hesperus* Host Preference and Host Utilization Affecting *Lygus* Management in Cotton, Megha N. Parajulee, m-parajulee@tamu.edu, Texas AgriLife Research and Extension Center, Lubbock, TX

Multi-year survey to examine the role of non-cotton hosts in supporting *Lygus* bugs in cotton in the Texas High Plains indicated that over 30 host plants contribute to *Lygus* population activity in cotton. Alfalfa and Russian thistle were among the most dominant hosts to impact *Lygus* population dynamics in Texas cotton. Seasonal population dynamics and intercrop movement behavior of *Lygus* will be discussed in relation to landscape habitat mosaic in a predominantly cotton monoculture system in the Texas High Plains.

Wednesday, March 25, 2009

1:00–3:00 pm

36. How Successful Is Area-Wide Pest Management? Examination of Recent Programs

Room D133

Area-wide Pest Management (AWPM) is a relatively recent approach to pest management built on the traditional Integrated Pest Management (IPM) concept. AWPM is usually targeted at key pests of crops, livestock, or other agricultural products for which managing pests over a wide geographic area may be more effective than managing on a field-to-field basis. To be specific AWPM can be defined as IPM applied against an entire pest population within a delimited geographic area. AWPM programs require ecological and biological understanding of the pest species, a long-term commitment to the program, and coordination among farmers and other stakeholders in program implementation. AWPM programs are often logistically complex, requiring detailed planning and management, and may require cooperation or active participation by a group of stakeholders committed to the project's success. Such non-technical issues can be more important for determining success or failure than purely scientific and technical aspects of program implementation. This symposium will explore recent AWPM programs and lessons learned from them. The symposium is timely because AWPM has gained momentum over the last decade and has advanced a great deal in terms of the extent of implementation.

Moderators and Organizers: Gary L. Hein, ghein1@unl.edu, Department of Entomology, University of Nebraska, Lincoln, NE; Frank B. Peairs, Frank.Peairs@ColoState.edu, Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins, CO; Norman C. Elliott, norman.elliott@ars.usda.gov, USDA-ARS Plant Science Research Laboratory, Stillwater, OK

1:00 36.1 Area-Wide Management of Invasive Weeds with Emphasis on Biological Control of Saltcedar, R. I. Carruthers, ray.carruthers@ars.usda.gov, USDA-Agricultural Research Service, Exotic and Invasive Weeds Research Unit, Western Regional Research Center, Albany, CA

Exotic invasive plants have become a huge economic and environmental issue for land-managers all across the United States. Weed invasions are sometimes likened to wildfires in slow motion, as they spread throughout habitats at alarming rates. Attempts to control weedy invaders are difficult and expensive, as they inhabit both cultivated and natural areas, often crossing socioeconomic boundaries. One effective approach to managing these weedy invaders is to use methods of Areawide IPM. Such an approach has been successful with weeds such as leafy spurge, melaleuca, saltcedar and medusahead rye. The Area-wide management saltcedar will be discussed as a detailed example.

1:20 36.2 The Cereal Aphid Areawide IPM Program: A Socioeconomic and Ecological Evaluation, Kris Giles, kris.giles@okstate.edu, Department of Entomology and Plant Pathology, Oklahoma State University, Stillwater, OK

In the Great Plains of the US, dryland winter wheat is regularly grown in continuous monocultures that promote pest colonization and population increase in the absence of natural enemies. Faced with pest pressures on a low value crop, many wheat producers have moved towards diverse systems with

resistant plants in an effort to reduce pest pressure, minimize inputs, and increase net returns. The cereal aphid areawide IPM project in wheat included detailed socio-economic evaluations and landscape level pest ecology studies. Findings from this project reveal that producers consider diversification an important part of long-term sustainable crop production and pest management.

1:40 36.3 Successful Area-Wide Management of Codling

Moth: Available Tools, Grower's Involvement, and Industry Support, Alan Knight, alan.knight@ars.usda.gov, Agricultural Research Service, USDA, Wapato, WA

The USDA-ARS funded a five-year multi-institutional project to implement the use of sex pheromones for codling moth in conjunction with the use of other selective control strategies for secondary pests across large contiguous areas of pome fruit production. Twenty-two sites were established in Washington, Oregon, California, and Colorado from 1995 to 1999 involving 533 growers farming 9,763 hectares. Growers reduced use of broad spectrum insecticides 80% while reducing fruit injury from codling moth. New pest problems developed in some treated orchards and the role of biological control increased only marginally. Grower adoption of sex pheromones increased following the end of governmental support, but few coordinated grower projects remain. Concerns for the evolution of resistance to new insecticides and their impact on biological control remain important factors impacting implementation of sustainable IPM programs in pome fruit.

2:00 36.4 Area-Wide Pest Management Programs in

Cotton: Boll Weevil and Pink Bollworm, Charles T. Allen, allenc@txbollweevil.org, Texas Cooperative Extension, Abilene, TX

Eradication of the boll weevil required sustained commitment by growers, state and federal legislatures, USDA, state universities, state departments of agriculture, grower run foundations and others. The commitment by growers to eradicate the pest is indicative of the optimistic attitude that prevails among the cotton producer leadership since the idea of boll weevil eradication was first proposed in 1958. The boll weevil eradication program has been a massive project. Its completion in many of the cotton growing areas of the US resulted in cotton production systems with greatly improved economic and environmental sustainability. The benefits will continue into the future.

2:20 36.5 Evidence for an Area-Wide Impact of Bt Maize on

Suppression of European Corn Borer Populations in the United States: Benefits to Non-Bt Corn Growers, William D. Hutchison, hutch002@umn.edu, E.C. Burkness, and R.D. Moon, University of Minnesota, St. Paul, MN; T. Leslie, S. Fleischer, Penn State University, University Park, PA; M. Abrahamson, Minnesota Department of Agriculture, St. Paul, MN; K. Hamilton, Wisconsin Department of Agriculture, Madison, WI; K. Steffey and M. Gray, University of Illinois, Urbana IL; R. Hellmich, USDA-ARS, Ames, IA; V. Kaster, Syngenta Seeds, Slater, IA; T. Hunt and R. Wright, University of Nebraska; Concord and Clay Center, NE; P. Mitchell, University of Wisconsin, Madison, WI

Since approval of transgenic field corn in 1996 use of all transgenic crops worldwide has sustained double-digit growth each year and total plantings of 282.4 million acres. Of the 90 million acres of field corn grown in the U.S. in 2007, ca. 50% of the Midwestern maize was planted to hybrids transformed to express *Bacillus thuringiensis* (Bt) toxins. Although the primary targeted pest, European corn borer (ECB),

Ostrinia nubilalis, is known to feed on multiple hosts, we hypothesized that widespread use of Bt corn could have a regional suppression effect. Since 2000, populations of ECB have declined in Minnesota, Illinois, Iowa, Nebraska and Wisconsin. Using long-term larval and moth flight data, we present statistical evidence for a regional suppression effect. We illustrate significantly different per capita population growth rates of ECB larvae in high vs. low-Bt use states, and present preliminary data on the economic benefits to non-Bt corn acreage.

2:40 36.6 What are the Elements of a Successful Area-Wide Pest Management Program?, Norman C. Elliott, norman.elliott@ars.usda.gov, USDA-Agricultural Research Service, Plant Science Research Laboratory, Stillwater, OK

Area-wide pest management (AWPM) attempts to control pests over broad geographic areas. AWPM is contrasted with traditional pest management, which controls pests one field at a time. A diversity of AWPM approaches exist and strategies used are based on the particular target species and aspects of biology and ecology that present promising avenues for area-wide suppression. This talk will attempt to compare the programs discussed in the preceding talks as well as other documented AWPM programs. The intent is to assess types of pests, circumstances, and programs that lead to effective AWPM.

2:52 Discussion

37. Barriers to Adoption of Biopesticides: Three IPM Symposia Later, Where Are We?

Room D134

Biological pesticides, 2.4% of the global pesticide market, are growing quickly and are projected to reach \$1 billion by 2010. Until recently when commodity prices skyrocketed, there has been no real growth of the \$30 billion chemical pesticide market. By combining performance and safety, biopesticides offer value through benefits generally not realized by conventional pesticides. Biopesticides can perform efficaciously while providing customers the flexibility of minimum application restrictions, superior residue and resistance management potential, and human and environmental safety benefits. Despite these advantages, there are significant barriers that impede adoption of biopesticides. These barriers include a highly competitive and crowded market with many chemical pesticides, risk averse customer, complex selling channel, perceived lack of efficacy and lack of awareness and understanding. The BPIA conducted a survey of customer perceptions of biopesticides in 2003 and 2008. CA Pest Control Advisors, CA growers, FL distributors, FL growers and golf course superintendents were surveyed about present and past biopesticide usage, reasons for using and not using biopesticides and where they get information about biopesticides. A summary of the results of the 2008 survey will be presented and compared to the 2003 survey. These data will be discussed along with biopesticide success stories with a focus on integration of biopesticides into IPM programs.

Organizer: Pamela G. Marrone, pmarrone@marroneorganics.com, Marrone Organic Innovations, Inc., Davis, CA

37.1 Introductory Comments and Summary of the Workshop Discussion, Pamela G. Marrone, pmarrone@marroneorganics.com, Marrone Organic Innovations, Inc., Davis, CA

37.2 Presentation of BPIA Survey, Bill Stoneman, bstoneman@biopesticideindustryalliance.org, Biopesticide Industry Alliance, (BPIA), McFarland, WI

38. IPM Needs for the Future of Biofuels/ Biomass

Room D135

The interest in and movement toward production of biofuel crops will have a number of issues affecting IPM. Both current and new crops will have pest and diseases issues that may be novel themselves or that may affect nearby non-biofuel crops. Use of pesticides and other synthetic inputs may increase due to the value of the crops, and hasten pesticide resistance. Conversely, planting increased acreage of certain biofuel crops may serve as refuges to mitigate development of resistance to toxins in genetically modified crops. We will discuss the loss of services from beneficial natural enemies of crop pests with changes in landscapes, due to planting increased acreage of corn for biofuel; influence on resistance management from plantings of biofuel crop; searching for insects and diseases of novel biofuel crops; and the potential for exotic biofuel crops to become invasive weeds. This mini-symposium is sponsored by the Plant-Insect Ecosystems Section of the Entomological Society of America.

Organizer: Robert N. Wiedenmann, rwieden@uark.edu,
Department of Entomology, University of Arkansas, Fayetteville,
AR

38.1 Increasing Corn for Biofuel Production Reduces
Biocontrol Services in Agricultural Landscapes,
Douglas A. Landis, landisd@msu.edu, Department
of Entomology, Michigan State University,
East Lansing, MI; Mary M. Gardiner, Department
of Entomology, The Ohio State University,
Wooster, OH; Wopke van der Werf, Centre for
Crop Systems Analysis, Department of Plant Sciences,
Wageningen University, The Netherlands;
Scott M. Swinton, Department of Agricultural,
Food and Resource Economics, Michigan State
University, East Lansing, MI

The value of natural biological control of soybean aphid to producers who use an economic threshold IPM strategy averages \$33 ha⁻¹ at 2007-8 prices, totaling or \$239 M y⁻¹ in Iowa, Michigan, Minnesota and Wisconsin, USA. Recent biofuel-driven growth in corn planting results in lower landscape diversity, altering the supply of aphid natural enemies to soybean fields and reducing biocontrol services by 24%, a loss to soybean producers in these states at least \$58 M y⁻¹ in reduced yield and increased pesticide use. For producers who rely solely on biological control, the value of lost services is much greater.

38.2 Assessing the Potential Impacts of Pests within
Biofuel Crops: A New Journey Is Under Way,
Michael E. Gray, megray@illinois.edu, Department
of Crop Sciences and the Energy Biosciences
Institute, University of Illinois, Urbana, IL

The use of *Miscanthus x giganteus* and switchgrass (*Panicum virgatum*) has great potential for biofuel purposes. However, their large-scale production on a significant number of hectares will potentially expose these biofuel crops to numerous pests and pathogens. In 2008, we began our investigation as one of several programs within the Energy and Biosciences Institute, a partnership of scientists funded by British Petroleum and located at the University of California, Berkeley, Lawrence Berkeley National Laboratory, and the University of Illinois, Urbana-Champaign. The scientists within our specific program have begun to investigate the potential for insect pests, plant pathogens, and nematodes to negatively

impact *Miscanthus* and switchgrass biomass production. Longer term objectives include an assessment of the potential for pests within these biofuel crops to affect pest population dynamics in nearby crops grown for grain. Results from our investigations will provide a basis on which to develop sound management approaches to limit the impact of pests within biofuel crops.

38.3 Refuge or Reservoir: The Potential Impact of a Biomass Crop on Corn Rootworm Ecology, Joseph L. Spencer, spencer1@illinois.edu, Illinois Natural History Survey, University of Illinois, Champaign, IL; S. Raghu, School of Natural Resource Sciences, Queensland University of Technology, Brisbane, Queensland, Australia

The most significant U.S. corn pest, the western corn rootworm (WCR), can also complete development on the perennial grass, *Miscanthus x giganteus*. Production of *Miscanthus* on 'idle' Corn Belt ground would juxtapose this biomass crop with the primary WCR host. High mobility among WCR, especially in the eastern Corn Belt where they oviposit broadly across the landscape, will facilitate interactions that may exacerbate or mitigate existing management challenges. It is irresponsible to expect that Corn Belt pest ecology will be unaltered when a perennial host of our most adaptable and economically important corn pest is added to the system.

38.4 One Person's Joy Is Another One's Sorrow: Concerns about the Potential Invasiveness of Biofuel Crops, Robert N. Wiedenmann, rwieden@uark.edu, Department of Entomology, University of Arkansas, Fayetteville, AR; S. Raghu, School of Natural Resource Sciences, Queensland University of Technology, Brisbane, Queensland, Australia

One aspect of biofuel crops that is often missing from discussions is the potential invasiveness of these species. Many of the same traits that make them ideal for growth as biofuel crops are those traits associated with invasive weeds. As we deploy biofuel species into the environment, we need to recognize and assess the possible beneficial and negative consequences of planting large acreage of the crops, as well as the economic and environmental costs if they were to become invasive.

39. Transcending Boundaries with Innovations in IPM for School and Childcare Facilities: Innovative and International Programs

Room D136

Transcending geographic and traditional role boundaries can help make IPM happen in all of our schools and childcare facilities. We know how to manage pests primarily with sanitation and exclusion, reducing both pesticide use and pest complaints substantially. We also know how to enlist all of those in the school community with a role to play including pest management staff and contractors; custodial, maintenance, food service, school health and administrative staff; and students, parents and others. Our challenge is to multiply our successes by more effectively coordinating efforts across state and international boundaries, making the most efficient use of resources to reach all school districts and regularly measuring and reporting progress towards high level IPM in all schools. In this mini-symposium, we will address the cost-benefit case for IPM in schools, drawing both on new tools that help determine cost-effectiveness and tested models for successful, affordable IPM. We will report on international school and childcare IPM efforts in the US, Mexico, Japan and South Korea. We'll also hear about four new regional school IPM working groups, a new school IPM "toolbox", the national school IPM strategic plan, updates on laws and

regulations, and verification and certification for schools and service providers. The session will provide valuable "how-to" information on adoption of IPM in schools.

Organizers: Dawn Gouge, dhgouge@ag.arizona.edu, Department of Entomology, University of Arizona, Maricopa, AZ;

Thomas Green, ipmworks@ipminstitute.org, IPM Institute of North America, Inc., Madison, WI

1:00 39.1 IPM South of the Border, Dawn Gouge, dhgouge@ag.arizona.edu, Department of Entomology, University of Arizona, Maricopa, AZ

A project was undertaken to focus on pest management practices in schools and child care facilities located along the Arizona/Sonora, Mexico border. Though border child care facilities are housed within maquiladoras (generally U.S. owned factories), initial needs-assessments showed that current management practices are not progressive. Pesticide use is highly variable, and in Sonora Mexico many products no longer registered for use in the U.S. are routinely applied. Structural pest-proofing of schools in Sonora Mexico has not been possible due to structural decay or poor facility construction. This session will address the significant structural improvements that are needed, as well as increased educational efforts and pesticide-use regulation.

1:20 39.2 U.S. Army Implementation of IPM Star in the Pacific Region, Sandra Alvey, Sandra.alvey@us.army.mil, U.S. Army Center for Health Promotion and Preventive Medicine, Entomological Sciences Program, Aberdeen Proving Ground, MD

In accordance with the Department of Defense Pest Management Program, the U.S. Army works to ensure environmentally sound and effective programs to prevent pests and disease vectors from adversely affecting real property, natural resources, and the health and welfare of soldiers and their family members. Through a partnership with the Environmental Protection Agency and the IPM Institute of North America the U.S. Army Family & Morale Welfare, and Recreation Command (FMWRC) funded IPM Star evaluations of 18 Army installation Child Youth Service programs. Eight overseas installations were awarded IPM Star certification directly resulting in improved preventive medicine standards, public health awareness and environmental protection.

1:40 39.3 Challenges and Innovations in In-House Programs in Major City School Systems, Gregg Smith, Gregg.smith@slc.k12.ut.us, Salt Lake City School District, Salt Lake City, UT

Implementing Integrated Pest Management in a large school district presents challenges for both the management and staff. Foremost to the success of an IPM program is the leadership and commitment demonstrated by school district management. Emphasizing the importance of a healthy school environment through professional behavior and IPM education rather than focusing on cost-benefits has minimized many of the obstacles to success often cited by others. We have identified and will present key attributes of our management approach and organization as well as innovative reporting tools that have contributed to the ongoing success and sustainability of our program.

2:00 39.4 The Orkin Integrated Pest Management Program for Schools, Patrick T. Copps, pcopps@rollins.com, Orkin Pest Control, Riverside, CA

A comprehensive Integrated Pest Management (IPM) program was designed by Orkin to address pest issues that can compromise an otherwise safe and healthy learning environment and to help school districts meet broader goals related to sustainability, green buildings, and even indoor air quality. The

Orkin IPM service protocols meet or exceed local and state guidelines and were specifically developed as a proactive approach to prevent the need for chemical solutions. The program includes on-site training and educational materials to educate staff on both the IPM program and their roles in the pest management process. Orkin also developed Junior Pest Investigators www.juniorpi.com to stimulate interest in entomology and Integrated Pest Management. The four-lesson unit for science classes (Kindergarten to eighth grade) contributes to an understanding of pests and effective low risk IPM strategies. Lesson plans were developed by professional educational writers, reviewed by extension entomologists and are consistent with national science standards.

2:25 39.5 School IPM Strategic Plan and the Four Regional Working Groups, Dawn Gouge, dhgouge@ag.arizona.edu, Department of Entomology, University of Arizona, Maricopa, AZ; Thomas Green, ipmworks@ipminstitute.org, IPM Institute of North America, Inc., Madison, WI

The goal of the Pest Management Strategic Plan (PMSP) for IPM in Schools is to replicate the well-documented successes of Integrated Pest Management in schools nationwide. This session will provide an overview of the PMSP for IPM in Schools. It will cover why improvements are needed, our plan of action and a discussion of sector roles. Members from each of the four regional school IPM working groups will talk about their group's efforts towards plan implementation, providing updates on progress and plans for the future. We will also address how items from the school IPM "toolbox", such as annual state report cards, can assist us in advancing and tracking our efforts towards full implementation by 2015.

2:45 Discussion

40. Role of Mineral Nutrition in IPM for Suppressing Plant Diseases

Room D137

Mineral nutrition plays essential and functional roles in plant development and growth. Mineral nutrients are involved in many physiological and biochemical processes as enzyme activators, structural components, metabolic regulators, substrates, and osmotica. Mineral nutrients can be supplied to the plant in inorganic or organic forms, but their availability depends on soil texture, pH, moisture, temperature, mineral solubility, nutrient retention of the soil, microbial activity of the soil, and the ability of the plant to use each nutrient efficiently. The nutritional status of the plant, in turn, affects inherent disease resistance which affects disease escapes, alters pathogenesis, and modifies the virulence of the pathogen and its ability to survive. Because nutrients influence the relationship between the plant and the pathogen, growers have a valuable IPM method already in place to effectively reduce damage from plant diseases. In order to better understand this relationship, the important role that a selected number of macronutrients, micronutrients, and beneficial nutrients play in IPM for protecting plants from destructive diseases will be presented to highlight their interactions and effects, and prescribe nutritional regimes that will minimize crop loss to disease and improve overall plant health and development.

Moderators and Organizers: Lawrence E. Datnoff, ldatnoff@agcenter.lsu.edu, Department of Plant Pathology and Crop Physiology, Louisiana State University, Baton Rouge, LA; Wade H. Elmer, wade.elmer@po.state.ct.us, The Connecticut Agricultural Experiment Station, New Haven, CT

1:00 40.1 Crop-Specific Sulfur Management for Optimizing Productivity, Quality, and Plant Health, Silvia Haneklaus, silvia.haneklaus@jki.bund.de, Elke

Bloem and Ewald Schnug, Institute for Crop and Soil Science, Julius Kühn-Institut, Federal Research Centre for Cultivated Plants (JKI), Braunschweig, Germany

Sulfur (S) deficiency impairs crop productivity and quality. Sulfur Induced Resistance (SIR) denotes the reinforcement of the natural resistance of plants against fungal pathogens by sulfate-based, soil-applied fertilization and is one constituent of the complex phenomenon of induced resistance. The potential efficacy of SIR expressed as a reduction of the disease index ranged from 5-50% to 17-35% in greenhouse and field experiments, respectively. Up-to-date research in the field of SIR will be presented for different host/pathogen systems and strategies provided for applied S fertilization practices in different crop systems, which live up to all agronomic aspects.

1:20 40.2 Role of Chlorine Nutrition in IPM for Suppressing Plant Diseases, Wade H. Elmer, wade.elmer@po.state.ct.us, The Connecticut Agricultural Experiment Station, New Haven, CT

Long before the role of Cl in crop production was recognized, Cl was routinely applied as chloride in NH₄-N, K, and Ca fertilizers. However, even in the last decade, the disease suppressing benefits of chloride salts are still mistakenly being ascribed to NH₄, K, or Ca. Soil applications of Cl influence nitrification, manganese availability, and beneficial soil microorganisms. Chlorine affects osmoregulation, organic and amino acid synthesis, nutrient cycling and root exudation that, in turn, directly influences the plant's susceptibility to infection. This presentation will explore the uses and mechanisms of suppressing diseases on asparagus, beets, wheat, and cyclamen with Cl.

1:40 40.3 Zinc Impact and Applications in Plant Disease Control, Brion Duffy, duffy@acw.admin.ch, Research Station Agroscope Changins-Wädenswil ACW, Wädenswil, Switzerland

Zinc deficiency is the most common/widespread micronutrient deficiency of plants with up to 30% yield loss. One-third of the world population is at risk of inadequate zinc intake, making zinc nutritional value of crops a health issue. Zinc is an essential micronutrient for all living cells. Zn-deficiency affects plant water uptake, phytohormone activity, and uptake of other nutrients. In pathogens and beneficial microorganisms zinc modulates growth, ecology, virulence, toxin and antibiotic production. An overview of zinc's role in plant disease control with examples of subtle but critical impact on multi-trophic interactions between plants, pathogens, and biocontrol agents will be presented.

2:00 40.4 Role of Nickel Nutrition in IPM for Suppressing Plant Diseases, Bruce W. Wood, Bruce.Wood@ars.usda.gov, U.S. Department of Agriculture-Agricultural Research Service, Byron, GA

Accumulating evidence implicates the essential nutrient, nickel (Ni), as potentially influencing crop diseases. Effects can be direct control of certain pathogens upon contact, increased/ decreased host-plant resistance, increased susceptibility at high concentration, or a variety of Ni-linked physiological and growth disorders. There is evidence that excessive usage of transition metal fertilizers, or certain agrichemicals, might be adversely impacting the endogenous biological availability of Ni for key disease-associated metabolic processes. Discussion will focus on evidence that Ni and Ni nutrition should be taken into consideration when developing IPM strategies of certain crops.

2:20 40.5 Suppression of Root Pathogen Activity with Aluminum Amendments, David Shew, david_shew@ncsu.edu, Department of Plant Pathology, North Carolina State University, Raleigh, NC

The chemistry of aluminum (Al) in natural and agricultural soils has been a topic of extensive study mostly due to the phytotoxicity of the metal to plants. However, numerous studies indicate that the ecology of numerous soilborne microorganisms, including many plant pathogens, is affected by the levels of Al activity present in acid mineral soils. Field and greenhouse studies have demonstrated that acidifying soil amendments can be part of an integrated approach to managing root diseases. The use of Al-containing amendments may become more important in disease management, especially where other controls are not highly effective.

2:40 40.6 The Role of Silicon in Enhancing Host Plant Resistance and Reducing Fungicide Applications, Lawrence E. Datnoff, ldatnoff@agcenter.lsu.edu, Department of Plant Pathology and Crop Physiology, Louisiana State University, Baton Rouge, LA

Although silicon is the second most abundant element in the earth's crust, many soils still may be low or limiting in this element. Although not considered an essential nutrient, when silicon is amended to silicon-deficient soils, plants may show improved growth and enhanced plant disease resistance. Many components of host plant resistance (i.e., lesion number and size) are reduced; consequently, the resistance of susceptible cultivars is dramatically improved. Silicon also has been shown to suppress plant diseases as effectively as fungicides; thus reducing the number and rate of fungicide applications. Based on these findings, silicon may play an important role in the IPM of plant diseases.

41. Termite Baiting Systems: Use of IPM Approaches for Control of Termites in Urban Environments

Room D138

Protection of structures from termite attack has historically been achieved through use of high volume application of insecticides to soil around and under structures. Termite baiting systems were introduced about 10 years ago as a more environmentally sensitive way to control termites. In fact, such termite baiting systems are often registered as reduced risk pesticides. Termite baiting systems encompass the entire IPM concept from scouting/monitoring, to detection, to bait introduction only when and where needed, removal of bait after control has been achieved, and continuous monitoring for termite encroachment. In fact, termite baiting systems are the termite control product of choice for historic and environmentally sensitive sites. Countries such as China are considering moving termite control to baiting systems as a means to reduce use of persistent organic pollutant insecticides. This workshop will review the IPM foundations that drive termite control baiting systems. Presentations will focus on termite detection/monitoring systems and termite colony identification DNA methods, use of in-ground termite baiting systems, use of above-ground termite baiting systems, use of termite baiting systems for area wide termite control, use of termite baiting systems as termiticide alternatives in countries such as China, and global challenges in termite baiting systems and their ramification for IPM.

Moderator and Organizer: Mike Tolley, mtolley@dow.com, Dow AgroSciences LLC, Indianapolis, IN

1:00 41.1 Introduction, Mike Tolley, mtolley@dow.com, Dow AgroSciences LLC, Indianapolis, IN

1:02 41.2 Termite Colony Identification and Detection/Monitoring Systems—Scout before You Treat, Ed Vargo, ed_vargo@ncsu.edu, Department of Entomology, North Carolina State University, Raleigh, NC

1:17 41.3 Termite In-Ground Baiting Systems—The Ultimate IPM Program, Claudia Riegel, criegel@cityofno.com, New Orleans Mosquito and Termite Control Board, New Orleans, LA

1:32 41.4 Termite Above-Ground Baiting Systems—Indoor Use of an IPM Approach, Ken Brown, ksbrown@cityofno.com, New Orleans Mosquito and Termite Control Board, New Orleans, LA

1:57 41.5 Termite Baiting Systems for Area-Wide Termite Control—IPM on a Grand Scale, James Smith, jsmith@terminator.cl, Controles Integrados S.A., Santiago, Chile

2:12 41.6 Use of Termite Baiting Systems in China as an Alternative to Persistent Organic Pollutants—The World Bank Project, Leng Choy Lee, llee@dow.com, Dow AgroSciences LLC, Petaling Jaya, Malaysia

2:27 41.7 Termite Baiting Systems: Global Challenges in Implementing Termite Control IPM, Nan-Yao Su, nysu@ufl.edu, Ft. Lauderdale Research and Education Center, University of Florida, Ft. Lauderdale, FL

2:42 41.8 Panel Discussion

2:57 41.9 Conclusion, Mike Tolley, mtolley@dow.com, Dow AgroSciences LLC, Indianapolis, IN

42. Creating Temporal and Spatial Refugia for Biological Control in Tree Fruits

Room D139

Registrations of new insecticides for tree fruits have created several unexpected outcomes for pest management. First, growers never expected to have so many options available following their history of gradual insecticide loss. Second, the new insecticides are not as effective as the organophosphates and require more applications per season. Third, the new materials purported to be 'more selective' have not proven to be benign to biological control. The result has been the adoption of various seasonal programs combining increased uses of sex pheromones and insecticides. Concurrently, outbreaks of secondary pests and the use of additional sprays have also increased. Today, the foundation for IPM in tree fruits is crumbling and is in need of repair. One solution may be to create refugia for natural enemies within and adjacent to orchards. This approach can include a variety of tactics including five approaches that have been studied recently: creating repositories for natural enemies developing on alternative hosts just outside the orchard, maintaining cover crops within orchards that benefit natural enemies, timing insecticides to minimize exposure of natural enemies, applying low volume sprays that create pockets of unsprayed foliage within the canopy, and adopting site-specific programs where only a proportion of the orchard is sprayed based on action thresholds. This mini-symposium will address each of these five approaches.

Organizer: Alan Knight, alan.knight@ars.usda.gov, Agricultural

Research Service, USDA, Wapato, WA

42.1 Introduction, Alan Knight, alan.knight@ars.usda.gov, Agricultural Research Service, USDA, Wapato, WA

42.2 Using Pest and Natural Enemy Phenology to Enhance Biological Control in Orchards, Vincent Jones, vpjones@wsu.edu, and Callie Baker, Department of Entomology, Washington State University, Wenatchee, WA

Pest management programs in Washington apple orchards are typically focused on optimal timing for pest suppression using some combination of phenology models and sampling. However, because the phenology of natural enemies is typically not known in the same detail as pest phenology, impacts of pesticides on natural enemies are relatively poorly known because sprays for different pests occur randomly with respect to natural enemy phenology. We present stage specific leafroller models, and the relationship of parasitoids attacking the different stages of the larvae, and show how this data can be combined into the WSU - Decision Aid System to reduce natural enemy impacts while maintaining control of leafroller populations.

42.3 Extra Orchard Rose and Strawberry Gardens Support Overwintering of an Important Parasitoid of Leafrollers in Washington Pome Fruits, Tom Unruh, tom.unruh@ars.usda.gov, Agricultural Research Service, USDA, Wapato, WA

Experimental and grower-planted rose plus strawberry gardens adjacent to orchards support the non-pest leafroller, *Ancylis comptana*, (Lepidoptera: Tortricidae) which is an overwintering and summer host for the parasitoid *Colpoclypeus florus* (Hymenoptera; Eulophidae). The adult parasitoid disperses from rose gardens into nearby orchards in early spring where they attack pest leafrollers. Subsequent generations of the parasitoid attack pest leafrollers when present in the orchards and recolonize the rose gardens from late summer into fall. This system appears to require some balance to be functional: the wasp requires adequate numbers of leafroller hosts in the rose gardens in the fall and in orchards during spring and summer to maintain high parasitism of pest leafrollers. Patterns of parasitism in orchards and gardens and parasitoid phenology in the gardens are presented to demonstrate these relationships.

42.4 25 Years of Modifying Orchard Environments for Ecosystem Services and Reduced Pest Pressure: What Have We Learned in the Upper Midwest?, Mark E. Whalon, whalon@msu.edu, Michigan State University, East Lansing, MI

With the initial development and publication of *Biological Monitoring in Apple Orchards: An Instruction Manual* (1981), a number of researchers, extensionists and growers in Michigan began experimenting with the physical manipulation of orchards and their surrounding environments to maximize biological control and minimize pest immigration. This work initially focused upon a study that detailed immigration into depopulated portable apple orchards placed into different orchard settings (abandoned, IPM, Organic and Conventional) from SW to NW Michigan (1981-84). Further work specifically addressed mites, leafrollers and leafhoppers in the early to mid-1990s. Various immigration barrier systems coupled with several orchard biotic agent augmentation strategies were evaluated in both stone and pome fruits in the late 1990's. From 1999 to today, our efforts have targeted the development and establishment of orchard companion plantings and orchard-border manipulations. These experiments and implementation schemes have included living hedges with different characteristics (drift inception, provision of biological control agent habitat, native pollinator refuges, bio-control agent dietary supplements) as well as various 'push/pull' strategies to move pest, predators or parasites from production areas into close proximity from

both adjacent and within orchard natural enemy enhancing ground cover production zones. These efforts have culminated in a USDA/NRCS program to assist Upper Midwest orchardist in planting up to 5,000A of biological control agent and native pollinator habitat adjacent to orchards by 2010.

42.5 Cover Crops: Inviting Natural Enemies into Your Orchard, Elizabeth Beers, ebeers@wsu.edu, Department of Entomology, Washington State University, Wenatchee, WA

Cover crops may serve many purposes in an orchard, including erosion control, weed management, and a nitrogen source for trees. There has been a recent interest in using cover crops for pest management purposes, specifically that of providing habitat for natural enemies or their alternate prey (host). Many of the past studies have emphasized overall measurements of biodiversity in response to cover crops, with less emphasis on practical outcomes (improved biological control of the target pest). An example is discussed concerning provision of habitat requirement for a target predator/prey system in apple orchards including syrphids and woolly apple aphids.

42.6 Low Volume Sprays for the Key Pest Opens Up Opportunities for IPM, Alan Knight, alan.knight@ars.usda.gov, Agricultural Research Service, USDA, Wapato, WA; Rick Hilton, Oregon State University, Medford, OR

The use of an ATV-mounted sprayer applying a low pressure and volume spray of insecticides with and without the use of a microencapsulated sex pheromone formulation for codling moth has been evaluated over several years. Levels of fruit injury have been reduced by as much as 98% with the use of synthetic pyrethroids but integrated mite management (IMM) was also disrupted. Seasonal low volume spray programs of acetamiprid did not disrupt IMM in apple but disrupted pest mites by mid-season in a pear orchard treated with kaolin for fruit finish. Further refinements in the development of "attract and kill" for codling moth should benefit biological control.

42.7 Intensive Codling Moth Monitoring and Reduced Treatment Program as a First Step Toward a Precision Agriculture System, Loys Hawkins, lhawkins@sutterra.com, and Kathleen McNamara, Bear Creek Orchards, Medford, OR; Alan Knight, Agricultural Research Service, USDA, Wapato, WA; Rick Hilton, Oregon State University, Medford, OR

A program of intensive monitoring for codling moth emphasizing the orchard borders was investigated on 51 acres of conventionally and 17 acres of organically farmed pears to see if it could substantially reduce the area of the orchard requiring subsequent treatment for codling moth. A high density grid of Pherocon™ CM-DA Combo™ lure traps were deployed under a Checkmate® CM Puffer mating disruption program, and codling moth pesticide treatments applied when trap thresholds were reached, only to those areas where codling moths were caught at levels indicating that treatment was needed. As the treatment thresholds being used were very conservative and trap density was higher than normal, it was assumed that the risk of missing any codling moth problems would be less than under the standard trapping regime. Results: no codling moth damage and management costs shifted from pesticide sprays to monitoring, with overall reduction of 48-56% in the cost of the pest control program. On the negative side was the increased labor requirement to maintain and monitor a higher density of codling moth traps, and multiple years will be required to determine sustainability. The study indicated intensive monitoring could be a valuable tool to help the grower move toward a precision agriculture system.

43. Strategic Partnerships for Urban IPM

Implementation

Room D140

City populations are exposed to variable but significant risks due to high levels of pest infestations and subsequent chronic pesticide exposures. Even as urban IPM investment by traditional Land Grant university extension is declining, there is a critical need for outreach, training and collaborative IPM programming in these complex environments. Cooperative Extension by definition 'provides educational and technical outreach to state residents on behalf of state universities,' and the vast majority of most states' residents now live in cities and suburbs. Urban populations are large and diverse with respect to income, culture, ethnicity and language. The urban built environment is also diverse in age, physical proximity and function. Many distinct entities in cities grapple with pest management issues - parks and streets operations; school districts and child care facilities; public and private housing personnel; municipal vector control programs, public health workers, pest management professionals and residents themselves. Thus, the urban environment presents both challenges and excellent opportunities for groups to collaborate to reach common goals in IPM outreach, education and implementation. For Cooperative Extension educators, it also raises fundamental questions on how best to build collaborative programming to meet these diverse needs.

This session will present "case studies" of innovative strategic partnerships that address IPM education and implementation needs in urban environments across the country. Speakers' topics will include economic, political, and community factors as well as health-based and job creation initiatives for embedding and sustaining IPM in urban communities.

Moderator and Organizer: Lyn Garling, ljg5@psu.edu, Pennsylvania IPM Program, Penn State University, University Park, PA

1:00 43.1 Building the Philadelphia School and Community IPM Partnership, 2002–2008, Michelle Niedermeier, mxn14@psu.edu, Pennsylvania IPM Program, Penn State University, Philadelphia Outreach Center, Philadelphia, PA

The Philadelphia School & Community IPM Partnership (PSCIP) is an urban IPM extension initiative of the Pennsylvania Integrated Pest Management (PA IPM) Program at Penn State. PSCIP promotes IPM outreach, education and adoption via train-the-trainer workshops and community-directed partnerships with neighborhood groups, health networks, schools and early education centers, city agencies, housing authorities and faith-based organizations. PSCIP is currently comprised of over 200 members from public, private, and nonprofit organizations. The presentation will outline our community-based approach, describe diverse projects and the successes and challenges we have experienced.

1:20 43.2 Promoting IPM through Health, Housing, and Policy Initiatives, Sharon Heath, sheath@health.nyc.gov, NYC Department of Health and Mental Hygiene, New York, NY

New York City's presentation will center on its efforts to promote IPM and will discuss legislative and regulatory initiatives which influence the use of pesticides, pest management practice and public awareness about safer pest control and its health benefits. Programmatic efforts, including IPM in public housing; community wide initiatives for rat control; and training and education for the general public and targeted groups through publication distribution, web page and portal developments will also be highlighted.

1:40 43.3 Utilizing Formal and Informal Health Networks to Promote IPM in Low-Income Neighborhoods, Marta Arguello, arguello@psrla.org, Physicians

for Social Responsibility, Los Angeles, CA

Physicians for Social Responsibility is a nonprofit environmental advocacy group of over 34,000 health professionals in 30 chapters nationwide. The 2500-member chapter in Los Angeles, CA works within a social justice framework and partners closely with impacted communities. The Healthy Homes Campaign addresses the disproportionately high level of exposures of urban low-income populations in substandard housing to pest and pesticides. PSR-LA has worked with local health and housing agencies to integrate IPM concepts into the systematic code enforcement program, trained over 100 tenant organizers and community health promoters and facilitated the first Green Shield Certified IPM practitioner in Los Angeles.

2:00 43.4 Making the Business Case to Health Insurers to Support IPM Services, Eileen Gunn, egunn@tmfnet.org, Asthma Regional Council, Boston, MA

The Asthma Regional Council of New England (ARC) works to reduce asthma triggers in the home, including exposures to pests. The health care sector is encouraged to help patients reduce these exposures in order to control asthma symptoms. By investing in pest control services for low-income patients who are allergic, insurers can improve patient health and reduce reliance on urgent care visits. ARC and the Boston Public Health Commission have developed a “business case” specifically promoting health care referrals to, and payment for, Integrated Pest Management services. The contents of the business case will be shared.

2:20 43.5 IPM Resident Educator Pilot Project in Boston Public Housing Authority, Patricia Hynes, hphynes@gmail.com, Boston School of Public Health, Boston, MA

The IPM Resident Educator Program at Boston Housing Authority (BHA) is a training program for residents to become peer educators within the housing authority’s IPM program. The peer educator program grew out of an IPM research and demonstration project in Boston public housing and is now institutionalized at BHA. This presentation will offer evidence of the effectiveness and impact of resident IPM educators and will provide a description of the recruitment and training program for resident educators.

2:40 43.6 Pest at Rest: A New Model for Creating IPM Jobs in Urban Communities, Rhonda Griffin, pestfreemaintenance@verizon.net, Pest Free Maintenance, Inc. Philadelphia, PA

In 2004, the non-profit Doe Fund, Inc. Launched “Pest at Rest” to provide integrated pest management services for three target markets in NYC; non-profit housing providers; government agencies; and building owners and property managers. The goals of *Pest at Rest* are threefold: to run a profitable pest control business, to create employment opportunities for homeless, unskilled and unemployed people, many of whom have significant barriers to employment; and to help New York City handle pest infestations that threaten public health and quality of life. In 2008, Pest at Rest began a sister project in Philadelphia, PA.

44. Integration of Insect-Resistant Genetically Modified Crops within IPM Programs

Room E141

Insect pests remain one of the major constraints to food and fiber production worldwide, despite farmers deploying a range of techniques to protect their crops. Modern pest control is guided by the principles of integrated pest management (IPM) with pest-resistant germplasm being an important part of the foundation of IPM. Biotechnology has allowed the development of novel, genetically modified (GM) crops that express genes from the bacterium, *Bacillus thuringiensis* (Bt) and produce proteins toxic to insects. Since 1996, when the first Bt maize variety was commercialized in the USA, the area planted to insect-resistant Bt varieties has grown dramatically, representing the fastest adoption rate of any agricultural technology in human history. In 2007, insect-resistant Bt corn and cotton plants were grown in 22 countries on 42.1 million hectares (104 million acres). Experience to date with these insect-resistant GM crops has demonstrated the powerful nature of this technology for insect management. This symposium examines that experience in the context of the economic, social and environmental considerations associated with the use of insect-resistant GM crops and their implications for insect management.

Organizers: Anthony Shelton, ams5@cornell.edu, Cornell University/
NYSAES, Geneva, NY; Joerg Romeis, joerg.romeis@
art.admin.ch, Agroscope Reckenholz-Tanikon Research Station
ART, Zurich Switzerland; George G. Kennedy, george_
kennedy@ncsu.edu, Department of Entomology, North Carolina
State University, Raleigh, NC

44.1 Introduction and Integration of Insect-Resistant
Genetically Modified Crops within IPM Programs,
George G. Kennedy, george_kennedy@ncsu.
edu, Department of Entomology, North Carolina
State University, Raleigh, NC

The contribution of insect resistant GM crops to sustainable crop protection systems will be greatest when used within an IPM framework. Insect resistant GM crops are proving safe, easy to use, and compatible with other IPM tactics. However, experience has revealed the potential for reductions in insecticide use in Bt crops to be accompanied by the emergence of secondary pests and the need to adjust pest management systems. Emphasis on resistance management to mitigate selection for pest adaptation to Bt-crops has elevated the role of resistance management to a position of fundamental importance within IPM.

44.2 Transgenic Maize and Cotton within IPM Program—
A U.S. and Global Perspective, Steven E.
Naranjo, Steve.Naranjo@ars.usda.gov, USDAARS,
Arid Land Agricultural Research Center,
Maricopa, AZ; Richard L. Hellmich, USDA-ARS
Corn Insects and Crop Genetics Unit, Ames, IA;
Graham Head, Monsanto Company, St. Louis, MO

In 2007, transgenic crops were grown on 114.3 million hectares worldwide in 23 countries. Currently, the three largest producers of Bt crops, which confer resistance to lepidopteran and coleopteran pests, are the US, India and China. Globally, Bt cotton and maize have been associated with an increase in farm income of \$13.2 billion and a reduction in insecticide active ingredient of 136 million kg in the first eleven years of commercial production. As host-plant resistance, Bt crops form a fundamental building block of IPM by providing exceptional pest control while facilitating and enhancing other component tactics such as biological control.

44.3 Insect Resistant Transgenic Crops and Biological
Control, Jörg Romeis, joerg.romeis@art.admin.
ch, Agroscope Reckenholz-Tänikon Research
Station ART, Zurich, Switzerland; Roy G. Van
Driesche, Department of Plant, Soil and Insect
Sciences, University of Massachusetts, Amherst,

MA; Barbara I.P. Barratt, AgResearch Invermay, Mosgiel, New Zealand; Franz Bigler, Agroscope Reckenholz-Tänikon Research Station ART, Zurich, Switzerland

Natural enemies fulfill an important ecological and economic function by reducing herbivore populations and thus, they contribute to sustainable IPM systems. It is well established that plant resistance factors that affect herbivores also interact with natural enemies and consequently with the biological control function they provide. There is evidence today that insecticidal transgenic crops (Bt crops) have no direct adverse effects on natural enemies due to their narrow spectrum of activity. In systems where Bt crops replace insecticides, this technology can contribute to natural enemy conservation and thus be a useful tool in IPM.

44.4 Transgenic Vegetable and Fruit Crops within IPM Programs—The U.S. and Global Market, Anthony Shelton, ams5@cornell.edu, Cornell University/ NYSAES, Geneva, NY; Marc Fuchs, Cornell University/ NYSAES, Geneva, NY; Frank Shotkoski, Cornell University, Ithaca, NY

Fruits and vegetables are major components of a healthy diet, but are subject to severe pest pressure. Approximately 30% of insecticides applied worldwide are used to control insects affecting vegetables and fruits. Transgenic (GM) vegetables and fruits offer unique opportunities for controlling insects and the pathogens they transmit. Aphid transmitted viruses have been particularly difficult to manage by tactics aimed at reducing aphid populations. Farmers in the USA have benefited from GM virus resistant squash and papaya and *Bt* sweet corn has proven effective against Lepidoptera. However, the best opportunities for GM vegetables and fruits may be in developing countries.

44.5 Economic, Social and Environmental Considerations for Genetically Modified Crops for Insect Management, Steven Sexton, ssexton@are.berkeley.edu, and David Zilberman, Department of Agricultural and Resource Economics, University of California, Berkeley, Berkeley, CA

Transgenic varieties have been adopted to address major pest problems in production of cotton, corn, soybean, and Canola in 17 countries. Empirical studies suggest that these varieties tend to increase yields by as much as 70% if they are used to address pest problems that hadn't previously been contained. They reduce pesticide applications and lower health costs when they replace chemical pesticides. The productivity of crops that include transgenic varieties increased faster than the productivity of crops that did not include transgenic varieties. Thus, these damage-reducing transgenic varieties tend to lower food prices and reduce the acreage needed for agricultural production. In some cases, the effectiveness of transgenic varieties may be constrained by resistance build-up. In other cases, adoption of transgenic varieties may reduce crop biodiversity. There are solutions to address these problems, however, and reason to believe neither is yet very serious. In addition, intellectual property rights may limit the availability of GM varieties, but these constraints can be addressed with mechanisms like an intellectual property rights clearinghouse. The most significant obstacle to growth in the adoption of transgenic varieties is an inflexible regulatory regime that raises transaction costs and curtails the introduction of new traits for developing countries, which stand to benefit the most from continued innovation in agricultural biotechnology.

44.6 GM Crops—Industry and the Public, Tom Facer, tfacer@farmfreshfirst.com, Farm Fresh First, LLC, Oakfield, NY

The use of GM crops for direct food consumption has lagged behind the utilization of GM crops for manufacturing, animal feed and fiber in the US. This slowed adaptation is a result of food retailers' resistance to the marketing of GM crops, either labeled as GM or not. In recent years, there has been a gradual shift towards the limited use of GM crops for direct food consumption with no label designation. The public will ultimately determine the continued use of GM crops, presentation will center on the current trends of use.

45. Transcending Boundaries: Using Geographic Information Systems (GIS) Application for Invasive Species Prediction and Control

Room E142

Mapping, predicting, and managing invasive species in agricultural settings is a high priority for producers, managers, scientists, and natural resource planners. Invasive species management aims to control invaders and mitigate their impact. The first step in management is to understand, in a spatial sense, where they occur. Another facet of management is to predict future niche environments so that these areas can be monitored to prevent or limit movement of the species. In addition, managers need to plan control measures and this again can be done in a spatial sense. Each of these steps can use geographic information systems applications to help plan scouting, control tactics, and prediction. In this symposium, four topics will be addressed. The first will discuss using GIS to exam the threat of invasive species in both native and agronomy based ecosystems by examining the arrival, establishment and spread of an invasive. The second speaker will integrate GPS to examine area-wide management of an insect at the multi-field and landscape level. The third speaker will examine using GIS technologies in concert with remote sensing to manage plant diseases in a single field environment for in-season control. The last topic to be discussed will use historic data sets in a single field to examine how weed species within a field change or are similar across years and integrate this information into future management.

Organizer: Sharon A. Clay, sharon.clay@sdstate.edu, Plant Science Department, South Dakota State University, Brookings, SD

45.1 Overview of Applications for GIS for Invasive Species Prediction and Control, Sharon A. Clay, sharon.clay@sdstate.edu, Plant Science Department, South Dakota State University, Brookings, SD

45.2 Monitoring the Arrival, Establishment, and Spread of Invasive Species Using a Geographic Information System, Patrick C. Tobin, ptobin@fs.fed.us, Forest Service, U.S. Department of Agriculture, Northern Research Station, Morgantown, WV; Shelby J. Fleischer, sjf4@psu.edu, Department of Entomology, The Pennsylvania State University, University Park, PA; E. Anderson Roberts, roberts@vt.edu, Department of Entomology, Virginia Tech, Blacksburg, VA

Biological invasions threaten native- and agro-ecosystems, and are comprised of three processes: arrival, establishment, and spread. The arrival process refers to a movement of individuals from a source population to a destination habitat, and is facilitated through global trade and travel, and atmospheric, hydrologic, or other natural transport mechanisms. Following its arrival, an invasive species will either become established or not. There are many biological and ecological factors that influence establishment

success, and due to Allee effects and stochastic forces that act upon low-density founder populations, it often becomes a question of the size of the initial arriving population. If establishment is successful, the species will then start to spread and expand its range. The spread of biological invasions often proceeds through stratified dispersal, in which local population growth and movement are coupled with long-range dispersal. Because the population ecology of each of these three processes is unique though not necessarily independent, they each can influence the monitoring program and particularly the management guidelines and policy. Applications based upon GIS are valuable tools that allow managers to monitor the arrival, determine successful establishment, and estimate the rate of spread of an invasive species. In this presentation, we will describe the population ecology of biological invasions and address the use of geospatial tools in facilitating our understanding and management of invasive species with particular attention to non-native invasive insect species.

45.3 Integrating GPS, GIS Technologies, and Remote Sensing to Manage Plant Diseases and Pests,
Forrest W. Nutter, Jr., fwn@iastate.edu, Department
of Plant Pathology, Iowa State University,
Ames, IA

Within the integrated disease/pest management paradigm, crop consultants, agrichemical representatives, and integrated extension workers all provide advice to farmers on what strategies and tactics are needed to cost-effectively maintain high crop yield potentials. However, within the precision crop protection paradigm, it is critical that farmers understand that (for most crops), they are actually managing the amount of healthy green leaf area that will directly influence crop yields. To achieve site-specific attainable yields, crops are in a race to produce and maintain healthy green leaf area at a rate that greatly outpaces the rate that plant diseases and pests are removing healthy green leaf area. Remote sensing, GPS, and GIS technologies offer tools that can precisely estimate healthy green leaf area during the growing season, and more importantly, these technologies have tremendous potential to not only detect crop stress, but also to accurately discriminate among the causes of crop stress. It is our hypothesis that plant diseases/pests remove green leaf area from crop canopies in unique temporal and spatial patterns that can be used to accurately identify (discriminate) the cause(s) of reduced green leaf area within crops. Thus, remote sensing, GPS, and GIS technologies have the capability to monitor crop health, as well as to accurately discriminate among the many biotic and abiotic agents that affect crop health. Example pathosystems will include *Cercospora* leaf blight, soybean rust, soybean cyst nematode, and lightning injury in soybean crops.

45.4 Area-Wide Insect Management Plans for Corn Rootworm Using GIS, B. Wade French, wade.french@ars.usda.gov, USDA, ARS North Central Agricultural Research Laboratory, Brookings, SD

Corn rootworms (Coleoptera: Chrysomelidae) are serious pests of maize in the United States and Europe. Historically, chemical pesticides and crop rotation have been used to control these pests, creating economic and environmental concerns. A five year corn rootworm areawide management program was established in five states to manage corn rootworm populations on a multi-field or landscape scale to help alleviate these concerns. The goal was to more fully understand the spatial relationships between these pests with some physical of the landscape. Geographical information systems (GIS) and spatial analytical techniques were used to examine relationships between corn rootworm metapopulation dynamics, soil texture, and elevation. Procedures used to describe the relationships included an interpolation technique, spatial autocorrelation analysis, and contingency analysis. Corn rootworm metapopulation distributions were aggregated and related to soil texture and elevation. The information derived from the spatial analyses indicates how GIS can be used in areawide pest management to provide inputs for spatially explicit models that predict future pest populations and devise more well-informed pest management decisions. These techniques could easily be extended to study the spatial dynamics between other pest populations in agricultural landscapes.

45.5 Using GIS for Site-Specific Weed Management,

J. Anita Dille, Dieleman@ksu.edu, Department of Agronomy, Kansas State University, Manhattan, KS; Jeffrey W. Vogel, Kansas Department of Agriculture, Topeka, KS; Tyler W. Rider, Ness City, KS; Robert E. Wolf, Department of Biological and Agricultural Engineering, Kansas State University, Manhattan, KS

Within a GIS we can bring together information about weed spatial distribution and competitiveness, sprayer application technologies, and economics, in order to develop site-specific weed management approaches. We proposed a two-pass system using variable or low-rate soil-applied herbicide, followed by a map-based, foliar-applied herbicide in our rowcrop systems of Kansas. Based on weed species, density, and size, potential crop yield loss was determined and provided the basis to calculate the “economically optimal rate.” A prescription map was created and applied using a variable rate sprayer and evaluated on nine different farmer fields. This was successfully implemented but challenges will be described.

46. The IPM Explosion in California Retail Stores

Room E143

In California, urban pesticide use contributes to widespread contamination of surface water. Regulatory and local agencies recognize that education of those who use and sell pesticides— including consumers and retail store employees—will help people choose reduced-risk pest management practices. Pesticides are sold at a variety of stores ranging from independent nurseries and big-box stores with large garden departments to smaller chains and supermarkets that offer more indoor-use type pesticides. Store employees often give consumers incorrect information. Some consumers may purchase and apply the wrong product, misuse the product, and possibly cause damage to health and the environment. This symposium will focus on efforts to educate consumers and retail store employees about IPM and new reduced-risk products, and how recent consumer preferences for greener products are reinforcing these educational efforts. We'll also discuss the role of store managers, pesticide buyers, and the pesticide manufacturers themselves.

Moderator and Organizer: Nita Davidson, ndavidson@cdpr.ca.gov, Department of Pesticide Regulation, Cal/EPA, Sacramento, CA

1:00 46.1 Introduction, Nita Davidson, ndavidson@cdpr.ca.gov, Department of Pesticide Regulation, Cal/EPA, Sacramento, CA

1:10 46.2 Online Training for Improving IPM and Pesticide Safety Information Dissemination by Retail Employees, Mary Louise Flint, mlflint@ucdavis.edu, University of California Statewide IPM Program and Department of Entomology, University of California, Davis, CA

Retailers are a key source for consumers trying to make pest management decisions, yet few employees have adequate training to answer these queries. With high staff turnover, many employers are reluctant to provide time or travel funds for off-site or even on-site training. Online training can provide flexibility and expertise. The UC Statewide IPM Program has created two free, online programs focused on choosing and handling pesticides and nonchemical tools. These 40-minute modules are packed with video clips,

interactive sequences, and quizzes to deliver key principles. Individuals completing the courses receive a certificate of completion from UC.

1:30 46.3 IPM Kiosks—Using Touch Screen Computers to Provide IPM Information to Consumers, Cheryl Wilen, cawilen@ucdavis.edu, University of California Statewide IPM Program (UCIPM) and University of California Cooperative Extension, San Diego, CA

UCIPM developed portable, touch screen computer kiosks to help consumers get quick and environmentally sound answers to common home and garden pest problems. Since April 2007, 16 kiosks have been rotated among retail nurseries, big box stores, and libraries. UC Master Gardeners use them at county fairs, and home & garden shows in over 30 counties. In 2008, UCIPM updated the kiosks with information on new pests, and added new videos and printable handouts. Users can now find information on over 60 pests, including identification and management, and least-toxic pest management practices. Other topics include safe use and disposal of pesticides, mitigating runoff to improve water quality, and lawn and landscape tips.

1:50 46.4 Educating Consumers in Retail Stores about Reduced-Risk Practices and Products Using Fact Sheet Displays, Shelf Talkers, Store Events, and Product Sample Giveaways Reach Far Beyond the Local Community, Annie Joseph, anniejoseph@ix.netcom.com, Our Water Our World, Benicia, CA

Educating consumers at the point of purchase about reduced risk practices and products has far-reaching effects. For the past ten years, fact sheet rack displays, shelf talkers, store events, and sample product giveaways have helped to change consumer habits and store offerings. This has benefited not only the consumer, but has influenced pest management recommendations by store staff, the products that the stores stock for sale, and the products manufacturers are bringing to market to meet the new demands.

2:10 46.5 Documenting Change in Customer Preferences for Pest Management and How Garden Centers Have Recently Responded, Dan Joseph, djoseph@regannursery.com, Regan Nursery, Fremont, CA

Customers have traditionally come into retail nurseries asking for solutions to pest and disease problems. They have mostly relied upon the recommendations of the nursery professional. The past several years with more information in the press regarding pollutants, better reduced-risk solutions in the marketplace, and a more educated customer concerned with family and pet health, environmentally friendly solutions are more the norm. See how the store mix is changing with the efforts of the retailer and the demands of the customer even when more toxic solutions are available.

2:30 46.6 Providing Retail Customers with Sustainable Pest Management Strategies and Products: How Product Innovation, Technology Deployment, and Consumer Behavior Must Converge to Provide Sustainable Solutions, Chris Wible, Chris.Wible@Scotts.com, The Scotts Miracle-Gro Company, Marysville, OH

Effective home pest management relies on both products and practices. The right product, developed to manage the target pest, combined with the right application method and homeowner cultural practices are

necessary for success. Manufacturers must continually improve the product design, consumer communication, and product selection process to provide environmentally sustainable home pest management solutions. Find out how consumer insights, technology, and innovation shape the do-it-yourself home pest management category and change the product mix, the product selection process, and consumer behavior.

2:50 Discussion

47. Environmental Stewardship and IPM: “Green” Governmental Support and Grower Adoption of IPM

Room E144

Many IPM strategies are available that have joint plant and environmental protection benefits. However, due to perceived and actual risk of adopting IPM, lack of incentives that spread financial risk may act as a barrier to adoption. Government-sponsored programs are becoming increasingly available to provide ‘green’ incentive payments for natural resource conservation. IPM experts will present government policy experiences in securing such support for IPM, and review case examples of how ‘green’ incentive payments can motivate growers to higher levels of IPM adoption. They will introduce concepts, mechanisms, and experiences in establishing a productive environment to stimulate IPM adoption through grower participation in conservation programs. Policy and grower experiences will be taken from the US and Canada.

Moderators and Organizers: Michael J. Brewer, brewerm@msu.edu, IPM Program, Department of Entomology, Michigan State University, East Lansing, MI; Peter B. Goodell, ipmpbg@uckac.edu, University of California Cooperative Extension, Statewide IPM Program, Parlier, CA

1:00 47.1 Welcome, The Concept of “Green” Governmental Support for Grower Adoption of IPM, Michael Brewer, brewerm@msu.edu, IPM Program, Department of Entomology, Michigan State University, East Lansing, MI

Pest managers are challenged to adopt IPM that is more environmentally benign. Progress has been made in development of reduced-risk pesticides and alternatives to pesticides, but these techniques tend to be complex, causing real and perceived barriers in adoption. Concurrently, financial assistance available in conservation programs has increased to encourage grower adoption of farm practices that conserve natural resources. In recognition of IPM’s value as a joint plant and environmental protection tool, is ‘green’ government support available to encourage IPM adoption? We introduce concepts, mechanisms, and experiences in establishing a productive environment to stimulate IPM adoption through grower participation in conservation programs.

1:15 47.2 IPM and the Canada-Ontario Environmental Farm Plan Program, Donna Speranzini, donna.speranzini@ontario.ca, Ontario Ministry of Agriculture, Food and Rural Affairs, Vineland, ON, Canada

The Canada-Ontario Environmental Farm Plan is an incentive program involving all aspects of stewardship and soil and water conservation, including IPM. Now a national program, the program is voluntary and confidential. Small groups of growers attend a technical course and complete an environmental self-assessment and action plan. Applications for environmental conservation funding can be made based on the action plan. IPM projects are consistently ranked high. The keys to the creating

this window to access environmental conservation funding are the technical workshops, self-assessment and action plan development, and partnership between government agencies.

1:40 47.3 IPM NRCS Technical Services and the Environmental Quality Incentives Program, Benjamin Smallwood, Benjamin.Smallwood@wdc.usda.gov, Ecological Sciences Division, USDA Natural Resources Conservation Service, Washington, DC

The 2008 US Farm Bill has specified language that USDA will address IPM adoption with support from its conservation programs. Farm Bill conservation provisions call for increased technical and financial assistance for IPM including: increased promotion of pest prevention, pesticide use reduction, biological control approaches, monitoring, and use of least hazardous pesticides; improved recognition and reward of the multiple benefits of IPM to water and air quality, biodiversity, soil quality, and human health; and increased outreach efforts and forging new partnerships with other organizations. The USDA Natural Resources Conservation Service is responding with financial and technical assistance provided through conservation programs like the Environmental Quality Incentives Program to implement this guidance.

2:05 47.4 IPM and Resource Conservation: Building Partnerships to Increase IPM Adoption in California, Peter B. Goodell, ipmpbg@uckac.edu, University of California, Cooperative Extension, Statewide IPM Program, Parlier, CA

Linking IPM and resource conservation is a daunting task in a state as large and diverse as California. Creating partnerships help bring into focus those practices which overlap pest management and conservation issues. The primary environmental driver has been to reduce the risk of pest management activities to water and air quality. UC Statewide IPM Program has developed linkages with key partners including UC Cooperative Extension, USDA NRCS, California Department of Pesticide Regulation, local Resource Conservation Districts, commodity groups, farmers and consultants. We provided training, developed evaluation and reporting tools, supported projects that provide demonstration sites for proof of concept, and created opportunities for IPM cost sharing.

2:30 47.5 IPM and Resource Conservation: Building Partnerships to Increase IPM Adoption in Michigan, Michael Brewer, brewerm@msu.edu, IPM Program, Department of Entomology, Michigan State University, East Lansing, MI

Working across institutions, agencies, and the agricultural and environmental communities, our goal was to increase implementation of IPM with joint natural resource conservation and plant protection value through grower participation in USDA conservation programs. The team advised conservation program administrators and launched a variety of educational activities to support grower development of IPM plans and grower applications to conservation programs to aid their adoption of IPM. Outcomes have included increasing financial support for growers to adopt IPM in Michigan and beginnings of measurement of resulting environmental risk reduction.

2:50 47.6 Wrap Up: Putting into Practice "Green" Governmental Support for Grower Adoption of IPM, Peter B. Goodell, ipmpbg@uckac.edu, University of California Cooperative Extension, Statewide IPM Program, Parlier, CA

Incorporating IPM into relevant conservation management practices requires system level efforts and is outside the realm of individual agencies or groups. Innovative public/private partnerships are a

requirement to develop large, overarching community driven programs that reflect the issues and solutions of farmers, consumers, environmentalists, and regulators. This mini-symposium has introduced individual examples that address this challenge. What are the common threads and take home messages useful in building similar programs in other areas?

Wednesday, March 25, 2009

3:30–5:30 pm

Brainstorming Sessions

Brainstorming sessions will be held related to the four keynote presentations: IPM adoption, training, marketing, and systems design. Other brainstorming sessions are also available. The goal of these sessions is to encourage dialogue/discussion among attendees and with the keynote speakers; diverse perspectives from participants may stimulate unique solutions to obstacles in specific areas of IPM. The results of the keynote sessions will be summarized in the final session of the symposium.

48. *Brainstorming Session 1: Integrating IPM with the Design of Cropping Systems: A Multifunctional Approach*

Room D133

Historically, the design of crop rotations has been a key strategy for managing pests. However, the availability of pesticides and fertilizers has led producers in North America to rely on rotations comprised of only one or two crops. This approach has led to resistant pest species, environment contamination, and high input costs, which has stimulated producers to question the effectiveness of pesticide-centered management. However, producers are also concerned that changing their rotations will require the use of crops with lower value. They believe that profits will be reduced or even eliminated by crop diversity in rotations. The agricultural community in Europe is also concerned about pesticide-centered management, and they developed the concept of multi-functional rotations to increase their options with both rotation design and pest management. Designing rotations to accrue a multitude of benefits has enabled producers to broaden their choice of crops and still maintain profitability. For example, multifunctional rotations in the high-value vegetable production systems of the Netherlands reduce pesticide use 90% and fertilizer input almost 30%. Even with low-value crops added to these systems, profit is maintained at similar levels to conventional rotations because of reduced input costs. Success with this approach requires integrating principles related to pest and nutrient management with the design of cropping systems. The purpose of this brainstorming session is to explore possible development of multifunctional rotations in North America. We will use a systems inquiry approach to facilitate discussion among participants, with the goal of identifying scientific needs and possible obstacles related to research on rotation design.

Moderators and Organizers: Ray William, williamr@hort.oregonstate.edu, Oregon State University, Corvallis, OR; Janjo de Haan, janjo.dehaan@wur.nl, Wageningen University, Leystad, The Netherlands; Randy Anderson, randy.anderson@ars.usda.gov, USDA-ARS, Brookings, SD

3:30–5:30 Brainstorming Session

49. *Brainstorming Session 2: Branding IPM*

Room D135

This session will look at current IPM marketing efforts in food and fiber, consumer attitudes toward eco-messages, and the limiting factors that face marketers in all segments of the IPM spectrum. What makes successful programs economically viable and what limits the success of other efforts? Will educating the end consumer increase the demand for IPM produced food and fiber? Is a national certification program needed to assist consumers in their product selection? How can we differentiate between advanced IPM programs and minimum standards for IPM? How do we motivate steady progression toward the advanced end of the spectrum and promote IPM more effectively in the marketplace?

Moderators and Organizers: Susan Futrell, sfutrell@mchsi.com, Red Tomato, Canton, MA; Susan Ratcliffe, sratclif@illinois.edu, North Central IPM Center, University of Illinois, Urbana, IL

3:30–5:30 Brainstorming Session

50. Brainstorming Session 3: Education and Training in IPM

Room D137

This brainstorming session will engage the participants in addressing both the required knowledge and sources of education and training in IPM. Our goal will be to pool the participant's information and experience on the subject in an effort to determine current capabilities and future directions. Emphasis will be placed on providing IPM practitioners to work throughout the world in agriculture, communities and natural areas.

The typical knowledge base for IPM includes identifying key pest and beneficial organisms, understanding the ecology and adaptability of these organisms, preventing pest outbreaks through habitat manipulation, mastering scouting and other monitoring techniques along with the application of economic and other action thresholds, and designing systems of mitigation ranging from preventative to remedial that minimize environmental impact. To this is added experience with the habitat, e.g., crops or buildings; an understanding of laws and regulations pertinent to pest management, a reasonable exposure to pest management information and organizations, familiarity with the safe and appropriate use of pesticides, and so forth. The participants will discuss these and related topics. Education and training in IPM must enable pest managers to synthesize knowledge because pest problems are dynamic as organisms disperse and adapt. Additionally, experience is needed to accurately diagnose problems and rapidly solve them while minimizing side effects and economic losses. In agriculture, this practical approach requires interdisciplinary education and training in the traditional scientific disciplines of agronomy, entomology, plant pathology, and weed science, plus internships that emphasize hands-on, practical experience. The emerging profession of plant medicine is being developed to satisfy this need. Doctoral programs are offered at the University of Florida, University of Nebraska, and Chungbuk National University in South Korea. There are masters programs at Chungbuk National University, National Taiwan University, and National Ping Tung University in Taiwan. Bachelors programs include the National Chiayi University and others to follow in Egypt and Thailand. The participants will learn about interdisciplinary plant health programs, and consider specialized IPM education and training for communities and natural areas.

Moderators and Organizers: Norman Leppla, ncleppla@ifas.ufl.edu, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL; Robert J. McGovern, rjm@ifas.ufl.edu, Department of Plant Pathology, Plant Medicine Program, University of Florida, Gainesville, FL; Gary L. Hein, ghein1@unl.edu, Department of Entomology, Doctor of Plant Health Program, University of Nebraska, Lincoln, NE

3:30–5:30 Brainstorming Session

51. Brainstorming Session 4: IPM Adoption: Keys to Implementing IPM and Gaining its Full Benefits

Room D138

During this Symposium, presenters have shared their experiences in encouraging the adoption of IPM: from urban and school systems, agricultural fields, to natural resource/recreational landscapes. Are there any commonalities as we move from IPM development to IPM implementation in these varied settings? How do we identify, address, and balance key factors that affect the extent and gains of IPM adoption? To frame this brainstorming session on IPM adoption, we offer that ecological, health economic, and social/policy assessments (qualitative, quantitative, or both) are keys to optimizing IPM adoption within a chosen setting. An example from South Asia will be used to kick off this brainstorming session. We invite you to add your experiences to this discussion as we strive to develop a framework for implementing IPM to gain its full societal, economic, and ecological benefits.

Organizers and Moderators: Michael J. Brewer, brewerm@msu.edu, IPM Program, Department of Entomology, Michigan State University, East Lansing, MI; Margaret Appleby, margaret.appleby@ontario.ca, Ministry of Agriculture, Food and Rural Affairs, Brighton, ON, Canada; Alan Cork, a.cork@gre.ac.uk, Natural Resources Institute, University of Greenwich at Medway, Kent, United Kingdom

3:30–5:30 Brainstorming Session

52. Bed Bugs and Public Health: Establishing the Connections

Room D139

Over the past 10 years, the United States and other countries have experienced a dramatic resurgence of bed bugs. The public health impacts of this blood-feeding pest are probably underestimated. Although bed bugs have not been implicated in the transmission of disease, they can significantly impact the physical, mental, financial, and social well being of sufferers, and require the use of insecticides in close proximity to people. Large populations of bed bugs have also been implicated in the development of anemia and may contribute to asthma. Because of the long hiatus in bed bug infestations, many people are unaware of them and in many cases IPM strategies have not been adopted. New approaches to raising awareness and managing bed bugs on a community-level are needed. Many sufferers have nowhere to turn for help with bed bugs, such as financial aid, medical attention, and even physical labor needed to begin bed bug control. This workshop seeks to explore and document the links between bed bug infestations and public health, to foster the development of networks and new approaches to their spread, and to illuminate the opportunities for collaboration for a more comprehensive approach to managing bed bugs.

Other topics to be explored include evaluating the mental, social, and physical health impacts of bed bugs, engaging the experts from the field of public health, including medical and social services, and using IPM research and outreach to improve bed bug management, while minimizing the risks of controlling them.

Organizers: Jody Gangloff-Kaufmann, JIG23@cornell.edu, New York State Integrated Pest Management Program, Cornell University, Farmingdale, NY; Tim Gibb, gibb@purdue.edu, Department of Entomology, Purdue University, West Lafayette, IN;

Steve Jacobs, sbj2@email.psu.edu, Department of Entomology,
Penn State University, University Park, PA
Moderator: Tim Gibb, gibb@purdue.edu, Department of Entomology,
Purdue University, West Lafayette, IN

3:30 52.1 Bed Bugs in Context: Potential Impacts on the
Health of Today's Vulnerable Populations, Elizabeth
S. Kasameyer, Liz.kasameyer@baltimorecity.
gov, Baltimore City Health Department, Division
of Healthy Homes, Baltimore, MD

Bed bugs represent a burgeoning epidemic in the US which demands an immediate response in order to prevent the negative health outcomes associated with infestation. This discussion will focus on the clinical implications of infestation for our most vulnerable populations, including: children, the elderly, diabetics, people with compromised immune systems, and cardiovascular disease. The context in which this epidemic is occurring will also be explored in terms of other national health concerns, such as Community-Acquired Methicillin Resistant *Staphylococcus aureus*, which have the potential to compound the negative health outcomes associated with bed bug infestation.

3:50 52.2 The Societal Connections Used by Bed Bugs: Possible
Steps to Consider When Moving from Just
Fighting Fires to Systemic Isolation, Stephen A.
Kells, kells002@umn.edu, Department of Entomology,
University of Minnesota, St. Paul, MN

Bed bugs are a nest parasite and a systemic pest in our society. During the present resurgence, there has been considerable re-learning in how to cope with infestations. However, their ability to move among temporary human nesting sites, such as hotels, and toward more permanent sites (residences) has been underestimated. Complaints from temporary nesting sites are now displaced by problems encountered with multifamily housing, student residences and low income housing. This is now feeding the infestation back to other societal common-points such as hospitals, schools and places of business. With an increase in such habitat complexity, control in commercial housing areas has been costly and largely remains incomplete. The challenge will be to decide on a societal basis what practices and resources will best impact bed bug sources, or their mechanism of transmission, to reduce the societal spread. This presentation will discuss past cases of societal spread and assessment methods to reduce the risk of societal bed bug movement.

4:10 52.3 Community-Level Response to Bed Bug Infestations
in Hamilton County, Ohio, Jeremy D.
Hessel, Jeremy.Hessel@hamilton-co.org, Environmental
Health Division, Hamilton County Public
Health, Cincinnati, OH

Bedbugs have been and continue to be an emerging pest throughout the Cincinnati metro area. There are several theories with regards to how and why they have returned and how they got here. This presentation will discuss the uniform response and approach that Hamilton County Public Health and the City of Cincinnati Health Department have taken. We have learned through experience in the field and through education in the community what approaches work. Hamilton County Public Health's proactive response to bed bugs will hopefully reduce the impact of bedbugs in the community.

4:30 52.4 Implementing a Bedbug IPM Program in Low
Income Housing, Changlu Wang, cwang@aesop.
rutgers.edu Department of Entomology, Rutgers
University, New Brunswick, NJ

The cost and effectiveness of two bed bug integrated pest management (IPM) programs were evaluated in 16 low-income apartments. The apartments were randomly divided into two treatment groups: diatomaceous earth dust based IPM and chlorfenapyr spray-based IPM. Bed bug counts were monitored bi-weekly. Mattress and box spring encasements were installed and hot steam was applied to infested areas. Additionally, bed bug intercepting devices were installed under furniture legs in dust-based IPM group. After 10 weeks, bed bugs were eradicated from 50% of the apartments in each group. Program cost and effectiveness of the bed bug intercepting devices are discussed.

4:50 52.5 Examples of Successes in Bed Bug Management and What's Still Missing, Jody Gangloff-Kaufmann, JIG23@cornell.edu, New York State Integrated Pest Management Program, Cornell University, Farmingdale, NY

Bed bugs are pests that truly require an integrated pest management approach. Yes, control tools must be integrated. But the most successful bed bug management programs integrate a network of entities, including pest management professionals, health agencies, housing authorities, advocates, and those affected by bed bugs. Education and collaboration are emphasized. Examples of successful collaborations in the United States and elsewhere will be described along with gaps in our ability to aide those affected by bed bugs.

5:10 52.6 Discussion of the Connections between Bed Bugs and Public Health, Steve Jacobs, sbj2@email.psu.edu, Department of Entomology, Penn State University, University Park, PA

Discussion leader will wrap up the session with a summary of the topics presented and then lead a discussion for speakers and audience about the connections between bed bugs and public health, and the future of bed bug management on a community-wide scale.

53. Building Integrated Pest Management in Affordable Housing through Strategic Partnerships

Room D140

This session will present case studies of innovative partnerships in city environments and training tools to address IPM implementation in affordable housing. Pest infestations are a significant health and quality of life issue affecting residents of affordable housing. Studies of asthma among inner city children have shown that nearly 20% were sensitized to rats, 15% were sensitized to mice, and 69% were sensitized to cockroaches. Pat Hynes and Gail Livingston will discuss the Pest-Free Housing Initiative, a Boston-based partnership that is considered by many to be the gold standard for institutionalizing IPM practices in affordable housing. They will provide details on key strategies and lessons learned during the ten years this programs has been in operation, describing results achieved, and providing recommendations for adapting their model to other urban settings. Dion Lerman will discuss the unique role that Penn State's Philadelphia Schools and Community IPM Partnership has carved out for creating inroads in IPM education for urban communities. Allison Taisey will describe the leadership role that the Northeast Regional IPM Center played in developing a training curriculum for a one-day IPM training program that has been delivered to public health and housing officials throughout the country. The curriculum, which provides practical guidance for control of cockroaches, rodents and bed bugs, was developed by the Northeast IPM Center in partnership with EPA, HUD, USDA, CDC, the National Center for Healthy Housing, Penn State University and the National Pest Management Association.

Moderator and Organizer: Katherine J. Seikel, Seikel.kathy@epa.gov, U.S. EPA, Office of Pesticide Programs, Washington, DC

Panelists:

Patricia Hynes, hphynes@gmail.com, Department of Environmental Health (retired), Boston University, Boston, MA

Dion L. Lerman, dlerman@psu.edu, Philadelphia School and Community IPM Partnership (PSICP), Pennsylvania Integrated Pest Management (PA IPM) Program, Penn State University, Philadelphia, PA

Gail Livingston, Gail.Livingston@bostonhousing.org, Boston Housing Authority, Boston, MA

Allison Taisey, aat25@cornell.edu, Northeastern IPM Center, Ithaca, NY

54. New Technologies and Tools for IPM Programs

Room E141

Historically, chemical and natural-derived products have played an important role in IPM crop programs. The development and registration of new active ingredients for pest control is not only a long, arduous process, but also requires a great deal of resources. Continuing to find novel uses for and optimizing control with existing active ingredients is very important to maintain useful tools for IPM programs. Bait systems and trapping represent another valuable technology which can increase the control options within IPM programs utilizing existing active ingredients. All of these technologies represent very valuable tools in modern IPM programs. This symposium will review new technologies that are presently available or are anticipated to be available in the near future with a focus on their integration into existing IPM programs.

Organizers: Luis E. Gomez, egomez2@dow.com, Dow Agro-Sciences LLC, Indianapolis, IN; John C. Palumbo jpalumbo@ag.arizona.edu, University of Arizona, Yuma, AZ

Moderator: Luis E. Gomez, egomez2@dow.com, Dow Agro-Sciences LLC, Indianapolis, IN

3:30 54.1 Introduction: The Need of New Technologies and Tools for IPM Programs in Crops, Luis E. Gomez, egomez2@dow.com, Dow AgroSciences LLC, Indianapolis, IN

3:40 54.2 New Chemical Alternatives and Other Novel IPM Tools in Vegetables, John C. Palumbo, jpalumbo@ag.arizona.edu, University of Arizona, Yuma Agricultural Center, Yuma, AZ; David J. Schuster, University of Florida, Gulf Coast Research & Education Center, Wimauma, FL

American vegetable growers have the reputation of delivering a high quality product to the marketplace that is both aesthetically appealing and safe to the consumer. Growers accomplish this in part by using insecticides to control a number of important insect pests. In the past, they relied primarily on broadly toxic insecticides but also raised concerns with environmental and dietary risks. However, a number of

new “reduced-risk” insecticides have been developed that that now offers them safe and effective alternatives. Our presentation will focus on the unique qualities and activity of several of these new active ingredients, and provide examples of their implementation within vegetable pest management programs.

4:05 54.3 New Insecticide Alternatives and Other Novel
IPM Tools in Tree Fruits, Jay F. Brunner, jfb@
wsu.edu, Washington State University, Tree Fruit
Research and Extension Center, Wenatchee, WA

The EPA to phase out azinphos-methyl (AZM, Guthion) by 2012 coupled with the registration of new insecticides over the last few years signals the end of an era. The value of new insecticides resides in their human safety, reduced environmental impact, and an increased resistance management capacity. However, since the new insecticides tend to be more expensive, have a shorter residual life, have a narrower spectrum of activity, and are not as efficacious on key pests as products they replace the challenge for tree fruit crops comes in understanding how to fit them into pest management programs.

4:30 54.4 Development of Novel IPM Tools with Existing
Products for Fruit Flies and Other Invasive
Species, Roger I. Vargas, roger.vargas@ars.usda.
gov, U.S. Department of Agriculture, Agricultural
Research Service Pacific Basin Agricultural
Research Center, Hilo, HI; Ronald F. L. Mau, University
of Hawaii at Manoa, Honolulu, HI; Jaime
Pintero, University of Hawaii at Manoa, Honolulu,
HI; Luis E. Gomez, Dow AgroSciences LLC,
Indianapolis, IN

In 1999 a 10 yr Area-Wide Pest Management (AWPM) program was initiated for management of fruit flies in Hawaii. The AWPM program integrated two or more control components (field sanitation, protein bait sprays, male annihilation, sterile insects, and parasitoids) into a comprehensive package that has been economically viable, environmentally acceptable, and sustainable. The program has resulted in area-wide suppression of fruit flies, a reduction in the use of organophosphate insecticides, and the impetus for further growth and development of diversified agriculture in Hawaii. An important activity of the program was development of partnerships with industry and the transfer of novel technologies immediately to farmers. Among the technologies developed were novel monitoring dispensers, reduced-risk protein bait treatments, and reduced-risk male annihilation sprayable applications. These technologies represent some of the most environmentally safe and technologically advanced fruit fly detection and control products developed to date. The development of GF-120 Fruit Fly Bait and SPLAT-MAT ME with spinosad and the transfer of these technologies to farmers now offer a safe methodology to control fruit flies in Hawaii throughout large areas.

4:55 54.5 IR-4 Influence in the Development of Novel IPM
Tools for Pest Control: The Story of Spinosad
Seed Treatments, Keith Dorschner, dorschner@
aesop.rutgers.edu, Rutgers, the State University
of New Jersey, Princeton, NJ

The IR-4 Project (Interregional Research Project No. 4) is a publicly funded program that assists growers of specialty crops to gain registrations for pest control products. The costs associated with GLP data generation and the fees required to submit a tolerance petition to the U.S. Environmental Protection Agency are often too high to justify the research investment for the smaller markets of the specialty crops. Without the assistance of the IR-4 Project many specialty crop growers would be unable to use the newer or safer pesticides on the market. IR-4 can occasionally help bring novel application technologies to market as well. The development of spinosad seed treatment will be presented as an example on how IR-4 can support the introduction of novel technologies to the market.

5:20 54.6 Summary and Discussion: The Importance of New Technologies in IPM Programs, John C. Palumbo, jpalumbo@ag.arizona.edu, University of Arizona, Yuma Agricultural Center, Yuma, AZ

55. Reduced Risk Pesticides: Challenges and Opportunities in Achieving Healthy Ecosystem Goods and Services

Room E142

While the dramatic increase in pest management costs under the 1996 Food Quality and Protection Act (FQPA) are well documented, the scope, scale and temporal effects of the ensuing ecological perturbations are only now being elucidated. Practitioners using FQPA promulgated biologically based, “reduced risk” or “organophosphate-alternative” tools have begun to report far reaching ecological effects associated with these changes. It now appears that some of these changes may yield significantly less stable “ecological conditions” than pre-FQPA pest management programs in some cropping systems, and enhanced stability in others. The challenge is to find predictive indicators that yield clear signals of the ecological “condition” of fields, orchards and vines where IPM is practiced. With these reproducible indicators, net benefits or losses under FQPA promulgation will become more apparent. More importantly, loss of some beneficial species, that previously provided vital ecosystem services, may have led to significant instability that pre-FQPA systems did not exhibit. To properly measure these changes, a more thorough understanding of the ecological perturbations in agricultural systems are needed at the landscape level across many of the production systems affected by FQPA. Insights into the ecosystem services provided to agriculture by surrounding habitats (e.g., the influx of natural enemies and pollinators), may prove key to countering some of the losses in the affected agroecosystems. Moreover, new ecological understanding may point to the economic value of preserving surrounding native habitat in the agricultural landscape. This Workshop will introduce examples of these indicators in IPM systems and changes that FQPA has presented to agriculture, as well as begin a dialogue aimed at developing appropriate recommendations to relevant government agencies.

Moderators and Organizers: Robert M. Nowierski, rnowierski@csrees.usda.gov, and Mary Purcell-Miramontes, mpurcell@csrees.usda.gov, USDA-CSREES, Washington, DC

3:30 55.1 Disruption of Secondary Pests of Apple in the Northwest by Reduced-Risk Pesticides, Elizabeth Beers, ebeers@wsu.edu, WSU Tree Fruit Research & Extension Center, Wenatchee, WA

The transition from an organophosphate-, carbamate-, and organochlorine-based pesticide regime to one based on reduced-risk pesticides is well underway in Northwest orchards. While the newer pesticides bring lower mammalian toxicity, they have been found to be disruptive to several secondary pest systems. The well-established integrated mite control program can be disrupted by neonicotinoids and an IGR; the additive effects of multiple, slightly disruptive products is contributory. Woolly apple aphid, a minor pest in the organophosphate era, has become more problematic in recent years; both release from pesticide suppression and disruption of biological control are suspected.

3:45 55.2 Are We Moving Towards Ecologically Based IPM in Apple Orchards? Measuring the Biodiversity and Effectiveness of Beneficial Arthropods as Bioindicators, Dave Biddinger, djb134@psu.edu, Penn State University Fruit Research and Extension Center, Biglerville, PA; Tim Leslie, Timothy.

Leslie@liu.edu, Department of Biology, Long Island University, New York, NY; L.R. Donovall, ldonovall@state.pa.us, Pennsylvania Department of Agriculture, Harrisburg, PA

Integrated Pest Management was originally conceived as a way to manage pests through an understanding of their interactions with other organisms and the environment (i.e. agro-ecology). “Ecologically-based” IPM is considered to be a movement towards sustainability in agriculture and up the so-called “IPM continuum” as defined by the IPM Roadmap. It incorporates ecological and economic factors into agroecosystem design and decision-making in ways that also addresses the public’s concerns about food safety and environmental quality. Impacts on beneficial biodiversity were assessed in two USDA-RAMP grants that developed reduced risk IPM programs for apple and peach in the eastern US.

4:00 55.3 Effect of Neonicotinoids on Bees, Anne L. Averill, aaverill@ent.umass.edu, Department of Plant, Soil, and Insect Sciences, University of Massachusetts, Amherst, MA

Neonicotinoids present a potential hazard to pollinators. Traits that make them good insecticides, particularly water solubility, systemic activity, and persistence, enhance exposure to pollinators on flowering crops. Some studies show that use of labeled rates of neonicotinoids results in contamination of pollen and nectar, and research determining mortality and sublethal effects on behavior of adults and colony health is ongoing. Assessment is rare under field conditions, and given the array of neonicotinoids and the variety of uses, we are far from being able to provide reliable information to beekeepers and growers about neonicotinoid risk to pollinators and possible routes towards mitigation of risk.

4:15 55.4 Unintended Consequences of Stacking Herbicide Tolerance Traits in Soybean, David A. Mortensen, dmortensen@psu.edu, J. Franklin Egan, jfe121@psu.edu, Richard G. Smith, rgs14@psu.edu, and Matthew Ryan, mrr203@psu.edu, Department of Crop and Soil Sciences, The Pennsylvania State University, University Park, PA

Widespread adoption of glyphosate tolerant soybeans has increased the selection pressure for glyphosate resistant weeds. Already twelve agronomically important species have evolved resistance. To address this problem, the industry is commercializing soybean that are resistant to glyphosate and to dicamba. Despite industry claims of low environmental risk, dicamba, a broadleaf weed herbicide, is highly volatile and extremely active on many broadleaf crop and field edge plants. The high risk of injuring soybean, not carrying the dicamba trait, will drive growers to adopt glyphosate/dicamba tolerant cultivars. Such a practice has a high potential of widespread injury of susceptible broadleaf crops and of significantly reducing floristic biodiversity in field edges and nearby non-crop habitat, which provide essential ecosystem services.

4:30 55.5 Are We Reducing Risk? Insights from Implementing a Reduced-Risk IPM Program in Blueberries, Rufus Isaacs, isaacs@msu.edu, Department of Entomology, Michigan State University, East Lansing, MI

The changing suite of insecticide options in minor crops provides opportunities to develop IPM programs that are not dependent on neurotoxins with high environmental and human risk. Expected benefits of such programs include improved safety to beneficial insects, workers, and consumers. This presentation will focus on a blueberry RAMP project in which we measured the implications of reduced-risk IPM programs for pest control, natural enemies, insecticide residues, and cost. A recent study of pollinators in

blueberry fields will also be presented highlighting how IPM programs can contribute to conservation of native bees and the services they provide to pollinator-dependent crops.

4:45 55.6 The Power of New Reduced-Risk Chemistries:
Monitoring and Measuring Impacts to Ensure
Healthy Ecosystem Goods and Services, Mark
Whalon, whalon@msu.edu, Department of Entomology,
Michigan State University, East Lansing,
MI

It is time for IPM to step up to a new role in ecosystem assessment. Endangered species, global warming and biodiversity concerns are driving many society mandates to measure agricultural impacts on vital ecosystems. Rich ecological insights have resulted from systematic, pair-wise, farm-scale IPM-based ecosystem studies (2004-8). These measures pointed to subtle, intergenerational impacts of some 'reduced-risk' and 'OP-alternative' tools. Perhaps IPM has unrealized opportunities and much wider application in ecosystem assessment in the future.

5:00 Panel Discussion

Wednesday, March 25, 2009

6:30–8:00 pm

56. Open School IPM Session

Room D134

Organizers: Thomas Green, ipmworks@ipminstitute.org, IPM Institute of North America, Inc., Madison, WI; Dawn Gouge, dhgouge@ag.arizona.edu, Department of Entomology, University of Arizona, Maricopa, AZ

What steps are needed to effectively coordinate our efforts across state and international borders to achieve high-level IPM in schools? This informative session on School Integrated Pest Management will also provide networking opportunities and brainstorming on solutions to barriers to broader adoption of IPM in schools. Participation of key influencer and practitioner groups is integral in attaining our goal of full implementation by 2015. Whether you want to know more about the Pest Management Strategic Plan for IPM in Schools or have specific questions regarding your sector's role, we encourage both your questions and contributions.

7:00 pm

57. IPM Implementation: Forging Stronger Partnerships between Biocontrol Producers, Researchers, and Agricultural Clientele

Room D140

Organizer: Lynn M. LeBeck, exdir@anbp.org, Association of Natural Biocontrol Producers (ANBP), Clovis, CA

Augmentative biological control is a critical tool in many IPM programs. The companies that produce beneficial insects, mites and nematodes look to new research to help them improve the effectiveness, diversity, and quality of their living products. Feedback from their clientele is also an essential component for providing natural enemies that the IPM practitioner will enthusiastically rely on to help control pests where appropriate. This brainstorming session will provide an opportunity for biocontrol producers, researchers and agricultural clientele to discuss current challenges and opportunities for building better partnerships. Strengthening these interactions will assure that biocontrol producers continue to meet new market demands, improve production techniques and provide effective, high quality products. This session will be facilitated by the Association of Natural Bio-Control Producers (ANBP), an organization serving all sectors of natural enemy production and use through advocacy, education and quality assurance.

Thursday, March 26, 2009
8:30–10:30 am

**58. Integrated Vegetation Management (IVM)
Partners—Managing Ecosystems Together!**

Room D133

Education and awareness are keys to changing behavior. In the important areas of managing and controlling nuisance weeds and invasive plant species in rights-of-way, building grounds and institutional landscaping, Federal and State parks and forests, golf courses, nature trails and community parks, it is vital that users and applicators know and understand the concept of integrated vegetative management (IVM), an extension of Integrated Pest Management.

The IVM concept depends on the awareness and utilization of all the tools in the toolbox available to a right-of-way maintenance manager, a building and grounds maintenance operator, golf course superintendent and a professional landscaper and nurseryman. All segments of these user communities should be well versed in the scope of IVM. To accelerate this awareness and education, this program segment will acquaint policymakers and symposium participants with the elements of IVM. Four speakers will describe how they employ IVM techniques in their areas of responsibility, from urban areas to open range, from rights-of way to international applications.

Organizer: Allan Noe, anoec@croplifeamerica.org, CropLife Foundation, Washington, DC

8:30 58.1 Integrated Vegetation Management Best Practices,
Richard Johnstone, ivmpartners@comcast.net, President, IVM Partners, Newark, DE

Integrated vegetation management (IVM) is a system in which undesirable vegetation is identified, action thresholds are considered, and all possible control options evaluated and selected control(s) implemented. Control options, which include biological, chemical, cultural, manual, and mechanical methods, are used to prevent or remedy unacceptable, unreliable, or unsafe conditions. Choice of control option(s) is based on effectiveness, environmental impact, site characteristics, worker/public health and safety, security, and economics. The goal is to manage vegetation to balance benefits of control, costs, public health, environmental quality, and regulatory compliance.

This paper will describe case study examples of how IVM best practices can provide the primary service of the ROW; such as safe and reliable electricity or highway safety and aesthetics, while also lowering costs and meeting secondary concerns; such as wildlife habitat, threatened or endangered species,

watershed protection, invasive weed control, wildfire protection, reduced pollution and lowering the carbon footprint of maintenance practices.

9:00 58.2 Open Range Vegetative Management Presentation—
Speaker to be named

9:30 58.3 Integrated Vegetation Management in Urban
Natural Areas: Overview, Case Studies, Prospects
John Vickery, jvickery@mcg.net; Megan
Bowes, Colorado Native Plant Society, Denver,
CO

Natural areas programs in US cities vary from the newly formed with small remnant, native plant communities, to the long-established, with relatively large systems with a range plant community integrity represented in the portfolio. Some systems include sizable restorations or semi-native recreations. Others have small-to-medium sized areas planted largely with native plants as an alternative to standard 'turf-trees- flower beds-playground-picnic area parks'. Distinctive aspects of weed management in urban natural areas include: high user impacts; more significant edge effects; relatively greater number exotic species; higher burden of garden escapes and exotic, perennial ornamentals; relatively frequent disturbance; more public scrutiny of and sensitivity to management methods, especially pesticides; and greater volunteer involvement. In this session, an overview of natural areas programs in US cities is provided, examples of system-wide IWM strategies are given, and case briefs of pilot programs and individual noxious weed control projects are examined. Opportunities, new approaches, and challenges with respect to applying IPM techniques in Integrated Vegetative Management are explored.

10:00 58.4 From Integrated Pest Management to Integrated
Vegetative Management: a Global Perspective.
Keith Jones, keith.jones@croplife.org, CropLife
International, Brussels, Belgium

CropLife International is the global federation representing the major companies manufacturing crop protection and green biotechnology products. The federation has regional and national association members in over 90 countries throughout the world. CropLife International, as well as its member companies and associations, is committed to supporting a sustainable approach to agricultural production and pest control, and within this, sustainable use of crop protection and biotechnology products. As part of this commitment, the industry promotes Integrated Pest Management (IPM) strategies. In line with the International Code of Conduct on the Distribution and Use of Pesticides (FAO, 2002), CropLife recognizes that chemical pesticides are one of a range of tools—albeit an essential one—that are used within IPM strategies. The industry, through both the federation and individual companies, has implemented programmes over the past two decades to promote IPM and the responsible use of pesticides. These programmes are aimed at helping farmers and other users to access the information, tools and products required to increase agricultural productivity and improve their livelihoods. When control interventions are required, these programmes help to maximize benefits, while minimizing any risk to human health and the environment.

In common with IPM, Integrated Vegetation Management (IVM) uses a variety of control options and management strategies to control pests, in this case, vegetation. Examples from around the world include control of invasive species, such as acacia, in Southern Africa. This exotic tree is one species that threatens the natural vegetation in the Fynbos Biome and is controlled with targeted herbicide use. Similarly, herbicides are used to control introduced species in the ecologically sensitive Galapagos Islands. Other examples include the chemical, mechanical and biological control of water hyacinth in Africa, the biological control of the invasive cactus, prickly pear in Australia, the mechanical and chemical clearance of weeds that are breeding grounds for dengue and malaria vectors in the Philippines, and the control of weeds, including highly flammable species, on road, powerline and rail reserves through mechanical and chemical control in several countries. All of these approaches require an understanding on the ecology of the area to be managed, plus availability of appropriate tools, including herbicides.

Appropriate management practices protect, and even enhance biodiversity; this includes maintenance and enhancement of field margins by farmers, and use of practices such as conservation agriculture. This paper will discuss these issues in more detail.

59. Biorational Control: Mechanism, Selectivity, and Importance in IPM Program

Room D135

Our session deals with novel approaches for biorational insect pest control aiming at developing selective insect control agents acting on specific biochemical sites such as neuropeptides, ecdysone and juvenile hormones, GABA, ACh and ryanodine receptors, and natural products such as plant lectins and others originating from tropical plants. All of which are important components in IPM programs.

Countermeasures for resistance to biorational control agents using advanced biological and biochemical approaches are discussed.

Organizers: Isaac Ishaaya, vpisha@volcani.agri.gov.il, Agricultural Research Organization, The Volcani Center, Bet Dagan;
A. Rami Horowitz, hrami@volcani.agri.gov.il, Department of Entomology, Agricultural Research Organization, Gilat Research Center, MP Negev, Israel

59.01 Genetically Modified Insects as a Tool for Biorational Control

Thomas A. Miller

59.1 Rynaxypyr®: A New Reduced Risk Insecticide for IPM Programs, Paula G. Marçon, paula.c.marcon@usa.dupont.com, John Andalaro, and Rich Carver, DuPont Crop Protection, Stine-Haskell Research Center, Newark, DE

Rynaxypyr® is a new insecticide from the anthranilic diamide class of chemistry with exceptional activity on a broad spectrum of economically important pest species. The novel mode of action of Rynaxypyr® is activation of insect ryanodine receptors. Activation stimulates release of stored calcium from the sarcoplasmic reticulum of muscle cells, causing impaired muscle regulation, paralysis and ultimately insect death. Differential selectivity toward insect ryanodine receptors over mammalian receptors has been extensively demonstrated. Rynaxypyr® has remarkably low toxicity to mammals, fish and birds and high insecticidal potency, setting a new standard for insecticides that led to reduced risk decision by US EPA. The rapid cessation of feeding, strong residual activity and excellent rainfast properties of Rynaxypyr® deliver nearly-immediate and long-lasting plant protection under a range of growing conditions at low use rates. The high larvicidal potency and long-lasting activity of Rynaxypyr® provide excellent crop protection, even when circumstances prevent optimal application timing, while its selectivity to non-target arthropods conserves natural parasitoids, predators and pollinators. An extensive resistance risk assessment global study was conducted over a four-year period and indicates negligible risk of cross-resistance with existing insecticides, which suggests that Rynaxypyr® will be an excellent tool for growers in rotational programs within insecticide resistance management programs. The reduced risk status, novel mode of action, and unique selectivity against pollinators and beneficial arthropods are key attributes of Rynaxypyr®, making it a suitable pest management tool with an excellent fit in integrated pest management programs.

59.2 ©-Aminobutyric Acid Receptors: A Rationale for Developing Selective Insect Pest Control Chemicals, Yoshihisa Ozoe, ozoe-y@life.shimaneu.ac.jp, Department of Life Science and Biotechnology, Shimane University, Matsue, Japan

©-Aminobutyric acid receptors (GABARs) serve as a validated target for safe insecticides. Two phenylpyrazoles, fipronil and ethiprole, are currently used as practical insecticides. 3D-QSAR of ligands and homology models based on the electron microscopy or X-ray structures of homologous receptors provide information about the 3D structure of the insecticide-binding site in GABARs. It is possible to clone the genes encoding the subunits of GABARs and to express the wild type and binding-deficient mutants in cell lines or oocytes. Patch/voltage-clamp electrophysiology and ligand-binding assay make it possible to analyze the functions of the expressed receptors. The progress of studying methods should open up new opportunities for developing safer insecticides.

59.3 Biorational Integration, Resistance Management, and Ecological Assessment in Tree Fruit Orchards, Mark E. Whalon, Whalon@msu.edu, and John Wise, Department of Entomology, Michigan State University, East Lansing, MI

The key question before IPM leaders around the globe today is whether or not we will learn from past insecticide transition episodes to inform and develop emerging IPM programs that avoid ecological, evolutionary and economic consequences in the ongoing global pesticide paradigm transition. Beginning with the passage of the Food Quality Protection Act (1996) in the US, far reaching changes in IPM tree fruit and vegetable programs in the Upper Midwest have ensued. These changes are another episode in IPM paradigm shifts and have characteristics in common with other historical pest management shifts including the transitions from botanicals and heavy metals to the chlorinated hydrocarbons in the 1940-50s, the chlorinated hydrocarbons to the organophosphates (OP's) in the 1960s, the synthetic pyrethroids in the early 1980s, pheromones in the late 1990s and early 2000s and now the demise of the OP's with a surprising proliferation of neonicotinoids, oxadiazines, insect growth regulators (IGR's), spinosyns, biopesticides, etc. These transitions have often been accompanied in tree fruit production with the previous evolution of resistance, secondary pest outbreaks, biological control loss and the disruption of IPM systems. Inevitably, these changes result in an overall increase in the cost of production and, as we have shown in Michigan--perhaps for the first time, broad agroecological impacts.

59.4 IPM in Arizona Cotton: Successful Adoption of Selective Controls for Multiple Key Insect Pests, Peter C. Ellsworth, peterell@cals.arizona.edu, University of Arizona, Arizona Pest Management Center, Department of Entomology, Maricopa, AZ; Steven Naranjo, steve.naranjo@ars.usda.gov, University of Arizona, Arizona Pest Management Center, Department of Entomology and USDAARS, Arid Lands Agricultural Research Center, Maricopa, AZ; John C. Palumbo, jpalumbo@cals.arizona.edu, University of Arizona, Arizona Pest Management Center, Department of Entomology, Maricopa, AZ; Al Fournier, fournier@cals.arizona.edu, University of Arizona, Arizona Pest Management Center, Department of Entomology, Maricopa, AZ

Integrated Pest Management (IPM) depends on maximal use of ecosystems services for the control of target pests, and prevention of secondary pest outbreaks and costly pest resurgences. "Biorationals" can be key to exploiting ecosystems services such as natural enemy conservation, but are not a US-EPA recognized pesticide classification. They are generally considered to be compounds of natural origin and/or of such target specificity that they have limited or no adverse effects on the environment and beneficial organisms. Because ecosystems services are specific to the community they serve, a compound's classification as "biorational" depends on the context in which it is used. This presentation will detail a working model for deploying successful IPM in high input / high value systems where multiple

pests are managed through validated biorational and other approaches, and where growers make specific decisions to preserve valuable compounds for the future through proactive resistance management.

59.5 Ecological Determinants of *Bemisia tabaci* Resistance to Insecticides, Steven J. Castle, steven.castle@ars.usda.gov, USDA-ARS, Maricopa, AZ; John C. Palumbo, University of Arizona; N. Prabhaker, University of California, Riverside, CA; Rami Horowitz, Agricultural Research Organization, Israel; I. Denholm, Rothamsted Research, UK

The global importance of *Bemisia tabaci* offers unique opportunities to examine patterns of infestation among diverse habitats and identify major factors that determine pest status. Effective new modes of action have recently improved prospects for stable management of *B. tabaci*. However, insecticide resistance remains an impediment to achieving détente with *B. tabaci*. Progress towards combating resistance requires knowledge of the conditions under which resistance arises and identifying tactical measures that most effectively counteract resistance. Our presentation will examine ecological characteristics of *B. tabaci* that influence patterns of resistance in various agricultural settings and emphasize new opportunities to incorporate novel modes of action into a sustainable management program.

60. A New Pesticide Evaluation and Selection Tool for Agriculture

Room D136

When a pesticide is required, users face a daunting array of considerations including efficacy, cost, persistence, transport and environmental fate, residue potential at harvest and postharvest, and acute and chronic toxicity to applicators, consumers, beneficials, aquatic and terrestrial organisms. Data and tools needed to fully evaluate options are not readily available. The lack of a credible, comprehensive and easy-to-use tool has limited IPM promotion and performance benchmarking by grower groups, USDA, eco-certifiers and commercial food buyers. Our new tool permits users to evaluate hazards to each resource concern, assess individual or combined pesticide products, weigh impacts of application methods and quantity and frequency of application, account for site-specific conditions, access information on mitigation options for specific product/application selections, and evaluate an index “score” and ranking for each application and specific endpoints of concern. The tool includes innovative, new environmental indicators and a novel user interface. A pilot is underway to test the tool in US apple production. Our goal is to mitigate agricultural impacts on soil, water and air quality, avian and aquatic life, beneficial organisms, and worker and consumer health and safety by improving selection of pest management options and access to information on mitigation impacts.

Organizers: Thomas Green, ipmworks@ipminstitute.org, and Wade Pronschinske, wade@ipminstitute.org, IPM Institute of North America, Madison, WI

8:30 60.1 Demonstration of Pilot Program for Apple Orchards, Michael Guzy, guzym@enr.orst.edu, Dept of Biological & Ecological Engineering, Oregon State University, Corvallis, OR

9:10 60.2 Human Dietary and Worker Risk Indices, Charles Benbrook, cbenbrook@organic-center.org, The Organic Center, Enterprise, OR

9:30 60.3 Assessing Risk to the Terrestrial Biota, Pierre Mineau, Pierre.Mineau@ec.gc.ca, National Wildlife Research Centre, Science and Technology Branch, Environment Canada, Ottawa, ON, Canada

9:50 60.4 Deriving Estimated Environmental Concentrations through Water Modeling and Adjustment Factors, Michael Guzy, guzym@enr.orst.edu, Department of Biological & Ecological Engineering, Oregon State University, Corvallis, OR; Pierre Mineau, Pierre.Mineau@ec.gc.ca, National Wildlife Research Centre, Science and Technology Branch, Environment Canada, Ottawa, ON, Canada

10:10 60.5 Internationalization, Paul Jepson, jepson@science.oregonstate.edu, Integrated Plant Protection Center, Oregon State University, Corvallis, OR

61. Increasing Grower Use of *Thrips* IPM Systems to Manage Insecticide Resistance

Room D137

Thrips are a very important insect pest group across a wide range of high value crops around the world. Three genera, *Frankliniella*, *Thrips*, and *Scirtothrips*, account for most of the losses caused by thrips. In addition to the indirect and direct damage caused by thrips feeding on crops, *Frankliniella* species vector devastating tospoviruses. Although there are successful IPM programs for thrips management, economic pressures work against grower adoption in all areas. Effective chemical controls for thrips are few; the major pest species are resistant to most of the commercially available modes of action. This lack of effective products for rotation coupled with the lack of IPM to reduce treatment frequency puts intense selection pressure on the few remaining effective products in some crop systems. Globally, this situation is particularly acute in peppers, tomatoes, strawberries, bulb vegetables, cucurbits, and greenhouse-grown crops. Speakers in this symposium will discuss integrated management practices for pest thrips species in several of these problem crops. We will conclude the symposium by discussing what can be done to increase the diversity and sustainability of tactics used for thrips management and how to increase the adoption of these management tactics among growers.

Moderators and Organizers: James E. Dripps, jedripps@dow.com, Crop Protection Research and Development, Dow AgroSciences, Indianapolis, IN; Joe Funderburk, jef@ufl.edu, Department of Entomology, University of Florida, Quincy, FL

61.1 Introduction: Why Do We Need IPM and IRM for Thrips?, Joe Funderburk, jef@ufl.edu, Department of Entomology, University of Florida, Quincy, FL

There are over 5500 known species of thrips. Their small size, cryptic habits, and biological attributes make them the stealthiest of insect invaders, and thrips are major impediments to international trade. About 20 species are largely cosmopolitan. The spread of *Frankliniella occidentalis*, *Thrips tabaci*, and *Thrips palmi* has resulted in the de-stabilization of integrated pest management programs wherever they

have become established. Populations are largely resistant to most major classes of insecticides. These species of thrips have the ability to develop resistance quickly, and attempts to control rather than manage populations threaten the sustainability of newer, efficacious insecticides.

61.2 Thrips IPM in Solanaceous Vegetables and Cucurbits,
Stuart R. Reitz, stuart.reitz@ars.usda.gov,
Agricultural Research Service, U.S. Department
of Agriculture (USDA), Tallahassee, FL

Feeding and virus transmission by thrips are among the most important problems facing production of solanaceous and cucurbit crops. In field-grown crops, most damage comes from immigrating thrips. Therefore, the key to thrips IPM lies in limiting this primary damage. Recently, there has been a great deal of success through the appropriate integration of ultraviolet-reflective mulches, systemically acquired resistance, natural enemy conservation, and judicious use of insecticides. An improved understanding of species-specific dispersal and seasonal dynamics will enable management tactics to be better targeted of management tactics, and economic validation of IPM programs will foster their adoption.

61.3 Thrips IPM in Bulb Vegetables, Brian A. Nault,
ban6@cornell.edu, Department of Entomology,
New York State Agricultural Experiment Station,
Cornell University, Geneva, NY

Thrips control in bulb vegetables has been best achieved using insecticides. Thrips have become increasingly more difficult to manage with insecticides because populations have developed resistance against them. Overcoming this problem has stimulated research in three main areas: discovery of novel insecticides for thrips control, evaluating action thresholds to optimize insecticide use, and exploring non-insecticide approaches for thrips control such as host plant resistance and cultural practices. This presentation will concentrate on these three areas by providing examples of onion thrips control in onion cropping systems in North America.

61.4 Thrips IPM in Greenhouse-Grown Crops, Anna
Luczynski, ALuczynski@koppert.ca, Biological
Systems, and Karel Bolckmans, Koppert BV,
Surrey, BC, Canada

Several thrips species are serious greenhouse crop pests. They can cause direct plant damage by reducing yield or affecting cosmetic appearance of the harvested product. They can also vector plant diseases. Chemical control of thrips is often ineffective in part because their developmental stages can be found in a number of distinct habitats; within plant tissue, on leaves, inside flowers and in the soil. Biological control of thrips employs an array of natural enemies capable of suppressing thrips in each habitat. This strategy provides an effective and sustainable control of these important greenhouse crop pests.

61.5 Managing Thrips and Insecticide Resistance at the
Same Time, Pablo Bielza, pablo.bielza@upct.es,
Departamento de Produccion Vegetal, Universidad
Politécnica de Cartagena, Cartagena, Spain

Insecticide resistance has been documented in a number of chemical classes in the Western Flower Thrips (WFT). Resistance is associated with modification of target sites and, mainly, enhanced detoxification. High frequency of insecticide applications, continuous presence of hosts and the lack of refuges for susceptible populations, and, definitively, a production system that permits a high pressure of selection, leads to development of insecticide resistance. An Insecticide Resistance Management strategy based on resistance mechanisms (not only on modes of action) has been designed for WFT, with additional measures as the use of some pesticides as synergists or soil treatments.

61.6 Summary and Discussion: Common Themes for Increasing Thrips IPM and IRM, James E. Dripps, jedripps@dow.com, Anthony Weise, and Luis Gomez, Crop Protection Research and Development, Dow AgroSciences, Indianapolis, IN

In all crops, sustainable thrips management requires full integration of cultural, biological, and chemical tactics. Using multiple tactics increases the effectiveness and sustainability of each individual tactic. IPM is a primary component of insecticide resistance management (IRM), and IRM is a primary component of IPM. For example, judicious use of selective insecticides that preserve natural enemies reduces the number of insecticide applications needed, prolonging the effective life of those insecticides. But adoption of integrated thrips management programs will occur only if we can change grower mindset regarding the risk-reward proposition of longer term, sustainable management strategies versus short-term control tactics.

62. Structural Pest Control and Water Quality: Issues, Needs, Approaches, Collaborations

Room D138

Connections between structural pest management and water quality issues have been relatively unexplored. In 2007, the “Green-Blue Summit: Clean Water through Residential IPM” included a daylong discussion on the impacts of pest management in and around homes on the environment. Following up, the Western and Northeastern IPM Centers organized an on-going series of national conference calls pursuing the topic of structural pest management impacts on water quality and other environmental parameters. Issues raised in these interactions included effective outreach to homeowners, children and pest management professionals; partnering with health outreach organizations; research needs on the sources and fates of pesticides in water; data needs for linkages between IPM and water quality; structural pest management practices likely to impact water quality; and verifying IPM in structural pest management. In this workshop speakers and participants will identify key areas of known or potential impact of structural pest management on water quality and discuss current and potential strategies for addressing these impacts.

Organizers: Lynn Braband (Moderator), lab45@cornell.edu, NYS IPM Program, Cornell University, Rochester, NY; David Tamayo, tamayod@saccounty.net, Storm Water Quality Section, County of Sacramento Department of Water Resources, Sacramento, CA

8:30 62.1 Introductory Remarks, Lynn Braband, lab45@cornell.edu, NYS IPM Program, Cornell University, Rochester, NY

8:35 62.2 Industry Perspectives on the Relationships between Structural Pest Control and Water Quality Issues, Ron Harrison, rharriso@rollins.com, Orkin Pest Control, Atlanta, GA; Darren Van Steenwyk, darrenv@clarkpest.com, Clark Pest Control, Lodi, CA

9:05 62.3 Widespread Surface Water Impacts of Pyrethroids in Urban Areas of California, Armand Ruby, armand@armandrubyconsulting.com, Armand Ruby Consulting, Capitola, CA

9:35 62.4 Sharing the Load: Cross-Jurisdiction Partnerships
Enhance IPM Outreach in California, David
Tamayo, tamayod@saccounty.net, Storm Water
Quality Section, County of Sacramento Department
of Water Resources, Sacramento, CA

10:05 Panel Discussion between Speakers and Audience

63. IPM Working Groups: Transcending Boundaries across States, Disciplines, and Agencies to Implement IPM

Room D139

Working groups funded by the USDA IPM Centers have facilitated multi-state activities that have increased communication among states, scientists and educators working in several disciplines, and with numerous stakeholder groups. This has led to a variety of outcomes, including regional workshops, publications, and research projects, which have influenced implementation of IPM in the U. S. and beyond. The purpose of this workshop is to share information on tools, techniques and outlooks necessary to form productive work groups. Additionally, outputs and outcomes of successful projects will be discussed in detail. Work groups may use crops, disciplines, topic areas or geographic regions as their foci. Information on impacts to grower communities will be shared in addition to instructions on how to form similar productive coalitions for serving extension clientele.

Moderators and Co-organizers: Robert Wright, rwright2@unl.edu, Department of Entomology, University of Nebraska, Lincoln, NE; Susan Ratcliffe, sratclif@illinois.edu, North Central IPM Center, University of Illinois, Urbana, IL; Paul Jepson, jepsonp@science.oregonstate.edu, Environmental and Molecular Toxicology and Integrated Plant Protection Center, Oregon State University, Corvallis, OR

8:30 63.1 Great Lakes Vegetable Working Group, Jim Jasinski, jasinski.4@osu.edu, The Ohio State University, Urbana, OH

8:50 63.2 Great Lakes Fruit IPM Working Group, David Epstein, epstei10@msu.edu, Michigan State University, East Lansing, MI

9:10 63.3 NRCS and IPM Working Group: Grower Incentives for IPM, Mike Brewer, brewerm@msu.edu, Michigan State University, East Lansing, MI

9:30 63.4 PNW Pest Management Workgroup—Transcending Boundaries with a Geographically Based Workgroup, Catherine Daniels, cdaniels@wsu.edu, Washington State University, Pullman, WA; Erin Hodgson, erin@biology.usu.edu, Utah State University, Logan, UT; Janice Chumley, rnjic@uaf.edu, University of Alaska-Fairbanks Soldotna/Kenai Extension District, Fairbanks, AK; Ronda Hirnyck, rhirnyck@uidaho.edu, University of Idaho, Boise, ID

10:00 63.5 Western IPM Center Weather Systems Workgroup:
Providing Web-Based Decision Support
Tools That Address the Climate and Weather
Complexities of the Pacific Northwest, Leonard
Coop, coopl@science.oregonstate.edu, Integrated
Plant Protection Center, Oregon State
University, Corvallis, OR; Chris Daly, daly@
nacse.org, NACSE, Oregon State University,
Corvallis, OR; Alan Fox, alan@foxweather.
com, Fox Weather LLC, Fortuna, CA; David
Gent, gentd@onid.orst.edu, USDA-ARS Forage
Seed and Cereal Research Unit, Corvallis, OR;
Paul Jepson, jepsonp@science.oregonstate.edu,
Integrated Plant Protection Center, Oregon
State University, Corvallis, OR; Bill Pfender,
pfenderw@onid.orst.edu, USDA-ARS Forage
Seed and Cereal Research Unit, Corvallis, OR;
Carla Thomas, cthomas@ucdavis.edu, University
of California, Plant Pathology, Davis, CA; Walt
Mahaffee, mahaffew@science.oregonstate.edu,
USDA-ARS Horticultural Crops Research Unit,
Corvallis, OR

64. IPM Strategies for the Pest Management Industry

Room D140

This session will focus on a variety of pest problems facing the urban pest management industry. Presenters will discuss some of the more challenging pests, such as bed bugs, along with some novel IPM approaches for structural pests. The presenters represent the technical departments of urban pest management firms from several different geographical locations in the United States. Regionally diverse pest management information will be provided.

Moderator and Organizer: Patricia Hottel, mcteknical@aol.com, McCloud Services, Hoffman Estates, IL

64.1 Bed Bugs: An Ideal Pest for IPM, Richard Cooper, rick.cooper@cooperpest.com, Cooper Pest Solutions, Lawrenceville, NJ

Educating pest management professionals about IPM strategies is essential. The principals of an integrated pest management approach can be applied in a very effective manner in relationship to dealing with bed bug management. Unfortunately, the IPM model is not necessarily applied by many in the pest management field. Instead, bed bug management often involves chemically invasive methods throughout infested structures. Of particular concern is the fact that many of these applications are aimed at mattresses, sofas and other upholstered furniture where people sleep or rest, and where subsequent risk of pesticide exposure is great. Liberal applications of one or more pesticides are also typically made throughout the remainder of the infested environment. Despite the extensive use of pesticides, rarely are infestations eliminated in a single service and it is not uncommon for numerous re-applications to be made in an effort to eliminate the problem. This presentation will review why bed bugs are an ideal pest for the implementation of an IPM approach.

64.2 Comparison of Reduced Impact versus Traditional Approaches for Urban Pest Management, Keith Willingham, kwillingham@west-ext.com,

Western Exterminator Company, Anaheim, CA

Western Exterminator Company, Anaheim, California evaluated three strategies: Eco, Eco Plus Non repellent and Traditional approaches for urban pest management in 2005 and 2006. Callbacks, chemical cost, and quality assurance ratings for these three strategies were comparable. However, both our customers and customer service technicians were concerned with the efficacy of Eco approach in summer months. In 2007-2008, we compared the route efficacy between Reduced Impact and Traditional approaches. Callback, cancellation, chemical cost, and quality assurance rating were comparable between these two approaches.

64.3 Sustainable Urban Wildlife Remediation, Scott McNeely, scottmpc@bellsouth.net, McNeely Pest Management, Winston Salem, NC

In this presentation we will take a look at human/wildlife conflicts arising in urban settings. With “urban sprawl” occurring throughout much of the United States there is an ever increasing frequency of human interactions with various species of wildlife where conflict resolution is needed. Discussion concerning several common urban wildlife species will be presented in this program with a balanced overview of remediation techniques.

64.4 The Use of Pheromones as Part of an IPM Program, Jeff Weier, jweier@spraguepest.com, Sprague Pest Solutions, Tacoma, WA

Insect pheromones have been used for years in IPM programs as a monitoring tool. In pest management, pheromones have been developed for variety of stored product insects including several beetle and moth species. Commercially produced lures are widely available but the means for interpretation of the captures are still being developed. Novel uses of insect pheromones in pest management programs are now emerging. Over the past five years, we have demonstrated that intensive trapping of stored product moths, such as the Indianmeal moth (*Plodia interpunctella*), with pheromone traps can slow the growth of populations in commodity storage during the summer months. Recently new products have been developed that use stored product moth pheromones to reduce population growth by disrupting mating in the target populations. One such product has been used for the past year in the Pacific Northwest. Results of the use of this product are effective population reduction with reduced use of pesticides. The use of intensive trapping, mating disruption and a well designed pheromone monitoring program can be significant components of IPM programs. These methods are ideally suited for sustainable programs, green programs as well as use in certified organic processing and storage facilities.

64.5 Invasive Species: Transcending Boundaries, Mark Sheperdigian, shep@rosepestsolutions.com, Rose Pest Solutions, Troy, MI

In North America, invasive species account for the vast majority of pest management procedures and applications for urban pests. Comparing the list of native to non-native pests and the measures taken to control them demonstrates the severity of the non-native pest impact on IPM. Once established, operations to control these pests become a daily effort. Efforts aimed at keeping new non-native species from becoming invasive in North America may be the single most important action to prevent the need for pest management operations.

65. The Challenges of Developing and Implementing IPM Programs for Bark Beetle Infestations in Western North America

Room E141

In natural resource management, integrated pest management (IPM) strategies have been described, but are infrequently implemented. This is particularly true for native insects, such as bark beetles (Coleoptera: Curculionidae), that undergo episodic outbreaks often at large spatial scales. Bark beetles are commonly recognized as the most important mortality agent in western coniferous forests. For example, the last decade has seen extensive amounts of bark beetle-caused tree mortality in spruce forests of south-central Alaska and the Rocky Mountains, lodgepole pine forests of western Canada and the Rocky Mountains, pinyon-juniper woodlands and ponderosa pine forests of the southwestern U.S., and pine-dominated forests in Mexico. Managing associated levels of bark beetle-caused tree mortality is a routine problem, particularly in high-value areas (e.g., campgrounds) and the wildland-urban interface. Changing climate attributes suggest the risk of infestation at all scales may be increasing, especially along ecotones. These changes put more pressure on emerging and existing chemical and semiochemical-based tactics developed for treatment of individual trees and forest stands. In concert with vegetation management, these tactics represent a tool box of treatment options. This workshop will focus on the needs and challenges of developing and implementing IPM or more perhaps accurately integrated resource management programs concentrating on bark beetle infestations in conifer forests of western North America. Speakers will include notable experts from Canada, Mexico, and the U.S. working on integrated management of bark beetles.

Moderators and Organizers: Jane L. Hayes, jlhayes@fs.fed.us, Western Bark Beetle Research Group, Pacific Northwest Research Station, USDA Forest Service, La Grande, OR; Christopher J. Fettig, cfettig@fs.fed.us, Western Bark Beetle Research Group, Pacific Southwest Research Station, USDA Forest Service, Davis, CA; Steven J. Seybold, sseybold@fs.fed.us, Western Bark Beetle Research Group, Pacific Southwest Research Station, USDA Forest Service, Davis, CA

65.1 Application of Semiochemicals for the Management of Bark Beetles in Canadian Forests, John H. Borden, johnb@pherotech.com, Contech International, Delta, BC, Canada

65.2 Applying the Principles of IPM to Bark Beetle Management in California, Mary Louise Flint, mlflint@ucdavis.edu, Urban & Community IPM, University of California Statewide IPM Program and Extension Entomologist, Department of Entomology, University of California, Davis, CA

65.3 The Role of Vegetation Management in Successful Bark Beetle IPM, Ken Gibson, kgibson@fs.fed.us, Forest Health Protection, USDA Forest Service, Missoula, MT

65.4 Contrasting IPM of Bark Beetle Outbreaks in Canada and Mexico, Jorge Macías-Sámano, jmacias@ecosur.mx, Grupo de Ecología Química, Colegio de la Frontera Sur/ECOSUR, Tapachula, Chiapas, Mexico

65.5 Application of Risk and Hazard Rating Systems to the Management of Bark Beetles in Forests of the Western United States, Jose F. Negrón, jnegron@fs.fed.us, Western Bark Beetle Research Group, Rocky Mountain Station, USDA Forest Service, Fort Collins, CO

65.6 An IPM Program for *Dendroctonus Rhizophagus* in Mexican Pine Forests, Gerardo Zúñiga, capotezu@hotmail.com, Departamento de Zoología, Escuela Nacional de Ciencias Biológicas-Instituto Politécnico Nacional, Mexico

66. Municipal Pesticide Bylaws in Canada— The Impact on Pest Management Practices

Room E142

In June 2001, the Supreme Court of Canada upheld a municipal bylaw that prohibited the use of pesticides on public and private property. The judgement was based on a distinction between essential and non-essential uses of pesticides, provided the bylaw purpose “is to minimize the use of allegedly harmful pesticides in order to promote the health of the inhabitants”. Since, over 150 municipalities and 2 provinces have adopted bylaws severely restricting the use of pesticides within their jurisdiction. These bylaws now account for nearly 50% of the Canadian population. The public discussions have left little room for IPM practitioners who see pesticides as a necessary tool within a justified and rational program. This workshop will review all sides of the argument and draw lessons for IPM practitioners. Presenters have direct involvement in municipal bylaw debates. An overriding theme will be the need for education of the decision makers in regards to pesticide use in public areas, including education of the public on the role of pesticides in pest management program; education of pesticide users on the importance of reducing unnecessary pesticide use; and education of elected officials on least-toxic pesticides. The Canadian experience illustrates the importance of novel programs to comply with more stringent legislative requirements, such as stronger emphasis on preventative pest control, better documentation of pest problems, and increased auditing of work performed.
Moderator and Organizer: Mario Lanthier, office@crophealth.com, CropHealth Advising and Research, Kelowna, BC, Canada

8:30 66.1 The Arguments of Municipal Pesticide Bylaws, Mario Lanthier, office@crophealth.com, CropHealth Advising & Research, Kelowna, BC, Canada

Public discussions about municipal bylaws rapidly become partisan debates. Those in favor or against bylaws both claim scientific knowledge, public support and moral authority. Specific topics will include the legal background that allows for municipal bylaws in Canada, the arguments in favor of bylaws by environmental groups and members of the medical community, the arguments against bylaws by trade organizations and pesticide manufacturers, and the impact on IPM practitioners and their use of pesticides.

9:30 66.2 An Example of Municipal Bylaw: The City of Kelowna Pesticide Reduction Strategy, Michelle Kam, ask@kelowna.ca, City of Kelowna, BC, Canada

Municipalities have the authority to limit specific activities that involve pesticides, such as applications for cosmetic purposes, but cannot regulate sale or purchase of these products. Most Canadian municipal bylaws use similar wording, with differences for local considerations. This presentation will examine the City of Kelowna bylaw as an example. The “Pesticide Use Regulation Bylaw” was adopted by City Council in 2008 following 3 years of a pesticide reduction strategy. Specific topics will include public input, staff directed research, the Pesticide bylaw advisory committee, and actual bylaw wording.

9:00 66.3 The Genesis and Effectiveness of Municipal Pesticide Bylaws in Canada, Carol Mee, cmee@toronto.ca, Environmental Information and Education, Toronto Public Health, Toronto, ON Canada

A reduction in non-essential use of pesticides is documented where pesticide bylaws are combined with a public education campaign. The conclusion is supported by surveys done in municipalities that have adopted a pesticide bylaw. This presentation will review the City of Toronto as an example. The 4-year old bylaw was adopted to address health and environmental concerns. Specific topics will include the origins of the bylaw, impact on commercial landscape services, public opinion surveys on use of pesticides and natural gardening techniques.

10:00 66.4 PlantHealthBC Pest Management Accreditation, Kent Mullinix, kent.mullinix@kwantlen.ca, Institute for Sustainable Horticulture, Kwantlen Polytechnic University, Surrey, BC, Canada

IPM accreditation programs were developed by the landscape industry as an answer to municipal pesticide bylaws. Commercial pesticide users that receive detailed IPM training can be exempted from the provisions of the municipal bylaw. This presentation will review the "PlantHealthBC Pest Management Accreditation" as an example. It was developed to work with municipalities to advance the practice of IPM by landscape care service providers. Specific topics will include program development and objectives, accreditation standards, program elements, and municipalities as key partners. There will be a short discussion of the successes and failures of these programs.

67. Advancements and Innovations for Urban Municipality IPM Programs

Room E143

IPM program specialists within city municipalities as well as the private sector face the dual challenge of balancing the risks posed by pests and pesticides, while communicating the rationale for IPM efforts in simple, understandable forms. This symposium will examine advancements and innovations in urban IPM programs, challenging program planning and decision making processes, and the essential need for integration and collaboration within and between municipalities. City models from both the general and the specific (San Francisco and Portland, Oregon) will be presented. However, the minisymposium is designed to allow for ample discussion time following each speaker with the goal of stimulating audience feedback, discussion, and the overall promotion of innovative municipality IPM efforts.

The following will be discussed:

- 1) Maximizing the effectiveness and innovations for municipal IPM programs within programs of limited resources.
 - 2) How IPM decisions are made in the context of urban complexity and the interconnectedness of structures, landscapes and urbanites.
 - 3) Successful urban IPM policies and public processes on the general scale and for San Francisco and Portland.
 - 4) The implementation of the precautionary principle and how it influences municipality IPM processes.
- Moderator and Organizer: Chris A. Geiger, chris.geiger@sfgov.org, Integrated Pest Management Program, San Francisco Department of the Environment, San Francisco, CA

9:00 67.1 Cities, Pests and People: The Interconnectedness

of Municipal IPM Programs, Bobby Corrigan,
Cityrats@mac.com, RMC Pest Management
Consulting, Richmond, IN

Obviously, modern cities are complex structural and societal environments. Urban pests of city landscapes and structures are incredibly opportunistic upon these environments and thus affect our major metropolises on a highly interconnected scale. Simply stated, urban pest populations are not restricted to people's property lines or those of municipal agencies— they are inter-agency in scope. To achieve long term success, municipal IPM programs must be pest-specific and ideally should be keenly matched and designed with, the interconnectedness of a city, its operation, and ultimately its people.

9:45 67.2 IPM in San Francisco, Chris A. Geiger, chris.
geiger@sfgov.org, Integrated Pest Management
Program, San Francisco Department of the Environment,
San Francisco, CA

Many public agencies have emulated San Francisco's urban IPM program, which is based on the precautionary principle, pest prevention, and stakeholder involvement. This session will review some of the program's highlights, the strengths and weaknesses of the "SF Approved" pesticide list system, the realities of implementing the precautionary principle, and new tie-ins with the LEED-EB green building certification.

10:30 67.3 Innovative Approaches in City Park IPM Programs,
John Reed, PKJOHNR@ci.portland.or.us,
Integrated Pest Management Program, Portland
Parks and Recreation-City Nature, Portland, OR

Portland Parks and Recreation is responsible for the stewardship of 10,000 acres of diverse urban and natural area parkland, and has been implementing and refining park-specific IPM programs for over 20 years. Challenges include endangered species act listings, invasive weeds, and reduced staff attempting to meet ever-increasing public needs. Portland Parks have responded with programmatic adaptations focused on risk reduction and innovative IPM projects that form governmental and community partnerships. Examples include IPM research trials, environmental certification processes, endangered species exemptions, and the development of innovative city park IPM practices that ultimately result in tangible public and environmental benefits.

Thursday, March 26, 2009

10:45 am–noon

Closing Plenary Session

Portland Ballroom 254-255

10:45 Presiding, Thomas Green, ipmworks@
ipminstitute.org, IPM Institute of North America,
Inc., Madison, WI

10:55 Keynote Brainstorming Session Reports
Integrating IPM with the Design of Cropping Systems: A Multifunctional
Approach, Ray William, williamr@hort.oregonstate.
edu, Oregon State University, Corvallis, OR

Branding IPM, Susan Ratcliffe, sratclif@illinois.edu, North

Central IPM Center, University of Illinois, Urbana, IL
Education and Training in IPM, Gary L. Hein, ghein1@unl.
edu, Department of Entomology, University of Nebraska,
Lincoln, NE

IPM Adoption: Keys to Implementing IPM and Gaining Its Full
Benefits, Michael J. Brewer, brewerm@msu.edu, IPM Program,
Department of Entomology, Michigan State University, East
Lansing, MI

11:30 IPM—Where to Next?, Dennis D. Kopp,
dkopp@csrees.usda.gov, U.S. Department of
Agriculture, Cooperative State Research, Education
and Extension Service, Washington, DC

This presentation is intended to be an introspective look at the Federal sector growth and resource support for Integrated Pest Management (IPM), from the evolution of the concept, its growth in the past, to its present configuration, and what appears to be the playing field and opportunities of the future. The past or history of IPM is the easiest to piece to envision, since many of us at this meeting have had the opportunity to shaping and contribute to IPM's past. The present is a bit more difficult to see, yet this conference provides a wonderful window into some of the remarkable IPM work that has just been completed or is still in progress. The future is more speculative, certain reasonable postulates and projected direction in Federal sector support and resources can also be drawn from present trends and external influences. In this presentation, I will share my thoughts regarding future opportunities that could provide new resources necessary to maintain and grow public support for IPM.

11:50 Closing Remarks, Thomas Green, ipmworks@
ipminstitute.org, IPM Institute of North America,
Inc., Madison, WI