ipm
Integrated Pest Management
for our environment • for our future

contents

6th International IPM Symposium
coordinated by the Office of
Continuing Education

ILLINOIS

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ipmsymposium09/

welcome

Transcending Boundaries

It is with great pleasure that we welcome you to the Sixth International IPM Symposium, occurring March 24–26 in Portland, Oregon. Our all-volunteer planning committees for the meeting have worked hard to bring you an excellent program focusing on transcending boundaries in IPM. The plenary session provides an informative kickoff for our meeting, followed by equally stimulating sessions on water quality and structural pest issues, to "green" IPM and IPM in schools. The wide range of topics blends disciplines and content and embodies the very definition of IPM. There are several sessions relating to a "green" theme, very appropriate given the city we are meeting in. We hope you will enjoy the many cultural and outdoor offerings as well as the special building tours of the environmentally sensitive convention center and hotel.

Join your colleagues from around the world to hear about the latest research, discover new ways to deliver the IPM message, and connect with old friends and new colleagues. We look forward to seeing you at the poster receptions, hearing from you during the symposia, and talking with you during the social events. Welcome to Portland!

Sincerely,

George F. Czapar, Thomas A. Green, Carrie Lapaire Harmon
Co-chairs, 6th International IPM Symposium

contributors and sponsors

We thank our contributors and sponsors for their generous support of IPM and this symposium.

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  - Risk Management Agency (RMA)
- U.S. Environmental Protection Agency (EPA) Office of Pesticide Programs—PestWise
- University of California Statewide IPM Program

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exhibitors

Exhibits are located in Portland Ballroom 256-257-258, on the second level of the Oregon Convention Center. This is also the location for poster sessions, continental breakfasts, and breaks.

Audubon International

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general information

Registration and Information Desk

The Registration Desk will be located on the second level, outside the Portland Ballroom, of the Oregon Convention Center.

The desk will be open:

Monday, March 23, 3:00–6:00 PM

Tuesday, March 24, 7:00 AM–6:00 PM

Wednesday, March 25, 7:00 AM–6:00 PM

Thursday, March 26, 7:00 AM–NOON

The Oregon Convention Center operates a Visitor Information Counter on the first level for information about Portland.

Presenter Practice Room

If presenters need to preview their presentations, come to the Registration Desk during its hours of operation.

Poster Sessions

Two poster sessions will be held: on Tuesday, March 24, and Wednesday, March 25, from 5:30 to 7:30 PM in the Portland Ballroom 256-257-258. While all posters will be displayed for the duration of the symposium, authors are asked to be by their posters according to their final poster number: odd numbers on Tuesday and even numbers on Wednesday.

Posters can be set up beginning at 9:45 AM on Tuesday in the Portland Ballroom 256-257-258. They should be in place by 5:00 PM on Tuesday. They can be removed after the Wednesday session is over at 7:30 PM. They must be removed by noon on Thursday.

Posters will be mounted on display boards using tacks. Tacks will be available for mounting. Posters are to be no larger than 4 feet wide x 4 feet high (122 cm x 122 cm) in size.

If you would like to have your poster posted on the 2009 IPM Symposium Web site, copy your poster as a .pdf file and send to the symposium email address: ipmsymposium@ad.uiuc.edu.

Poster session abstracts are found on Page 80.

Poster Session Receptions

All registered participants and their registered guests are invited to attend the receptions, held during the poster sessions on Tuesday, March 24, and Wednesday, March 25, from 5:30 to 7:30 PM each night in Portland Ballroom 256-257-258. Hors d'oeuvres and a cash bar will be provided during the receptions.

Media

The Registration Desk will serve as the media desk, located on the second level outside Portland Ballroom. Reporters and other members of the media should register at the Registration Desk. Media kits will be available.

Session Moderators

If you have technical difficulties during your session, please find the volunteer with the radio, or come to the Registration Desk.

Continuing Education Credits

Sign-in sheets will be located in the sessions that qualify. Stop at the Registration Desk for more information.

Symposium Evaluation

An online evaluation survey will be conducted after the symposium. An e-mail message will be sent to you with the details; we hope that you will take a few minutes to complete the survey. Your feedback has significant impact on the Steering Committee's evaluation of this year's Symposium and planning decisions for the next.

Post-Symposium

Presentations and posters will be added to the Web site after the symposium.

www.ipmcenters.org/ipmsymposium09

daily schedules

Sunday, March 22, 2009

Related Meeting	Location	7AM	8	9	10	11	12	1PM	2	3	4	5	6	7	8	9
Biological Control USDA-CSREES Regional Projects Meeting	Hood/Helen and 3 Sisters Rooms, Doubletree Hotel, Portland															

Monday, March 23, 2009

Related Meetings	Location	7AM	8	9	10	11	12	1PM	2	3	4	5	6	7	8	9
Biological Control USDA-CSREES Regional Projects Meeting	Hood/Helen Rooms, Doubletree Hotel, Portland															
IPM CRSP Technical Committee Meeting	Oregon Room at the Doubletree Hotel, Portland															
Multi-Region IPM Coordinator Meeting	Halsey/Weidler Room at the Doubletree Hotel, Portland															
NEREAP Meeting	Sisters Room at the Doubletree Hotel, Portland															
SERA-3 Meeting	Alaska Room at the Doubletree Hotel, Portland															
NCERA 201 Meeting	Bachelor Room at the Doubletree Hotel, Portland															
WERA-069 Meeting	Idaho Room at the Doubletree Hotel, Portland															
Functions																
World Forestry Center Museum Reception and Dinner	World Forestry Center															
Tour																
Heron Lakes Golf Course (Certified Audubon Cooperative Sanctuary)	meet in the Doubletree Hotel Lobby															
Registration	Portland Ballroom Lobby, Oregon Convention Center (OCC)															

Tuesday, March 24, 2009

Plenary Session	Location	7AM	8	9	10	11	12	1PM	2	3	4	5	6	7	8	9
Opening Plenary Session	Portland Ballroom 254-255															
Concurrent Sessions																
1. Global Food Shortages: Role of IPM	Room D133															
2. Utilizing Communications and Technology to Deliver Your IPM Message	Room D134															
3. International Cooperation: Researchers and Regulators Working Together to Build Management Strategies for Growers	Room D135															
4. Innovative Food Industry Programs Are Accelerating Adoption of IPM and Other Best Management Practices	Room D136															
5. Integrating Strategies for Invasive Species Management: Capacity, Compatibility, and Operational Challenges	Room D137															
6. Urban Pest Ant Management	Room D138															
7. IPM Strategies for the Management of Insect-Transmitted Plant Virus Diseases	Room D139															
8. Evaluating Impacts of IPM: Methods and Examples	Room D140															
9. Implementation of IPM in the Corn and Soybean Transgenic Landscape: A Lost Cause?	Room E141															
10. Diversity in IPM Education and Delivery Systems: Strengths, Weaknesses, Opportunities, and Threats	Room E142															
11. Economics of IPM in Developing Countries	Room D133															
12. Distance Education in IPM by the IPM^3 Training Consortium	Room D134															
13. Biofumigation in the Pacific North West—Their Effect on Plant Pathogens and Plant Pests	Room D135															
14. IPM Evolution to Green Revolution	Room D136															
15. Soil Quality Management as an Approach to Pest Management: Examples from Organic Research	Room D137															
16. Applied Research in Urban IPM	Room D138															
17. Transcending Geographic and Institutional Boundaries to Address a Migratory Pest: The Corn Earworm Story	Room D139															
18. Potential Revision of the IPM Road Map	Room D140															
19. Transcending Farm Boundaries: Improving Our Understanding of Insect Relationships within and between Cropping Systems Using Protein Marking Techniques	Room E141															
20. Tools for Fostering IPM Success in Residential Environments	Room E142															
21. The Eco-labeling Explosion—Keeping Up in a Rapidly Changing Marketplace	Room E143															
22. Promoting Implementation of IPM in Schools	Room D144															
Poster Sessions																
Poster Setup	Portland Ballroom 256-257-258															
Poster Session–odd numbered posters	Portland Ballroom 256-257-258															
Functions																
Continental Breakfast	Portland Ballroom Lobby															
Luncheon and Integrated Pest Management Achievement Awards Presentation	Portland Ballroom 252-253															
Poster Session Reception	Portland Ballroom 256-257-258															
Related Meetings																
23. Hands-On Introduction to Integrated Pest Management Tools: eXtension	Room D134															
24. 2008 National Extension IPM Special Projects Program (EIPM) Reporting Workshop	Room D133															
Registration	Portland Ballroom Lobby															

Wednesday, March 25, 2009

Concurrent Sessions	Location	7AM	8	9	10	11	12	1PM	2	3	4	5	6	7	8	9
25. Integrated Crop Management: Transcending IPM Boundaries	Room D133															
26. Scaling Up Regional Food Systems: Implications for IPM Education and Research	Room D134															
27. Biorational Control: Mechanism, Selectivity, and Importance in IPM Program	Room D135															
28. Transcending Boundaries with Innovations in IPM for School and Childcare Facilities: Cost-Benefit Case for IPM in Schools	Room D136															
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															
30. Sustainable Subterranean Termite Management	Room D138															
31. Indoor IPM and Green Buildings: Is There a Connection?	Room D139															
32. History, Causes, and Challenges of Insecticide and Herbicide Resistance	Room E141															
33. Reaching Out to the Public: Developing and Delivering Residential IPM Messages	Room E142															
34. Branding IPM in the Marketplace	Room E143															
35. IPM at the Landscape Level: Prospects and Challenges	Room E144															
36. How Successful is Area-Wide Pest Management? Examination of Recent Programs	Room D133															
37. Barriers to Adoption of Biopesticides: Three IPM Symposia Later, Where Are We?	Room D134															
38. IPM Needs for the Future of Biofuels/Biomass	Room D135															
39. Transcending Boundaries with Innovations in IPM for School and Childcare Facilities: Innovative and International Programs	Room D136															
40. Role of Mineral Nutrition in IPM for Suppressing Plant Diseases	Room D137															
41. Termite Baiting Systems: Use of IPM Approaches for Control of Termites in Urban Environments	Room D138															
42. Creating Temporal and Spatial Refugia for Biological Control in Tree Fruits	Room D139															
43. Strategic Partnerships for Urban IPM Implementation	Room D140															
44. Integration of Insect-Resistant Genetically Modified Crops within IPM Programs	Room E141															
45. Transcending Boundaries: Using Geographic Information Systems (GIS) Application for Invasive Species Prediction and Control	Room E142															
46. The IPM Explosion in California Retail Stores	Room E143															
47. Environmental Stewardship and IPM: "Green" Governmental Support and Grower Adoption of IPM	Room E144															
48. *Brainstorming Session 1:* Integrating IPM with the Design of Cropping Systems: A Multifunctional Approach	Room D133															
49. *Brainstorming Session 2:* Branding IPM	Room D135															
50. *Brainstorming Session 3:* Education and Training in IPM	Room D137															
51. *Brainstorming Session 4:* IPM Adoption: Keys to Implementing IPM and Gaining Its Full Benefits	Room D138															
52. Bed Bugs and Public Health: Establishing the Connections	Room D139															
53. Building Integrated Pest Management in Affordable Housing through Strategic Partnerships	Room D140															
54. New Technologies and Tools for IPM Programs	Room E141															
55. Reduced Risk Pesticides: Challenges and Opportunities in Achieving Healthy Ecosystem Goods and Services	Room E142															
Functions																
Continental Breakfast	Portland Ballroom 256-257-258															
Poster Session Reception	Portland Ballroom 256-257-258															

Wednesday, March 25, 2009, continued

Tours	Location	7AM	8	9	10	11	12	1PM	2	3	4	5	6	7	8	9
Sustainability Tour of the Oregon Convention Center	Meet at IPM Registration Desk, Oregon Convention Center															
Sustainability Tour of the Doubletree Hotel	Meet at Doubletree Hotel Lobby															
Related Meetings																
56. Open School IPM Session	Room D134															
57. IPM Implementation: Forging Stronger Partnerships between Biocontrol Producers, Researchers, and Agricultural Clientele	Room D140															
Poster Sessions																
Poster Session–even numbered posters	Portland Ballroom 256-257-258															
Registration	Portland Ballroom Lobby															

Thursday, March 26, 2009

Plenary Session	Location	7AM	8	9	10	11	12	1PM	2	3	4	5	6	7	8	9
Closing Plenary Session	Portland Ballroom 254-255															
Concurrent Sessions																
58. Integrated Vegetation Management (IVM) Partners—Managing Ecosystems Together!	Room D133															
59. Biorational Control: Mechanism, Selectivity, and Importance in IPM Program	Room D135															
60. A New Pesticide Evaluation and Selection Tool for Agriculture	Room D136															
61. Increasing Grower Use of *Thrips* IPM Systems to Manage Insecticide Resistance	Room D137															
62. Structural Pest Control and Water Quality: Issues, Needs, Approaches, Collaborations	Room D138															
63. IPM Working Groups: Transcending Boundaries across States, Disciplines, and Agencies to Implement IPM	Room D139															
64. IPM Strategies for the Pest Management Industry	Room D140															
65. The Challenges of Developing and Implementing IPM Programs for Bark Beetle Infestations in Western North America	Room E141															
66. Municipal Pesticide Bylaws in Canada—The Impact on Pest Management Practices	Room E142															
67. Advancements and Innovations for Urban Municipality IPM Programs	Room D140															
Tours																
Sustainability Tour of the Oregon Convention Center	Meet at IPM Registration Desk, Oregon Convention Center															
Sustainability Tour of the Doubletree Hotel	Meet at Doubletree Hotel Lobby															
Functions																
Continental Breakfast	Portland Ballroom 256-257-258															
Related Meetings																
Urban IPM Coordination Committee Meeting	Bachelor Room at the Doubletree Hotel, Portland															
Management of Pesticide Resistance USDA-CSREES Regional Project Meeting (WERA060)	Idaho Room at the Doubletree Hotel															
Registration	Portland Ballroom Lobby															

Friday, March 27, 2009

Related Meetings	Location	7AM	8	9	10	11	12	1PM	2	3	4	5	6	7	8	9
Management of Pesticide Resistance USDA-CSREES Regional Project Meeting (WERA060)	Idaho Room at the Doubletree Hotel															

symposium program and 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, *Rhynchoforus 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 and 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 consist 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 consist 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 stormwater 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 with in-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

9:00 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.

9:15 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.

9:30 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.

9:45 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 and made 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 fruitfly 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 (*RAGI* 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 germplasm 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, Hariet 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. By1997 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 it ability to vector and spread Piece'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 and important vectors in the spread 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 it range of host plants as the bacterial disease appears to be evolving.

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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 non-pesticide 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 Wilen, 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, rlgilbertson@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, glyphosate-resistant 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.

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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 on 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 on 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, jepsonp@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 Castelhano, 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 IPM^3 Training Consortium

Room D134

The workshop will demonstrate distance IPM education provided by the IPM^3 Training Consortium. The IPM^3 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 Module*s, and *Specialty Topic Module*s. 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 IPM^3 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 Tubermoth, *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 tubermoth (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 nematodes 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 ^{0}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 nematodes 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 know for quite some time that Brassicaceae glucosinolate breakdown products (mainly isothyosianates and ionicthyosianates) have pesticidal properties that has lead 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 if different *Brassicacea* 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, Merril 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@ofrf.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@ofrf.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 manager 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, tneltner@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 (pvalue=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 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.

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, lrteuber@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. Eisenhauer 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 is 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 non-organic 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 A 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@clemson.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 LC_{50} 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@nrcan.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, Belguim

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 Flufenerim, a Novel Insecticide for Controlling Whiteflies and Aphids—Biological and Biochemical Aspects, Murad Ghanim, ghanim@agri.gov.il, Svetlana Kontsedalov, Galina Levdov, A. Rami

Horowitz, and Isaac Ishaaya, The Volcani Center, Bet Dagan, Israel

Flufenerim 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. Flufenerim showed exceptional potency against the whitefly *Bemisia tabaci,* the green peach aphid *Myzus perisae,* and the melon aphid *Aphis gossypii* with LC_{50} values lower than 1 mg a.i./litre. After 24 generation selection with flufenerim, no decrease in susceptibility of *B. tabaci* was found. Flufenerim showed no cross resistance with selected *B. tabaci* resistant strains against *neonicotinoid*s.

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

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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.

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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, sarrmakh12@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, sarrmakh12@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@engr.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.

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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@clemson.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 by 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@cals.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 "Area-wide 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 M*anagement 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 Area-wide 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.

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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 NH_4-N, K, and Ca fertilizers. However, even in the last decade, the disease-suppressing benefits of chloride salts are still mistakenly being ascribed to NH_4, 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, lllee@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 there surrounding environments to maximizing biological control and minimizing 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@suterra.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 is 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, USDA-ARS, 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.

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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 increasing 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 demonstrations 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 topic 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 multi-family 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 AgroSciences LLC, Indianapolis, IN; John C. Palumbo jpalumbo@ag.arizona.edu, University of Arizona, Yuma, AZ

Moderator: Luis E. Gomez, egomez2@dow.com, Dow AgroSciences 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 Pinero, 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, isaacsr@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 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, anoe@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

59.1 Rynaxypyr®: A New Reduced Risk Insecticide for IPM Programs, Paula G. Marçon, paula.c.marcon@usa.dupont.com, John Andaloro, 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 γ-Aminobutyric Acid Receptors: A Rationale for Developing Selective Insect Pest Control Chemicals, Yoshihisa Ozoe, ozoe-y@life.shimane-u.ac.jp, Department of Life Science and Biotechnology, Shimane University, Matsue, Japan

γ-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 agro-ecological 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 USDA-ARS, 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 post-harvest, 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@engr.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@engr.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, jepsonp@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 lead 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 repellant 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, Departmento 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 provides. 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 mini-symposium 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 programmatical 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

poster abstracts

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

Agricultural IPM Systems

P001 Development of an Integrated Pest Management Program for Pennsylvania's Conifer Industry

*Cathy Thomas, caththomas@state.pa.us, and Sarah Pickel

Pennsylvania IPM Program, Bureau of Plant Industry, Pennsylvania Department of Agriculture, Harrisburg, PA

In Pennsylvania, 25% of the state's total agricultural sales are from specialty crops. One of the major specialty crops is conifers, in the form of cut Christmas trees or balled/burlap conifers. Pennsylvania is ranked fifth in the nation for total Christmas tree and conifer sales. To maintain stock quality, nurseries rely heavily on pesticides to prevent major pest damage. Nationally, Christmas tree growers use approximately 71,000 lbs of pesticides annually. The most commonly used insecticide is chlorpyrifos, a broad-spectrum organophosphate. Many formulations of this pesticide are restricted-use by the US EPA. In 2004, IPM program leaders at the PA Department of Agriculture began working with a group of conifer growers as part of a project to reduce broad-spectrum insecticide use, specifically for the control of white pine weevil, *Pissodes strobi* (Peck). This native pest affects several conifer species, causing as much as 30% damage to the crop, despite multiple insecticide applications. The project involved weekly one-on-one on-farm training visits with an IPM Field Specialist covering important IPM techniques (pest trapping, tracking of Growing Degree Days and scouting) and monthly educational meetings with project leaders and grower participants. After three seasons, the growers were consistently using 50—70% less spray material than in seasons prior to the project and yet achieved <1% damage. The growers had also incorporated reduced-risk pesticide products into their control arsenal. Currently, project leaders are working on a similar project targeting invasive hard scales.

P002 Using Earthworms to Suppress Soilborne Diseases

Wade H. Elmer, Wade.Elmer@po.state.ct.us

The Connecticut Agricultural Experiment Station, New Haven, CT

Field plots were established in *Verticillium dahliae*-infested soil and planted to eggplants in 2005-2007. Depending on the year, 16-88 earthworms (*Lumbricus terrestris*)/m2 were added to plots (3.5 m2, 4 plants/plot). Plots were monitored over the season for growth and for Verticillium wilt. Plants grown in earthworm-amended plots were larger, had more fruit, and exhibited fewer symptoms of disease than plants in control plots. We hypothesized that the disease-suppression associated with earthworm amendments may involve an increase in beneficial microbes. Greenhouse studies were established and four earthworms were added to 2-liter pots filled with soil infested with *Fusarium oxysporum* f. sp. *asparagi* or *F. oxysporum* f. sp. *lycopersici*, and then planted to asparagus or tomatoes, respectively. An equal number of pots did not receive earthworms. All pots received applications of dried manure and ground alfalfa. After 3 mo., pots with asparagus amended with earthworms had 60% larger root systems and had 50% fewer root lesions than plants grown without earthworms. Greenhouse tomatoes grown with earthworms were twice as large, had 3 times as many fruit, and had 50% less stem discoloration than controls. The rhizosphere soil around both plants was sampled and found to contain 10- to 12-fold increases in fluorescent pseudomonads when compared to controls. Filamentous actinomycetes were also increased by 50% in soil augmented with earthworms. The number of *Fusarium* species/g soil did not differ from controls. The disease-suppression associated with earthworms may result from a significant increase in beneficial microbes.

P003 The Pacific Northwest Pest Alert Network, an Interactive Internet Site Promoting Stewardship

*Jerry Neufeld[1], jerryn@uidaho.edu, Steve Reddy[2], Clint Shock[3], Lynn Jensen[4], Jeff Miller[5], William Bohl[6], Tony

McCammon[7], Nora Olsen[8], Steve Hines[9], and Steve Norberg[10]

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It is difficult to coordinate the timely delivery of information over large areas to provide growers with real time advice on today's immediate pest problems and also have the advice directly tied to current research results. A Web Site/email-based pest alert system was developed to notify people interested in crop production of pest outbreaks and forecasts of pest outbreaks from multiple information sources. The alert system was designed through innovative programming so that alerts would be intimately and automatically linked to extension recommendations based on field research results. The system was first utilized in the Treasure Valley of southwestern Idaho and southeastern Oregon (TVPestAlert.net) and we have expanded the network to additional areas in the Pacific Northwest (PNWPestAlert.net) as interest has grown. When pest outbreaks are confirmed, or forecasted based on growing degree day models, an email notification is immediately sent to subscribers. Links to pest management information are automatically attached to each alert. In 2008, the service had grown to 554 subscribers and 36,909 web visits. As a result of this service, 17% of subscribers were able to reduce the number of sprays applied to their crops in 2008 and 39% of all subscribers increased field scouting to document pest levels and better synchronize control measures with pest populations. In addition, from 2004 to 2008 Web Site subscribers reported using 6% less chemical on average on their crops than they used before they used the pest alert network. This system has increased the adoption of Integrated Pest management (IPM) practices.

P004 Biology and IPM of Rust Mites in Oregon and Washington Vineyards

*Vaughn M. Walton[1], waltonv@hort.oregonstate.edu, Amy Dreves[2], Angela Gadino[1], Ute Chambers[1], and Patty Skinkis[1]

[1]Department of Horticulture, Oregon State University, Corvallis, OR; [2]Crop and Soil Science Department, Oregon State University, Corvallis, OR

Short Shoot Syndrome (SSS) is recognized to cause economic losses in vineyards in the Pacific Northwest of the United States. New grower reports of similar symptoms were found in Roseburg (Oregon), Monterey and Sonoma (California) vineyards during 2008. The aim of this research was to investigate the causes of SSS found in vineyards in this region. It was hypothesized that SSS are caused by eriophyid mite feeding on young developing tissues and is supported by research during the past three seasons. In order to minimize symptoms caused by eriophyid mites, winter shoot samples were analyzed on an industry-wide basis during 2007 and this survey was expanded during 2008 and control recommendations were made to growers based on mite incidence. Data from several treated vineyards during 2007 and 2008 show a decrease in mite numbers and damage. It is believed that *C. vitis* outbreaks occur on an industry-wide level in Oregon due to currently used fungicide spray regimes. For this reason, a focused research effort to develop integrated control practices for eriophyid mites, powdery mildew, and conservation biological control of spider mites is essential for sustainable grape production in the Northwest. In order to investigate the impact of often-used pesticides, trials were started in two mite-infested vineyards during 2007 and 2008. Data from 2007 and 2008 shows increased abundance of key biological control agents in blocks which received reduced and no sulfur. Field and laboratory trials are currently in process in order to optimize biological control of this damaging pest.

P005 Strawberry IPM with the University of Maine Cooperative Extension

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Strawberries are an important crop for small farms in the Northeastern United States. Historically, the crop was intensively managed, using high levels of pesticides to control insects and diseases including tarnished plant bug (*Lygus lineolaris*), strawberry bud weevil (*Anthonomus signatus*), two spotted spider mites (*Tetranychus urticae*) and gray mold (*Botrytis cineria*). Because the crop is sold fresh, often "pick your own", tolerance to pests is low and potential exposure to pesticide residue is high. Consumers coming to farms were concerned about pesticide use. In 1993, the University of Maine Cooperative Extension initiated a strawberry integrated pest management (IPM) program to address concerns of farmers and consumers regarding pesticide use. The program introduced pest monitoring techniques, including weekly scouting, and economic action thresholds developed in the northeastern United States. The program now serves over 50 farms statewide, and works with neighboring states to provide information throughout the region. Nine sites within Maine are now monitored during the growing season and regularly updated information is delivered to growers throughout the state via weekly newsletters, e-mail, and Web Sites. Pre-season grower meetings provide information on monitoring and management technologies. Applied research is an important part of this program, cooperating with growers to evaluate plant pest resistance, low risk pesticide efficacy and biological controls to reduce pest populations. Evaluations indicate that nearly all participating growers have modified their pesticide use as a result of the program. Most have seen an improvement in the crop quality and profitability, and a reduction in consumer concerns.

P006 Transcending Borders: Oriental Fruit Moth Mating Disruption across Adjacent Plantings of Apple and Peach

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The codling moth (CM), *Cydia pomonella* (L.), and oriental fruit moth (OFM), *Grapholita molesta* (Busck), can cause serious economic damage on apple, (CM and OFM), and peach (OFM). As part of an integrated pest management (IPM) program, mating disruption (MD) is an effective tool in managing economic populations of these internal-feeding Lepidoptera. In the eastern United States adjacent planting of apple and peach often occur on the same orchard and OFM readily disperses between both crops. In 2007 and 2008 we conducted experiments at three commercial orchards in New Jersey to determine if MD applied against OFM, across adjacent peach and apple blocks, provides better control than if applied to either crop alone. Our research results presented here are part of a multi-state Risk Avoidance and Mitigation Program (RAMP) grant funded by the USDA-CSREES. CheckMate CM/OFM Duel® and CheckMate OFM® dispensers were applied in mating disrupted apple and peach blocks respectively. We monitored moths weekly using delta traps baited with sex pheromone between late April and early Oct. Data from 2007 suggests that MD applied to apple plots decreased OFM capture in adjacent peach plots. Capture of OFM decreased significantly between 2007 and 2008. Internal worm damage to peach did not exceed 0.1%.

P007 Integrated Pest Management Program in the Northern Mariana Islands

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The tropical islands of the Northern Marianas have year-round pest management problems which are heavily influenced by the climate. The present economy is mainly dependent on the Asian economy, and not the mainland USA economy; whatever happens in Asia is multiplied on to Northern Marianas. The number of farms and farmers is decreasing rapidly, down about 20-50% in the past 2 years. Pest management is also very tricky here, since all pests have been imported into these island ecosystems, without natural enemies. Even after successful suppression or eradication programs, new plagues of pests may be delivered by tropical storms and typhoons. Typhoons and near typhoons also regularly destroy most vegetation, and all the standing crops. Pest populations may fluctuate rapidly and greatly with severe impacts on crop production. At times of high pest incidence, farmers may apply pesticides without any reference to actual insect pest levels, and with little knowledge of other options to achieve economically feasible crop protection management. When pesticides are heavily used, the farmers have little knowledge of optimal pest management strategies. Of particular concern, the water supplies on the three main islands of Rota, Tinian, and Saipan are very susceptible and vulnerable to contamination from pesticide runoff. The soils are thin, and lie above a base of limestone and coral; pesticide leaching through these soils is rapid, increasing the risk of water supply contamination. The implementation of an IPM program that reduces the use of pesticides will reduce the risk of drinking water poisoning from such runoff. IPM management strategies, with the integration of several interdisciplinary approaches will provide the best approach to this complicated agricultural management system. It also becomes a very important element in the planning and delivery of our IPM program. The program priorities are 1) reduce the risk of drinking water contamination by lowering the use of poisonous pesticides; 2) educate the farmers and general public on pesticide safety and the alternatives to poisonous pesticide use; 3) develop and deliver IPM information materials through training programs, workshops, and demonstration sites to establish a wide network of cooperating farmers and field technicians who will accomplish the long-term implementation of these management strategies; 4) examine and implement biological control solutions to as many pest problems as possible, as part of a functional IPM management system. The IPM program at Northern Marianas College NMC-CREES has a continuing responsibility to develop and implement IPM crop protection methods and strategies for the Commonwealths farmers.

P008 Legume ipmPIPE—A Tool for Disease Management and Education in Legumes

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The Integrated Pest Management Pest Information Platform for Extension and Education (IPMPIPE) began as a dynamic, integrated national warning system for soybean (and other legumes such as common bean) that would promote efficient

and coordinated IPM decision systems with the Soybean Rust ipmPIPE and Soybean Aphid ipmPIPE. In 2007, the Risk Management Agency presented the question of determining causes of disease and insect losses in fresh and dry peas and beans, chickpeas, lentils, lima beans, and cowpeas to the ipmPIPE. Thus, conception of the Legume ipmPIPE began with the objective of addressing multiple pests on related hosts rather than the single crop and pathogen or pest. Specialists from 26 states established sampling protocols, identified diagnostic procedures, and developed new diagnostic assays for viruses in 2007. National mapping of this information on a public Web Site began in 2008, extending the applicability of the ipmPIPE system, which was well received by stakeholders during national meetings. Continued development has begun with the integration of additional pathogen information and images to the Web Site (http://legume.ipmpipe.org). The diversity of both pathogens/pests and hosts are uniquely suited to demonstrate the value of the ipmPIPE as a "one-stop shop" for legumes where educators and stakeholders can, within three easy links, obtain information on pathogens/pests identified in an area as well as relevant information on each pathogen/pest of interest.

P009 The Benefits of Field Pest Surveys to IPM Programs

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Field surveys of pest problems during the growing season provide both short term and long term benefits that are important to producers, agronomists, crop consultants and others for making critical pest management decisions. Short term benefits include real-time information on the occurrence, distribution, and severity of a pest—allowing immediate action—if needed. Field surveys also provide information that allows validation of tools important to successful IPM programs, including pest forecasting models and economic threshold data. In addition, they also provide immediate information about potential yield and quality problems of the crops—information used in crop pricing and marketing. Long term benefits include providing data on the relative shifts in pest composition and populations over time and space, shifts in virulence of pathogens, shifts in pest and beneficial populations, relationships between weather and pest occurrence, and impacts of cultural practices on pathogens and insects. Highlights from the 20-year IPM crop survey program at NDSU will be given to illustrate both the short and long term benefits of pest survey.

P010 A Sweet Corn Integrated Pest Management Program for Maine: An Extension-Farmer Partnership

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Sweet corn is a very important retail vegetable crop in Maine, due to high consumer demand for fresh corn during the summer months. However, an aggressive insect pest complex, including European corn borer, corn earworm and fall armyworm, combined with very low consumer tolerance for insect damage can make this crop challenging to grow profitably. High rates of insecticides used in the past to achieve high crop quality are no longer considered economically, environmentally or socially tolerable. For more than 25 years, the University of Maine Cooperative Extension has been working with local farmers to develop and support IPM practices for sweet corn production. This program was the first to introduce pest monitoring techniques and the use of economic action thresholds to Maine sweet corn growers in 1983. The program now reaches over 100 farms statewide, and has joined a network to provide information throughout the Northeast region. More than twenty farmers now work with Extension to provide monitoring sites and pest information each season, which is shared with over 100 growers via weekly electronic newsletters and Web Sites. Farmers have participated in applied research projects throughout the program, including projects to evaluate trap types and placement, specialized silk treatments, and parasite releases. Program evaluations indicate that participating growers have modified their pest management practices as a result of their participation, most often reducing the amount of pesticide used. Most have seen an improvement in crop quality, and found that IPM has improved crop profitability.

P011 Monitoring of Ergot (*Claviceps purpurea*) Ascospore Release to Better Time Fungicide Application in NE Oregon Turf Grass Seed Production

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Ergot (*Claviceps purpurea*) is an important floral disease of grasses, characterized by the conversion of seed into elongated black sclerotia. In grass seed production fields, seed yield losses result from the direct replacement of seed with sclerotia, and during recleaning of seed to remove the sclerotia to meet seed certification standards. In recent years, ergot incidence and severity has increased in perennial ryegrass

fields near Hermiston, OR. To better understand the host and environmental factors that contribute to ergot development, soil moisture conditions, timing of host flowering, and airborne ascospore density of *C. purpurea* were monitored in two fields of Kentucky bluegrass fields near LaGrande, OR, and one field each of Kentucky bluegrass and perennial ryegrass near Hermiston, OR during 2008. The locations differ in elevation and soil moisture holding capacity. The field sites were established in areas of known ergot occurrence. Burkard volumetric spore traps were used to monitor airborne ascospore densities. Currently, one or more applications of fungicides are used to lower ergot infections at anthesis, without regard to ascospore release. Because soil moisture is required for sclerotial germination and production of ascospores, soil moisture conditions may be used to predict the occurrence of ascospores of *C. purpurea* relative to flowering in grasses. Anticipated results from the study will be used to develop an IPM approach to reduce ergot losses through timing of fungicide applications, based on timing of host flowering and ascospore occurrence.

P012 Defining the Role of First Detectors for Soybean Rust in Iowa

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Successful management of soybean rust requires rapid identification and timely application of fungicides to prevent further infection. Many scouting and management efforts can be held in abeyance if the risk of rust infection is low. In 2004, the Iowa Soybean Rust Fast Track System was established to promote awareness and ensure rapid identification of soybean rust through trained First Detectors. Since 2004, more than 700 First Detectors have been trained in Iowa. Initially, the primary responsibility of First Detectors was to filter out suspect samples that were clearly infected with other foliar soybean diseases, not rust. However, experiences in the southern United States and from the discoveries in Iowa in 2007 revealed that identification of soybean rust in the field at low incidence (<10% leaves infected) and severity is very difficult. For accurate confirmation of soybean rust in fields with low incidence, leaf samples must be incubated and microscopically examined, not just observed for lesions and pustules in the field. Because of the difficulty identifying soybean rust in the field, First Detectors no longer are asked to filter out samples from other soybean diseases. First Detectors now serve as a conduit to get good samples submitted properly to the Iowa State University Plant and Insect Diagnostic Clinic even if characteristic lesions and pustules are not observed. First Detectors also serve as the means for rapid communication to keep growers informed about the risk of soybean rust reaching Iowa and to provide appropriate management recommendations.

P013 Mites as Predators of Immature Corn Rootworms (*Diabrotica* spp.)

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Corn rootworms are economic pests of maize throughout the Midwest. However, biological control of rootworms remains poorly understood, largely because few studies have quantified how predators limit pest populations and subsequently protect crops. Many arthropods have been reported to feed on immature rootworms, including meso- and astigmatid mites, although little is known about the predatory capability of key natural enemy taxa. We collected mites from a continuous corn field in South Dakota and assayed mites for rootworm DNA. Eleven taxa tested positive, indicating that they had consumed rootworms, although these results need to be validated by examining additional specimens and performing feeding assays. The predatory capability of two commercially available Hypoaspis species (*H. aculeifer* and *H. miles*) was investigated in lab assays. Both species consumed rootworm eggs and 1st instar larvae. However, in a predator-addition field experiment, root damage ratings were higher in plots where H. aculeifer was added. In summary, preliminary data suggests that certain soil-dwelling mites may be important natural enemies of rootworms, although some species may function as intraguild predators.

P014 Organic Weed Control in Watermelons

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Integrated pest management (IPM) is an essential element for certified organic crop production and producers place weed control as their highest research priority within their IPM programs. The objective of these experiments was to investigate the impact of integrated organic weed control systems on watermelon (*Citrullus lanatus* var. *lanatus*) yields. Six watermelon varieties were transplanted at two locations (Lane, OK and Center Point, OK), into randomized complete block experiments with four replications. The seeded varieties were "Early Moonbeam", "Sugar Baby", and "Allsweet", and three seedless varieties were "Triple Crown", "Triple Prize", and "Triple Star". The weed control system at Lane utilized black plastic mulch on the crop row, while the area between rows was cultivated to control weeds. The no-till organic system at Center Point used a mowed rye and vetch cover crop, hand weeding, and vinegar (5% acetic acid) for weed control. When

averaged across varieties, the organic production system at Lane produced significantly more fruit per plant (4.2 vs. 2.3 fruit/plant), greater marketable yields (35.2 vs. 18.5 lb/plants), and higher average marketable weight per fruit (13.4 vs. 8.9 lb) than at Center Point. Plants at Center Point produced a greater percentage of marketable fruit, 92%, compared to plants at Lane, 63%. The plastic mulch and cultivation between crop rows was a successful method of weed control at the Lane location and provided a stronger weed barrier to prevent weed growth than the cover crop mulch at Center Point.

P015 Impacts of Ambient Temperatures on IPM of Cereal Leaf Beetle and Russian Wheat Aphid in SE Washington State

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Hippodamia convergens (Convergent Ladybird Beetle)is the primary native Coccinellidae predator of insects attacking cereal grains and pasture grasses in the PNW Region of the USA. Excellent management of Cereal Leaf Beetle and Russian Wheat Aphid populations has occurred until 2008. Comparisons of ambient temperatures from DPE to heading dates in 2007 and 2008 pllus population dynamics demonstrate how weather can affect a simple predator-parasitoid-prey relationship in wheat. A subsequent summer adult population of Cereal Leaf Beetle occurred during extreme hot weather following wheat harvest with complete crop destruction of late seeded spring grains resulting. Zeta-Cypermethrin was applied as a rescure treatment for the first time in 5 years.

P016 Adopting New IPM Methods for Cucurbit Virus Disease Management in the Mid-Atlantic

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Pumpkins are a valuable vegetable crop throughout the mid-Atlantic region, with the per acre value reaching $3000. Virus diseases can cause significant losses in pumpkin fruit quality. Knowledge of prevalent cucurbit viruses, possible weed host reservoirs and aphid species found in pumpkin fields in the mid-Atlantic region is important, especially as new virus resistant pumpkin varieties are introduced. Symptomatic pumpkin leaves, nearby weeds and aphids were sampled in thirty fields in MD, PA and DE. Leaf tissue was tested, using commercially available ELISA kits, for the potyviruses Zucchini Yellow Mosaic Virus (ZYMV), Watermelon Mosaic Virus (WMV), and Papaya Ringspot Virus (PRSV). Samples were also tested for Cucumber Mosaic Virus (CMV), and with a generic potyvirus ELISA test. All pumpkin samples (n= 30) tested positive with the generic potyvirus test, but only 9 tested positive for specific potyviruses (5 for ZYMV, 3 for WMV, 1 for PRSV). No samples tested positive for CMV. Virus particles were recovered from pumpkin samples testing positive with the generic potyvirus test but negative for ZYMV, WMV and PRSV. Preliminary results suggest the virus is a strain of WMV. Sixty-four weed samples were also tested for the same viruses. Five were positive with generic potyvirus test: 2 pokeweed, 1 spurred anoda, 1 bur cucumber and 1 ground cherry. All weed samples were negative for the specific viruses tested. Aphid species found will be discussed. This survey will be continued in 2009.

P017 Field Evaluation of Some Biorational Insecticides against Yellowmargined Leaf Beetle, *Microtheca ochloroma*, in Organic Crucifer Vegetables

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The yellowmargined leaf beetle (YMLB), *Microtheca ochroloma* (Coleoptera: Chrysomelidae) is an introduced pest of cruciferous vegetable crops in southeastern U.S. Adults and larvae of this beetle feed on the foliage of crops such as turnip, mustard, radish, napa cabbage, cabbage, collards and watercress, with the potential for major economic loss. YMLB poses a major threat to organic vegetable production since organic farmers cannot use synthetic insecticides. Currently, there are no published results on the efficacy of insecticides approved by the Organic Materials Review Institute (OMRI) against this beetle. Field trials were conducted to evaluate the efficacy of select OMRI-approved biorational insecticides against YMLB in two commercial organic crucifer vegetable fields in Alabama during 2007-2008. The following treatments were evaluated: PyGanic® (pyrethrum), Aza-Direct® (azadirachtin), PyGanic® + Aza-Direct®, Entrust® (organic formulation of spinosad), and Mycotrol O® (organic formulation of Beauveria bassiana). Treatments were applied at field recommended rates on a weekly schedule. Insecticide efficacy was determined by comparing densities of YMLB larvae and adults, and crop damage ratings. Entrust® consistently provided the lowest pest densities and mean damage ratings and was the most promising treatment. The other treatments were not effective in reducing YMLB infestations.

P018 Invasive Species and Integrated Pest Management Practices in the Commonwealth of the Northern Mariana Islands

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The Commonwealth of the Northern Mariana Islands has very limited agricultural resources. Most agricultural productions are at subsistence level and any threat to these resources can seriously affect the livelihood of the community and economy of the Commonwealth. These islands systems are extremely fragile and vulnerable to the impacts of invasive species; therefore, any intrusion of alien species could be very devastating to the ecological balance. Numerous of invasive species already present in the CNMI that are seriously impacting agriculture development. Northern Marianas College's Cooperative Research, Extension and Education Service combined research and extension efforts are aimed at developing complementary methods of best management practices, and have adopted proven methods of addressing invasive species. Program is cataloging the pernicious invasive species, developing reference collections for educational purposes and collaborating with regional institutions to develop systems to minimize the deleterious impacts of invasive species through biological control. Program has successfully delivered information and increased awareness on invasive species and to understand the relationship between invasive species and agriculture production to farmers and other stakeholders. Also, IPM program has been able to minimize the impacts and damages invasive to their crops, and have improved the crop production in the Commonwealth.

P019 The Network for Environment and Weather Applications (NEWA) Delivers IPM Forecasts for Fruit and Vegetable Crops

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Weather information is crucial to managing pests and is pivotal to IPM practices. The New York State IPM Program operates and maintains the Network for Environment and Weather Awareness (NEWA). The network collects weather data, calculates insect, disease, and crop development models developed or recommended by Cornell faculty to support IPM practices and displays them at newa.nysaes.cornell.edu. NEWA automatically calculates and provides predictive model results on 21 insects and diseases. NEWA information is multiplied through extension newsletters, extension meetings, grower field meetings, and regional and statewide conferences. The Northeast Regional Climate Center (NRCC) collaborates with NEWA for weather database and predictive model programming, recently completing automated data quality control routines. NEWA collaborates with Rainwise, Inc. for weather stations and software for data transmission, recently completing ftp-based data delivery upgrades. There are currently over 1000 users registered on the NEWA Web Site and browsing increases each year. NEWA was evaluated in 2007 via a survey conducted by The Survey Research Institute (SRI), Cornell University. The phone survey was completed with 682 NY onion, potato, grape and apple growers, including 129 NEWA users and 553 non-users. NEWA users reported that they can save, on average, $19,500 per year in spray costs and prevent, on average, $264,000 per year in crop loss as a direct result of using NEWA pest forecast models. Temperature, precipitation and weather forecasts were the most important weather information. Ninety-nine percent of NEWA users would recommend the use of NEWA to other farmers.

P020 Use of NDVI and Soil Electrical Conductivity for Site-Specific Reniform Nematode Evaluations

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A test was established to determine the utility of NDVI for predicting *Rotylenchulus reniformis* numbers in specific soil electrical conductivity zones (ECa) and potential relationships to cotton yields. ECa was collected from a cotton field naturally infested with *R. reniformis* utilizing a Veris 3100 mapping system prior to planting. At the cotton plant 6 to 7 true leaf stage, NDVI reading were collected with a Greenseeker and *R. reniformis* samples were collected from soil and cotton roots. The Ag leader yield monitor PF3000 system determined yield. EC shallow and deep, NDVI, nematode numbers, cotton root mass and yield were analyzed with the SAS® CANDISC procedure and the resulting correlations were used to determine the relationship of these response variables with yield classes. There was a significant separation of the highest yielding areas from the lower yield classes along the 1st canonical axis, which accounted for 50% of the multivariance. High yielding areas were distinguished from the low yielding regions by cotton root mass (r = -0.80), *R. reniformis* per gram of root (r = 0.93), and NDVI at 45 DAP (r = -0.93). The 2nd canonical variant discriminated among the lower yielding areas. These differences were best described by EC values and the *R. reniformis* soil populations. Regression analysis indicated a significant (P = 0.06) relationship of *R. reniformis* counts with NDVI at 45 DAP,

with an equation of *R. reniformis* counts (Y) = 91.998 + 1.763 NDVI (X), although the coefficient of determination was very small.

P021 Integrated Management of Fruit Fly in Bitter Gourd Crop in Bangladesh: A Success Story

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Studies were conducted in farmer's fields in Jessore region during 2007 and 2008 cropping seasons to evaluate an IPM package for the control of fruit fly and three species of borers, common cut worm (*Spodoptera litura*), beet armyworm (*Spodoptera exigua*) and pumpkin caterpillar {Palpita (*Diaphania) indica*) in bitter gourd (*Momordica charantia*) crop. The IPM package consisted of sanitation (removal of infested shoots and fruits), use of cuelure pheromone baiting (bait traps were placed after flower initiation of the bitter gourd crop), and weekly release of an egg parasitoid (*Trichogramma evanescens* @ one gm of parasitized eggs per week per ha) and a larval parasitoid (*Bracon habetor* @ 1000-1200 adults per week per ha). The IPM package was compared with farmers' practice of foliar spray of synthetic pyrethroid insecticide (Cymbush 10EC @ 1 ml/liter of water) twice a week. The trial was laid out in RCB design with four dispersed replications following a community-based approach. In 2007 cropping season, the IPM practice reduced the infestations of fruit fly by 93.5% and that of the borer complex by 93.9%. Similarly, the infestations of fruit fly and borer complex in IPM practice were reduced by 94.7% and 93.7%, respectively, in 2008 cropping season. Because of very low pest infestations, the yields of healthy bitter gourd fruits in IPM practice increased by 1.4 times in 2007 and 1.6 times in 2008 as compared to that of the farmers' practice.

P022 The Iowa State University Corn and Soybean Initiative: Delivering IPM Programming to Iowa Growers and Their Advisers

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Promoting and facilitating use of integrated pest management (IPM) practices on Iowa's 24 million corn and soybean acres requires efficient, effective communication with growers and crop advisers who work for local agribusinesses. They must be kept informed of existing and emerging pests and the scouting and management options that are available. University research and extension personnel need to keep apprised of the pest scouting and management needs of growers and crop advisers. Efficient and sustained exchange of information is increasingly difficult as staffing of county extension offices throughout Iowa decreases. In December 2004, Iowa State University launched the Corn and Soybean Initiative, which is based on formal partnerships with more than 60 different agribusinesses, crop-related organizations and agricultural print media that serve the entire state. A high priority of the Initiative is to develop innovative ways to deliver pest management information to growers and crop advisers and to discern their pest management needs. Information is delivered through newsletters, fact sheets and other publications in electronic and hardcopy format for Initiative partners to use with their growers, through presentations at field days and winter meetings organized by partners, and by conducting field research and demonstrations in collaboration with partners. Pest management needs assessment is accomplished through day-to-day communications of university personnel with agribusiness partner staff, plus annual meetings of representatives from partner organizations with college administration, faculty and staff. The Initiative partners, the university personnel and the corn and soybean growers of Iowa all benefit from this unique set of relationships.

P023 Survey for *Phytophthora rubi* in Preplant and In-Field Root Samples of Red Raspberry in Washington State

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Phytophthora rubi (P.r.) is one cause of raspberry root rot with symptoms including leaf wilting, loss of vigor and plant death. Other disease organisms commonly found in the soil, such as Rhizoctonia and Fusarium, also cause root rot symptoms in raspberry fields. Typical detection technologies for P.r. are not specific or require very specialized skills. Growers in Washington often apply a fungicide treatment, particularly Ridomil (Metalaxyl -M), before identifying the cause of root rot in a field. Ridomil works to reduce symptoms of root rot only in Phytophthora infected areas, not in areas infected with other organisms. Growers using Ridomil to treat root rot symptoms without knowledge of the cause of root rot may be ineffectively using the fungicide. Recent developments of PCR (polymerase chain reaction) techniques have enabled other raspberry production regions to rapidly identify P.r. from pre-plant root stock and in-field raspberry plants. This project begins to determine the prevalence of P.r. in pre-plant stock and in-field raspberry plants in Washington State. In 2005, 2006, and 2007 growers submitted tissue samples to be analyzed for the presence of P.r. The analysis cost was subsidized by grant sources. Anonymous results are posted on the WSU Whatcom County Web Site. Over three years of the survey, 199 samples have been tested. Few have tested positive

for P.r.; 3% of pre-plant samples and 25% of in-field samples. With more information about the cause of root rot in a field, growers will be able to make informed decisions on fungicide treatments.

P024 Efficacy of Chemical Alternatives for Methyl Bromide in Lettuce Production: Field Experiment

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In Belgium the production of lettuce is economically very important. The major problems in lettuce production are the plant pathogen fungi *Sclerotinia sclerotiorum* (causing lettuce drop) and *Rhizoctonia solani* (causing bottom rot). These fungi can survive for different years in the soil as sclerotia and can cause serious crop losses. Until January 2006, Methyl bromide played a key role in the production of lettuce. However, Methyl bromide is phased out as it is an ozone-depleting chemical and alternatives are needed. The chemical alternative should be effective against fungi, weeds and nematodes. Therefore, the efficacy of different fumigants and combinations was tested in 2 replicates in a field experiment against fungi, nematodes and weeds. The tested fumigants were Methyl bromide (MeBr), Methyl iodide (MI), MI with Chloropicrine (CP), Metam sodium, Metam potassium, Dichloropropene (DD), Dimethyldisulfide (DMDS), Dazomet, DD with Dazomet, DMDS with Dazomet, CP and CP with DD. We could observe that al these fumigants were effective against weeds in comparison with the control. The average weight of the lettuce at the end of the experiment was significant higher for all these fumigants than the control accept for the combination of CP with DD. The three fumigants which were significant better than the control against fungi as well as against nematodes were MeBr and the combinations DD with Dazomet and DMDS with Dazomet. Metam sodium and Metam potassium were the least effective against fungi and nematodes. From this experiment we can conclude that the combinations of Dazomet with DD and Dazomet with DMDS have an overall efficacy and are good alternatives for Methyl bromide.

P025 University of Maine Potato IPM: Extension in the Field

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Potatoes are the leading agricultural commodity in the State of Maine with a total economic value to the state of over $500 million dollars and the Industry employs over 6000 individuals. The University of Maine Cooperative Extension's Potato Integrated Pest Management program impacts approximately 56,000 acres of potatoes. The program employs 20 program aides, maintains nearly 150 specialized insect traps, coordinates a statewide network of electronic weather stations, and surveys 125 potato fields on a weekly basis for weeds, insects and diseases. The data produced helps IPM scientists track potential pest outbreaks and helps provide growers with current information on specific and timely treatments in order to minimize the number of pesticide applications and maximize potato yield. In 2008 the University of Maine Cooperative Extension Potato Integrated Pest Management program produced an estimated $17 million positive impact for Maine potato growers.

P026 Integrating Flame Cultivation into Cranberry Weed Management: Assessing Crop Damage and Recovery Response

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Flame cultivation (FC) is a nonchemical method of weed control where target plants are damaged by brief exposure to high temperature. Response of cranberry vines to injury caused by FC is of interest to determine if this nonchemical strategy can be integrated into a multifaceted program for control of problematic weeds on commercial cranberry farms. We evaluated damage and recovery responses of two cranberry cultivars (Mullica Queen and Crimson Queen) after exposure to three FC: Infrared (IR), Open Flame (OF), and Infrared Spike (IRS). Clay pots planted with four cranberry uprights were subjected to a single exposure (zero, low, medium, high) from each FC; glyphosate wipes (common postemergence tool) were included as a treated control. Treatments were arranged in a randomized complete block design with five replications. Plants were evaluated for damage at 1, 7, and 28 days after treatment (DAT) and evaluated for recovery at 21, 50, and 125 DAT. For both varieties, damage to cranberry vines varied by FC. IR caused less damage at low exposure and IRS caused less damage at low and medium exposure than the treated control (Dunnett's, $p < 0.05$). Increased exposure beyond zero did not increase the damage rating at the final evaluation. Cranberry vines recovered from damage caused by all FC at all exposure levels; vines did not recover from injury caused by glyphosate wipes. Based on these results, more research will be conducted to further evaluate the integration of FC as a nonchemical tool for spot control of cranberry weeds.

P027 Integrated Management of Strawberry Anthracnose in Plasticulture Systems

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Anthracnose fruit rot (AFR) caused by *Colletotrichum acutatum* is the most devastating disease of strawberry (*Fragaria x*

ananassa) in plasticulture systems in NC due to rain splash-driven spore dispersal on plastic mulch under warmer weather conditions and use of highly susceptible strawberry cultivars. Advanced breeding lines such as NCC 99-13 and NCC 02-63 from the NC anthracnose resistance breeding program had 23.6% and 11.1% AFR incidence compared to the highly susceptible standard cultivar Chandler (70% incidence). Selected breeding lines also showed excellent resistance against quiescent infections. A highly sensitive real-time PCR protocol showed a significant ($P < 0.001$) correlation with inoculum levels and DNA quantification expressed by Ct values. Utilization of this protocol by plant suppliers could potentially limit infested planting stock from entering fruiting fields or suggest the need to implement an alternative IPM tactic. Four well timed applications of fungicides starting at 10% bloom provided statistically similar control as a season long program of 9 applications. The reduced spray program was scheduled as Captan 50WP 4.0 lb + Topsin-M 70W 1.1 lb (spray #1), Pristine WG 1.45 lb (spray #2, 4) and CaptEvate 68WDG 4.5 lb (spray # 3). Leaves assessed at the end of the harvest season indicated that this schedule also significantly suppressed quiescent infections similar to the season long program. Integration of IPM tactics including advanced detection technologies, host resistance, exclusion and critically timed applications of efficacious fungicides will make anthracnose fruit rot more manageable.

P028 Redefining the Contribution of the Nectariless Trait for Tarnished Plant Bug (*Lygus lineolaris* [Palisot de Beauvois]) IPM in Cotton

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In recent years, the tarnished plant bug (TPB), *Lygus lineolaris* (Palisot de Beauvois), has become the major cotton pest throughout the Mid-Southern U.S. cotton producing states. Several integrated pest management strategies are recommended for controlling TPB. However, chemical control strategies are the main tool used in controlling this pest. Presently, numerous insecticides are recommended for TPB control, but there is considerable variation in performance among these products. Standard insecticide use strategies can reduce TPB numbers, but none have been able to eliminate this pest. Insecticide susceptibility surveys have shown varying levels of resistance to several of these insecticides. Several host plant resistance traits in cotton cultivars have been evaluated against tarnished plant bugs. Large glands (nectaries) on cotton plants provide an important source of food and water for many adult insects commonly found in cotton fields. The removal of nectaries from cotton lines (nectariless trait) has been evaluated for reduction of several arthropod pest species in cotton. The nectariless trait is currently being re-evaluated as an IPM tool for managing TPB. The objective of this experiment was to evaluate the effect of nectariless cotton on TPB abundance and plant susceptibility to TPB in a sprayed/non-sprayed environment. In 2007 and 2008, selected nectariless and nectaried cotton varieties and spray regimes were evaluated for TPB. TPB numbers were evaluated weekly before and during flowering. The nectariless cotton variety reduced numbers of TPB during flowering in both years of this study compared to the nectaried. A nectariless cotton variety may help reduce TPB numbers and mitigate cotton yield losses from this pest. This trait coupled with other IPM options may help producers reduce yield losses associated with TPB infestations in cotton.

P029 Assessment of Dynamic Changes in Antibiotic-Producing Pseudomonas under Different Cropping Systems

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Antibiotic-producing *Pseudomonas* spp. exerts an important role in the management of soil-borne plant diseases to increase crop productivity via direct antagonistic action or triggering induced systemic resistance in the plant system. Each cropping system would influence these microbes, in their quality, and quantity and influence the survival and infection of plant pathogen populations. The objective of this study was to investigate potential biocontrol resources of *Pesudomonas* species under different long term cropping systems in Manitoba Canada. The *Pseudomonas* strains were isolated from bulk soils and rhizosphere samples collected from different cropping systems (different rotations, monoculture and with and without pesticides) at the Carman and Glenlea Research Stations in Manitoba Canada from 2006 to 2008. An in vitro test screened the isolates for their antagonism against *Sclerotinia sclerotiorum*.They were further characterized using gene-specific PCR primers for their antibiotics, and antibiotics were then confirmed by HPLC. It was found that pyrrolnitrin-producing strains were predominant in several cropping systems, followed by Phenazine-producing strains, while 2, 4-DAPG and pyoluteorin-producing strains were much less. Differences between the treatments were also found based on the frequency of isolation of antibiotic producing *Pseudomonas* strains. Higher relative numbers of antibiotic-producing isolates were obtained from cropping systems without pesticide treatment than cropping systems with pesticide treatment. The results obtained in this study strongly indicate that different cropping systems influence the antibiotic-producing sub-population dynamic of *Pseudomonas* spp.

P030 Reduced Risk Pest Management Systems for US Tart Cherry Production—Risk Avoidance and Mitigation Project (RAMP) I

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The Food Quality Protection Act (FQPA 1996) has directed an organophosphate (OP) phase-out for US tart cherries. This poster reports the evaluation of multiple factors necessary for cherry transition. A key focus was on the entomological aspect, with the overall goal of investigating biointensive, reduced risk, and OP-alternative pesticides to transition the tart cherry industry away from FQPA-targeted broad-spectrum pesticides and to implement economically viable and environmentally sound IPM programs. RAMP I researchers compared standard and alternative programs in Michigan and Utah. In a side-by-side comparison of Michigan orchards, researchers tested a system of reduced-risk and OP-alternative pesticides, compared directly to the standard azinphos-methyl (AZM)-based program. Each orchard was evaluated for the key pests plum curculio and cherry fruit fly, along with mites, leaf spot, brown rot, and other tart cherry pests and diseases. The efficacy of OP-alternative programs targeting the two key pests has shown limited success. Most orchards achieved similar control to the grower standard programs. The program measured the costs and difficulty for growers to adopt the alternative IPM program. The conventional system averages $47/acre less costly than the alternative system. Researchers also measured the ecosystem health of the two systems using natural enemies and native pollinators to monitor and compare the presence and diversity of these beneficial species. AZM-based orchards experienced less disruption than alternative orchards. Experience suggests that orchard ecosystems adapt to alternative regimes over time, thus orchards may compensate for the biological control reduction in the alternative programs over the 4 years of transition.

P031 *Mahanarva spectabilis* (Distant, 1909) (Hemiptera: Cercopidae) in *Brachiaria* Pastures in Brazil

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Grass pastures are the most important forage for cattle in Brazil and its beef-cattle industry thrives on large areas. Recent studies have indicated the occurrence of the genus *Mahanarva* in pastures of *Brachiaria brizantha* cv. Marandu. Insect collections were made in pastures in the Cerrado. The collections were carried out during the rainy season (December to March in 2005, 2006 and 2007) and the criteria for choosing collection sites were: areas planted with grasses using satellite images; reports of Mahanarva sp. infestations; areas with economic livestock production; and contacts with the agricultural extension service. In each section about 10 samples were collected in random transects. The collection sites were recorded on a spatial map. In the laboratory separation of groups based on adult phenotypes was performed, with the identification of species by examining male genitalia. The samples of adults exhibited variation in color of the tegmin. M. spectabilis host plants were identified during collection as: *B. brizantha* cv. Marandu, *Andropogon gayanus* cv. Planaltina, elephant grass, sugar cane and *B. brizantha* cv. *Xaraes*. The host plant with damage caused by *M. spectabilis* feeding was the cultivar Marandu, based on leaf necrosis area and death of the plant. The geographical distribution of spittlebug species is influenced by ecological conditions in each grass pasture region. The identification of *M. spectabilis* can be useful in *Brachiaria* sp. breeding programs. In the same way, the distribution of *M. spectabilis* indicates which areas are suitable for agronomic performance tests of new *Brachiaria* cultivars.

P032 Agricultural Connectivity Drives the Spread of Glyphosate-Resistant Horseweed

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The establishment and rapid spread of glyphosate-resistant (GR) horseweed (*Conyza canadensis*) highlight the vulnerability of cropping systems that rely on glyphosate-based weed control. A spatially explicit model of horseweed population dynamics was used to explore factors that release and constrain the spread of this troublesome herbicide resistant weed on the scale of multiple fields in a landscape. A 10 km by 10 km

aerial photo was partitioned into 360 fields (assigned to corn, soybean, or alfalfa) and into unsuitable habitat (urban development). Crops were rotated annually as expected in scenarios common to the Northeast United States with horseweed survivorship determined by crop management (glyphosate in RoundUp Ready (RR) crop equaled high survivorship). Simulated dispersal events began with a single plant and ended after five years, with weed dispersal occurring annually. Increased adoption of RR corn increased the number of infested fields (greater than 25 plants ha-1) from 21% to 28% when compared to current adoption practices. Rotations that included alfalfa reduced the number of fields infested to 6%. The condition that most restricted the success of the herbicide resistant weed was halving the proportion of the soybean crop treated with glyphosate herbicide. Continued adoption of RR crops will increase landscape connectivity for glyphosate-resistant weeds by reducing the distance between sites where glyphosate is applied. Output from the model underscores field observations; outcomes of weed management on one field spill over to many surrounding fields effectively coupling management at a scale well above the individual field.

P033 Black Vine Weevil (*Otiorhynchus sulcatus*) Monitoring in Field-Grown Ornamentals

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The black vine weevil, *Otiorhynchus sulcatus* F. (Coleoptera: Curculionidae) is a univoltine, polyphagous insect that is a severe pest of field and container-grown ornamentals as well as small fruit crops worldwide. Studies were performed in field-grown ornamentals during the 2008 growing season to determine the attractiveness of select plant volatiles to black vine weevil adults. Numerous odors were tested in the field to determine their ability to increase weevil numbers in plants in close proximity to an odor source. Identifying compounds attractive to adults enhances grower's ability to monitor for this pest in the field and more effectively time insecticide applications as well as opens the door to alternative management strategies.

P034 Planting Farmland Habitat to Provide Multiple Ecological Services

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Challenges for adoption of beneficial insect habitats for IPM in farmscapes include logistics, cost and priorities. One approach to increase adoption is to incorporate habitats providing multiple ecological services into existing CRP programs that provide growers financial and other incentives (e.g. hunting). Studies are presented that evaluate planted habitats using plant species and methods that have been approved for use in an existing CRP program, namely CP33, which is intended to enhance quail populations in farm landscapes. The plants selected are all prairie plants native to North Carolina that are easily established, provide resources season-long, are competitive with weeds, and are readily available from commercial sources. Species included are Little bluestem (*Schizachyrium scoparium*); Indiangrass (*Sorghastrum nutans*); Butterflyweed (*Asclepias tuberosa*); Common milkweed (*Asclepias syriaca*); Black-eyed Susan (*Rudbeckia hirta*); Purple Coneflower (*Echinacea purpurea*); Lance leafed coreopsis (*Coreopsis lanceolata*); Swamp sunflower (*Helianthus angustifolia*); Showy Goldenrod (*Solidago speciosa*); and Heath Aster (*Aster pilosus*). One study evaluated growth of planted habitats using two methodologies: 1) establishment using herbicides, and 2) establishment using an organic approach. A second study was begun that seeks to evaluate CP33-appropriate field borders for their value to parasitoids and predators of crop pests, predators of weed seeds, and farmland wildlife such as bobwhite quail and songbirds. Plots were established that included several early successional habitat types around 9 fields and 110 acres of the Organic Research Unit at the Center for Environmental Farming Systems, near Goldsboro, NC.

P035 Predicting Pest Outbreaks Using the UK-IPM Insect Trapping Network as an Early Warning System

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The Kentucky IPM program monitors the flights of six major field crop moth pests, and has developed data sets and trapping techniques that allow Entomologist to make inferences about when and if insect populations are likely to become economically important. This information saves time and money by alerting producers and consultants to critical periods of increased risk during which they need to intensify scouting. Tracking populations and identifying elevated risk early allows more time for treatment decisions and increases the likely hood of successful applications. Insect traps at two locations in Kentucky are checked weekly and resulting data is made available each Friday from March 1 through September 30 on the Kentucky IPM web pages, and in the Kentucky Pest News newsletter. Alerts/warnings of elevated risk are also sent via e-mail to County Extension Agents and Extension Specialists. To facilitate increased usage, the data have been made easier to interpret by displaying them in graphic form and in context with a rolling five-year average and data from know outbreak years. Surveys of Kentucky Certified Crop Advisors found that they use the flight data to make scouting decisions which resulted in information that was used to make control

decisions. Additionally, the information alerted them to problems they would otherwise have missed. Using the information saved consultants on average 2.5 hours for each event.

P036 Management Strategies for Pests of Organic Vegetables in New Mexico

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Over 130,000 acres are managed by organic farmers and ranchers in New Mexico, with many conventional farmers now transitioning to organic production. Many of these new or transitioning growers have little experience with the organic approach to pest management, and techniques for specific pests that were developed elsewhere do not always perform well under New Mexico growing conditions. There is a particular need for information on the management of pests of organic vegetables, and in order to address this issue, a pilot project was initiated in 2008 to develop research and demonstration plots for the management of curly top virus in tomato, cabbage pests on cole crops and squash bug (*Anasa tristis*) on cucurbits. A number of approaches were tested, included physical exclusion of disease vectors, resistant varieties, variation in planting date and various insecticidal products permitted under the National Organic Program. In all cases, the trials were conducted using a randomized complete block design with at least three replications per treatment. Two approaches to controlling beet curly top virus in tomato showed promise: the use of resistant varieties and floating row covers to exclude the insect vector [beet leafhopper (*Circulifer tenellus*)]. In the squash bug management trials, there were no differences in yield between the two cultivars tested ("Cashflow" and "Magda"), or between the yield of early versus late plantings of "Magda". The results of tests with various insecticidal products on all three crops will also be presented.

P037 Guidelines for Organic Vegetable Crop Production in New York

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Farmers interested in transitioning acreage to organic production or diversifying their organic crop mix to include vegetables have had few resources to help them develop the nutrient, weed, and pest management systems necessary for successful organic production. Available resources tend to be scattered across various Web Sites and publications, or are embodied in the experience of researchers and successful organic farmers. Concerns about weed and pest management failures are often cited by conventional farmers as obstacles to undertaking a transition to organic production. To help farmers capitalize on interest from a major New York-based organic food processor in sourcing raw product in New York, and with funding from the New York State Department of Agriculture and Markets, the New York State IPM Program has undertaken the job of coordinating the production of organic guidelines for selected crops in several commodities. IPM Program staff are ideally situated to coordinate multidisciplinary guidelines that emphasize cultural practices, sanitation, biological control, soil health, and other practices that are the foundation of IPM. We are accustomed to putting together pest management systems involving all the relevant disciplines and emphasizing prevention and reduced reliance on chemical controls. Finding effective pest control products approved for organic production can be a challenge for farmers and extension staff alike. These guides will include this information, helping farmers understand their options and providing extension staff with resources for working with their organic audiences. The process of developing the guides also identifies gaps in organic production information, providing a roadmap for needed applied research.

P038 Keeping Up with Pathogen Adaptation to Management Tools for Powdery Mildew in Cucurbit IPM Program

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The cucurbit powdery mildew pathogen has demonstrated ability to develop resistance to fungicides and adapt to varieties with genetic resistance, the two management practices for this common disease. Monitoring pathogen sensitivity to fungicides in production fields with a seedling bioassay provides information in 10 days that can be used to adjust fungicide programs. It can be used to examine impact of fungicide programs on pathogen sensitivity. Resistance to FRAC code 1 and to code 11 fungicides (e.g. Topsin and Cabrio) were found to be common in LI and eastern PA, thus these fungicides are not recommended. The pathogen is more sensitive to Quintec (code 13) than Procure (code 3) or Pristine (codes 7 and 11). Evaluations of fungicides and resistant varieties in replicated experiments are documenting impact of pathogen adaptation on efficacy of specific tools. Cabrio was ineffective. Quintec was more consistently effective than Procure or Pristine, reflecting bioassay results. Most squash varieties with resistance from one parent have not suppressed mildew as well as varieties with resistance from both parents in recent evaluations. This difference was not evident with butternut squash. But it has been the case with pumpkin for several years. Some commercial resistant squash and pumpkin varieties have not suppressed mildew relative to the susceptible standard variety. Most melon varieties resistant to pathogen races 1 and 2 provide excellent suppression, while others are not as effective. Resistant varieties complement fungicides because they suppress mildew best on lower leaf surfaces where pressure is greatest for fungicide resistance development.

P039 Developing IPM for Arthropod Pests of Timothy *(Phleum pratense* L.) in the Western United States

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Timothy (*Phleum pratense* L.) is an important high value-forage crop that is grown in Western states and scientifically based pest management strategies are lacking. It is largely marketed on aesthetic qualities and there are typically two cuttings a year. We studied local important pest issues in California, Nevada and Washington. Pest incidence and chemical management was explored in both California and Nevada for thrips (*Anaphothrips obscurus* Müller). Furthermore, sampling methods and economic thresholds were developed for thrips in California. Finally, reduced risk and nonchemical methods for Tetranychid mite management were assessed in Washington and Nevada. In California, we documented a new potential pest, an Eriophyid mite, and also found that thrips overwinter in the field as adults. Moreover, we found that thrips can be chemically-managed, but documented Tetranychid mite flares associated with cyfluthrin application. Burning timothy during the dormant period produced inconclusive results for thrips management. A sampling method for thrips that was consistent over time and space was developed. Finally, economic thresholds for thrips were set based on the aesthetic characteristic of leaf color in both the first and second cuttings. In Nevada, reduced risk chemicals for thrips and mite management were investigated as well as sampling studies on thrips. In Washington we found that mites could cause yield loss and that their incidence was closely associated with xeric conditions; finally, burning and mowing were as effective as oil or pesticide treatments.

P040 What Can We Learn from Multi-year IPM Scouting Data?

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An IPM company's scout-collected pest monitoring data was analyzed to address questions about pest dynamics in agricultural crops, and gage the usefulness of these data for hypothesis testing. In a perennial berry system (cranberries) we wondered if past data could be used to predict the size (N) of the pest (blackheaded fireworm) population the following season. A population prediction and analysis program was unsuccessful in generating accurate predictions, but did provide insight into the underlying nature of the pest population on different farms. Furthermore, we found a correlation between previous season adults and the following year's larvae and will test the predictions generated in the spring of 2009. In an annual vegetable system (potatoes) we used the pest monitoring data to i) determine the effect of crop rotation on tuber flea beetle levels; ii) look at population dynamics of green peach aphid and beneficial insects; and iii) theorize a binomial sampling method for green peach aphid, and compare it to the current full count method using operating characteristic curves. We found that yearly crop rotation abates the build-up of tuber flea beetles the following year; that considering natural enemies can guide pest control measures and reduce insecticide sprays; and for green peach aphid, binomial sampling was significantly less valuable than full count sampling to inform pest control decisions. We conclude that while pest management scouting data may be too variable in certain circumstances, it is useful to inform pest management practices and for guiding pest management practices and hypothesis testing.

P041 Ovipositional Preferences of the Japanese Beetle (Coleoptera: Scarabaeidae) among Warm- and Cool-Season Turfgrass Species

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Japanese beetles, *Popillia japonica* Newman, were evaluated for ovipositional preferences among four turfgrasses commonly used in the transitional climatic zone. In a choice experiment with the cool-season turfgrass tall fescue (*Festuca arundinacea* Schreb. "Millennium"), and three warm-season turfgrasses, Japanese lawngrass (*Zoysia japonica* Steud. "Zenith"), common bermudagrass (*Cynodon dactylon* (L.) Persoon "UConn"), and hybrid bermudagrass (*C. dactylon* x *C. transvaalensis* Persoon "Tifway"), females oviposited almost no eggs in hybrid bermudagrass and significantly fewer eggs in common bermudagrass than in the other two turfgrass treatments. In a second choice experiment with just the three warm-season turfgrasses, significantly fewer eggs were oviposited in hybrid and common bermudagrass than in zoysiagrass. Despite those differences, the percentage of turfgrass cores with evidence of female activity (presence of female or eggs, or signs of female digging) did not differ among the treatments in either experiment. In a no-choice experiment comparing the same four

turfgrasses, hybrid bermudagrass again received the fewest number of eggs, indicating that although P. japonica females will burrow beneath the surface of hybrid bermudagrass Tifway, a chemical or physical barrier is discouraging oviposition. Potential for using Tifway or similar turfgrasses in integrated pest management of Japanese beetle grubs is discussed.

P042 Evaluation of a Biorational IPM Program for the Control of Codling Moth in Small-Scale and Backyard Orchards

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IPM has been implemented on a significant portion of the commercial pear acreage in southern Oregon. With the use of mating disruption, codling moth granulosis virus, and newer less disruptive materials, the need for organophosphate and other broad-spectrum insecticides in pear production can be greatly reduced and, in many cases, eliminated. Extra-orchard sources of codling moth can pose a threat to commercial orchards which use IPM and organic programs. A multi-tactic approach for managing codling moth was designed for use in small-scale and home orchards. In order to maximize the acceptability of the program only biological and behavioral methods are utilized, the program consists of applications of entomopathogenic nematodes (*Steinernema carpocapsae*) for control of overwintering codling moth, applications of codling moth granulosis virus for control of codling moth during the growing season, and the use of traps baited with pear ester and acetic acid to attract female codling moths. This program was evaluated in eight treated sites throughout southern Oregon and compared to untreated check sites. A high level of codling moth control was achieved in the treated sites, in the untreated check sites the number of successful codling moth entries in apples averaged 0.58 per fruit while in the treated sites the number of successful entries averaged 0.06 per fruit.

P043 IPPCs Farmscaping for Beneficials Program: Where Farmers, Biodiversity, and Crop Production Meet

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In 2003, Oregon State University's Integrated Plant Protection Center began the Farmscaping for Beneficials Program (FSB). FSB is a farm-based research and education program that adapts and tunes conservation biological control (CBC) methodologies such as beetle banks, hedgerows and insectary plantings, to the local needs of Oregon farmers to increase on-farm beneficial invertebrate populations. Hundreds of farmers have participated in FSB's participatory research projects and outreach events which include farm walks, field classes, and bugscaping faires. **Methods:** At farm walks participants view the farm as an ecological landscape from a beneficial insect's point of view while seeing CBC in progress. Field classes are a more focused farm walk utilizing farmers as teachers. The Bug-Scaping Game, an interactive planning exercise, helps farmers plan and implement CBC practices. Bugscaping Faires are community CBC forums with conservation, non-profit, native plant, research and farm booths. **Projects:** 1) **Banking on Beetles in Oregon** Beetle Banks are on-farm semi-permanent habitat for predacious ground beetles. Through USDA, Sustainable Agriculture Research and Education funds Oregon farmers and FSB researchers are collaboratively developing beetle bank technologies. 2) **Beetles and On-Farm Habitat** We study how factors such as time, temperature, ground cover and habitat affect on-farm predacious ground beetle populations. 3) **Beneficials and Native Plant Surveys** To expand regional knowledge FSB partners with NRCS to record which beneficials frequent mature native plants. 4) **Establishing Demonstration Habitats**

Habitat demonstrations at local extension and NRCS centers, and on farms provide examples of how CBC practices can be incorporated into farm production plans.

P044 Implementing IPM in Pears Using Puffers for Codling Moth Mating Disruption and Other Organically Approved Pest Control Methods

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The use of codling moth mating disruption in southern Oregon pear production increased significantly in 2008 after a number of years with little or no growth. Most of the increase in mating disruption is due to increased use of puffers for dispensing pheromone along with greater grower cooperation. A 2008 comparison of an IPM program to a conventional program where mating disruption was not used showed synthetic insecticide use could be reduced by almost 80% while organophosphates were eliminated in the IPM program. In addition to the use of mating disruption in the IPM program, codling moth granulosis virus was used as well as multiple applications of Surround, i.e. kaolin. In this comparison the use of inorganic materials measured in total pounds applied was over four times higher in the IPM program than in the conventional program. An organic program used even higher amounts of inorganic materials, mainly Surround, as that material was the primary control for two important pests, pear psylla and pear rust mite. While the amount of organic pear production has increased during the last two to three years, the amount of certified or transitional organic acreage remains less than 5% of the total pear production in southern Oregon. A survey

of growers in 2008 when compared to a similar survey conducted in 2002 confirmed the increased adoption of mating disruption and continued movement away from organophosphates and other broad spectrum insecticides.

P045 IPM in Washington Apple Orchards: Letters from the Front

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Codling moth (CM) is the key pest of apples in Washington State. Azinphos-methyl (AZM) has been the most commonly used pesticide to control CM in Washington for over 30 years. However, AZM use is declining due to restrictions imposed as part of the scheduled EPA phase-out. Over the past 10 years, growers have begun to replace AZM with new insecticides such as neonicotinoids, novaluron, and, in 2008, rynaxypyr and spinetoram. We have experienced problems while transitioning to the new materials. Woolly apple aphid increased suddenly in 2005, the year that novaluron became registered. Outbreaks were controlled with diazinon, which further disrupts orchard ecosystems. Mites have been a more frequent problem as the use of neonicotinoids and novaluron has increased. We have observed mortality of predators after applications of AZM replacements over very large areas. Data from the NASS Agricultural Chemical Usage Census indicates that many of our observations are typical of apple orchards in the state. We are in the process of learning how to manage codling moth while preserving natural enemies of secondary pests in the orchard ecosystem.

P046 The Often-Overlooked Invertebrates: Monitoring and Managing Slugs in Grasses Grown in Oregon for Seed

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Grass seed fields in the Willamette Valley with minimum tillage seeding system, reduced field burning, improved field drainage, and increased organic matter are developing persistent slugs causing increasingly greater economic losses in grass seed and rotational crop production. The two prominent slugs causing damage are the gray field slug (*Deroceras reticulatum*) and the brown-banded slug (*Arion* spp.). Finding an accurate and timely method for quantifying slug population densities is essential. Rapid, easy to use relative methods such as slug blankets, overnight bait stations and plywood boards were compared to absolute sampling methods including cold water extraction and defined area trapping methods for detecting and estimating slug numbers in a field to assist growers and field reps in decision-making for determining treatment need and to evaluate control methods. Presence of young neonates, earthworm abundance, seasonal variation in weather including cold temperatures, high winds and moisture, and dry conditions negatively affected numbers of slugs counted; and directly influenced the effectiveness of treatments. Slug counts using blankets were repeatedly higher (58-89%) compared to the absolute methods. Slug mortality (80%) was observed within 1-3 days in plots treated with the standard metaldehyde treatments under favorable conditions. Mortality of slugs with iron-phosphate pellet formulations did not occur until 3-5 DAT, however feeding greatly declined after day 1. MetaRex worked best after active rains and Sluggo worked best when soil surfaces were dry. Grazing of sheep and cultivation of land, and poorer drained fields had lower numbers of slugs.

P047 The Need for a Multidimensional Potato Virus Management Plan in the Pacific Northwest

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The potato industry in the US is currently being affected by aphid-transmitted viruses such as Potato leafroll virus (PLRV) and Potato Virus Y (PVY), which cause severe yield losses and reduce tuber and seed quality. At present the most commonly practiced PVY-control strategies, roguing of symptomatic plants by hand and chemical insecticide applications against the aphid vectors are not effective at reducing PVY incidence. One of the reasons for this failure is that a few of the most agronomically preferred cultivars have no known resistance to PVY and still accumulates high virus titers while displaying reduced foliar symptoms, thus nullifying the effectiveness of roguing as a management strategy. Currently available insecticides are not effective either since the aphid vectors require only a few seconds of probing for the acquisition and transmission of the virus, which is not long enough for an insecticide to affect the aphid and prevent PVY transmission. Some of these vectors include non-colonizing aphids, such as cereal aphids, which are abundant in seed potato growing areas. Additionally, the presence of a prevalent and difficult to control weed in Pacific Northwest (PNW) potato cropping systems, hairy nightshade, increases the number of aphid vectors and consequently affects the epidemiology of PLRV and PVY. It is clear that a virus management plan inclusive of aphid management in various cereal crops, as well as hairy nightshade and aphid management strategies in potato fields is very essential to curtail the virus spread which jeopardizes potato production in the PNW and the US.

P048 Demonstrating Integrated Pest Management of Hot Peppers

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We studied the effects of organic and synthetic chemical fertilizers on crop growth, yield and associated insect pests for two varieties of hot pepper, *Capsicum chinense*: "Scotch Bonnet" and "Caribbean Red" in north Florida. Hot peppers were grown under three treatments: poultry manure; mushroom compost; or "Growers' Practice", (conventional pesticides and chemical fertilizers), with equivalent amounts of soil nutrients applied to all treatments. The Growers' Practice treatment permitted use of conventional insecticides if insect pests exceeded economic thresholds. Plant height and canopy diameter were significantly greater in the mushroom compost treatment for Scotch Bonnet; however, yields were not significantly affected by treatment or variety. The Growers' practice treatment resulted in lowest plant height in Caribbean Red. The dominant insect pests found were the silverleaf whitefly, *Bemisia argentifolii* (Hemiptera: Aleyrodidae); green peach aphid (Hemiptera: Aphidae); bandedwinged whitefly, *Trialeurodes abutilonea* (Hemiptera: Aleyrodidae); and western flower thrips, *Frankliniella occidentalis* (Thysanoptera: Thripidae). Significantly more insect pests were found on Caribbean Red than on Scotch Bonnet, but in none of the treatments did pests reach economic injury levels. Results indicate that hot peppers may be grown without using insecticides in Florida because insect pests did not reach levels high enough to affect yield. Furthermore, the crops may be grown using relatively inexpensive organic fertilizers because the use of synthetic chemical fertilizers does not result in higher yields. We found that organic methods can be profitable for growers in Florida provided pests remain below economic threshold levels.

P049 Sustainable Control of Vine Mealybug through Conservation of Natural Enemies with Selective Insecticides

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The vine mealybug (VMB), *Planococcus ficus,* is a highly invasive pest of exotic origin and has been a threat to the California grape industry during the last decade. The VMB has severe economic impact on the wine, table and raisin grape industry. Current management practices include heavy reliance on insecticides and, to a limited extent, on cultural and biological control. Although chemical control is effective, insecticides can be detrimental to non-target insects such as predators and parasitoids. For control of VMB, our study is focusing on including reduced-risk insecticides that are more compatible with biological control agents in place of conventional broad spectrum insecticides that are relied upon, in order to promote greater biological control towards sustainable management of VMB.

Communication and Education

P050 Spreading the Word about IPM: Collaborating with Public Libraries

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This poster summarizes a 2006-2007 project in which we collaborated with Georgia public libraries to promote IPM. We delivered IPM information and promotional materials (e.g., flyswatters and magnets) to 200 libraries across the state. These libraries serve 40% (1.8 million people) of the states population. Our goals were to promote IPM and to direct library patrons to local Extension offices for additional information about IPM. More than 90% of the library patrons responding agreed that 1) The project will help me use IPM around my home to control pests and reduce pesticide risks. 2) I will ask my child's school/day care to use IPM to control pests and reduce pesticide risks. 3) I support the use of IPM in agriculture to control pests and reduce pesticide risks. Libraries were enthusiastic partners and were eager for more information for their patrons. Libraries can provide infrastructure and staff assistance to provide information to the public.

P051 Youth IPM Programs: From Pest PI to CSI

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The University of Nebraska-Lincoln (UNL) Extension has provided adult education about Community IPM through consumer and school personnel training since 2002. Since then, they have also developed youth programs to educate future generations about the benefits of IPM and how it can improve human health and safety and protect the environment. These programs include Pest Private Eye, a first person role playing video game, and Pest Scene Investigation (PSI). UNL

Extension developed the initial concept, layout, and script for Pest Private Eye and then consulted with the UNL DEAL lab for programming and design. The game, with a primary audience of 4th-6th graders, teaches about IPM through the virtual investigation of a school invaded by pests. By learning and identifying pests, exploring rooms, and interacting with school personnel, the player, as Pest Private Eye, helps to solve the school's pest problems. Early versions were piloted in libraries, summer 4-H camps, and after school programs. The final version, completed late 2007, was distributed to public and elementary school libraries. The game is currently being revised and updated to include new technological capabilities and increase complexity. The PSI program, a take on CSI, began in 2008 with visits to library summer reading programs and science camps. By presenting live insects, insect displays, and investigative and pest control tools, students learn about how pests are "criminals," the evidence they leave behind, "crime scenes" where they are found, and what tools can be used to control them.

P052 E-Learning Technology for Conveying IPM and PSEP Knowledge to Florida's Citizens

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The foundation of traditional extension has relied upon face-to-face activities. With reductions in resources and exponential advancements in electronic technology, the University of Florida Cooperative Extension Service's (UFCES) IPM and PSEP programming efforts are evolving some of their programming into e-learning activities using Articulate software. In 2006, the PSEP launched a state-approved continuing education unit (CEU) program for licensed pesticide applicators to obtain credits by completing on-line tutorials. The tutorials are sold on-line through the IFAS Bookstore. The landscape maintenance and pest control companies servicing Florida's urban populations need standardized training in landscape IPM as they increasingly offer IPM services for landscapes. IPM training modules are available at no or low cost and can also be accessed by learners at their convenience. A multidisciplinary team of UF/IFAS specialists and landscape industry representatives worked to create the IPM research-based modules. All modules were reviewed by UF/IFAS faculty prior to public distribution. Groups of modules are also available that offer the training required by the Landscape Maintenance Association of Florida (LMA) to become a Certified Landscape Operator. To receive these certifications, individuals take a specific module series and then are tested by an independent group. Certification will be granted by the LMA, not UF/IFAS. This system allows completion of required CEUs and training activities without travel and at one's convenience, both advantages with today's time crunched lifestyle. User perception surveys indicate the system is effective in presenting information, an effective method of teaching, and as effective as face-to-face classes.

P053 Grower Incentives for IPM Web Site Enriches Collaboration for More IPM through Grower Participation in USDA Conservation Programs

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Historically, Land Grant universities have collaborated with the USDA Cooperative States Research, Education, and Extension Service (CSREES); U.S. Environmental Protection Agency (EPA) and state departments of agriculture to encourage effective and safe pest management. Recently, interest has grown in building adoption of IPM through farmer enrollment in conservation programs. Our work group broadens our IPM community to include representatives from the Natural Resource Conservation Service (NRCS), the USDA agency that administers key conservation programs. Our goal is to increase IPM use by growers through effective IPM planning and participation in USDA conservation programs such as the Environmental Quality Incentive Program (EQIP). The work group established a Web Site as a key tool to aid organization and share resources and accomplishments at the state and federal level. Some of the items available at the Web Site include:

- A general description of EQIP and its application process.
- Lists of IPM practices and EQIP incentive rates for easy state-by-state comparison.
- First-hand accounts by farmers who have successfully applied to EQIP to increase their IPM along with other farm conservation practices.
- Model documents that can serve as a template for building collaboration between NRCS and IPM programs.
- Work group minutes and reference materials from its monthly conference calls.
- Articles with national impact as well as research and Extension articles by members.

P054 The Southern Region IPM Center's 2009 Friend of IPM Awards

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The Southern Region IPM Center initiated the Friends of IPM Award Program in 2007 to recognize individuals and groups

who have made extraordinary achievements in integrated pest management in the southern region. Categories for awards include "Bright Idea" (innovative approaches to IPM), "IPM Implementer" (on the ground IPM users), "IPM Educator (academic or extension educators)," "Pulling Together" (teamwork), "Future Leader" (early-career leader), and "Lifetime Achievement." The prize is public recognition of the winners' achievements: an award ceremony in front of the winners' peers and published articles about the award. Winners in the first five categories also receive $2,000 to defray travel or other expenses to enhance their programs. During the first year of the competition, the Center presented six awards: Glades Crop Care (IPM Implementer), Marvin Harris and Bill Ree (IPM Teacher), Kentucky Wheat Science Program (Pulling Together), Texas IPM Program (Outstanding IPM Program), Jennifer Gillett (Future Leader) and John Jackman (Lifetime Achievement). For the 2009 award season, the Center received 15 nominations and will present five awards: Chris Mills, North Carolina (IPM Implementer), Amy Fulcher, University of Kentucky (Future Leader), Scott Ludwig, Texas AgriLife Extension (IPM Educator), the Southern Region School IPM Working Group (Bright Idea), and the North Carolina Western Christmas Tree IPM Program (Pulling Together).

P055 Reaching Out to the Public—Developing and Delivering Residential IPM Messages

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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.

P056 Utah IPM Pest Advisory Program and the Online Decision Aid Tool, Utah TRAPs (Timing Resource and Alert for Pests)

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The Utah IPM pest advisory program began in 1996 with tree fruit pest updates via periodic emails and a call-in phone message to a select group of commercial growers. Today, the program serves over 2000 commercial, residential, and private applicators in tree fruits, small fruits, vegetables, turf, and ornamental landscapes. The advisory program consists of free, weekly, subscription-based alerts containing pest biology, monitoring tips, site-specific degree days and treatment timings, threshold recommendations, and control options. Information provided in the advisories comes from weekly pest scouting and insect trapping by Utah IPM staff and volunteer "scouts" representing 26 locations. Weather data in each location and trapping results are used to run pest phenology models. In addition to the weekly advisory program, Utah IPM, in collaboration with the Utah Climate Center, offers Utah TRAPs (Timing Resource and Alert for Pests), an online decision aid tool that provides near real-time degree days, pest phenology, and treatment recommendations for many northern Utah locations. In fall 2008, a survey of all advisory recipients (33% response rate) provided useful program feedback, as well as revealed significant improvements in users IPM implementation.

P057 Online and Interactive IPM Educational Tools for Retail Employees

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Consumers looking for pest management information or help with choosing pesticides often turn to their local garden center, hardware or "big box" store for advice. Unfortunately employees of these stores frequently are unable to provide needed information because they have little or no training in pesticide or pest management related topics. The University of

California Statewide IPM Program (UCIPM) has created a free, online training program for retail employees and others such as Master Gardeners who give pest management advice. This program is available at www.ipm.ucdavis.edu/IPMPROJECT/edprogramsmenu.html. Another tool now being distributed to reach these audiences is a touch-screen computer kiosk that can be placed in stores or other public locations to help consumers diagnose problems and find least toxic solutions. Nineteen of these kiosks are in use around California. User statistics show increasing interest in these educational approaches.

P058 Tactical Agriculture (TAg) On-Farm Educational Program Makes Impacts with Growers as Soybean Acres Increase in New York State

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On-farm IPM (integrated pest management) educational programs were initiated with soybean growers to teach sound pest management decision-making and to improve farm profitability while protecting the environment. Extension efforts of the Livestock and Field Crops Team of the NYS IPM Program focused on the use of on-farm education in small learning groups. These groups, called Tactical Agriculture, or TAg, Teams, met at local soybean farms on a regular basis over the course of a growing season from 2005 to 2008. On-farm locations of TAg meetings enabled direct observation of disease, insect, and weed pest outbreaks, assisted farmer participants with making economically and environmentally viable management decisions, and encouraged farmers' interest in pest identification and discussion of management options. As a result of their participation in soybean TAg teams from 2005 to 2008, 90 participants from 74 farms in 10 counties in New York State will implement or will try to implement IPM on at least 85% of the 17,440 acres of soybeans that they manage.

P059 Find Out What's Bugging You at the New York State IPM Program Web Site

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Tour the highlights of our Web Site with the new graphic interface:

- Over 20 answers to the question What's Bugging You? This new section of the Web Site distills the facts about many household pests into compact mini-fact sheets with links to more information.
- TracSoftware helps growers keep records up-to-date, generate reports, analyze pest management strategies and improve IPM practices. TracTurf is the latest to join this family and includes TracLawn, TracSod, TracGrounds and TracGolf.
- Those who Teach IPM to children and growers will benefit from the resources we offer at this section.
- Use the Interactive Plant Manager, an online tool for diagnosing pests of woody ornamental plants.
- Bed Bugs have made a comeback. View our new, up-to-the-minute information which includes Bed Bug FAQs, Bed Bug Information Cards for Travelers, How to Talk to Callers about Bed Bugs (a guide for master gardeners), and Guidelines for Prevention and Management of Bed Bugs in Shelters and Group Living Facilities.

P060 The Interactive Plant Manager—An Online Tool for the Pests of Woody Plants

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A database of the common insects and diseases of trees and shrubs in the Northeast US was assembled. The database is searchable by pest name, host plant, symptom and signs or a combination of fields. Linked information sheets for the pests were developed giving descriptions, biology, monitoring and management. Images, including many of the plates from Insects that Feed on Trees and Shrubs (Johnson and Lyons), were incorporated to aid in diagnosis.

P061 Building Bridges between IPM and NRCS—Workshops and Guidelines

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Extension educators and Natural Resources Conservation Service (NRCS) staff partner with growers to prevent risks to the environment but have worked in isolation from one another in the past. Many NRCS technical staff, unaware of certain IPM concepts, have found it difficult to write conservation plans that encompass pest management principles. Similarly, many IPM practitioners are ill equipped to advise about practices that mitigate pest management problems because they don't understand NRCS vocabulary, perspectives, and processes. This two-year project helped to increase the knowledge that NRCS and IPM personnel have of one another's programs and methodologies. We held more than

six hands-on workshops in four states for at least 370 growers, NRCS staff, and Extension educators. Attendees rated the workshops high. Farmers who attended the workshops plan to increase their use of weed mapping, crop disease forecasting, insect traps, synthetic row covers, greenhouses, crop rotation, disease resistant varieties, and pest scouting. IPM and NRCS professionals learned how to help growers earn financial incentives for using IPM practices. Project cooperators developed and distributed handouts that are posted at http://northeastipm.org/nrcs.cfm along with success stories, definitions, links, and contacts. We produced a Guide to IPM Elements and Guidelines, which explains how to write checklists and coalesces existing knowledge into one document that may be used nationwide to encourage IPM adoption in audiences that previously had limited knowledge of it.

P062 Sowing Change in Turf Management: Natural Lawn Care Education and Pesticide Reduction

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Research has shown that pesticides used to manage turf are frequently detected in storm water samples and urban waterways. While homeowners play a significant role in the application and dispersion of lawn chemical inputs, they receive much of their education, if not maintenance, from green industry professionals. Similarly, municipalities are increasingly outsourcing lawn maintenance to private firms. In both the public and private sectors, a significant number of turf acres are effectively under the control of a small number of individuals. Regrettably, traditional lawn care focuses on a product application approach to achieve results, rather than a systems or process based approach. Thus there are few incentives for applicators to adopt alternative methods and reduce pesticide use. However, the growing recognition of lawn care's potential health and environmental impacts, coupled with increasing nation-wide demand for green products and services, is creating a powerful incentive for professionals to change their lawn care practices to meet these needs. Nevertheless, industry and researchers have been slow to respond to this trend. Safer Pest Control Project organized a series of workshops to promote alternative techniques for turf management to professionals, broadly termed Natural Lawn Care. Natural lawn care produces a healthier turf by improving soil conditions with organic amendments, stimulating native soil biology, selecting appropriate grasses and maintaining turf properly to reduce stress. The result is a hardier turf that requires fewer inputs. This poster will summarize preliminary data assessing pesticide practices prior to, and behavioral change after, the workshops.

P063 The National Pesticide Information Center: Integrating Risk Communication with IPM Resources for the General Public

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The National Pesticide Information Center (NPIC) is a cooperative agreement between Oregon State University and the Environmental Protection Agency. NPIC's mission is to promote informed decision-making by delivering objective, science-based information on pesticides. NPIC operates a nationwide toll-free service that annually receives over 25,000 calls. Over 90% of inquiries come from the general public; most are related to pest control. Annually, NPIC receives over 2.2 million web-hits, with "Pest control" as the most popular site. Our Web Site includes well-referenced information about home and garden pests such as rodents, bedbugs and weeds. NPIC continues to develop and expand a pest-specific IPM factsheet finder designed to connect people with local extension resources. Our specialists convey science-based pest control information including the importance of pest identification, the concept of an action threshold and key facts about pest biology. In addition, specialists can compare the toxicity of various products and discuss ways to minimize exposure, thereby reducing the risk to people, pets, the environment, and beneficial organisms. NPIC is capable of communicating these issues in over 170 languages by working with interpreters trained in medical and scientific terminology. In 2008, NPIC observed an increasing trend in public inquires related to bedbugs, school IPM and products suitable for organic gardening. Given the scope and demographics of our callers, we are well positioned to link the public with IPM information and provide complimentary risk communication.

P064 Fungicide Resistance Management Guidelines for Vegetable Crops Grown in the Mid-Atlantic Region

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In the mid-Atlantic region (NJ, MD, VA, DE, PA) of the United States approximately 90,000 ha of fresh-market and processing vegetable crops are grown each year. Over the past decade, new fungicide chemistries with specific modes-of-action have been developed for use in commercial vegetable production. Many of these new fungicides have a high-risk for fungicide resistance development. The number of fungicide chemistries available and differences in modes-of-action can make it very difficult for vegetable growers to develop and follow season-long fungicide resistance management programs. Since 2007, using Fungicide Resistance Action Committee (FRAC) codes, fungicide resistance management guidelines with tables for the 30 crop groups listed in the mid-Atlantic Commercial Vegetable Production Recommendation Guide have been distributed to vegetable growers in the region. Each FRAC table consists of all fungicide recommendations for a crop (or crop group) along with FRAC and risk management codes, diseases for that crop (or crop group) and fungicide resistance management guidelines for each particular FRAC code. This simple-to-use reference guide for keeping track of fungicide use was developed to help vegetable growers i) understand the importance of understanding and knowing FRAC codes, ii) determine proper fungicide chemistry rotations, and iii) help reduce the potential for fungicide resistance development in the region. Since 2007, over 2,000 fungicide resistance management guides have been distributed to vegetable growers representing approximately 21,000 ha of vegetable production in the mid-Atlantic region.

P065 Impact of IPM Training in Illinois Childcare Centers

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Babies and younger children are especially sensitive to pesticides as a result of behavioral and physiological factors. Children have immature organs, more unprotected skin and higher metabolic and respiration rates than adults, and exhibit mouthing activity with pesticide contaminated objects. Parents, childcare workers and staff are generally untrained in using commercial pesticides and may not follow safety recommendations or consider safer alternatives in efforts to provide a sanitary pest-free environment. Many states, such as Illinois, while not mandated by the federal government have enacted laws regulating the use of chemical spray pesticides in and around child care facilities. A survey of 3364 Illinois daycare centers was conducted to assess the direct and indirect impact of formal IPM training by the Chicago Safer Pest Control Project (SPCP) and support agencies trained by SPCP over a three year period. We were able to determine that formal training increased the level of confidence, positive attitudes (easy, controls pests, takes little time) and implementation of IPM by daycare workers; though not all practices subscribed and tools provided were implemented. IPM trained childcare professionals did not believe IPM was more affective than traditional pesticide practices and were mainly motivated by protecting children's health. The study has further implications as to its impact on changing environmental health practices in a large sector of mostly female managed micro-enterprises.

P066 Promoting Grower-to-Grower Mentoring to Encourage the Use of Biocontrol in Greenhouses

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Biological control of insect pests in greenhouses has been used successfully for many years. However, adoption of biocontrol by NYS growers has been low, especially for smaller, retail greenhouses. Success with biocontrol takes information, support, and dedication, so growers would benefit from grower-to-grower mentoring. Twenty-one growers and Extension staff toured 6 greenhouses in Ontario, Canada and Buffalo, NY to get some experience with the methods used and talk to growers about their experiences. While all the growers indicated they felt more confident using biocontrol after the tour and most intended to try it, they also suggested that additional regional, on-farm workshops would provide information and mentoring support. Six on-farm grower oriented discussion sessions were held around the state. Most sessions included a greenhouse tour and a grower with experience in biocontrol as the primary speaker. Research and extension support people added information and answered questions. Approximately 135 growers attended the meetings, and while 36% had already tried biocontrol, 68% indicated they intended to try it after the meeting. In addition, 84% said they would be willing to share the information with other growers. Future activities will be planned to further encourage the exchange of information, both through face-to-face meetings and electronic means.

P067 Ecologically Based Integrated Pest Management Collaborative Research and Capacity Building in Central Asia

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Through the funding from the USAID IPM CRSP program managed by the Virginia Tech, Michigan State University (MSU) and University of California-Davis, in collaboration with the International Center for Agricultural Research in the Dry Areas (ICARDA), and various national and regional partners are implementing a regional Integrated Pest Management (IPM) Program in Central Asia for the past four years. The project takes an integrated and participatory approach towards IPM capacity building and includes two collaborative research projects and an IPM outreach and education component. The project activities cover three countries in Central Asia including Kyrgyzstan, Tajikistan, and Uzbekistan. The Research project on Landscape Ecology and Biological Control is focusing on the collection and evaluation of locally adapted nectar plant species for their attractiveness to natural enemies of pests. The research project on biolaboratories is focusing on enhancing efficiency and product lines of Central Asian Biolaboratories and is evaluating locally adapted predatory mite species for the control of spider mites on key crops. The IPM outreach and education component is focusing on enhancing IPM training and extension programs targeting both academic and non-academic stakeholders including farmers and university students. IPM modules have been developed and are delivered through Student Field Schools (SFS) and Farmer Field Schools (FFS) in Kyrgyzstan and Tajikistan. To foster networking and linkages in IPM in the region and with the global community, a directory of IPM specialists in Central Asia was compiled and published, and a regional IPM forum was organized in Tajikistan in May 2007.

P068 The National Plant Diagnostic Network (NPDN) First Detector Online Learning Program

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The National Plant Diagnostic Network (NPDN, www.npdn.org/) has an extensive First Detector training program for county extension agents, crop consultants, Master Gardeners, growers, and others involved in pest management. The purpose of the First Detector educational program is to promote the early detection of unusual exotic pests and plant pathogens. First Detectors must be aware of the common pests in their local area, and also be familiar with new and emerging pest issues. During 2008, the NPDN launched a new series of online crop biosecurity training modules in order to expand training opportunities (available at: http://cbc.at.ufl.edu/). Upon completion of all core modules at the 70% level or higher, learners download a certificate of completion for online First Detector training. Training outcomes, use of on-line modules for local certification credit hours, and future module development plans will be presented.

P069 Weed Suppressive Groundcover Plant Material Promotion

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Recent research by Cornell University faculty and field staff identified perennial plants which are naturally weed suppressive and suited to most climates in New York State. These attractive plants represent a natural way to suppress weeds for consumers and a new market potential for NY greenhouse producers. We promoted these groundcovers to both growers and consumers through a color brochure, powerpoint presentation and webpage: www.nysipm.cornell.edu/nursery_ghouse/weed_supp_grcovers.asp The brochure was supplied to interested personnel in the Cornell Extension System who distributed it to growers, Master Gardeners and consumers. The brochure was well received and went into a second printing. The presentation was delivered to many greenhouse and nursery professional groups at 17 locations across New York over the past year to increase awareness of the use of these plants for weed suppression. We also coordinated the establishment of demonstration gardens at cooperators' facilities in six regions of the state. Open houses at the cooperating farms gave growers and consumers a chance to view the plants growing in display beds.

P070 University of Florida, Institute of Food and Agricultural Sciences, New EIPM-CS Program

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The current, comprehensive University of Florida, Institute of Food and Agricultural Sciences IPM Program, IPM Florida, has been in place for almost eight years. Consequently, its goals are consistent with those of the new Extension Integrated

Pest Management Coordination and Support Program (IPM-CS): 1. Serve as a focal point for institutional IPM and biological control, especially a link between clientele and UF/IFAS, 2. Determine needs and opportunities for applied research and demonstrations, and help develop and coordinate associated projects, 3. Enhance IPM communication through use of up-to-date information systems, 4. Prepare and deliver pest management guides, manuals, fact sheets and other Extension materials, 5. Increase the delivery of IPM through training for Extension agents, pest management professionals, growers and others, and 6. Serve as the UF/ IFAS contact for IPM information, coordination and consultation. To accomplish these goals, the proposed UF/IFAS EIPM-CS project is divided into IPM Coordination and six subprojects based on the Emphasis Areas: IPM in High Value, High Input or Intensively Managed Crops (citrus, vegetables and ornamentals), IPM Coordination within Conservation Partnerships, IPM Support for Pest Diagnostic Facilities, IPM in Schools, IPM in Housing, and IPM on Recreational Lands. Additionally, there is a continuation of IPM Collaboration between the University of Florida and Florida A & M University. The mission of IPM Florida is in agreement with the national IPM Roadmap, to provide statewide, interdisciplinary and inter-unit coordination and assistance in integrated pest management to protect agriculture, communities and the environment.

P071 Expanding IPM Educational Opportunities by Working With Nontraditional Audiences

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It is easy to work with audiences with which we are familiar and have always worked. But, there are many people who know nothing about IPM, and should. Agricultural oriented IPM traditionally works with producers, but not the people at the other end of the food system: restaurants, chefs and other prepared food audiences. The food industry and food issues are increasingly visible. On television, the food network is very popular. Newspapers have weekly sections dedicated to food/ food issues. Where is IPM in all of this? Ask a chef what he/ she knows about food production and the normal response may be "organic" and "locally grown". That is usually the depth of their knowledge. In New York, we have been working with high-end "white tablecloth" restaurants; culinary schools (The Culinary Institute of America and Rochester Institute of Technology), the professional chef organization (The American Culinary Federation), community college culinary programs (Schenectady County Community College and Cobleskill), The New York State Restaurant Association and local BOCES (high school level culinary schools). These groups are very interested in learning about local food production and the related issues of health and nutrition. By working with culinary professionals and identifying restaurants who "buy local", we have been teaching this new audience the importance of managing pests in an integrated manner. IPM has a great story to tell. Why not tell it to more people?

P072 South Dakota IPM: Increasing IPM Capacity through Multi-faceted Training

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A recent survey of South Dakota Extension Educators revealed that only 40% have a degree in agronomy/plant science. Professional development of county-based educators is a critical need for the SDIPM program to increase the county-level IPM capacity. The SDIPM Coordinator will provide leadership for county-based educators professional development through the development of a series of digital video training materials. Initial efforts in this area have been enthusiastically received. An IPM series will emphasize the basic tenets of IPM, resources for IPM decision-making, and identification of management alternatives. The SDIPM Coordinator will provide leadership for a two day summer training school scheduled for July 2009, that will provide hands-on pest identification, estimation of pest populations densities, damage symptoms and management alternatives.

P073 eOrganic: The Web Community for Organic Agriculture

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eOrganic (eorganic.info) is a web community where organic agriculture practitioners, researchers, and educators network, exchange objective, research- and experience-based information, learn together, and communicate nationally. One of eOrganic's missions is to develop organic agriculture content, including articles on organic disease, insect and weed management, for eXtension, the new national Extension web initiative (eXtension.org). eOrganic will publicly launch outreach material on eXtension.org in December 2008. Examples of eOrganic pest management content will be presented.

P074 Work Group with a Geographic Focus—A Different Way of Doing Business: The PNW Agriculture IPM Work Group Case Study

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The Pacific Northwest (PNW) and its neighboring states Montana and Utah have both impediments and resources to address the USDA IPM Roadmap. Impediments include significant climatic and environmental differences within states representing an area of nearly 1 million square miles. Among these six states more than 250 different minor crops are produced that contribute to a total annual value of agriculture approximating $12.6 billion. Production issues such as agriculture's impact on human health, water quality, air quality, food safety, and endangered species challenge ever-decreasing numbers of University specialists. Our primary resource is a long-standing tradition of Land Grant university collaboration and cooperative efforts in both research and extension systems within this geographic area. Faced with promoting IPM under these conditions, Pacific Northwest states chose to form a geographically-based work group that simultaneously addressed needs identified both in the IPM Roadmap as well as those identified by regional stakeholders. Given the circumstances it made sense to regionalize efforts and utilize a group problem solving approach rather than focus on forming traditional discipline-based or single crop-based work groups.

The work group concept has been highly successful in the Pacific Northwest. By sharing resources, we have maximized expertise and minimized duplication of effort. Over a six-year period work group outcomes indicate that in similar circumstances this option can produce a strong and productive coalition serving extension clientele. Building upon our partnerships, we have increased our clientele's "voice" at the regional and national levels.

P075 IPM Okahoma! Fulfilling the Needs of Oklahoma's Rural and Urban Stakeholders

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IPM Oklahoma! (www.ento.okstate.edu/ipm/) is the current distillation of Oklahoma State University's IPM program that was established in 1979 through Smith-Lever 3D funding. It is designed to be a first-line resource of IPM information for the rural and urban communities of Oklahoma. This program has a rich history of success and has achieved some notable successes for IPM implementation at the state and national level. The program's successes are due to several factors: (1) the development and maintenance of strong multi-disciplinary "IPM Teams" that work closely together, (2) the ability to leverage other resources with IPM funding to create synergy with these programs, (3) minimal use of IPM funding for salaries so that more funds available for programming, and (4) the development of IPM programs that are broadly focused, encompassing not only traditional agronomic crops, but also stored grains, urban and structural IPM, commercial and consumer horticulture, and natural resources management. Recent examples of Extension IPM programming efforts that continue to provide positive impact on Oklahoma citizens include IPM programs in Wheat, Stored Grains, Cotton, Pecans, Grapes, Biological Control of Weeds, Pasture and Rangeland, Commercial Turf, and most recently, School IPM.

P076 The Doctor of Plant Health: A New Interdisciplinary Program for Plant Health Practitioners

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Individuals with integrated knowledge and management skills are needed to deal with the complex and frequently interacting challenges to plant health. To meet this demand for plant professionals, the Doctor of Plant Health (DPH) program is now being offered by the University of Nebraska-Lincoln, Institute of Agriculture and Natural Resources. This degree is for students interested in a successful career as a plant health practitioner to address these complex needs. Plant health practitioners have a broad interest in plant sciences and the microbes, arthropods, and environmental conditions that affect the growth and production of healthy plants. Emphasis is on the prevention, diagnosis and management of both biotic and abiotic plant health challenges. The curriculum is broad-based, but students may emphasize crop or plant areas such as field crops, ornamentals, specialty crops, turf grasses, landscapes, or other professional interest areas, including regulatory or business management. Students completing the program would have career opportunities in industry, crop consulting, government, extension, and other private practice. Industry and government, both local and national, have indicated a desire to hire graduates with this type of training.

P077 Rangeland Grasshopper IPM Train-the-Trainer Workshops: An Efficient Educational Tool for Western Pest Managers

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Grasshoppers are recurrent pests in the 17 western states of the U.S. where they destroy 25% of rangeland forage at a cost of $950 million/year. During outbreaks grasshoppers require large-scale applications of broad-spectrum insecticides. Nowadays the responsibility for grasshopper control in the U.S. is borne almost entirely by the producer. Therefore, there is a compelling need to develop efficient, economically and environmentally viable grasshopper IPM strategies and deliver them to end-users. We developed a "Grasshopper IPM Train-the-Trainers Workshop" which focuses on the 3-phase approach: prevention (via cultural management), intervention (via hotspot detection and control), and suppression (via reduced agent-area treatments of infestations exceeding economic threshold). Particular attention is given to efficient management strategies (RAATs), control agents and their risk assessment. The goal of the workshop is to provide pest managers with the principles and practices that allow them to deliver to the end-users (federal land managers, farmers and ranchers) the best, available rangeland grasshopper IPM systems. In 2003-2008, we delivered 23 workshops to 9 western states with a total attendance of 500 people. The workshops were funded by USDA-APHIS-PPQ. Examples of impact of the workshops include: in 2003, about 400,000 acres of rangeland were protected from grasshoppers in Wyoming using RAATs, which saved the local agriculturists over half a million dollars. In 2007, in Nebraska, 63,000 acres were protected by RAATs reducing the amount of insecticide applied by 250 gallons. Successful operational RAATs programs have been conducted in 10 western states. Our "Train-the-Trainers" approach proves efficient in disseminating the vital information on grasshopper IPM.

P078 Development of First Detector Training Materials for Master Gardeners

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The National Plant Diagnostic Network (NPDN) Education and Training Committee, in cooperation with the Regional Integrated Pest Management (IPM) Centers, has started to coordinate with Master Gardener Coordinators across the country to develop first detector materials that can be incorporated into their training curricula. This is an opportunity to train Master Gardeners as first detectors during the process of teaching IPM strategies and diagnosis of common pests and weed identification. Over the past six years the National Plant Diagnostic Network (NPDN) has worked diligently to train first detectors and has registered over 9,000 people across the country. A "NPDN First Detector" is an individual who has been trained to further the security of both agricultural and natural resources by interacting effectively with plant diagnostic and control systems. The committee has identified key regulatory, quarantine and emerging pests, diseases and weeds, from each of the five NPDN regions and has partnered with Bugwood Wiki to house their training materials. These materials will include fact sheets, images and Power Point presentations that will be available for anyone conducting Master Gardener training. The current list of pests, diseases and weeds as well as a completed sample page can be viewed at: http://wiki.bugwood.org/NPDN-MG-Training. This coordinated approach to pest management training will mobilize thousands of first detectors capable of responding to new and emerging pest issues.

P079 Formation of the Western Bark Beetle Research Group, USDA Forest Service Research and Development

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During the last decade elevated levels of bark beetle-caused tree mortality have occurred in spruce forests of Alaska and the Rocky Mountains, lodgepole pine forests of the Rocky Mountains, pinyon-juniper woodlands of the southwestern U.S., and ponderosa pine forests of Arizona, California and South Dakota. Given the high regional significance of these impacts on all values derived from forest ecosystems, the executive leadership of the three western USDA Forest Service research stations (Pacific Northwest, Pacific Southwest, and Rocky Mountain) proposed a west-wide initiative to strengthen cooperative working relationships among researchers and their many partners. To meet this mandate, the

Western Bark Beetle Research Group (WBBRG) was created in January 2007. WBBRG is composed of scientists from the three research stations with expertise in bark beetle research, development, and application in the West. The mission of the WBBRG is to serve as an ad hoc umbrella organization aimed at fostering communication, and enriching scientific interactions among Forest Service bark beetle researchers in the western U.S. Specifically, the organization will lead in the identification of western bark beetle research priorities; pursue priority research; promote relevance of the research; and work to increase the overall quality, productivity, timeliness, and delivery of research. WBBRG emphasizes basic and application-motivated research that will enhance our scientific understanding of bark beetles and contribute to the development of integrated resource management strategy objectives of our diverse stakeholders, especially USDA FS Forest Health Protection, the National Forest System, state, county, and private land managers, and extension and academic cooperators.

Control Tactics

P080 Non-herbicidal Weed Control Strategies Implemented by City Parks Staff in the Northwest

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Communities across the Northwest are requesting parks maintenance staff to stop using herbicides as a weed control method in neighborhood parks. Currently 17 cities in the Northwest have adopted a pesticide-free park program, with more than 50 parks being maintained without the use of herbicides. Because this is not a traditional way of managing weeds, parks maintenance employees look to their peers for effective strategies. To document methods used as well as assist employees with sharing information on effective strategies, NCAP surveyed parks maintenance employees who manage developed parks and natural areas asking them which park areas they manage using herbicides and how often herbicides were applied. They were also asked which areas in parks they are most interested in learning about effective, non-herbicidal weed control strategies. The top five most problematic areas identified were: landscaped areas, fence lines, hardscapes, tree wells, and turf. In a second survey, they were asked to provide the names of weeds that are most problematic in these areas and to describe any effective, non-herbicidal control methods. NCAP also conducted site visits during August and September of 2007 in selected cities to witness and document strategies used. The results from the surveys and site visits were shared using a peer-to-peer approach at OSU-sponsored educational events, then compiled in a series of four reports focusing on four management areas using non-herbicidal weed control methods: maintaining tree wells, maintaining hardscapes and fence lines, maintaining shrub beds and landscaped areas, and maintaining turf.

P081 Effects of Silica on Controlling Brown Planthopper (*Nilaparvata lugens* Stal) in Rice (*Oryza sativa* L.)

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Rice varieties with different levels of genetic resistance to BPH (highly susceptible TN1, susceptible IR22, moderately resistant IR46, and resistant IR72 and Mudgo) were grow hydroponically with different levels of silica (SiO2) (0, 100, 200, 300 and 400 ppm in the nutrient solution) then inoculated with BPH. Significantly more silica was found in all varieties grown in culture solution with silica. Silica uptake by plants was greatest at levels between the 100 ppm and 200 ppm. Silica content was higher in leaves than leafsheaths. Silica content significantly differed among varieties. Silica adversely affected survival of BPH as early as 4 days on the resistant 45-day old IR72 and Mudgo plants after confinement of BPH. Adverse effects were detected on survival, number of adults that developed, population growth index, nymphal period and fecundity. The adverse effect of silica was noticeable on TN1 and IR22 on the 16th day after confinement of BPH. On 14-day old plants, silica significantly affect BPH survival and development on the resistant IR72 variety. However, silica prolonged the nymphal period of BPH on all varieties. Silica did not affect the amount of honeydew excreted by BPH adults. The remarkable effect of silica was detected when the resistant IR72 variety was grown in solution without silica, IR72 plant was highly susceptible to BPH. Implications are that silica may bolster the rice plant defense against BPH and the synergized effect on BPH-resistant varieties can enhance the level of resistance. Therefore, silica could be used as an alternative control agent in IPM as one of the control tactics which is sound to environmental rice growing ecosystem.

P082 Effectiveness of a Warning System and Reduced Risk Fungicides for Control of Summer Diseases of Apple in Illinois

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A wetness-based warning system for sooty blotch and flyspeck (SBFS) on apples, developed in North Carolina and Kentucky,

was evaluated during 2001-2008 in 14 orchards throughout Illinois for control of summer diseases of apples, including SBFS and fruit rots (black rot, bitter rot, and white rot). All trees in the orchards received fungicides sprays through the first cover spray (14 days after petal fall). The system delayed the second-cover fungicide spray until 175 hours of leaf wetness duration (LWD) had elapsed. LWD was measured by a sensor placed beneath the apple canopy. Use of the disease-warnings system saved an average of 3.2 of 7 fungicide applications per year (46% of the summer fungicide applications) and efficacy of disease control was equivalent to the traditional protectant fungicide program. The reduced-risk fungicide kresoxim-methyl (Sovran), and the organic fungicide, potassium bicarbonate (Kaligreen), provided control of summer diseases of apples equivalent to the protectant fungicide program. There were no significant differences in either incidence or severity of other diseases (scab, rusts, powdery mildew, fire blight) between trees sprayed according to the warning-system and trees received the traditional spray program. The warning-system is being implemented by several apple growers of Illinois.

P083 An Alternative Approach to Increasing Tomato Production by Reducing Incidences of Corky Root by Grafting in Albania

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The soil-borne fungal disease corky root of tomato, caused by *Pyrenochaeta lycopersici* Shneider & Gerlach, is a disease of concern for many tomato-growing areas in greenhouses using soil as a growing substrate.The use of grafting onto resistant rootstocks was evaluated during 2007 as a potential replacement of chemical control. The influence of grafting method for the control of corky root was studied in two greenhouse trials in Albania. The cultivar used as scion was cv. 665 and as rootstock Beaufort. Grafted and un-grafted plants of tomato (*Lycopersicon esculentum* Mill.) were grown in naturally infested soil in Israeli-type greenhouses in Tirana and Kruja regions. Grafting was found to be effective in reducing root disease and increasing root fresh and dry weight, fruit yield and number. The result showed that the incidence of tomato plants infected by corky root was 2-6.7% and 40-80% in grafted and un-grafted plants, respectively. The results recorded on tomato by evaluating the marketable yield showed the significant effects of grafting. The use of grafted plants enhanced yields (+110-147%). Using the Hedon scale to determine the overall acceptance of the grafted tomato fruits, the fruit from the Beaufort rootstock were comparable to the fruits from un-grafted tomato plants.

P084 Investigating the Epidemiology of Tomato Spotted Wilt on Tobacco to Predict Preseason and Early Season Risk

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Tomato spotted wilt (TSW) is an economically important disease of tobacco caused by Tomato spotted wilt virus, which is vectored by thrips. A preseason prediction system of TSW risk has been developed and validated for the first time in North Carolina in 2008. It provides risk on a county level in late March before the crop is transplanted. In parallel, the spatial distribution and temporal progression of TSW were studied in naturally infested fields in 2006, 2007, and 2008. Fields ranged in size from 76 x 11 meters to 137 x 10 meters. In each field TSW incidence was measured on a weekly basis. TSW temporal progression for each location was fit to a logistic regression model with cumulative degree days (CDD) and TSW field history as explanatory variables. Analyses revealed that the CCD and field history are significant explanatory factors of the temporal progression of TSW (early season risk). TSW spatial distribution in each location was investigated using universal kriging interpolations on TSW incidence from two different dates. The spatial pattern revealed isolated clusters, but overall it was rather random. These findings suggest that when thrips move into a field infections occur randomly. The project is now expanding to include 4 states in the southeast US and a Web Site for TSW prediction on tobacco using the above findings is under development. Eventually it will assist growers and individuals related to agro-business to make timely management decisions, especially during seasons of high TSW incidence.

P085 Recruiting Natural Enemies with Methyl Salicylate in Strawberry

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Herbivory induces plants to produce signaling volatiles. Methyl salicylate (MeSA) is commonly released from infested crops and the application of synthetic MeSA has increased the abundance of predators and parasitoids in grape and hop yards. The objective of this study was to determine the impact of synthetic MeSA in strawberry fields on ground dwelling predators, foliar natural enemies, and foliar pests. Control and MeSA plots were set up at the end of July 2008, and spaced ~80 m apart and embedded in a large continuous strawberry field. Samples were taken at the point source of MeSA, 5 m and 10 m away to also determine spatial effects, and samples were taken over a month to determine temporal trends.

There was no substantial impact of MeSA on the abundance of carabid beetles and spiders based on pitfall trap captures. MeSA enhanced the abundance of green lacewings and Chalcidoidea wasps based on sticky card captures, but did not affect abundance of cucumber beetle, thrips and other pests. Treatment*distant interactions affected green lacewings. More lacewings were captured at the point source of MeSA than at the 5 m and 10 m distances. Differences in natural enemies captured on sticky cards appeared around 3-24 days after MeSA was placed in the field. Captures from 0-3 and 24-31 days were not different.

P086 Identification of Pyrethroid Resistance Associated Mutations in the Para Sodium Channel of the Two-Spotted Spider Mite *Tetranychus urticae* (Acari: Tetranychidae)

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Controlling spider mite populations has become increasingly difficult because of the rapid evolution of resistance to acaricides. Resistance to pyrethroids has been linked to specific mutations in the voltage-sensitive sodium channel gene (para). Early detection of resistance is critical when developing resistance management strategies for *Tetranychus urticae*, one of the most important crop pest species worldwide. We investigated biochemical and molecular mechanisms of pyrethroid resistance in *T. urticae* strains from Greece. Enzyme activity assays and synergistic data indicated that although P450 monooxygenase activities were associated with the trait, target site insensitivity was the major resistance component. We have cloned and sequenced a 3.3-kb cDNA fragment of the *T. urticae* para sodium channel gene corresponding to domains IIS4 to IVS6. The deduced amino acid sequence from this cDNA showed highest identity (56%) to the *Sarcoptes scabiei*, and was phylogenetically classified within the divergent group of Arachnida. Comparing para gene sequences from bifenthrin resistant and susceptible strains, we identified several single nucleotide polymorphisms in resistant mites resulting in two amino acid substitutions: A Phe to Ile change in the highly conserved domain IIIS6, which is known to confer strong resistance to pyrethroids, and an Ala to Asp substitution in the II/III intracellular linker with unknown role. The mode of inheritance of the resistance proved to be incompletely recessive, which is consistent with a target site mechanism for pyrethroids. The mutation could be used as a prime target for developing a DNA-based screening method for pyrethroid resistance in field populations of *T. urticae*.

P087 Investigations on Population Dynamics and Bio-control Effectiveness for *Aphis gosypii* in Greenhouse Vegetables

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Aphis gosypii Glover is among key pests of greenhouse vegetables in Albania. The present investigation was twofold: first, we wanted to shed light on the biology of this pest, i.e. population dynamics; second, considering the increased consumer concern about the heavy use of pesticides in greenhouses, we wanted to assess the effectiveness of natural compounds against it. The study was conducted on a greenhouse located in Durrës (western lowland of Albania) during 2006–2007.

The treatments used were Rotenone, *Beauveria bassiana* (Naturalis), thiamethoxam (Actara), thiacloprid (Calypso), acetamiprid (Ramplan), pymetrozine (Plenum), natural pyrethrum (Keniatox), azadirachtin (Neemazal-TS), UFO, pyridaben (Esamite 20 WP) and untreated control. Samples were collected based on Gottwald & Hughes, 2000 in order to analyze the level of infection before and after the treatments, 3 days and 7 days after. Populations of *A. gosypii* reached its peak during May with thousand individuals per plant, infesting about 14 percent of the plants by exceeding the threshold of 10% of leaves infested. The natural compounds provided good control (more than sixty per cent). These results are optimistic in terms of integrated control of greenhouse pests.

P088 Highlights of Pest Management Centre Successes in Biopesticides

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Since its establishment, the Pest Management Centre (PMC) has supported biopesticides development and implementation with more that $4.6M committed to over 40 biopesticides projects between 2003 and 2009. The PMC also assists the biocontrol industry in registering their products in Canada. A number of successes achieved to date are presented including: the regulatory support work which led to registration of

Botanigard® and Prestop® in Canada; the publication of a study of the biopesticides industry in Canada; and the submission and registration of a number of biopesticides for more than 100 new uses.

P089 Effects of Sugar on Short-Term Decision Making and Oviposition Rates of the Parasitic Wasp *Apanteles aristotliae*

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Pollen and nectar from insectary flowers or cover crops planted around agricultural fields attract and increase the lifespan of natural enemies and their effectiveness against common pests. *Apanteles aristotliae*, one of the primary parasitoids of the leafroller pest Orange Tortrix (OT) in caneberries, may benefit from the presence of flower and nectar near caneberry fields. The objective of this study is to determine the effect of sugar intake on short term behavioral responses of *Apanteles aristoteliae*. Newly emerged Apanteles adult females were paired with a male, fed a 10% w/w sugar solution, and then starved of sugar for 20 hours. Wasps were then fed either water (starved condition), 10% w/w or 25% w/w sugar solution. Responses to sugar intake were tested in olfactometer choice trials between food and host cues. Female wasps were also presented with potential host OT larvae in oviposition trials to determine differences in parasitism of OT larvae. Females were frozen and bioassays were run to determine the sugar, glycogen, and lipid levels of females. Results will focus on differences in olfactory cue preferences and number of hosts parasitized as a result of feeding treatment and sugar levels present in the gut.

P090 Mechanical Control of the European Corn Borer, *Ostrinia Nubilalis* (Hübner) (Lepidoptera: Pyralidae) in Potatoes

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The European corn borer (ECB) is an established pest of potatoes in the Maritime Provinces in Canada. Damage results in stem breakage and yield reduction. Control measures involve precisely timed insecticide applications aimed at the hatching larvae because, once the larvae enter the stem they remain protected from insecticide sprays. Inclement weather often restricts insecticide application resulting in poor control. ECB larvae overwinter within the discarded stalks of potato plants. A device "the Potato Stem Crusher" was developed which allows growers to harvest and control simultaneously. The device is attached to the back of a potato harvester and as the potatoes are harvested, the stalks, before being discarded, pass through the device which crushes the stalks and larvae within them. An eighty percent larval mortality was achieved in efficacy trials. Details of the device will be presented.

P091 Mass Rearing and Release of Predators of the Hemlock Woolly Adelgid in Tennessee

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Eastern, *Tsuga canadensis*, and Carolina, *T. caroliniana*, hemlocks are being devastated in much of the eastern United States by the introduced pest, the hemlock woolly adelgid, *Adelges tsugae*. To combat the pest, biological control agents, predaceous beetles, are mass-reared at several laboratories in the eastern US for release into forests. At the University of Tennessees Lindsay Young Beneficial Insects Laboratory (LYBIL), we rear two beetle species: the coccinellid *Sasajiscymnus tsugae* and the derodontid *Laricobius nigrinus*. Since 2003, more than 560,000 beetles have been reared at LYBIL for release, primarily in the Great Smoky Mountains National Park and Cherokee National Forest. Because an artificial diet is not available, host material (adelgid-infested branches) must be collected for rearing. The rearing process is labor-intensive, especially for *L. nigrinus* which spends a portion of its life cycle in the soil. Descriptions and photos of pest and predator life cycles and predator rearing and release procedures are included.

P092 The Use of Intensive Trapping and Mating Disruption for Control of Stored Product Moths as Part of an IPM Program

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Insect pheromones have been used for years in IPM programs as a monitoring tool. 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 and mating disruption can be significant components of IPM programs as well targeting stored product moths. These methods are also suitable for use in certified organic processing and storage facilities.

P093 Cultural Control of Weeds in Herbicide-Free Annual Forages

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The adoption of zero tillage systems improves soil water conservation, allowing for increased crop intensification and diversification in the semiarid northern Great Plains. Zero tillage systems rely primarily on herbicides for weed management, increasing selection pressure for herbicide resistance. Spring and fall-planted cereals are well adapted to this region and may be suitable herbicide-free forage crops in zero tillage systems. In several trials, we have developed and tested cultural practices for herbicide-free production of annual cereal forage crops, including the influences of planting date, crop entry and population density, nitrogen fertilizer placement, and land rolling. Early planting without preemergence glyphosate in a zero tillage system resulted in excellent forage yields, similar to those from preplant tillage or zero tillage with glyphosate application. Early planting without in-crop herbicide resulted in a small accumulation of weed biomass and no weed seed production. Land rolling after planting approximately doubled densities of tumble mustard, Russian thistle, kochia, and redroot pigweed shortly after crop emergence and at harvest compared to non-rolled; forage harvest of barley occurred prior to any weed seed production. Herbicide application for broadleaf weed control in winter- and spring-seeded cereals did not influence forage yield or water use compared to herbicide-free crops. Combining cultural practices for annual cereal forage crop production can reduce herbicide use and weed seed production.

P094 Evaluation of Insecticide Seed Treatments to Manage Pests of Ornamental Kale

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Treating crop seeds with insecticides is a common method to preventatively protect field crops, such as canola and selected vegetables from damage caused by insect pests. Past research was conducted on evaluating insecticide seed treatments on cruciferous crops against aphids, flea beetles and thrips, but no studies were conducted evaluating seed treatments against pests attacking ornamental cabbage and kale. Due to the positive results from the field crop trials, studies were initiated to evaluate the efficacy of seed treatments on ornamental crops to manage arthropod pests. Ornamental kale seeds were treated by film coating with spinosad (Entrust, Dow AgroSciences), fipronil (Regent 750, BASF), flonicamid (Aria, ISK) and chlorantraniliprole (E2Y45, Dupont). Efficacy studies were conducted evaluating these treatments against green peach aphid, *Myzus persicae*, diamondback moth, *Plutella xylostella*, and cabbage looper, *Trichoplusia ni*. Flonicamid treated seeds resulted in plants with significantly fewer aphids than the other treatments. Caterpillars were successfully managed with the spinosad and chlorantraniliprole treated seeds. If this technology proves to be effective, then growers will be able to save time and money controlling greenhouse pests.

P095 Alaska Invasive Species Working Group

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Invasive species are a national and global priority issue with serious economic, environmental and health-related impacts. While Alaska does not have as major a problem with invasive species presently in the lower 48, they are being introduced at an increasing rate. Three of Alaska's major industries, commercial fishing, sport fishing, and tourism, may face serious risk economic loss (Invasive Species in Alaska, Union of Concerned Scientists 2003). These impacts affect many agencies organizations and private citizens. Alaska is in a unique but challenging position to avoid the ecological and economic losses experienced by the other 49 states. Alaska is large with a limited exchange of information within and between groups can result in a duplication of management efforts If Alaska is to prevent the multi-million dollar management expenditures experienced in other western states, a unified statewide effort is needed. Alaska occupies approximately 373 million acres, with multiple land management agencies. Federal agencies manage 64% of the land area. The remaining 36% is managed primarily by the State of Alaska, with lesser acreage managed by Alaska Native corporations, local governments, and private owners. This presents a critical conservation need to manage invasive species across agency boundaries. In recognition of the need to address invasive species issues collaboratively, Michele Hebert, Agriculture Agent obtained an EPA grant to initiate the Alaska Invasive Species Working Group (AISWG). The AISWG, now established, functions via annual statewide conferences, monthly teleconferences, newsletters, listserv and a Web Site.

Global IPM

P096 IPM Package for Vegetable Production in the Tropics

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IPM CRSP has been involved in promoting the development of IPM packages for vegetable crops for the past 15 years. The packages combining different components in various stages of development, validation and implementation for tomato, eggplant, crucifers, cucurbits, okra, beans, peppers, strawberries and naranjilla in different regions of the world. **Selection of seeds**: Seeds should be of a variety that is resistant to pests and high yielding. Examples: bacterial wilt resistant eggplant variety BARI Begun-6 in Bangladesh and and tomato variety MT-56 in Uganda. **Seed treatment**: Treating seeds with *Trichoderma*, *Pseudomonas florescens* and *Bacillus subtilis* protects seedlings from fungal, bacterial, and nematode diseases. **Solarization**: Soil solarization controls nematode, fungal diseases and weeds as practiced in Albania and Honduras. **Fertilization**: Application of VAM, compost, neem cake and other organic forms improves growth of the plants and reduces the incidence of nematodes and other pathogens. **Seedling selection**: Seedlings in the nursery should be examined for diseases, and infected seedlings should be discarded. **Grafting**: Grafting of high yielding scions on disease resistant rootstock is used to control soil borne fungi, bacteria and nematodes. **Traps and biopesticides**: Yellow sticky traps reduce pest populations such as aphids, thrips and whiteflies and pheromone traps are used for monitoring key pests. NPVs, Bt, and formulations of neem, Beuveria, Verticilliam, Metarhizium, Heterorhabditis, and Steinernema are then used for control of caterpillar, whiteflies, thrips and others. **Natural enemies**: Using local natural enemies such as predatory mites for control of phytophagous mites in strawberries reduces the need for pesticide applications.

P097 Developing and Implementing IPM Strategies for Groundnut in Ghana

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Groundnuts are an important crop for domestic consumption throughout much of West Africa. Numerous pest and agronomic production concerns plague farmers who cultivate this crop. Beginning in 1996 a program funded by the USAID through the Peanut CRSP in collaboration with North Carolina State University, the Crop Research Institure in Kumasi, Ghana and the Savanna Agricultural Research Institute in Tamale, Ghana has successfully developed and implemented groundnut IPM programming in both northern and southern Ghana. This was accomplished through initial crop surveys, focused applied research efforts, farmer schools, germplasm evaluations, and followup socioeconomic surveys. Initial surveys defined the major limiting factors in each region and research developed cost effective approaches to pest management. Participatory farmer schools and continual involvement with research institute scientists in the field plots has been excellent. More than 200 farmers in five villages have been trained and received certificates recognizing three years of participation. Surveys indicate grower acceptance of IPM programming is excellent including the adoption of new germplasm. Yields and acreage have more than doubled for participant farmers as compared to non participants.

P098 Interactive Reporting and Mapping Global Pest Occurence Using PestMapper

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An internet-based mapping application, pestMapper, is developed for sharing biological event such as biological invasions and pest distribution in large geographical areas. This Google® Map-based application maps reported events to a dynamic map with detail information displayed for each event. Users can use various built-in options such as region, event, pest, country, or time to display the map selectively. Alerting messages can be automatically sent to interested parties if certain types of events such as pest outbreak occur. The system also generates web-based alerting for certain pre-defined events. A time slider is available for users to view temporal distribution of a biological event. Data are entered using an online data entry component and database integration. Data will be fed automatically or semi-automatically in future version. Current version of the software can be readily modified for many other applications such as global species distribution mapping.

P099 Invasion of Papaya Mealybug, *Paracoccus marginatus*, in Asia

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Papaya mealybug (PMB), *Paracoccus marginatus* (Hemiptera: Pseudococcidae) is a polyphagous pest and it has been

recorded on several economic and weedy plants. On papaya, it infests along the veins of older leaves and all parts of young leaves and fruits. Affected older leaves dry up and shed prematurely, young leaves become curly, flowers and young fruits drop, and shoots appear bunchy.

Paracoccus marginatus is a native to Mexico. It was first described by Williams and Granara de Willink in 1992 from the specimens collected on cassava in 1955. By 2002, it has spread to most countries in the Caribbean including a few countries in South America. Between 2002 and 2006 it invaded Guam, Palau, Hawaiian Islands and Tinian in the Northern Mariana Islands. In 2008, it has been recorded in Bogor, Indonesia; Coimbatore, India; Colombo and Gampaha districts in Sri Lanka (L.D. Galanihi, pers. comm.); and northern part of Thailand (B. Napompeth, pers. comm.). This mealybug has been effectively suppressed through classical biological control process by introducing parasitoids, *Anagyrus loecki*, *Acerophagous papayae*, and *Pseudleptomastrix mexicana* (Hymenoptera: Encyrtidae) from Mexico in to the Caribbean, South American and Pacific countries. All the four countries in Asia are considering developing classical biological control program to suppress PMB so that they can prevent its spread within their countries and also reduce the chances of its introduction to the neighboring countries. Neighboring countries should take up effective quarantine measures to prevent the introduction of PMB.

P100 Global Experiences in IPM Education, Training, Information Exchanges, and Networking

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Human resources development and information exchanges are integral components for the successful development and implementation of Integrated Pest Management (IPM) programs. Even though the global community has accumulated a wealth of experience, access to IPM information by various stakeholders in a timely manner still remains a big challenge. This poster shares the global experiences in providing IPM education and training by focusing on both academic and non-academic stakeholders. The poster covers some of the experiences of the global community in sharing IPM related information. In addition, various platforms available for networking among IPM specialists and new approaches for providing IPM education and training are presented. The role of new tools of information and communication technologies (ICTs) for enhancing access and exchange of IPM information are presented. A strategy for creating a central repository of Global IPM information and knowledge-base that can be easily accessed by IPM stakeholders around the world is described.

P101 Evaluation of the Beetle *Zygogramma bicolorata* Pallister for the Control of the Invasive Weed Parthenium (*Parthenium hysterophorus* L.) in Eastern and Southern Africa

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Parthenium is a native of tropical America that has invaded Australia, large parts of Asia, several Pacific islands, eastern and southern Africa. It is an annual herb with prolific seed production, high growth rate, a capacity to release toxic chemicals and a wide-range of adaptation. In eastern and southern Africa, parthenium reduces yield of crops, competes with pasture species, displaces native plants and when consumed by domestic animals, taints their milk and meat. Parthenium also affects human and animal health by causing severe allergic respiratory reactions and contact dermatitis. Presently, biological control is the most effective and environmentally safe method of parthenium control. A project was initiated in Ethiopia and South Africa to evaluate biological agents including the leaf-feeding beetle, *Zygogramma bicolorata* for the control of parthenium under quarantine conditions. Adult feeding and oviposition were used as indicators of host suitability in no-choice (host alone in a cage). So far, *Z. bicolorata* has been tested on 38 and 20 plant species that are closely related to parthenium in South Africa and Ethiopia, respectively. The test species in South Africa included 14 sunflower varieties. Z. *bicolorata* did not damage any of the species tested except showing some level of feeding on some sunflower varieties. In all cases, the relative feeding/oviposition of *Z. bicolorata* was significantly less than that was recorded on parthenium. All the sunflower varieties will be included in a follow-up choice test to further examine the host range of *Z. bicolorata*.

P102 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

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The IRAC International Diamide Working Group (WG) was formed in April of 2008, to lead efforts aimed at the sustainability of use and resistance management of Group 28 Insecticides or ryanodine receptor activators. The Group 28 Insecticides currently extends to chlorantraniliprole- and flubendiamide-containing products (single products and/or pre-mixtures). Founding member companies of the Diamide WG are Bayer Crop Science, DuPont Crop Protection, Nihon Nohyaku/Nichino, and Syngenta. There is a clear common interest not only by industry, but also by academia, official bodies, and end users growers to effectively manage the field use of ryanodine receptor activators and to prevent or delay the development of resistance to one or more of these insecticides and maintain them as effective tools for pest control. The IRAC International Diamide WG is leading this effort and working to provide country groups with guidance and tools to effectively implement locally tailored Insecticide Resistance Management (IRM) programs for prioritized crop markets, based on risk of resistance development of key target pest species and insecticide use patterns currently practiced. In the very short period since its formation, the Diamide WG has already published a global reference document which outlines the basic recommendations for resistance management of Group 28 insecticides (www.irac-online.org/documents/Global_IRM_Guidelines_Group%2028_v1.0.pdf). 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.

P103 Laboratory and Field Studies of the Predaceous Mites *Amblyseius cucumeris* and *Amblyseius mckenzieli* in Central Asia

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The May, 2005, Stakeholder Forum in Tashkent identified expanding the product line of biological control agents and improving their production efficiency in Central Asian biolaboratories as being high priorities for USAID IPM CRSP research and education. After evaluation of several Phytoseiidae, our studies have concentrated on *Amblyseius cucumeris* and *Amblyseius mckenzieli* which are now being produced at biolaboratories in both Kyrgyzstan and Uzbekistan. These species are endemic and proved more amenable to production using available facilities than did other species that would require capital investment. *A. cucumeris* stage-specific development, survival, and feeding rates are presented for their predation on spider mites as well as on pollens. Females raised on native plant pollens lived longer and developed more rapidly than those raised on orchard pollens. Laboratory and field studies were conducted to determine predator:prey ratios necessary for control of the greenhouse whitefly on tomato plants in protected culture. The average number of whiteflies per plant at release ratios of 3:1, 1:1, and 1:2 were reduced relative to the no release control in both the laboratory and field studies for 35 days post release. However, whitefly egg densities continued to increase following release at all release ratios and in controls. The 3:1 release ratio provided the best control in both the laboratory and field studies. Releases of *A. mckenziei* for spider mite control in cotton fields in the Andijan region (Uzbekistan) and Osh region (Kyrgyzstan) resulted in guidelines for their release at different predator:prey ratios depending on high and low spider mite densities.

P104 CGIAR Systemwide Program on Integrated Pest Management (SP-IPM)

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The Systemwide Program on Integrated Pest Management of the Consultative Group on International Agricultural Research (CGIAR) is a global group of scientists and institutions that spearheads forward-looking research on crop pest and disease management by pulling together the individual strengths and expertise of several CGIAR centers and their partners. It aims at developing knowledge and technologies for innovative crop protection to increase and secure the production of safe food in an environmentally and economically sound way in the developing world. Collaborative research is carried out to provide valuable economies of scale, to avoid duplication of efforts, and to achieve synergistic effects with regards to relevance of research outcomes and impact. The program addresses current and future challenges including food scarcity, increased pest pressure, and declining soil health, and focuses on three main research areas (AIM): Adapting IPM to climate change; Improving agro-ecosystem resilience and Managing contaminants in food, feed and the environment. The outputs include: New knowledge and innovative technologies that provide IPM options to International Agriculture Research Center and National Agricultural Research and Extension System scientists and IPM promoters; Outreach programs, learning tools and guidelines on applying the new technologies; IPM Briefs reports and other scientific publications that inform

research managers, policy makers and decision makers in the public and private sector, and investment agencies.

P105 Transition of IPM using *Anaphes nipponicus* in Japan

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I confirmed that *Anaphes nipponicus* had emerged from *Oulema oryzae's* egg collected from Miyagi prefecture on 26th May, 2008 and a few places on Hokkaido on 15-17th June 2008 in Japan. Togashi(1974) had confirmed already *A. nipponicus* at Ishikawa prefecture in the seaboard of Sea of Japan, but else there have been no example of discovery in Pacific Honshu island. The Agricultural Research Service (ARS) has been conducting collection and importation of an egg parasitoid, *A. nipponicus*, from China to the USA for biological control of the cereal leaf beetle (CLB) (*Oulema melanopus*) since 2003. Barry B. Bai says that *A. nipponicus* successfully completed one generation in the CLB eggs. In Japan, the research of *Anaphes nipponicus* in regard to biological control has been discontinuously done since 1932, especially in Hokkaido. KUWAYAMA (1932) discovered *Oulema oryzae* (as *Lema oryzae*) and its egg parasitoid, *Anaphes nipponicus* and then conducted its protection and tried to release at the other place (Enbetu, Ikeda) in Hokkaido (1935). Furukawa (1993) confirmed the survival of *Anaphes nipponicus* on the age of decreasing chemical control in Hokkaido.

P106 Multilingual Online Presentations for the Dissemination of IPM Research Results to an International Audience

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The IPM CRSP (Integrated Pest Management Collaborative Research Project is an international program funded by USAID, with Virginia Tech as the management entity. This CRSP includes eight regional projects across the globe. The Eastern European Regional Project focuses on several high-value horticultural crops (tomato, cucumber, grape and apple) in Albania, Moldova and Ukraine. Following the breakup of the centralized communist economies in these countries, with privatization in the 1990s, infrastructure for information transfer has been inadequate to distribute research findings to broad audiences. This is especially critical because following privatization, there are many farmers with little farming experience. Our project includes countries with differing languages—Albania—Albanian; Ukraine—Ukrainian and Russian; Moldova—Romanian and Russian. In order to facilitate information sharing among research and extension personnel as well as interested farmers, a series of on-line presentations is under construction using Adobe Presenter. This approach uses translated text material in PowerPoint format, with accompanying auditory tracks in the appropriate language, thus making research results generated in one country accessible to a broad audience in the other countries. Files are initially shared in a password-protected project management site, and are ultimately posted in a public access Web Site for the Eastern European IPM CRSP Regional Project.

P107 Farmer-Level Production of Microbial Agents for Use in IPM Systems for Vegetables in Southeast Asia

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Microbial agents are important components of many IPM systems that have been developed for vegetable crops. They enhance uptake of nutrients by plants and protect plants from diseases and arthropod pests. They also allow farmers to reduce input of chemical fertilizers and chemical pesticides. However, most of these microbial products are quite expensive if they are purchased from an industrial source and most small holder farmers in Southeast Asia cannot afford them. As IPM programs were developed under the IPM CRSP Southeast Asia Project, these microbial agents were initially supplied by Universities and government agencies. In the past several years, farmers have been trained to produce their own microbial products and have been doing so quite successfully. In the Philippines, farmer groups and individual farmers are producing Trichoderma for use in protecting plants from soil-borne fungal pathogens and vesicular arbuscular mycorhizae (VAM) for enhancing nutrient uptake by plants. In Indonesia, bio-agent posts have been established in farmers' houses where Trichoderma is produced and mixed with a fermented compost for sale to other farmers. Other products include a nucleopolyhedrovirus (SeNPV) to protect plants against damage by the beet armyworm and the endophytic bactera, *Bacillus subtilis* and *Pseudomonas flourescens*, to enhance plant nutrition and defend against diseases.

P108 Integrated Control Strategies for Tomato Viruses in Mali, West Africa

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Tomato is a major crop in Mali. It contributes to improve the diet and revenues of poor famers. Pests such as white flies are a constant biotic constraint to tomato production. In order to insure tomato production, white flies must be properly managed. Due to heavy pesticide application of pesticides on cotton, white flies have migrated to solanaceous crops such as tomato and have caused more than 80% yield reduction. The objective of IPM research was to increase tomato production by reducing virus incidence. Methods including seed bed protection, use of tolerant varieties and host free period were used to control white flies. The host-free period resulted in reduced virus incidence and a delay of 30 days before virus onset for the first growing season: September to December. It is expected that better results will be obtained if the host-free period is extended to June and July.

P109 Q-TRAP: In-Transit Detection of Bioinvasive Insects in Intermodal Shipping Containers

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Invasive alien species are non-native organisms that cause, or have the potential to cause, harm to the environment, economy or human health. Biotic invasions can occur when organisms are transported to new, often distant, ranges where their descendants proliferate, spread and persist. Over 2000 exotic insect species are now established in the US: 20% of which feed on trees and shrubs. National quarantine agencies are hard pressed to keep up with burgeoning volumes of global trade. Container transport is the basis of world trade. Every year 48 million shipping containers pass between the world's seaports, carrying around 90% of the planet's general cargo. Between 1985-2000, 577,829 insects were intercepted in United States ports, 7,890 (1.4%) were associated with wood, timber or wooden packing materials. APTIV has evaluated several configurations of attractants, designs, and use patterns and found high rates of insect recapture inside experimental shipping containers, both with and without cargo. Test insects included several species of bark beetle, and a field collected Cerambycids and Elaterids. We installed an experimental prototype in commercial container loads of nursery plants being shipped intrastate from the Willamette Valley of Oregon to several destinations in the United States. A total of 661 arthropods were recorded from the 11 devices that were returned to APTIV from the point of destination. We demonstrated that APTIV's sensitive Q-TRAP ran 24 hours per day, every day that cargo was in transit, attracting insects to a containment surface where they remained for identification upon return to our laboratory.

P110 Village-Level Integrated Management Strategies for Malaria in Mali, West Africa

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Malaria is one of the main causes of childhood mortality which claims 40% to 60% of children in some villages in Mali (region of West Africa). Although the country mandate is free bednets and medicines for every child and pregnant mother, they do often do not reach the village when needed. To serve as an example of how a relatively isolated, subsistence farming village with a 9 month dry season in Mali might manage malaria, students and faculty linked with the village of Sanambele in an on-farm action research process. The objective of the collaborative on-farm, in-village IPM research was to develop a replicable, sustainable, village-level, integrated malaria management strategy. Innovative methods included engaging the village middle school in a community awareness poster campaign and cooperatively developing with MSU students and faculty a small enterprise that created a revenue stream for village women from their own handicrafts. In addition, villagers used physical reduction of dry season breeding sites and biocontrol of vector larvae / adults with entomopathogenic bacteria and fungi with a history of being produced in African villages. The first year the village implemented their IPM strategy, they experienced the heaviest rains, and therefore the worst malaria season, for 10 years. Yet, Sanambele experienced a reduction in infant/childhood deaths from malaria.

P111 The Use of Satellite Data to Improve Locust Monitoring and Management in Central Asia

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Locusts thrive in the arid zones of Central Asia. The most important species is the Asian Migratory locust *Locusta migratoria migratoria* L. (AML), which inhabits common reed (*Phragmites australis*) wetlands along rivers and lakes but can travel long distances to damage crops. Its vast (>1 million ha) breeding area is located in the River Amudarya delta near the Aral Sea, Uzbekistan. Locust swarms threaten the irrigated crops in the radius of up to 1,000 km. The goal of locust control is to prevent the swarm development by applying insecticide treatments to locust infestations. However, ground surveys and finding infested areas remain an arduous task in the huge delta. As a result, wetlands become blanketed with broad-spectrum insecticides, aggravating the ecological disaster of the Aral Sea. Despite control efforts swarms escape control and damage crops. Identification of reed areas as potential AML habitats is the key to successful management of this pest. The use of satellite (Landsat and MODIS) imagery allows to improve efficiency of locust habitat monitoring. Satellite data help to target control operations only to the reeds, which occupy less than 18% of the delta. Early season Landsat data can be used to generate a potential AML habitat map. Landsat data were able to correctly identify 87% of the reed beds, but had difficulties separating reeds from other vegetation in mixed stands. Late season Landsat data were useful in locating the AML's oviposition sites. The use of satellite data is an important step towards the efficient locust IPM strategy in Central Asia.

P112 Global Status of Successful IPM Strategies for Thrips-Transmitted Tospovirus Epidemics in Diverse Cropping Systems

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Tospoviruses (genus *Tospovirus*, family Bunyaviridae) cause economically important diseases in numerous important vegetable, legume and ornamental crops in many parts of the world. Initially a monotypic genus, consisting of *Tomato spotted wilt virus* (TSWV), so far, more than 15 distinct tospoviruses have been described from different parts of the world. Recurring tospovirus epidemics include those caused by TSWV and Iris yellow spot virus (IYSV) in the U.S.A., Peanut bud necrosis virus and Watermelon bud necrosis virus in India, and *Groundnut ring spot virus* in South America. The wide and overlapping host ranges for both viruses and their thrips vectors, emergence of resistance-breaking strains, and difficulties in predicting their outbreaks are some of the constraints to developing effective IPM tactics. Despite these challenges, successful IPM strategies have been developed in Australia, Europe, India, and the USA for a few tospoviruses. Examples include IPM of TSWV in the southeastern United States where risk factors that contribute to increased disease incidence were identified and tactics to reduce those risks have been developed. A similar strategy was developed for PBNV in India. Growing virus-resistant or tolerant varieties has been an important component of these successful IPM strategies. Progress has been made in identifying similar risk factors for IYSV infection in onion and these risk factors could potentially be used for developing an effective IPM strategy. Use of a combination of different tactics that include both pre-plant and post-planting plant production and protection practices have the best potential in reducing the impact of these viruses.

IPM Evaluation and Promotion

P113 The Wisconsin Healthy Grown Potato Program: Success in Eco-labeling

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The Wisconsin eco-potato project began in 1996 with the development of a set of goals which include: increased Integrated Pest Management, reduced use of high-risk pesticides, ecosystem restoration, increased biodiversity, and improved soil and water quality. The success of this project has come from the continual involvement of growers in the development and implementation of standards. Research-based measurement systems for pesticide risk (both human and environmental risk) and IPM have been developed and used to monitor changes in grower practices. In 2000, a stringent IPM standard was developed which enabled growers to market their eco-brand for potatoes (Healthy Grown). The potatoes are certified by Protected Harvest, an independent non-profit certification organization. This subset of Healthy Grown growers have documented significant reductions of high-risk pesticide use and demonstrated an increase in IPM strategies through targeted outreach programs. In 2007, a natural community standard was added to the protocol. This standard ensures that growers are ecologically restoring their privately owned, non-agricultural lands. Each year, about 4000 acres of potatoes are certified for sales. This product should fit nicely into the retail sector looking toward providing ecologically grown, safe and environmentally sound produce.

P114 A Grape Grower's Guidebook for Assessing Environmental Risk and Facilitating Adoption of IPM

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Insect and disease pests are a major challenge to Michigan grape production, and growers continue to require effective management programs in order to grow grapes economically.

Currently, grapes receive high inputs of pesticides to prevent infestation by the complex of pests that can cause reduction in yield and fruit quality, or the rejection of the crop during inspection. As societal concerns increase about pesticides and other farm inputs, federal regulatory action, publicly supported organizations, and corporate customers are encouraging grower transition to sustainable production practices. Michigan grape growers need an integrated tool to assess environmental risk and design site-specific plans that incorporate IPM and sustainable strategies. Working in partnership with the Michigan Agriculture Environmental Assurance Program (MAEAP), we are creating a grower guidebook that will incorporate a risk analysis component that satisfies MAEAP standards and can be delivered through our groundwater stewardship network of technicians, industry, and university personnel. This guidebook will enable growers to track their progress using IPM strategies and provide the industry with evidence for benchmarks for advancing IPM and sustainable practices. Providing growers with the ability to customize a plan using research-based options increases ownership and implementation of management plans incorporating both IPM and environmental sustainability at the farm level.

P115 Assessing IPM Adoption of Processing Tomato Growers

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The Great Lakes Vegetable Working Group developed a survey to assess the level of IPM adoption by grower's of processing tomatoes in the Midwest (IN, MI, OH) and Ontario, Canada. The survey was arranged in nine sections and available to growers through the Internet and in hard copy format at certain vegetable educational meetings from January, 2006 to May, 2007. There were 38 respondents from Indiana, 4 from Michigan, 28 from Ohio, and 22 from Ontario, Canada. Of the 92 respondents to the survey, zero growers were classified as low IPM adopters, 55 growers were classified as moderate IPM adopters, and 37 growers were classified as high IPM adopters based on the number of practices and tactics used in their overall production operation. The responses were analyzed using SPSS. Profiles for typical high level IPM adopters were developed. Any clear practice deficiencies found within the grower population will be used to guide future research projects and Extension programs.

P116 Orkin Partners to Advocate and Educate on IPM Best Practices

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For years, pest management company Orkin, Inc. has spearheaded efforts to promote IPM best practices in food manufacturing, health care and schools, where health and safety are top priorities. **Food Manufacturing**: The Gold Medal IPM Partner Awards, co-presented by Orkin, The IPM Institute of North America and NSF International, recognize food and beverage processors that have shown outstanding commitment to their IPM partnerships. Since its inception, the program has recognized dozens of facilities across the United States and Canada that have upheld rigorous IPM protocols, and its IPM advocacy has reached many more through food-industry media coverage. **Health Care**: Orkin also collaborates with the American Society for Healthcare Environmental Services (ASHES) to promote IPM best practices in health care facilities. Orkin experts co-authored the official IPM "how to" guide for more than 1,800 ASHES members across the United States and launched an IPM best-practices Web Site at www.HealthcarePestControl.com, where users can take a self-assessment of their current IPM practices and download customized tips for improvement based on their responses. Orkin also co-authored a "10 Step Guide to Implementing an Integrated Pest Management Program" with Hospitals for a Healthy Environment (now Practice Greenhealth) for distribution to their more than 5,000 health care facility members. **Schools**: In 2008, Orkin launched Junior Pest Investigators, a series of free K-6 lessons available at www.JuniorPI.com. Through this innovative learning program, based on National Science Standards and approved by an advisory council of national school-IPM experts, students uncover the essentials of Integrated Pest Management (IPM) at school and at home. To date, nearly 800 teachers have registered to use Junior P.I. materials in their classrooms.

P117 Impacts of IPM in Developing Countries: Evidence from the IPM CRSP

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Several countries in Asia, Africa, Latin America, and Eastern Europe have established IPM programs over the past 15 years with the assistance of the Integrated Pest Management Collaborative Research Support Program (IPM CRSP). These programs have produced practices that have reduced pests, raised incomes, and reduced pesticide use. This poster

provides a summary of the economic impacts of those IPM efforts on a country by country basis. Measuring the impacts of IPM programs is crucial both for accountability purposes and for guiding resource allocation across programs and IPM practices. This poster summarizes impacts estimated in studies on the IPM CRSP and it provides new estimates of the net benefits of recent IPM efforts. For the latter, information was gathered from several country on the adoption of specific practices and on resulting yield and cost changes. This information was combined with production and price data to estimate market level economic benefits of the IPM programs. Scientist-questionnaires were sent to IPM CRSP site coordinators in East Africa, West Africa, Southeast Asia, East Asia, Central Asia, Latin America and Eastern Europe. Examples of impact estimates were $56 million in net benefits over 15 years for tomatoes in Albania, $11 million for plantain in Ecuador, and $0.8 million for tomatoes in Uganda. Previous studies provided information on poverty reduction for a peanut IPM program in Uganda, nutritional benefits of grafting eggplant for bacterial wilt in the Philippines, and the environmental benefits of onion IPM in the Philippines.

P118 Measuring the Adoption of Biointensive IPM and Associated Ecological, Social, and Economic Changes in the Tart Cherry Industry: An Innovative Project Evaluation System

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A key objective of the USDA-funded RAMP project for US tart cherries is to "test and refine an innovative project evaluation system that measures the adoption of biointensive IPM and associated ecological, social and economic changes in the industry." It is crucial to integrate data collection efforts so that all stakeholders, from growers to researchers, understand the impacts of project activities and can make information-based decisions on how to proceed. During a previously funded RAMP project, a draft model for measuring tart cherry IPM was developed, and is now in the process of being validated by researchers, industry representatives and growers. The framework operates at three levels: strategies, tactics and tools. The project has currently identified five principal IPM strategies for tart cherry orchards: 1) monitoring, the foundation of any IPM program; 2) pest suppression, including insects, mites, weeds, fungi, bacteria, nematodes and viruses; 3) continuing education and professional development, in order to stay abreast of new technologies as they come on the scene; 4) gathering and applying information from best possible sources; and 5) managing pollinators, which has become increasingly important as populations of honey bees have become a concern in recent years. This poster presents the process used to develop the Tart Cherry IPM Framework and how it will be used to integrate ecological, social and economic changes in the industry. Preliminary findings from a 2004 baseline survey and a 2008 follow-up survey are also presented.

P119 Economic Impact of *Lygus* in Arizona Cotton: A Comparative Approach

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In Western production agriculture, *Lygus* spp. (Hemiptera: Miridae) have at times caused major losses to cotton, vegetables, seed crops, and a variety of other crops. However, the economic impact of this pest remains largely undocumented in most crops. Two major sources of data were used to quantify the economic impact of Lygus in low-desert upland cotton production in Arizona. First, a Pesticide Use Reporting database was derived from user reports to the Arizona Department of Agriculture entered by the USDA's Arizona office of the National Agricultural Statistics Service. They provided five year's worth (2001-2005) of custom and aerial application records statewide, representing the majority of insecticide use in cotton (due to state reporting requirements). Secondly, data were derived from an annual "Cotton Insect Losses" survey of cotton Pest Control Advisors (PCAs) that has been ongoing for 28 years. Both data sources include information on the target pest for insecticide applications, making it possible to single out Lygus control efforts. An analysis of these data provides important baseline information on the current economic impact of Lygus in Arizona cotton and will help us document future changes due to the introduction of new control strategies (e.g., Carbine, starting in 2007) or landscape-level changes, such as the introduction of new crops.

P120 IPM and the Idaho Potato Industry—Results of Statewide Grower Surveys

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We documented use of IPM practices within the Idaho potato industry by conducting a statewide survey of commercial producers during spring 2006. Our prior surveys during 1992 and 1998 provided a quantitative basis for documenting changes. Grower use of about half of the cultural practices was statistically greater in 2006 than during 1998; use of the remaining cultural practices generally held steady at their prior levels. Essentially no gains have been made in use of biological control practices since 1998. Direct use of insect biocontrols is virtually untried; more than 9 in 10 growers said they never mass-release insectary-reared agents, never use "least-toxic" biorational pesticides and never plant fencerow insectary plants as habitat for natural biocontrol agents. Use of field scouting generally was similar to 1998 adoption level. Depending on the pest, at least 8 in 10 growers depend on scouting to determine pesticide use. Virtually all commercial potato acreage in Idaho (95% to 98%) is treated with an herbicide,

fungicide and insecticide. Survey respondents also reported they applied nematicides and soil fumigants to 64% and 70% of commercial potato fields, respectively. All of these 2006 values are within 3-points of values from our 1998 survey. About 80 percent of Idaho potato producers meet the scouting and thresholds standards for prescriptive-to-midlevel-biointensive IPM system. Gains in IPM adoption especially are evident when judged against our 1992 baseline surveys; perhaps 1 in 3 growers had met this standard for prescriptive IPM seventeen years ago.

P121 Integrating Fungicidal Control Programs to Maximize Economic Return on Tomato Production in Albanian Greenhouses

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This research project evaluated the performance of tomato disease control under four different disease control programs ranging from a minimally acceptable to a highly intensive program. These four diseases control spray programs were compared on the basis of cost and disease management as well as the environmental impact. These experiments were carried out in Lushnja region during 2007 for the first crop of tomato cultivation. The standard fungicide program remains the most efficacious recommendation. It control the main tomato diseases better than the others treatments and had no significant differences with intensive program. However, it was more expensive than the control and low cost programs but less expensive in cost and with lower environment impact than intensive program.

IPM in Natural Areas

P122 Host Specificity Testing for Biological Control Agents of *Ulex europaeus* L.

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Native to Europe, *Ulex europaeus*, or gorse, is a large prickly shrub that has established colonies along the western coast of North America, where it was reported in as far north as the Queen Charlotte Island, British Columbia to the southern coast of California. Biological control has been implemented to help reduce the spread of gorse, but had no noticeable effect on plant density. Work is underway to test the safety of additional gorse biocontrol at the USDA certified quarantine at Oregon State University. In the present study, host-range of gorse thrips, *Sericothrips staphylinus*, has been tested on a total of 45 plants species; and gorse-tip moth, *Agonopterix umbellana*, will be tested on 35 plants species. The gorse thrips testing is completed, while testing of the gorse-tip moth has just begun. Gorse thrips did not develop from egg to adult on any of the North American native plants tested. However, it did develop on three European plant species, two of which are closely related to gorse: *Genista monspessulana* and *Petteria ramentacea*. The third plant that the thrips was able to develop on is *Vicia tetrasperma*, which has prompted us to carry out more testing on native *Vicia* spp. We concluded that gorse thrips is safe to the North American native and economically important plant species and will submit a petition for its release to the USDA APHIS Technical Advisory Group. In addition, results from the impact of gorse thrips on gorse seedlings experiment is also provided.

P123 The Challenges of Developing and Implementing IPM Programs for Bark Beetles in Western Coniferous Forests

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Integrated pest management (IPM) programs attempt to reduce insect associated losses to acceptable levels using multiple techniques that are effective, economically viable, and ecologically compatible. Management tools are constantly being developed for forest pests and IPM programs have been described for several species and systems, but are rarely implemented. This is particularly true for native bark beetles (Coleoptera: Curculionidae, Scolytinae), a large and diverse group of insects, commonly recognized as important tree mortality agents. Depending on the bark beetle species and numerous other factors, the extent of tree mortality may be limited to small spatial scales (e.g., individual trees or small groups of trees) that may go unnoticed or impact large areas (e.g., >9 million ha). Here we focus on the challenges of developing and implementing IPM programs for bark beetles in western coniferous forests. We discuss how forest management influences the amount and distribution of bark beetle-caused tree mortality at various spatial and temporal scales, and describe important relationships among several biotic and abiotic factors that affect forest susceptibility. The applications and limitations of available bark beetle hazard rating systems and management tools are discussed.

P124 Precision Management of Invasive Herbaceous Perennial Weeds in Sensitive Habitats at Lake Tahoe

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Several herbaceous invasive perennial weed species have recently established within the Tahoe Basin. Herbicidal control cannot be implemented in certain areas due to water quality concerns, and mechanical methods are ineffective. Current regulations prohibit measurable residues of pesticides in Lake Tahoe, and an existing agreement with local regulators prohibits spray applications of herbicides within 7.62 meters of surface water bodies. Concerns about damage to the endangered plant Tahoe yellowcress (*Rorippa subumbellata*) also limit our options. To overcome these restrictions and protect sensitive habitats, in 2005 we successfully investigated application of herbicides to herbaceous perennial weeds using a dip and clip method. In 2007, we tested the efficacy of the method in controlling a scattered one-acre infestation of yellow toadflax (*Linaria vulgaris*) adjacent to the Truckee River outlet from Lake Tahoe. Most of the plants were within 3 meters of open water. A control plot consisting of 219 plants was clipped manually. Three additional plots containing 259 to 358 plants each were treated. Plants were cut at the base using clippers that had been dipped in a solution of glyphosate. Monitoring in 2008 showed no effect on the control plants but significant reduction in plant densities in all treatment plots, with one plot showing 100% control. The success of this initial trial resulted in a second trial on an infestation of perennial pepperweed (*Lepidium latifolium*) in 2008. The method, while labor-intensive, provides land managers with an effective management option for the eradication of establishing infestations of herbaceous perennial weeds in sensitive areas.

P125 Determining Sampling Area of a Bark Beetle Pheromone Trap System for Management Applications

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Bark beetle traps have been extensively used to monitor beetle populations. However, little is known about the relationship between trap placement, environmental variables, and insect movement and capture. The goal of this study was to measure the sampling range and effective sampling area of a semiochemical attractant-baited trap system used for western pine beetle (*Dendroctonus brevicomis*) in the western United States. To determine the probability of long-range beetle recapture, beetles labeled with fluorescent powder were released at a central point within an array of pheromone-baited traps (16-funnel Lindgren funnel traps with attractant lures of frontalin, exo-brevicomis, and myrcene or alpha-pinene) distributed in cardinal directions at intervals up to 1500 m. We conducted trials in Oregon, Idaho, and Arizona. Trials were conducted in each location corresponding to two different beetle generations. Weather data were recorded for each release-recapture period. Total recapture fraction over all locations averaged 0.15-0.18. Eighty percent of all beetles were recaptured within 800 m of the release point and all were captured within 2000 m. Meteorological data analyses from Oregon sites reveal that wind may affect insect movement and therefore should be considered in trap placement. Total recapture fraction was positively correlated with wind speed ($r=0.78$), but may be confounded by seasonal effects; lower recapture fractions were observed early season. These findings may enhance the integrated resource management applications of this tool by providing information about effective placement of traps for monitoring or use in suppression, and potentially in inference of beetle densities within a particular area.

P126 Development and Implementation of an Area-Wide Management Plan for the Invasive Weed, Tansy Ragwort, in Northwestern Montana

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The initial infestation of the poisonous weed, tansy ragwort (*Senecio jacobaea*), in northwest Montana in 1996 was first thought small enough to be eradicated. However subsequent surveys indicated that the actual infestation, including outlying populations, covered over one-half million acres of mixed federal, state, and privately owned land. To adequately address this problem, and raise the funding necessary for an area wide management program, a cooperative weed management area was created, overseen by an interagency steering committee. This committee ultimately designed and implemented a IWM program that consisted of (1) suppression of plant densities and seed production in core areas by using herbicides, (2) containment along the periphery of the infestation and vectors to prevent the further spread of the weed, (3) eradication of outlying pockets, (4) the use of biological control as a long term, permanent solution, and (5) a monitoring program, including education and public awareness. This program has been exceptionally effective and its organization and operation can serve as a model for the development of management programs for other new weeds that will be found in the northern Rockies in the future.

P127 Semiochemical-Releasing Flakes Protect Conifers from Bark Beetles

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Verbenone and methylcyclohexenone (MCH), two anti-attractants for *Dendroctonus* spp. bark beetles, were formulated in laminated pheromone-releasing flakes for application to protect individual trees or entire forest stands from bark beetle attacks. Broadcast applications of verbenone-releasing flakes, using either aircraft or ground-based crews, significantly reduced attack by *Dendroctonus ponderosae* (mountain pine beetle) on *Pinus contorta* (lodgepole pine) in Idaho and California and *Pinus albicaulis* (whitebark pine) in Wyoming. Similarly, aerial applications of methylcyclohexenone, an anti-attractant for *Dendroctonus pseudotsugae* (the Douglas-fir beetle), significantly reduced the rate of attack by *D. pseudotsugae* on *Pseudotsuga menziesii* (Douglas-fir) in Washington. Verbenone flakes also provided significant protection to lodgepole pines from attack by mountain pine beetle when applied with a sticker to the trunks of individual, high-value trees. This flake formulation, which is the first consistently effective formulation appropriate for area-wide treatments, shows promise for rapid response in treating large and/or remote acreages of conifers that are under increasing attack by bark beetles as a consequence of forest management decisions and climate change. Individual tree applications show promise for use in urban forests, campgrounds, administrative sites, ski resorts, and other high-value trees.

P128 Experimental Trials, Regulatory Tribulations, and Theoretical Fuzziness in the Development of an IPM Program for Burrowing Shrimp

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A short history of the experimental trials we have executed and the regulatory and political hurdles we have encountered while developing an IPM program for burrowing shrimp (*Neotrypaea californiensis* and *Upogebia pugettensis*) in Willapa Bay/Grays Harbor Washington is presented. Due to the unique nature of our agricultural setting, the management of indigenous species on commercial shellfish beds within an estuary, we faced several challenges to the traditional (e.g., Kogan's (1998)) IPM paradigm. For example, almost all potential biological control agents are also quite generalist and difficult to manipulate; a host-specific parasite is an exotic species and requires several more years of research. Reduced risk compounds such as 25b list materials are wholly ineffective. Most effective pesticides could cause broad spectrum damage in the estuary. Others lack corporate sponsorship due to the crop's minor status and complicated use. Policy regarding the management of indigenous species in an estuary is compounded among state and federal agencies and societal attitudes are generally confused. Nevertheless, we have constructed a developing IPM program for burrowing shrimp that features dozens of scientists from state, federal, and private institutions. Currently, tactics and strategies resemble a "reduced risk" program, along the lines of "supervised control" as outlined by Ehler and Bottrell (2000). For example, we could not describe an economic action threshold in the traditional sense, but have developed a decision tree for control action based on characteristics of the bed, shrimp recruitment, and an adjustable minimum threshold burrow count. We currently are advancing a single compound for third-party registration.

P129 Variable Response of Perennial Pepperweed to Sheep Grazing

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Two studies were conducted in Reno, Nevada to determine the effect of grazing on perennial pepperweed growth. Each trial was established to investigate a different grazing strategy; 1) short duration intensive grazing (small plot trial) and 2) longer duration, less intensive grazing (large plot trial). Both studies were initiated in 2005 and consisted of two treatments, grazed and non-grazed. Individual treatments were replicated three times and were applied to plots that measured 0.5 acres in the small plot trial and approximately 10 acres in the large plot trial. Grazing in each study occurred three times per year for three consecutive years. Perennial pepperweed density and biomass was reduced in the grazed plots compared to the nontreated check in the small plot trial. In this trial, however, nongrazed plots had significantly greater species diversity than grazed plots. No significant differences existed among grazed and nongrazed plots in the large plot trial. These results suggest that grazing for perennial pepperweed management should be intensive and short in duration. One drawback to this approach is potential injury to nontarget perennial species.

IPM Strategies

P130 Implementation of IPM Scouting Program for Tomato and Cucumber Crop Production in Albanian Greenhouses

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An IPM demonstration project on tomato crops cultivated in greenhouses was conducted in the main region (Lushnja) of vegetable production in Albania. Plant protection specialists and the grower of one tomato greenhouse were responsible for pest monitoring, record-keeping, and weekly meetings to make pest management decisions based on the information collected. Comparisons were made between the IPM treatments vs. the grower's conventional pest control practices. Results indicate that the scouted greenhouse resulted in reduced pesticide usage without affecting plant quantity and quality. This was achieved at a lower overall cost, even with the increased labor for monitoring. The benefit of the scouting program was early detection of pests and diseases at low level. Additionally by specifically locating infestations, spot pesticide applications were made instead of grower's routine practice of spraying all the greenhouses. The scouting program from March to June, 2007 resulted in 46.6% fewer pesticide applications and a 29.37 % savings (or 6969 lek per 0,1/ha). An other IPM demonstration project on cucumber crops cultivated in greenhouses was conducted during autumn 2007.The scouting program from September to November resulted in 58.76% fewer pesticide applications volume and a 28.1 % savings (4553.3 lek / 0,1ha) without affecting plant quality and salability.

P131 An Assessment of Integrated Pest Management (IPM) in Orange and Ulster Counties, New York

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Cooperative Extension (CCE), NY has offered an IPM program to farmers in NY since 1984. Baseline data regarding IPM adoption, growers' profiles, and factors that influence participation in an IPM program are limited. We used an advisory and focus group to conduct a survey to determine the level of IPM adoption and factors that could improve the adoption of IPM practices in NY. Fifty two percent of questionnaires were returned. Our results indicated that (56%) of respondents fell in the "Moderate IPM users" group and 88% referred to CCE information and extension agencies for their pest management decisions. Of the variables tested regarding decisions growers consider before implementing IPM tactics, growers cited that an IPM tactic's ability to a) increase yield or improving crop quality (56%), or b) decrease pests (54%) as important factors. Results had significant positive correlation between IPM adoption and farmers perception of having sufficient knowledge of IPM tactics. Thereby increased IPM education for farmers may help increase adoption. Farmer perception of consumer or market demand for IPM managed crops managed demonstrated a positive correlation with IPM use. This implies if more markets for commodities produced with IPM existed additional IPM would be used. Our results indicate a need for more IPM knowledge among farmers and the public. We recommend dissemination of information with an emphasis on clear, simple instructions for IPM use. Also, educate consumers about IPM products in the hopes of establish more markets for IPM products. If implemented IPM adoption is likely to increase.

P132 Development of Landscape Diagnostic Field Guides

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The objectives of this project are to complete 3 pocket IPM field guides that will be published in association with the Natural Resource, Agricultural, and Engineering Service, (NRAES). This is a national publishing house that publishes material for the public. These field guides will cover broadleaf woody ornamentals, needled evergreens and herbaceous ornamentals. They will be titled *Broadleafed Shrubs and Shade Trees: Problems, Picture Clues and Management Options; Needled Evergreens: Problems, Picture Clues and Management Options,* and *Herbaceous Ornamentals: Problems, Picture Clues and Management Options*. The content will come from the text and pictures on the very succesful University of Maryland's Home and Garden Information Center's diagnostic Web Site: plant-diagnostics.umd.edu. Users will easily navigate through their problems through the use of a large number of color pictures. These books will reduce pesticide use by helping users with indentifying problems correctly and following IPM management recommendations. The guides should appeal to a wide audience including Extension and Green Industry professionals, Master Gardeners, First detectors and the general gardening public.

P133 Flash Grazing of Hogs in Apple for Reduced-Input Pest Management

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A project to develop and evaluate an orchard system for Upper Midwest (USA) fruit growers that integrates rotational swine grazing for control of insect and disease pests, while enhancing profit potential through sales of organic pork was investigated in 2007-2008. The impact of hog grazing on aborted apples for control of one of the most serious pests of organic apples, *Conotrachelus nenuphar*, was evaluated most extensively. The number of "June Drop" apples for two cultivars, Idared and McIntosh, was quantified as a mean of approximately 123 apples per tree for both years. Forty-seven percent of field-collected, aborted apples in 2008 had at least one *C. nenuphar* oviposition scar, and 15.7% of drops contained viable larvae. Twenty-seven two-month old Berkshire hogs (Ca. 20-30kg), grazed prior to predicted emergence of *C. nenuphar* larvae, consumed 99.8% of dropped apples in 0.4ha plots in 2007. In 2008, 24 two-month old Berkshire hogs consumed 99.9% of dropped apples. Hogs were rotated among 3 grazed plots, spending 2-3 days in each grazed plot per week for three weeks. A controlled feeding experiment demonstrated that ingestion of *C. nenuphar* larvae in apples by pigs was 100 percent lethal to the larvae. Spring egg-laying injury from *C. nenuphar* in 2007, prior to start of grazing, was 11% in grazed plots, 8% in non-grazed. Summer *C. nenuphar* feeding injury, following the start of grazing in 2007, was 4.9 fold higher in non-grazed control plots ($p=0.0148$, $t=8.1$, $df=2$). Spring *C. nenuphar* oviposition injury in 2008 was 8.7% in non-grazed plots and 4.1% in grazed plots ($p=0.2856$, $t=1.2$, $df=4$). Summer *C. nenuphar* feeding injury was 3.4 fold higher in non-grazed plots in 2008 ($p=0.0001$, $t=15.3$, $df=4$). Grazed plots also had significantly less codling moth injury to fruit ($p=0.0019$, $t=3.8$, $df=4$), significantly lower percentage grass cover in tree rows, significantly higher bare ground coverage (alpha=0.05, $n=4$) in tree rows, and significantly lower grass biomass in grazed plots ($p=0.035$, $t=3.1$, $n=4$). Rooting of young hogs (under 45kg) in the tree row soil as they foraged through the orchard averaged 4-6 inches in depth. Rooting by hogs larger than 45kg resulted in some exposure of tree roots and some destruction of sod in the drive rows. Overall, the health status of all animals was acceptable, and did not require the use of any pharmaceuticals. Apple pulp and discarded whole apples were provided continuously, about 450 kg per day since weaning, providing over 50% of their daily food intake. Anecdotal observation in 2007 suggested superior weed control and improved nutrient availability resulted from hog grazing/rooting. Data collected during the 2008 season on weed growth, nutrition, and control of codling moth (*Cydia pomonella*) and apple scab (*Venturia inaequalis*) will be reported on in this paper.

P134 IPM of Filbertworm in Hazelnut Orchards in Oregon

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The filbertworm, *Cydia latiferreana*, is a key pest of hazelnuts in Oregon. Current control relies on chemical sprays and orchard floor management. Our research objectives are to improve treatment timing and to investigate new strategies for filbertworm control. The seasonal flight pattern of filbertworm was monitored using pheromone-baited traps in commercial hazelnut orchards and adjacent oak trees. Moth flight in the orchard center, orchard border rows and adjacent oaks was recorded twice a week. Filbertworm were trapped from June to October with the majority caught in oaks and at orchard borders. The timing of nut infestation was determined in an abandoned orchard by enclosing 100 hazelnut-bearing branches in gauze bags. Ten bags were opened per sample date to expose the nuts to filbertworm for a two-week period. Oviposition and nut infestation occurred from June until October and peaked from mid-July to August. Data suggest that filbertworm damage occurs during a longer period than previously believed. Filbertworm migrate into commercial orchards from surrounding host plants. The susceptibility of filbertworm larvae (with and without hibernacula) and pupae to entomopathogenic nematodes (EPNs) was tested. All stages are susceptible. The nematode Steinernema carpocapsae was most efficacious. Field trials with hibernating filbertworm treated with EPNs show that control efficacy increases with nematode rate. Larval preference for overwintering sites was investigated indicating the importance of orchard floor management. The larvae prefer organic matter (grass and debris) over bare orchard floor. EPNs are a promising tool, while orchard floor management is an essential component of filbertworm control.

P135 Integrated Management of Potato Late Blight in Cyprus Based on Real-Time Forecasting and Mapping of the Disease

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Potato is one of the most important crops of the agricultural economy in Cyprus. Late blight (*Phytophthora infestans*) is the most destructive disease of potato, causing severe losses especially in humid years. To prevent yield losses, potato producers

apply fungicides based on empirical and calendar information. This approach is not always effective and frequently leads to excessive pesticide use, with a negative impact on the environment and human health. During the 2007- 08 growing season a study was initiated with the aim to introduce an IPM scheme for late blight in Cyprus, based on real time forecasting and mapping of the disease. To this end, a network of agrometeorological stations was established in the major potato growing area of Kokkinochoria, which broadcast wirelessly the micro-environmental conditions. These meteorological data are processed using nine forecasting models (Hyre, Wallin, BLITECAST, Smith, Winstel, Forsund, Fry, NEGFRY, Ullrich), each suggesting a respective spraying scheme. These schemes are compared to the conventional control practice with a view to develop a prognosis system that would achieve a significant reduction of fungicide application combined with satisfactory control of late blight. Data/results from the weather stations and the forecast schemes are incorporated on a web-based Geographic Information System (GIS) platform that will be freely accessible to agronomists and growers in the future. The first results indicate that most of the forecasting models tested achieve a considerable reduction of fungicide applications. Further results concerning the evaluation of forecasting models and the development of the GIS platform will be presented.

P136 Trac Software Improves Pesticide Record-Keeping for the Agricultural and Turfgrass Industries

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Trac Software, an Excel-based program, enables easy maintenance and reporting of accurate crop protection records. Versions for fruit, TracGrape, TracApple, TracPear, TracStoneFruit, TracCherry, and TracBerry have proven vital to a farmer's market edge by generating detailed pesticide records for traceability. In 2008 a total of 650 copies of Trac Software for fruit were downloaded from http://nysipm.cornell.edu/trac/downloads/ by 427 individuals. Trac Software pesticide information is routinely updated. Trac Software was evaluated in 2007 with a 16 question phone survey conducted by The Survey Research Institute, Cornell University. Of those surveyed, 61% agreed that Trac Software has helped their farm business bottom line: primarily through improved office staff efficiency, avoidance of fines for non-compliance, and estimating pesticide needs for bulk purchases. Fully 28% agreed that Trac Software had improved their access to new markets. The survey clearly found that Trac Software improves the pesticide spray record-keeping and reporting ability of farmers. Trac makes record-keeping easier—70% agreed; improves accuracy—76% agreed; streamlines reporting—76% agreed; and helps meet reporting requirements—84% agreed. The fact that 98% will continue using it underlines the positive impacts of Trac Software for farmers. Trac Software specifically designed for professional turfgrass managers in New York to record, organize and report pest management and fertilization practices was released on CD in 2008 and includes TracLawn, TracGrounds, TracGolf and TracSod. Trac makes record-keeping and reporting for government agencies easier, improves the accuracy and consistency of pest management records, and promotes the practice of IPM.

P137 *Bacillus amyloliquefaciens* KPS46 Increases IAA and Phenolic Content for Enhanced Growth Promotion and Induced Systemic Resistance in IPM Program of Green Soybean Production

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B. amyloliquefaciens KPS46 has been reported to activate key elicitors in enhanced plant growth and induced systemic resistant against soybean bacterial pustule under greenhouse condition. In this study, we evaluated whether KPS46 performed accumulation of IAA and phenolic content against several diseases under field experiment. The impact of KPS46 as a benefit part of IPM that might affect virus disease and insect vector was also conducted. Field experiment was set up as RCBD with 6 treatments during August-October, 2007 and February-April, 2008 at Nakhon Pathom and Nakhon Ratchasima plot sites. Soybean seeds cv. AGS292 treated with KPS46 was a pattern of enhanced seedling growth phenotype and induced systemic resistance of soybean plants. The accumulation of IAA and phenolic content was significantly detected from KPS46 treated seeds ($P<0.05$) which was similar to those obtained from greenhouse tested. KPS46 agent reduced natural infection of several diseases including damping-off, root or foot rot, anthracnose, bacterial pustule, and soybean mosaic virus. The reduction of SMV development observed in KPS46 treatment was correlated with low number of aphid population suggesting that management of aphid vector was successful. Moreover, all treatments in IPM program of disease, insect pest and weed management applied with KPS46 were differences in the incidences of important pests. Overall, when combined with KPS46, yield was

increased by over 27%. The results strengthen the strategies of KPS46 mechanisms that is the best approach for disease management and incorporated use in IPM program of green soybean production.

P138 Highlights of PMC Successes in Potato

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Since its establishment, the Pest Management Centre (PMC) of Agriculture and Agri-Food Canada has conducted and supported work to provide new and alternative tools for growers to use in combating some of the worst pests of potatoes including late blight, Colorado potato beetle and wireworm. A pesticide risk reduction strategy has been developeded to provide potato growers with reduced risk management approaches for wireworm control, and a number of products have been submitted for registration for use against this and other pests of potato. Progress achieved thus far is presented.

P139 New Biotypes of Brown Planthopper in Thailand

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In the early 1970s, only biotype-1 of brown planthopper (BPH) prevails in the rice growing regions of Thailand. Rice varieties grown during the time had no resistance to BPH. RD9, the first improved variety with resistance to the insect was released in 1975 and became widely grown in the farmers field in 1976. Since then, several other high yielding varieties with incorporated BPH resistance gene(s) were released. During the last three years, outbreaks of BPH in the central regions of the country have been reported. Some varieties which have previously shown resistance to the pest were similarly damaged by the heavy planthopper infestation. Insect biotype identification in field collected BPH from two central provinces, Chainat and Phitsanulok, revealed the presence of biotype-3 and two new biotypes in the insect population. The newly identified biotypes were designated as biotype-5(t) and biotype-6(t). Both BPH resistance genes Bph3 and bph4 conveyed resistance to biotype-3 whereas one or both of the genes were susceptible to the new biotypes. While Bph3 gene governs resistance to biotype-5(t), bph4 gene is rendered susceptible by the insect biotype. On the other hand, both genes showed susceptibility to biotype-6(t).

P140 An IPM Approach for the Management of Thrips-Transmitted Tospoviruses in Vegetable Cropping Systems in South and Southeast Asia

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In recent years, diseases caused by tospoviruses (genus: *Tospovirus*, family: Bunyaviridae) have become a major threat to a broad range of agricultural and horticultural crops. To date, seventeen different tospoviruses have been characterized and twelve thrips species (*Thysanoptera: Thripidae*) have been identified as vectors of these viruses. Due to the broad host range of thrips and tospoviruses, overlapping cropping practices, indiscriminate use of insecticides resulting in vector thrips developing insecticide resistance, controlling diseases caused by tospoviruses has become a challenge for sustainable production of vegetables in smallholder farming systems of South and Southeast Asia. The Integrated Pest Management-Collaborative Research and Support Program (IPM CRSP) funded by USAID has initiated multi-disciplinary, system-wide research and technology transfer programs for a comprehensive development strategy to mitigate the impact of tospovirus diseases in smallholder agriculture in the region. The main objectives of the project are to (i) conduct strategic research on tospoviruses and thrips vectors and identify host plant resistance and (ii) conduct applied and adaptive research to deploy eco-friendly integrated disease management strategies to prevent outbreaks of tospovirus diseases. Current strategic research has documented five tospoviruses and four vector thrips species in different vegetable crops in India and Indonesia. Diagnostic methods have been developed for accurate detection of tospoviruses in vegetable crops. The project has contributed to institutional capacity building within developing countries for conducting research on tospovirus diseases through graduate education and short- and medium-term training programs. Outreach activities have facilitated an increased awareness of tospovirus disease problems in vegetable crops.

P141 Alternative Management Strategies for Grape Berry Moth

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Grape berry moth (GBM) *Endopiza viteana* is the key arthropod pest of grapes in New York, Pennsylvania, Michigan and other grape-growing regions east of the Rocky Mountains. Larvae feed directly on fruiting structures causing yield loss and perhaps more significantly, contamination by providing an entry point for rot organisms. Prior to the late 1980s GBM in central New York and the Lake Erie grape belt of western New York and western Pennsylvania was kept in check through 3 to 5 applications of a broad-spectrum insecticide. Although effective, this management program was expensive, disruptive of natural enemies, and potentially detrimental to the environment and food safety. The development and implementation of the Grape Berry Moth Risk Assessment (GBMRA) Protocol (Hoffmann and Dennehy, 1988) greatly reduced the need for calendar based insecticide applications, eliminating them in some vineyards, and quickly became the grower standard. The effectiveness of the GBMRA protocol started to fail in the late 1990s due to changes in the environment, production practices and the loss of conventional insecticides. Recent research on alternative management strategies for GBM in Labrusca grapes has focused on a multi-pronged approach of using pheromone mating disruption, and biological control along with new generation and conventional insecticides. Taking information from research blocks to commercial vineyards is the key to a successful implementation of IPM protocols. Small group "Coffee Pot" meetings are used to communicate important information throughout the season and growers can find short information videos on YouTube at www.youtube.com/LERGPvids.

P142 Biological and Molecular Characterization of Thrips-Transmitted Iris Yellow Spot Virus: Tools and Technologies for Developing IPM Strategies

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Iris yellow spot virus (genus *Tospovirus*, family Bunyaviridae) has been a major constraint to production of both bulb and seed onion crops in several parts of the country, notably in the Pacific Northwestern region of the US. The virus is transmitted by onion thrips, *Thrips tabaci* in a circulative and propagative manner. To develop IPM tactics for reducing the impact of IYSV, tools and technologies for rapid and sensitive detection methods were developed. IYSV isolates from commercial onion fields were collected and pure cultures were established on selected indicator hosts to determine the biological variability such as symptomatology and virulence. Using recombinant nucleocapsid (N) protein and NSs proteins, polyclonal antisera were prepared and characterized and an antigen-coated ELISA format was developed for detecting IYSV in plants and thrips. Using primers from the N gene, a rapid and sensitive real-time RT-PCR method was developed. To better understand the variability at the molecular level, the N genes several IYSV isolates were cloned and sequenced. Phylogenetic analysis showed the presence of two distinct populations of IYSV based on the N gene sequences. With a few exceptions, one group largely consisted of the US isolates, while the second group was mainly comprised of isolates from other parts of the world. Availability of serological and molecular tools for virus detection in plants and thrips and knowledge on strain variability would be useful for developing IMP tactics such as screening and identification of onion varieties and germplasm with virus resistance or tolerance.

P143 Progress and Challenges in Developing IPM Strategies for Thrips-Transmitted Iris Yellow Spot Virus Epidemics in Bulb and Seed Onion Crops

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Iris yellow spot virus (IYSV), of the genus *Tospovirus* and family Bunyaviridae, continues to be a production constraint for bulb and onion seed crops in the US. Total crop losses have been observed in several commercial fields in the Pacific Northwest (PNW). The virus is vectored by onion thrips (*Thrips tabaci*). Initially confined to the Treasure Valley in the PNW, the virus has spread to almost all states in the western US and has been reported from Georgia, Michigan and New York, and from Ontario, Canada. Developing management strategies has been difficult. The biannual seed crop and the annual bulb crop seem to provide the green bridge for both the virus and its thrips vector. Besides onion, several annual weeds were found to be infected with IYSV. However, the potential overwintering sources of the virus and the vector are not known. The limited number of approved insecticides for thrips control in onion is a constraint to developing an IPM strategy. Despite these shortcomings, progress has been made in identifying certain production practices that seem to affect the final disease incidence. Poor soil fertility and moisture stress tend to exacerbate the virus infection. Maintaining optimum plant stand, adoption of early season thrips control, sound weed management, and separation of bulb and onion fields seem to have a positive effect in reducing the disease incidence. A risk index based on these factors could be potentially developed and used in formulating an effective IPM program for this important pest complex.

P144 High Tunnels and Grafting Provide Complementary IPM Strategies for Organic Tomato Production

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High tunnels are gaining popularity for organic and conventional tomato growers as they may provide season extension, reduced foliar disease incidence, and increased fruit quality. However, crop rotation is often compromised, and root-infecting diseases can be prevalent in these systems. A research program was initiated to evaluate commercially-available tomato rootstocks capable of reducing root disease incidence and increasing yield under tunnel and field conditions. Plants grafted onto "Big Power" rootstock showed reduced levels of root-knot nematode infection and reproduction compared to non-grafted controls and other rootstocks containing the Mi gene ($P<0.05$). "Big Power", "Beaufort", and "Maxifort" showed excellent resistance to southern stem blight (caused by *Sclerotium rolfsii*) ($P<0.05$). A systems research trial was established at the Center for Environmental Farming Systems (Goldsboro, NC) to compare grafted and non-grafted plants within field and high tunnel production, and under low disease pressure from root-infecting pathogens. The tunnel system had reduced levels of tomato spotted wilt virus and gray leaf spot (caused by *Stemphylium* spp.). In the tunnel, total fruit yield was higher when "Maxifort" rootstock was utilized ($P<0.05$), and grafting showed no effect in the field. Fruit damage caused by insects and tomato spotted wilt virus was higher in the field ($P<0.05$). In contrast, fruit cracking and catfacing incidence was higher in the tunnel system ($P<0.05$). High tunnel production offers a unique set of challenges for growers, and grafting with resistant rootstock offers a complementary role in an integrated pest management approach for tomato.

P145 Convenience and Simplicity? An Illusion and a Detriment to Integrated Weed Management

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Two of the main benefits growers ascribe to crop production systems based on herbicide-resistant crops (HRC) are the convenience and simplicity of weed control. However, these presumptions of convenience and simplicity are not valid and have negative environmental, ecological and economical implications. Importantly, the inclusion of integrated weed management (IWM) philosophy and resulting diversification of weed management tactics resolves these issues. The one aspect that likely could gain traction with growers is the improved economics of IWM; using a diverse weed management program improves profitability compared to single herbicide tactics most often used in HRCs. Interestingly, growers and agchem professionals are aware of negative ecological implication of the current systems but apparently have determined that the presumed convenience and simplicity of the systems overrides the negative aspects of the current practices. An Iowa survey of 6588 growers indicated that 26% of the growers reported that HRC fields are becoming more weedy and 45% reported that increased glyphosate rates and frequency of application is now required for weed control. The same questions were answered by 568 agchem professionals who reported a higher concern for weedy fields (40%) and more glyphosate needed (57%). Given the rapid evolution of glyphosate-resistant weeds in cotton and soybean production systems based on HRCs, it is difficult to understand why growers continue base weed control on a single herbicide tactic. The adoption of IWM can resolve the negative aspects of the current HRC systems but has, to date, not been widely accepted by growers.

P146 A Systems Approach for Managing Phytophthora Diseases in Horticultural Nurseries

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Nursery plants are susceptible to several diseases caused by species of the water mold *Phytophthora*. Nursery plants are also important long-distance vectors of non-indigenous pathogens such as the sudden oak death pathogen, *P. ramorum*. Pre-shipment inspections have not been adequate to ensure that shipped plants are free from Phytophthora, nor has this method informed growers about sources of contamination in their nurseries. We applied an approach based on Hazard Analysis of Critical Control Points (HACCP) for systematically detecting sources of Phytophthora contamination in four Oregon nurseries. We identified critical control points (CCPs) in commercial production systems and sampled bimonthly over a 2-year period. Plants, potting media, containers, irrigation water, and can yard substrates were sampled at all stages of production. Putative Phytophthora isolates were tested with genus-specific PCR and identified to species by direct sequencing of the internal transcribed spacer (ITS) rDNA. The most frequently encountered species were *P. cinnamomi*, *P. syringae*, *P. citricola*, *P. cryptogea*, *P. gonopodyides* and *P. citrophthora*. Results showed that healthy container plants often became contaminated when set out on contaminated can yard substrates. Used containers were sources of contamination at all four nurseries, as was water from irrigation ponds at two nurseries. After identifying CCPs where contamination occurred, we worked with nursery managers to develop best

management practices specific for each nursery. The systems approach worked well in targeting sources of Phytophthora contamination in nurseries, and could be applied to other pathogens and pests to ensure the health of nursery stock.

P147 Integrated House Dust Mite Management Indoors Using Ultraviolet-C

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House dust mites (HDM) are a serious public health threat, with up to 80% of US homes being infested and having allergen levels that are significantly high in 35% of those (>10 µg/g dust for Dermatophagoides farinae). Some 30% of the population is allergic to various HDM proteins in fecal pellets, cast skins, egg shells, with symptoms ranging from mild allergic rhinitis to life-threatening asthma. Less appreciated is the impact of mite allergens on companion animals, which suffer various degrees of atopic dermatitis. Longstanding approaches to reducing symptoms have been removal or entrapment (bedding barriers) of offending allergens, and chemically controlling allergen producers. Acaricides labeled for HDMs include benzyl benzoate, tannic acid or disodium octaborate tetrahydrate. Chemical use, although considered safe, may be problematic for various reasons including: 1) resistance development; 2) challenge of application (raking powders into carpet then vacuuming); 3) sensitivity of individuals to irritating powders; and 4) staining of sensitive fabrics. We report that a non-chemical-control strategy maybe tractable for HDM management. In the lab, a very brief (~1 sec) ultraviolet-C light exposure kills house dust mites. Since DNA damage is the likely mode of action, impact is not immediate. After several days there is a dramatic impact at the population level and nearly 100% of exposed eggs fail to hatch. Combined with a vacuum (Oreck) the UV-C offers the integrated power of mite/allergen removal and the potential to kill mites that remain behind in carpet and mattresses.

P148 Evaluation of Composted Dairy Manure and Biorational Products for the Control of Diseases of Fresh Market High Tunnel Tomatoes

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The effects of soil, transplant and foliar treatments on severity of tomato diseases and yield in high tunnels under transition to organic production were studied. Treatments applied were the biofumigant QRD 300 (*Muscodor albus*), a biocontrol agent Trichoderma hamatum 382 (T382), and the fungicides Kocide 2000 and hydrogen peroxide/OxiDate, with and without annual application of composted dairy manure. Natural disease pressure was low until late-season high humidity and cool temperatures resulted in increased Fulvia leaf mold and Botrytis gray mold. All of the treatments reduced the severity of leaf mold; the most effective was Kocide 2000. Plants grown in compost-amended soil had significantly less leaf mold than those grown in non-amended soil in 2007; there were no differences in 2008. None of the treatments were effective against gray mold in 2007. Plants grown in compost-amended soil had significantly more gray mold than those grown in non-amended soil, but the opposite was observed in 2008. Tomato plants were pruned more aggressively in 2008 than in 2007 to promote better air movement in the canopy, which may explain the different results during the two years. OxiDate reduced the severity of gray mold in 2008. Tomato plants treated before transplanting with T382 and grown on soil treated with QRD 300 yielded significantly more marketable fruit than the untreated control in both years. Compost amendment significantly increased the percentage of marketable fruits and decreased the incidence of minor fruit rots in 2007, but there were no significant differences in 2008.

P149 Agricultural Risk Reduction at the Pest Management Regulatory Agency (PMRA)

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The Pesticide Risk Reduction Program is a joint initiative of Health Canada's Pest Management Regulatory Agency (PMRA) and Agriculture and Agri-Food Canada (AAFC). The program is designed to support the development, availability and adoption of sustainable pest management tools and practices in agriculture and reduce the risk associated with pesticide use in agriculture through the development and implementation of risk reduction and transition strategies. Transition strategies are designed to help growers transition from pesticides being lost through re-evaluation. The program has worked with commodity stakeholders in developing these strategies to help fill pest management gaps in Canadian crop production systems. The implemented strategies have encouraged the registration and use of low risk or biopesticide products and through research, have promoted the development of new integrated pest management tools and practices. Through this program, the PMRA consults with grower organizations, federal government departments, provinces and territories, and other stakeholders to identify pest control problems and regulatory needs in agriculture. By collaborating with registrants, the PMRA promotes and facilitates the registration of lower risk products and biopesticides and maximizes registrations for minor use crops, including label expansions. The PMRA may prioritize these registrations based on agricultural needs. By looking at more innovative and flexible avenues for data generation and equivalency, the PMRA has become involved in joint reviews with the US as well as global reviews.

P150 Site-Specific Management Resulting in Conservation of Natural Enemies

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Site-specific management of insect pests, i.e. spatially and temporally targeting insecticide applications within a production area only where and when needed, has a number of benefits; decreased amounts of insecticides means decreased environmental and health risks, greater economic return, and greater sustainability of agricultural production. It has also been speculated (and demonstrated on small scales) that targeting insecticides may conserve natural enemies in untreated areas of the fields. These natural enemies then contribute to subsequent control of remaining sub-threshold insect pest populations. The green peach aphid, *Myzus persicae*, is the most important vector of virus diseases in seed potato in North America. It tends to first colonize the margin of a field prior to dispersing across a field. The temporal period of this event is long enough to facilitate a targeted application of insecticide at just the field's edge, resulting in control of initial colonizing aphids. Several fields were treated with insecticide targeted only at the field's edge while neighboring fields were completely treated. We compared the impact of the two application methods on the populations of predators. We found that 4 and 10 days after application the number of natural enemies found within fields were significantly higher in edge treated fields than in those receiving treatment across the entire field.

P151 Technology Transfer through the Hawaii Area-Wide Pest Management Program for Control of Fruit Flies in Hawaii

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Melon fly, *Bactrocera cucurbitae* (Coquillett), Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann), oriental fruit fly, *Bactrocera dorsalis* (Hendel), and Malaysian fruit fly, *Bactrocera latifrons* (Hendel), have accidentally become established in Hawaii, and attack more than 400 different host fruits. These fruit flies inhibit development of a diversified tropical fruit and vegetable industry, require that commercial fruits undergo quarantine treatment prior to export, and provide a breeding reservoir for their introduction into other parts of the world. Previous fruit fly control measures in Hawaii relied heavily on the application of organophosphate insecticides to crops. 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 are novel monitoring dispensers, reduced-risk bait sprays, and reduced-risk male annihilation applications. These technologies represent some of the most environmentally safe and technologically advanced fruit fly detection and control products developed to date. Permanent registration of these technologies is currently being completed to support sustainability of the Hawaii program.

P152 Evaluation and Redistribution of Spotted Knapweed Natural Enemies in Arkansas

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Spotted knapweed is an invasive species in the United States which is expanding in Arkansas as well as other central and southern states. Several exotic natural enemies now established in northern regions of North America are candidates for redistribution these areas. We evaluated the impact of one species, Urophora quadrifasciata, already established in Arkansas without intentional releases in the region. This gall fly produces more flies per capitula and exhibits an additional generation (a third) than reported from other regions. However, continued knapweed spread southward and greater seasonal seed production suggest this species is incapable of suppressing knapweed in Arkansas. We are redistributing and releasing two additional natural enemies, the lesser knapweed flower (or seed head) weevil, *Larius minutus* and the knapweed root weevil, *Cyphocleonus achates*. The redistribution of these species focuses on synchronizing the insects collected from northern states with their target release locations in Arkansas.

P153 Pheromone Baited Traps for the Detection of Low Mealybug Populations Levels in Vineyards

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A tool to detect low population densities and low fruit infestations levels can be very useful for pests that have quarantine status or that might rapidly build up in the field. Recently the sex pheromone of several mealybug species have been identified and synthesized, including Pseudococcus viburni and P. longispinus, the most common species in Chilean vineyards. A field trial was carried out in the 2007-2008 season in central Chile to determine the sensitivity of pheromone baited traps to detect mealybug presence. Four or five traps of each of the two species were deployed in four organic vineyards in September, and male caught were counted, every 15 days approximately, until harvest (May). On each occasion, five plants per trap were also sampled visually (3 min). At harvest, bunch infestation and damage (10 per plant) were determined on 20 plants per trap. Pheromone traps caught males from November to May, with *P. viburni* levels larger than *P. longispinus*. Seasonal average populations (December to April) by visual counts was very low (0.005 to 0.5 individuals per plant), as well as plants with infested bunches (0.8 to 13%) and mean bunch infestation (0.2 to 4.1%). Damage severity on average had an index lower than 0.06. Male catches in April correlated with bunch damage ($p = 0.006$; $R2 = 0.38$) and bunch percent infestation ($p = 0.03$; $R2 = 0.25$). This study shows the usefulness of mealybug pheromone baited traps for the detection of low populations and bunch infestation levels.

P154 FAST-ID: Instrumentation for In Situ Monitoring and Automatic Classification of Flying Insects

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We have developed prototype remote unattended optical instrumentation capable of automatically counting and classifying insects in flight. Neither acoustic or image based, the instrument uses a solar cell as an unconventional sensor to record rapid fluctuations in light intensity caused by the shadow or reflection of a flying insect. Digitized signals capture unique flight signatures containing rich spectral information allowing precise classification of the insects. The integrated technology is referred to as Flight Activity Signature Technology for Identification (FAST-ID). Preliminary investigations have shown the ability to unambiguously identify several species of aphids, moths, and mosquitoes (including sibling species and sex). Ongoing hardware device design and development will produce stand-alone units with embedded processing for automatic signature collection and long range wireless communication. A modular design will facilitate add-on components such as solar power or enhanced batteries, external IR lighting, and a suite of sensors that provide additional environmental information that will be tagged as metadata specific to each individual flight signature. Software research and development is focused on more robust algorithms designed for classification of a greater number of species or other taxonomic groupings, as well as automatic clustering of unknown species. Pest surveys, in agricultural, forestry and quarantine applications, are labor intensive and time consuming. FAST-ID will provide real-time, automated information about local pest populations allowing targeted and effective intervention operations.

Urban IPM Systems

P155 Developing and Expanding IPM in the Rapidly Growing Area of Southern Nevada

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Over the past ten years, Las Vegas Valley grew from 500,000 to nearly 2.5 million. With this increase in population, there is a growing challenge to meet the needs of pest management with minimum impact on residents. As pesticide usage continues to expand, and concerns about pesticides and the environment grow on all fronts, the need to increase educational reach into the community also grows. The public needs to be made aware that IPM is much more than good cultural practices and safe/eco friendly products. Such pesticide training has traditionally been conducted as stand-alone programs for specific groups such as pest control operators, farmers and nurserymen. Integrating IPM training into other programming has been found to reach more potential users effectively. This also proved successful in the Master Gardener training by including a section on pesticide safety, including IPM. A CEU training tract was added to a large green industry training. This was successfully accomplished with water conservation training. When universities first identified water issues, water conservation training classes were not well attended. More clientele was reached by including water conservation topics in other horticultural programming. With this in mind, the UNCE Water, Horticulture, Environmental and Economics team looked at new clientele groups to target, such as Commercial Training Conferences, Master Gardener Training, Correctional Horticultural Training programs, Invasive Weeds programs and stand-alone gardening programs such as Desert Green. Each of these community outreach programs focuses on a different group that otherwise would not have a large representation at a stand-alone program for Pesticide CEUs. One important but overlooked clientele is employees and staff

in other areas of an organization. This is true of mega-resorts in Las Vegas. Those who work in areas other than horticulture must understand the principles of IPM. This includes those who control funding for projects and products. Those in charge must understand why bugs are bought to control bugs and why harmless white powder called diatomaceous earth is worth the money. Good educational programming in a rapidly growing community such as Las Vegas encompasses many partners and a diverse clientele.

P156 Designing an Integrated Pest Management Program for Hispanic Landscape Maintenance Professionals

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According to a 2005 University of Florida Nursery and Landscape Industry Economic analysis report Florida's landscape sector accounts for 5.255 billion dollar sales a year; of which nearly 30% is related to landscape maintenance businesses. The use of IPM principles to maximize pest management by applying chemicals when appropriate is an essential component to a sustainable environment. Traditionally, IPM educational publications have been produced and directed towards English speaking audiences. However, in Florida a demographic change is rapidly occurring where the number of landscape management companies employing Hispanic speaking personnel is increasing annually. In the southern part of Florida the Hispanic employees in landscape businesses is nearly sixty percent. Central and North Florida are seeing increasing numbers of Hispanic employees in landscaping companies as well. The purpose of this project is to develop a basic IPM Scouting Kit to educate the growing number of urban Hispanic landscape personnel. The overall objective is to increase the Hispanic employee's knowledge of the importance of identifying and protecting beneficial insects, using appropriate cultural landscape practices and applying pesticides properly. Several classes have been conducted and the results show: 50% of participants indicated they were better able to identify beneficial insects and described their skill as good or excellent. 40% stated they would now scout for insects prior to applying pesticides. 90% stated their ability to do their job had improved. All of the participants stated the IPM program was beneficial to them and the scouting kit would be useful on their job.

P157 Training Purchasing Officers and Extension Agent Trainers to Increase IPM Adoption in Tennessee's Child-Serving Facilities

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To increase voluntary adoption of IPM in Tennessee's child-serving facilities three objectives were undertaken in a USDA Southern Region IPM grant. In the first objective, hands-on training of IPM, Model IPM policy and bid specification development was provided to forty school purchasing officers and pest management decision-makers. A follow-up phone survey indicated 81% of the school systems with these trained pest management decision-makers were using IPM. In the second objective, using the train-the-trainer method as is done with Master Gardeners, 46 Extension agents [Agricultural (41%), Family and Consumer Sciences (48%) and 4-H (35%) in 40 counties] and four Child Care Resource and Referral Agency personnel were trained to provide IPM workshops. In 2006, trained Extension agents provided 150 IPM workshops to child care workers and school pest management decision-makers resulting in 2149 contacts. In the third objective, an IPM continuum and statewide award/ recognition system, based on results of an online interactive survey, were developed to acknowledge child-serving facilities that reduce pesticide risks, and to market IPM in such facilities. In 1997, indoor school district IPM adoption was estimated at 12% (74% return) and in 2002, had reached 25% (36% return). In 2008, although only 6.7% of school districts completed the online survey, 54% of schools used high IPM. It appears the rate of IPM adoption is doubling about every 5 years. Through continued Extension efforts we hope all Tennessee schools will be using IPM by 2013.

P158 Biological Control of the European Chafer *(Rhizotrogus majalis)* with *Heterorhabditis bacteriophora* and *Bacillus thuringiensis* subspecies *tenebrionis*

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The European chafer, *Rhizotrogus majalis*, is a major pest of turfgrass in eastern North America. It was first found on the west coast of North America in New Westminster, British Columbia in 2001. As an invasive, non-native white grub, it has caused considerable damage to lawns and boulevards. Damage to grass is most severe in the fall and spring, caused by the feeding of third instars chafer larvae on the roots of grass. Secondary damage to lawns and boulevards is caused by skunks and crows, which dig through the grass to feed on the chafer larvae. With more emphasis on non-chemical pest management, use of insecticidal drenches to control this pest in urban settings is not acceptable and municipalities are searching for alternative control tools. We tested *Bacillus thuringienis* subspecies *tenebrionis* (Novodor) against second and third instar European chafer, and the entomopathogenic nematode, *Heterorhabditis bacteriophora*, against first, second, and third instar European chafer. Experiments were conducted in constructed grass plots. Treatment with *B. thuringienis* subspecies *tenebrionis* was ineffective against both second and third instar larvae. Treatment with *H. bacteriophora* at a rate of 750,000/m2 applied at the first and second instar significantly increased chafer mortality. City boulevards with infestations of European chafer were treated with *H. bacteriophora* at the first instar stage to evaluate efficacy in situ. Treatment with *H. bacteriophora* significantly reduced chafer densities in boulevards. *H. bacteriophora* can be successfully used as a biological control agent for first and second instars of the European chafer in turfgrass.

P159 Managing the Invasive Goldspotted Oak Borer in the California Wildland-Urban Interface: Outlines of an IPM Program

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In May 2008, a new and potentially devastating pest of oaks, *Quercus* spp., was discovered in southern California. The goldspotted oak borer, *Agrilus coxalis* Waterhouse (Coleoptera: Buprestidae), colonizes the sapwood surface and phloem of the main stem and larger branches of at least three species of Quercus in San Diego County, California. Larval feeding kills patches and strips of the phloem and cambium resulting in crown die back followed by mortality. Since 2002, aerial surveys in San Diego County have detected about 17,000 dead oaks. In a survey of forest stand conditions at three sites in this area, 67% of the oaks had external or internal evidence of *A. coxalis* attack. Because *A. coxalis* has only just been discovered in California, specific management practices have not been tested. However, landscape and land managers need guidelines for managing this pest now, given its potential for damage. We describe a provisionary plan for an IPM program for this new pest based on IPM principles developed for other well-known *Agrilus* spp. pests of shade trees, e.g., the bronze birch borer, *Agrilus anxius*, and the emerald ash borer, *Agrilus planipennis*. Key techniques include monitoring adult flight with purple- or green-colored sticky panel traps and sanitation of oak firewood by various methods including solarization. Movement of firewood is a major pathway of dispersal for many insect pests in the U.S., and represents one hypothesis for the introduction of GSOB into California. Outreach efforts to minimize further movement of infested firewood within the state are also essential.

P160 Building IPM Capacities in Latino Daycare Centers in Philadelphia

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The Spanish-speaking population in the United States is growing at 12% per year and in Philadelphia, this trend also holds true. The overall population of Latino cultural groups in the consolidated Philadelphia metro area is 348,135 and represents Puerto Rican, Mexican, Dominican, Cuban, El Salvadoran, Guatemalan, Nicaraguan, Venezuelan, Columbian and Ecuadorian. The Mexican community in particular is growing rapidly and the population is proportionally young, with many children living in substandard housing conditions in low-income households. These very conditions are conducive to high pest infestations and Latino children are at risk for pest and/or pesticide related health problems. Despite these facts, few IPM resources and outreach efforts have been developed, extended and implemented targeting this important demographic. Building on the PA IPM Program's urban IPM efforts in Philadelphia, we developed and implemented a pilot IPM project reaching out to Latino children and their families via area Daycare Centers. To date, four IPM training modules have been developed and delivered in Spanish to more than 100 community educators, childcare center directors and teachers serving Latino childcare establishments. Documented changes in attitudes, behaviors and IPM protocols resulting from training are being analyzed. Additionally, culturally-appropriate outreach materials for the wider community are nearing completion. Products produced and lessons learned from this project will be transferable to Latino populations and educators across the city as well as other urban Latino educators across the country.

P161 Wide Area Integrated Pest Management of the Formosan Subterranean Termite in the French Quarter of New Orleans, Louisiana

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The Formosan subterranean termite, *Coptotermes formosanus*, is a serious pest in areas where it has become established and is one of the most destructive insects in Louisiana. A pilot test was begun in 1998 in the French Quarter of New Orleans to demonstrate the effectiveness of using area wide integrated pest management to reduce densities of termites. All properties in a contiguous 15 block area in the French Quarter were treated using commercially available baits or non repellent termiticides. In 2002 the treatment zone was expanded to include the blocks surrounding the initial treatment area. Glue boards were used to estimate alate numbers and in-ground monitors were used to determine foraging activity. Alates were sampled once a week in April and two to three times weekly during the flight season (May through July 15) in 1998 through 2008. A reduction in termite numbers of 75% was observed in Area I and a 50% reduction were observed in the other areas. Monthly monitoring of foraging activity began in January, 1999 to determine the number of stations with termites. A 50% reduction in termite activity was observed in these stations. Inspections of properties using infrared technology and visual inspections of courtyards and trees are being conducted to detect and treat termites. A third, fourth and fifth expansion began in 2003, 2006, and 2007, respectively. Continued treatment, expansion, and monitoring are required to assess the long-term effects of the area-wide management program.

P162 Implementing School IPM in a Small School District in the Show-Me State

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The Monroe Model for implementing IPM in schools has been applied successfully in school districts around the US. An EPA Region 7 grant funded implementation of a pilot school IPM program in a rural Missouri school district to see if similar success could be attained as in larger districts. The Missouri School IPM Workgroup identified a school district for the pilot program with a supportive administration. The district has three schools and continues to make improvements as recommended in the initial site assessment including wire shelving and snap-top storage in kitchen areas, locked cabinet for greenhouse pesticides, moisture management, clutter reduction, and improved overall sanitation and exclusion. Educational activities included on-site training sessions for staff, pest control company, and other facility managers in addition to distribution of Pest Presses to school staff. Physical improvements, in conjunction with increased monitoring, have led to a 91% reduction in pesticide applications in 2008. University of Missouri Turf Extension Program joined as a new project partner to improve IPM on the grounds and athletic fields. Staff attitudes have shifted toward approval and there has been a reduction in pest complaints. The district was presented an EPA Award of Recognition and featured in a local TV newscast. The district plans to apply for IPM Star Certification in 2009. Progress in the state includes production of "IPM in Missouri Schools" DVD, presentations at school facility manager meetings, and an IPM policy being included in the school board policy manual of 35 districts.

P163 Novel Bed Bug Detection Device

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Bed bug (*Cimex lectularis*) populations are on the rise worldwide, rapidly emerging as a dominant pest threat in temporary and permanent human habitation, as well as different modes of transportation. Reports of bites and infestations, from five-star hotels and cruise ships to college dorms and private residences, are becoming more and more common. As the danger of bed bug infestations grow, industry experts agree: early detection and post-treatment testing are two of the most important elements in the fight against these pests. We have researched bedbug responses to a wide range of stimuli including temperature, sound, host odors and physical designs. By videotaping bed bug behavior, we have been able to optimize each of these factors to design and manufacture an integrated detection device. This poster will present research results, and introduce the CDC3000, a novel bed bug detection device that is now commercially available for deployment in bed bug IPM programs.

P164 Current Status of IPM Implementation in North Carolina Public Schools

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The School IPM Program of North Carolina State University has been instrumental in promoting the adoption of integrated pest management in Public Schools on a voluntary basis until 2006 when the School Children's Health Act (SCHA) was passed. This Act requires school districts to notify parents, guardians and staff about pesticide use on school property and to implement IPM programs by 2011. The goal of this study was to assess the level of IPM implementation in North Carolina public schools. Telephone surveys of Pest Management

Professionals (PMPS) that contract with schools and of maintenance directors of schools were conducted in 2006 and 2007 respectively to address this goal. Survey data indicate that Pest Management Professionals (PMPs) have changed their pesticide use patterns to increase effectiveness and safety of school occupants, although they still apply pesticides routinely in food service areas. School maintenance personnel are more supportive of the pest management efforts. Overall, more than 62% of the school districts have IPM programs. The extension program and the SCHA have effectively helped these school districts to adopt IPM however there is need to continue educating PMPs and school personnel about the value of IPM to establish the changes, and to increase IPM implementation especially in regions of the state where IPM implementation is poor.

P165 The Efficacy of OvoControl P (nicarbazin) as a Contraceptive in Pigeons for Urban IPM

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Pigeons are found in virtually all urban and developed areas of the United States. They are considered a pest species and provided no protection under federal or state laws, which safeguard other birds. Pigeons cause extensive property damage and are a source of public health risk and disease. Commonly poisoned with non-selective toxicants, OvoControl (nicarbazin) provides a non-toxic and humane alternative—contraception or "birth control" for birds. Registered by EPA in mid-2007, the product is now licensed in forty-nine states. A product based on the same active ingredient has been used in Italy since 2002. Avian contraception provides a non-toxic alternative for population management of pigeons consistent with IPM principles. Contraception complements all existing exclusion and removal techniques. The population control efficacy of OvoControl was recently tested at a site in San Diego, CA. Two locations were selected—one treated and one control. OvoControl was administered to a flock of 150 pigeons for a period of 12 months. The population of pigeons at the treated site declined by 53% during this period whereas the population of the control flock remained unchanged. The data collected in San Diego are consistent with larger scale studies conducted in Italy. Effective use of the product, site location, bird conditioning, dose distribution, automated feeders and remote camera monitoring equipment is included.

P166 IPM and Reduced-Risk Management of Golf Course Putting Greens

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We designed a project to provide information on the feasibility and performance of golf course turf managed with few or no chemical pesticides. The project is conducted on the 18 putting greens of the Green Course at Bethpage State Park, Long Island, NY. In its 9th year, the project is currently funded by NYS Office of Parks, recreation and Historic Presrvation and previously by NE IPM and the USGA. Current golf course pest management practices ("unrestricted") are compared with IPM and reduced-risk (previously non-chemical) management. Further comparisons are made between standard cultural practices and "alternative" practices that we believe will reduce turfgrass stress and thereby minimize pest problems. Total management systems, as practiced by turf managers are imposed, rather than focusing on individual technologies and isolated practices. Systems are evaluated for numerous aesthetic and functional factors including: visual quality of the greens, pest occurrence and severity, environmental impact of pesticide applications, golfer satisfaction, and cost. Pesticide applications on the IPM greens were 27-66% less than on the unrestricted pest management greens, and quality on the 6 IPM greens almost always equaled that of the unrestricted pest management greens. We were unable to consistently retain acceptable quality on totally non-chemical greens and therefore modified those systems to a reduced risk strategy as of 2003. Results from the first 8 years will be presented and discussed. Recently the project has expanded to include tees and fairways; spread successful practices to adjacent courses; and produce a manual on reduced risk golf course management.

Other

P167 Essential Oil of Waya (*Plectranthus* Sp) Composition and Acute Toxicity Against *Callosobruchus maculatus* F. (Coleoptera: Bruchidae)

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Plectranthus species is an aromatic plant called waya and cultivated in Congo-Brazzaville for treating pains after the child birth. Essential oil was extracted from *Plectranthus* with a waterfall distiller and identified to contain more than 76% of (E)-myroxyde and other compounds including terpenes. The oil is acutely toxic to and repellent to *Callosobruhcus maculatus* F., the main insect pest of stored pigeon pea seeds in Congo. Eighty percent of insects put in the choice situation between treated and untreated seeds with this essential oil were repelled. The oil studied exerted also an acute toxicity against *C. maculatus* adults and eggs. The LD50s recorded were 3.1 µL and 2.6 µL per dish respectively in the two development stages.

P168 Can Phosphite Be a Surrogate for Phosphate?

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Potassium phosphite is regularly applied against plant diseases caused by oomycetes such as Phytophtora, Plasmopara and Pythium. While potassium phosphite is an approved pesticide in the U.S., it is not officially registered in Europe and promoted there as a fertilizer and plant strengthener. Though the mode of action is not completely resolved, phosphite obviously interferes with the phosphorus (P) metabolism of fungi. In some studies phosphite had a negative impact on crop performance, while usually no negative impact has been found. Facing worldwide limited P deposits and increasing prices for fertilizer products, the question arises whether phosphite could be an additional P source, and what growth effects can be expected. In the presented study the influence of foliar-applied phosphite on the P supply of maize was studied in relation to the soil P. In the greenhouse plants showed a stunted growth and died off if phosphite was the exclusive plant available P source. Under field conditions plants showed broad chlorotic spots/streaks on leaf blades, leaf margins/tips were necrotic when the soil was deficient in P; only phosphate alleviated yield on with an increase of dry matter production by 29%, while phosphite reduced yield by 18%. In the vegetative plant tissue the total P content was highest when phosphite had been applied. Phosphite was determined in all plant parts after foliar treatment and accumulation was notably high in developing corncobs. The results reveal that phosphite is no adequate supplement for phosphate in plant nutrition.

P169 Control of Rice Blast Disease with Powder Formulation of Antagonistic Bacteria in Thailand

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The antagonistic bacteria against *Pyricularia grisea*, a causal agent of rice blast disease, isolates number B-125, B-059 and B-097 which showed the large mycelial growth-inhibition in plate assays and also showed the effectiveness in controlling rice blast symptoms in detached leaf method and in the field trials, were developed as talcum-based powder formulations. The population of antagonistic bacteria in powder formulations were 1.28 x 1011, 3.08 x 1013and 1.0x 1014 CFU/gram, respectively, The viability of antagonistic bacteria in powder formulations were 8.5 x 1010, 1.3 x 108 and 6.5 x 107 CFU/gram, respectively, after storage at 28°C for 7 months. For the storage at 4°C, 7 months, the viability of bacteria in powder formulations were 8.15 x 1010, 2.85 x 1010 and 1.05 x 1010 CFU/gram, respectively. These powder formulations were tested to determine the effectiveness to control rice blast disease in the field trials. The results revealed that the powder formulations of antagonistic bacteria B-097 and B-125 were effective to reduce collar rot and neck blast incidence when applied as a foliar spray 4-5 times or as a seed treatment and foliar spray.

P170 Case for Expanding the Interdisciplinary Context of IPM and the Problem Motivating Research

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Implicit in our investigation of new and improved methods for IPM, is an assumption that these methods will be applied in objectively well-defined management scenarios—by decision makers who are primarily interested in economic optimization and ecological system performance in relation to cost. We argue that there is a strong need to redress our conception of the management problem to align it with an understanding of how farmers conceive of pest problems (in the sense of the psychology of problem solving) and how their choices relate to their priorities and constraints. While it is clearly important to understand how IPM tactics perform in terms of ecological systems, this information will be even more useful if translated or adapted to the decision-making processes used by land managers. This "translation" would likely require the cooperation of psychologists, sociologists and, in general, more multidisciplinary research teams.

P171 Knotweed Control in the Chehalis Basin: Five Years of Lessons Learned

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The Nature Conservancy began controlling *Polygonom cuspidatum*, *P. sachalinense*, and *P. bohemicum* (Japanese, giant and bohemian knotweeds) in the Chehalis River Basin (Washington) in 2004 based on evidence of its likelihood to significantly alter riparian habitats if its spread continued unchecked. During the 4 years as the project lead, TNC has employed an adaptive management approach to achieve success and incorporate lessons learned. Changes have been made in treatment methodology based upon evolving science and field observations. For example, based on measures of knotweed regeneration, foliar treatments of aquatic-approved imazapyr have been adopted as the primary control method, while the less effective injection and foliar application of glyphosate has been reduced. Also, observations that soil type and shading influence the efficacy of chemical treatments have informed management. For instance, on gravel bars in full sun, one year of chemical treatment will generally result in 100% control, whereas in shaded sandy-loam or forest soils, regeneration of small, sickly stems will continue for several years following annual treatments. TNC has also evolved in its outreach methodology, engaging partners in the educational community on the threat of invasive species to riparian habitats in and out of the classroom. Partnerships are a cornerstone to the long-term success of the project. TNC's ability to adapt to the evolving landscape of invasive species management has allowed for the on-going success of knotweed control in the Chehalis River Basin.

P172 Enhancing Leafroller Parasitoid Activity in Caneberries with the Improved Timing and Selection of Pesticides

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The orange tortrix (*Argyrotaenia franciscana* Fernald) is a leafroller contaminant in caneberries. This leafroller is attacked by a large suite of parasitoid wasps, but the extent to which these parasitoids are affected by pesticides is unknown. This four year project aims to: determine the incidence, timing and activity levels of the key parasitoid species in caneberry fields with different pesticide programs, investigate the direct effects of pesticides on these species in laboratory and field bioassays, and to develop improved monitoring practices and phenological models for key leafroller and parasitoid species. A total of 198 fields over a 150 mile region with different spray regimes were monitored for leafroller larvae and adults, and 11,614 leafroller larvae have been collected. Orange tortrix parasitism ranged from 24.4 to 38.5% over the four years, and oblique-banded leafroller (*Choristoneura rosaceana* Harris) parasitism ranged from 15.8 to 20.5%. Parasitism was consistently higher in fields that did not use broad-spectrum pesticides. The braconid wasps *Apanteles aristoteliae* Vier. and *Meteorus argyrotaenia* Johan. were responsible for over 2/3 of the orange tortrix parasitism and over half of the oblique-banded leafroller parasitism. Cultures of *A. aristoteliae* were established, and laboratory and field bioassays of its susceptibility to the six most commonly used insecticides in caneberry fields were conducted. *A. aristoteliae* showed a range of pesticide susceptibilities, and these results will be used in conjunction with phenological models of parasitoid activity to provide recommendations about how to avoid disturbing these parasitoids during their periods of activity.

P173 Eggplants as Model Guardian Plant Systems for Whitefly IPM in Greenhouses

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The use of Guardian Plants is an IPM technique deploying plants to attract the pest and support natural enemy reproduction. They can play dynamic roles as indicator plants, trap plants, and natural enemy reproductive sites. Pest suppression with Guardian Plants can take place in different ways depending on the plant type and relative numbers of pests and natural enemies: 1) the plant pulls the pest away from the crop being "guarded"; 2) the natural enemy congregates on the plant where it kills the pest, and/or 3) a focused management action (pesticide spray, vacuuming, crushing, etc.) is targeted at the pest on the Guardian Plant or the infested Guardian Plant is removed from the greenhouse. This poster reports results of a 2-year study using Eggplant Guardian Plants at three poinsettia sites and one annual bedding plant site to manage sweet potato and greenhouse whitefly. The Eggplant Guardian Plants served three functions: as an indicator and trap plant and a site for natural enemy reproduction. Pesticide use was reduced in 75% of the test sites. The Guardian Plant approach uses plants that are highly susceptible to the target pests but also suitable as a site for natural enemy reproduction. For example, whitefly appears to thrive on eggplant, as fecundity is particularly high on this host. Further research is needed to determine how to create conditions for a stable ratio of healthy/parasitized nymphs on the Guardian Plant to sustain a pest/natural enemy balance that provides whitefly management within the greenhouse without multiple parasites releases.

P174 Epidemiology of Grapevine Leafroll Disease in Washington State Vineyards

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The wine grape industry in Washington State annually contributes in excess of $3 billion to the state's economy and has a national economic impact of $4.7 billion. The rapid expansion of the wine grape industry within the past two decades has predisposed the viticultural enterprise to several debilitating virus diseases. The Pest Management Strategic Plan for Washington State Wine Grape Production (2004) has identified grapevine leafroll disease (GLD) as the most economically important disease of wine grapes in the state. Using molecular diagnostic methods, six different grapevine leafroll-associated viruses (GLRaV-1, -2, -3, -4, -5, and -9) have been documented in wine grape cultivars showing GLD symptoms. Mixed infections of these viruses in different combinations were found to be more frequent in a single grapevine than single virus infections. Among different GLRaVs documented, GLRaV-3 was found to be the most prevalent. Our results also revealed the presence of other grapevine viruses in mixed infections with GLRaVs in grapevines showing GLD symptoms. Robust sampling strategies and diagnostic methods were developed for accurate detection of these viruses. Studies on spatial distribution of GLD showed an aggregated pattern suggesting that disease spread occurs between neighboring vines. Greenhouse experiments indicated root grafting as a potential means of GLD spread between neighboring vines. Our research indicated that GLD can spread to young plantings from a heavily infected neighboring vineyard. An understanding of various aspects of the biology and epidemiology of GLD is providing opportunities for development of strategies to mitigate the negative impact of the disease.

P175 Arabica Coffee Pest Profiles in the Mount Elgon Area of Uganda

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Pests are an important constraint to Arabica coffee production in Uganda. Bardner (1985) and Ngambeki et. al. (1992) documented several insect pests and diseases as occurring on Arabica coffee in the Mt. Elgon area. Over the years however, there have been changes in the farming systems and practices due to increasing human population; these coupled with changing climatic conditions may have led to changes in the pest profiles in the Arabica coffee zone of Mt. Elgon. Consequently it is important to understand the pest profile before design any integrated pest management system. In Uganda under the Integrated management collaborative support program (IPM CRSP) biological monitoring was conducted to establish the current pest status of Arabica coffee in the Mt Elgon. The monitoring was conducted in 6 locations in the districts of Manafa, Mbale and Sironko from July, 2006 to June, 2007. Data on insect pest and disease incidences were collected once every month during the monitoring period.

The most prevalent insect pests of Arabica coffee were Coffee stem borer (*Bixadus sierricola* White), coffee root mealybugs (*Planococccus irenue*s De-Lotto), antestia bugs (*Antestiopsis* spp. Ghesq. and Carayon), aerial scales (*Coccus alpinus* and *Coccus viridulus* De Lotto) and mealybugs (Planococcus kenyae Le Pelley and *Ferrisia virgata* Cockerell) While Coffee leaf rusts (*Hemileia vastatrix* Berk et Br.) and coffee berry disease (*Colletotrichum kahawae* Waller and Bridge) were the most prevalent diseases in the zone. The incidences of pests and diseases were influenced by altitude and slope orientation. The incidences of coffee stem borers (R=-0.6), leaf skeletonisers (R=-0.56), aerial scales (R=-0.52) and mealybugs (R=-0.58), coffee berry borer (R=-0.66) and lacebugs (R=-0.5) were, significantly (p 0.05), negatively correlated with Altitude. The incidence of coffee berry disease (R=0.73), however, was significantly positively correlated (p 0.005) with altitude. Incidences of antestia bugs, root mealybugs, leaf miners and caterpillars were not significantly (p 0.05) influenced by change in elevation. Generally, increase in elevation led to lower incidences of most insect pests.

These results therefore have provided the basis for the development of IPMCRSP research agenda for Arabica coffee pests in the Mt. Elgon area.

P176 HydroMechanical Obliteration (H_M_O) in Golden Gate National Recreation Area

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We are reporting on the use of a new control technique, HydroMechanical Obliteration (H_M_Osm), on six invasive plant species in Marin County, California at the Golden Gate National Recreation Area (GGNRA). Data collection consisted of a combination of before and after plots while others were recorded with photo-documentation. H_M_O involves the use of small amounts of cold water at 3500-7000 PSI to remove woody and herbaceous perennial plants. The result is a leave-in-place mulch with herbaceous plants or in the case of French Broom (*Genista monspessulana*) mature plants were

removed and piled. For Cape-ivy (*Delairea odorata*) and English ivy (*Hedera* sp.) significant reductions in both species were achieved with a single treatment. For Harding grass (*Phalaris aquatica*) multiple treatments over time were required. We had great success with Cape ivy and panic veldt grass (*Ehrharta erecta*) control as a follow-up to our initial mechanical removal of Cape-ivy conducted two years earlier. On jubata grass (*Cortaderia jubata*) only small plants were removed with one treatment, larger plants have taken 3-4 treatments over 12 months and French broom (*Genista monspessulana*) growing among compacted rock along Bolinas Lagoon removal was also successful. We found H_M_O to be a beneficial and cost-effective addition to our IPM toolbox.

P177 IPM Technology Translation—The Global Governance Impasse: Experts and Lay Publics at a Crossroad

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The IPM tool portfolio around the globe continues to grow. Ingenuity allows for a very broad and exciting range that includes new seeds, sophisticated chemical pesticides, natural plant oils, IT and sensors and genetically modified—GM crops. But with the excitement of the promises around new technologies, parallel concerns about allocation of risks and benefits gain prominence. Until recently, experts in science, government and industry were the sole authorities in charge of technology translation and regulation; a trend that is being reversed around the globe, giving "lay publics" represented by consumers, farmers and activists a bigger say in how new technologies are implemented. In this paper we review some examples of pesticide and GM crop governance from developed and less-developed regions in the world which point to a fast shift in balance. We argue that some of the impasses in the regulatory approval and adoption of key IPM are the result of poor communication between the camps of experts and lay publics defined by farmers, technology users and consumers. Our research points to the need for closer consultation in the early stages of IPM technology design and translation to achieve better regulation and governance designs with broader socio-economic returns.

P178 Evaluation of Integrated Pest Management Module for the Management of Sucking Pests and Necrosis in Sunflower

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A field trial was undertaken at Regional Agricultural Research Station, Raichur, Karnataka, India to evaluate suitable IPM module for the management of sucking pests and necrosis virus in sunflower. Adoptable module (Module-I) comprising growing of four rows of sorghum around the field (sown 15 days prior to sunflower crop), Seed treatment with imidacloprid 75 WP @ 5 g/ kg of seed at the time of sowing, application of vermicompost (2.5 t/ha) + 50 per cent recommended dose of fertilizer, application of NSKE 5 per cent after 30 days and spraying of Oxydemeton methyl EC @ 1.5 ml/l. at 45 days. Module -II consisted of four rows of sorghum around the field (sown 15 days prior to sunflower), seed treatment with imidacloprid 75 WP @ 5 g/kg of seed at the time of sowing, recommended dose of fertilizers as per package of practices and spraying of oxydemeton methyl @ 1.5 ml/l. at 30 and 45 days. Two modules were compared with untreated control. The mean populations of leafhoppers and thrips indicated a lowest of 4.06 and1.80 per plant in Module-I followed by 4.33 and 2.30 per plant in Module-II, untreated control recorded 9.66 and6.93 leafhoppers and thrips per plant respectively. The mean incidence of necrosis also clearly indicated a lowest of 5.70 per cent in Module-I followed by 5.78 per cent in Module-II with maximum incidence of 15.18 per cent in untreated control. Module-I recorded the highest yield of 14.2 q ha-1 followed by 13.0 q ha-1 in Module-II. Untreated control reported yield of 8.0 q ha-1. The net returns of Rs.16,370 was realized in Module-I against Rs.9,190 in untreated check.

P179 Microbe-Antagonists of Vegetable Rhizosphere and Their Use against Microorganisms Plant Disease

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The vegetables among the food products are often exceptional importance. They contain accessional nutrients for human beings (hydrocarbons, proteins, fats) and there are also many substances that cant be found in major foodstuffs. There are vitamins, organic acids volatiles and other aromatic fragrant component. In Georgia there are different types of diseases fungous, bacterial and virus in vegetable cultures. For that reason fruitfulness is 30% less and getting less.

One of the biological methods of struggles is the use of Microbe-antagonists. In soil spread of Antagonists kill fungi spore or even present them from causing diseases. The microbe-antagonists can also lessen the spread of pathogenic microbes, compete with them in absorbing food substance, accelerate the substance change and help them to struggle against the diseases. In plant risosphere the microbe-antagonists isolate the Antibiotics, which we meet in different quantity. A plant through its root can absorb different types of organic substance and also Antibiotics among them. In plant tissue the Antibiotics help to increase bactericides of cell juice, which helps the plant to resist contagious diseases. In other words imunobiological features of plant reflect the absorption of Antibiotics by plant. As there are lots of Antagonists in soil, its possible to isolate and use them as pure cultures to fight diseases. It's also know that there are some chemical substance used as Antiseptics to elaborate plant seeds. Those substance are concentrated in a plant tissue and they distinctively decreasing the growth and the value of the plant. This might be harmful for society and environment. Microbe-antagonists are absolutely harmless they support to produce ecologically clean products and they protect environment from pollution. There for the powerful microbe-antagonists produced by us will be used as most effective source for fighting pathogenic micro-organisms causing diseases and for increasing vegetable crops. Finally, it's important and also research novelty to isolate research and use Antibiotics Microbe-antagonists for Georgian environment The project research purpose to reveal antibiotics producente Microbe-antagonists in vegetable cultures resosphere to use obtain powerful Antagonists against Microorganisms living is soil causing plant diseases. In order to study in plant risosphere microbe-antagonists behavior we need to know there quantity and species composition and to have exact point about there development and collection soil climate ecological conditions. Its necessary to study of different types of Microbes and also the relationship between soil micro-organisms. For the first time in Georgia will be used biological methods of controlling and use of living micro-organisms make the base for protection nature and people.

P180 Management of White Grubs through Light Mediated Insect Trap and *Bacillus cereus* strain WGPSB-2 in Northwest Himalayas of India

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White grubs (Coleoptera: Scarabaeidae) are the cosmopolitan insect pests of agriculture, forest and pasture lands. The adults defoliate the plants and the grubs with subterranean habitat feed extensively on the roots. A two pronged strategy involving an efficient, eco-friendly, low cost, light based insect trap for capturing the adults and a novel entomopathogen, *Bacillus cereus* strain WGPSB-2 for the management of grubs was developed. Large scale deployment of the above technology was done on community basis in 18 villages of low, mid and high altitude areas including two experimental farms of Uttarakhand hills of North-West Himalayas of India. Three years experimentation during 2006 to 2008, revealed a drastic reduction in beetle population to the tune of 75.8, 78.5 and 80.5% in low, mid and high altitude villages respectively. A significant reduction of the grub population was recorded from 87.8 to 95.7% in three years across the different villages. As a result of reduction in grub population, per cent increase in yield of different crops was recorded from 23.8 to 187.9% in different villages and experimental farms of low, mid and high altitudes. The technology is thus, capable of managing white grubs at different altitudes of hills in general and North-West Himalayas of India in particular.

P181 IPM for the Rhinoceros Beetle: Development and Implementation to Coconut Farmers Using the FFS Approach

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The coconut palm plays a pivotal role in the cultural and socio-economic milieu of the rural population of Malaysia. It also forms an important raw material resource for export-based small and medium coconut-based processing industries. Insect pests, such as the rhinoceros beetle, *Oryctes rhinoceros* (L.), rank as important amongst the limiting factors of production. Normal efforts at management entail the regular use of pesticides which invariably impact upon the environment and escalating cost of production under the current scenario of production. The drive towards the advocacy of environmental stewardship programs in plantations necessitates research and developmental efforts towards the evaluation of a bio-based integrated pest management program for this pest. Trials were thus conducted using the basic components of the IPM program were as follows: (i) Mass trapping using pheromone-baited traps, (ii) use of the fungus *Metarhizium anisopliae*, (iii) Cultural practices such as removal of breeding sites and pulverization of coconut trunks, and (iv) Use of the baculovirus. The transfer of technology to farmers of the basic program was implemented based on the Farmer Field School (FFS) approach. The broad technical and socio-economic merits and limitations or challenges in using the IPM and the FFS approach are outlined. The need for an area-wide strategy of effective management is emphasized, in addition to recognizing the potential impact on the IPM program by changes in pest dynamics especially with recent emergence of invasive pests

such as the hispid, *Brontispa longissima* (Gestro) and the red palm weevil, *Rynchoporus ferrugineus*.

P182 Bio-Intensive Management of Collar Rot Affecting Sugar Beet in India with Microbial Antagonist NIPROT *(Trichoderma viride)* and Su-Mona *(Pseudomonas fluorescens)*

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Biopesticides Niprot (*Trichoderma viride*) and Su-Mona (*Pseudomonas fluorescens*) were evaluated for studying the dosage, extent of suppression of collar rot caused by *Sclerotium rolfsii* in sugarbeet grown in India. Apart from their application as enriched farmyard manure and seed coating biopesticide were also drenched at 30,60 and 90 days after sowing to evaluate the need of additional applications. During the crop period (October-March) , the first incidences of *S. rolfsii* was observed 60 days after sowing and the disease incidence gradually increased to 17% till the crop was harvested at 120 DAS. Though the individual treatment of Niprot and Su-Mona was able to suppress the disease but their combined application gave highest plant stand and lowest disease incidence (2.48%)and yield (73.16 tons/ha).The brix content of the beet was also observed to be significantly higher (21.80) as compared to the control (17.98). The microbial profile of the field showed that the bioagents could establish themselves well in the treated plots and could bring down the population of pathogen *Sclerotium rolfsii* effectively. Comparing the cost benefit ratio, the best application strategy to apply biopesticides when the disease incidence is low (<20%) is soil preparation with enriched FYM and seed dressing (1:17.89). In tropical country like India, sugar beet was observed to gain the required average weight of 1.8 kgs within a short period of four months as compared to longer crop duration of six months in temperate regions. Other pests which were found to be economically damaging were leaf defoliator *Spodoptera litura*, root knot nematodes *Meloidogyne* spp. and cutworm *Agrotis* spp.

P183 Application of Chitosan on Cucumber Plants—Suppression of Pythium-Foot Rot and Induction of Defense Resistant

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Biological activity of chitosan, a non-toxic and biodegradable polymer of beta-1,4-glucosamine, on Pythium root rot of cucumber was investigated. Hydroponically growing cucumber plants in the presence of chitosan (100, 200 or 400 µg/ml) controlled root rot caused by *Pythium aphanidermatum* and triggered several host defense responses, including the induction of structural barriers in root tissues and the stimulation of antifungal hydrolases (chitinase, chitosanase, and beta-1,3-glucanase) in both the roots and leaves of cucumber. Although, chitosan did not cause any apparent phytotoxicity to cucumber plants, it adversely affected the growth and sporulation of *P. aphanidermatum* in culture media. A close examination of hyphal cells revealed that chitosan caused wall loosening, vacuolation, and, in some cases, protoplasm disintegration. This may, in part, explain the limited ability of the pathogen to colonize root tissues in the presence of chitosan. Ultrastructural study of root tissue from chitosan-treated plants showed that fungal cells were mainly restricted to root surfaces. The interplay of the antifungal and eliciting properties of chitosan makes chitosan a potential to become a useful agent for controlling root rot of cucumber caused by *P. aphanidermatum*.

P184 New Mosquito Biolarvicide Formulation for Improved Residual Activity

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Novel biolarvicide formulations were designed and developed to enhance residual activity of Bacillus thuringiensis Berliner var. israelensis (Bti). These formulations were developed specifically to maintain the active ingredient in the upper feeding zone and to provide efficacy regardless of water quality.

P185 Survey of *Rhizoctonia solani* Isolates Distribution in Potato Farms by Seed Tubers

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In this study, 58 isolates of *Rhizoctonia solani* collected from tuber, stem and root of potato plants in Hamedan and Kordestan province (Iran).all of them were multinucleate. 56 isolates belonged to AG-3, one isolate belonged to AG-4 and one isolate didn't anastomosis with any tester anastomosis group used in this study composed G-1-IB, AG-2-2-B, AG-3, AG-4, AG-5, AG-6, AG-8, AG-9, AG-10, AG-11 and AG-13. In somatic compatibility groups (SCG) identify test, 56 isolates belonged to AG-3, divided to 43 groups that 35 groups had only one isolate. Groups with more than one isolate involved C, F, J, K, T. Z, EE and PP. Isolated placed in EE group obtained from same farm in Qorveh, while, Isolates placed in C, F, J, K, T, Z and PP groups, obtained from different area. Either, results of molecular surveys by RAPD primers shown that, isolates belonged to each side groups, formed same cluster with a minimum similarity coefficient of 0.96. Therefore,

since isolates belonged to same somatic compatible group are genetically identical or closely related and may represent clones, Rhizoctonia solani AG-3 isolates may transmitted between farms. Finely, as a management tactic, culturing of potato seed tubers infected by *Rhizoctonia sclerotia*, special in different farms, should be prevented.

P186 IPM in Malaysia: Case Studies on Virus Diseases of Chilli and the Diamondback Moth on Cabbage

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Integrated pest management (IPM) had its beginning in the late 60s in Malaysia in plantation crops, such as oil palm and cocoa, in response to the ecological maladies caused by the use of indiscriminate use of broad-spectrum based pesticides. It was then followed in the late 70s in rice and then subsequently to horticultural crops in the 80s. Here, we provide case studies of IPM programs against two major problems in horticultural crops, viz., chilli viruses and the diamondback moth, *Plutella xylostella* (L.) on cabbage. Chilli cultivation in Malaysia is threatened by various insect pests and diseases especially the melon aphid, *Aphis gossypii*. Besides causing direct damage on chilli, the aphid transmits two most important viruses on chilli namely, chilli veinal mottle virus (CVMV) and cucumber mosaic virus (CMV). The implementation of the IPM program includes using of reflective plastic mulch, maize as barrier crop and chilli variety having "V" shape architecture. On the other hand, the diamondback moth program hinged upon the use of biological control using endemic and exotic parasitoids, utilization of microbial pesticide, *Bacillus thuringiensis*, pheromone trap and dynamic economic thresholds levels to rationalize pesticide applications. The initial responses to these programs were very encouraging based on the wide adoption by growers who recognized their socio-economic merits. However, despite the initial enthusiasm, sustained use has been a major challenge against the scenario of strong pesticide industry "pull" and falling commodity prices. The need to re-design the conventional top-down model of IPM program development to strengthen farmer empowerment is the future paradigm.

P187 IPM Strategy for Striga in Maize in Nigeria—A Case Study of Kaduna and Zamfara States

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Parasitic weed *Striga hermonthica* has been a serious bottleneck to cereal production in the Northern part of Nigeria especially in Kaduna and Zamfara states. Several control methods have been tested for the control of the pest but with little or no success. An IPM strategy involving the use of tolerant varieties of cereal, chemical and plant product to reduce the menace of the pest was developed. In 2006 and 2008 studies were carried out to assess the effectiveness of the IPM on reducing the effect of *Striga* in maize and sorghum. The result of the studies indicated that the combination of chemical with tolerant variety was not as effectve as the combinations of both with plant product (mulching with melon shell). It is envisaged that mulching with melon shell will have a long time effect on reducing the effect of Striga with little or no chemical application. The susceptible varieties used for the study gave appreciable yield with either chemical alone or in combination with plant product.

P188 Prospects of Microsporidia for Biological Control of the Teak Defoliator, *Hyblaea puera* Cramer (Lepidoptera : Hyblaeidae)

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Hyblaea puera causes severe defoliation of teak trees every year in the plantations of South India affecting the growth of the trees considerably. For the first time a highly virulent microsporidian parasite was isolated from this pest which could induce severe pathological effects in this insect. Mid gut and fat body were the primary tissues infected by the parasite. During the later stage of infection, it was observed to multiply in the tracheal epithelium, malpighian tubules and gonads as well. Infection of the ovaries in females resulted in transmission of the parasite to the progeny through infected eggs and transovarial transmission was recorded to the extent of about 80%. The mature environmental spores of the parasite had a mean size of 5.2±0.18µm X 2.8±0.06µm. Preliminary studies revealed presence of diplokaryotic stages in the life cycle of the parasite. Among the tissues infected, highest spore yield was obtained from midgut tissue. Spore yield from gonads and fat bodies were identical. Studies on horizontal transmission revealed that a single infected larva introduced among a healthy group of larvae and reared together, could result in >90% infection among the individuals of the group. Similar horizontal transmission could effectively occur in nature through contamination of foliage of the trees from infected individuals during pest outbreaks. The high degree of vertical transmission of the parasite in H. puera, besides the horizontal, provides a cutting edge for using this organism for

biocontrol of the teak defoliator. The results indicate prospects of the parasite as a biocontrol agent against the teak defoliator in future.

P189 Effect of Intercropping and a Biopesticide on Population Dynamics of Two Aphid Species, *Brevicoryne brassicae* and *Aphis gossypi* (Homoptera: Aphididae)

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In a bid to develop technologies that serve grower needs for economic and safe management of aphids and aphid-vectored diseases; a repeated study to assess the potential of intercropping and/or usage of a biopesticide was conducted on two different crops, cabbage and hot pepper, in Uganda. A split-plot randomized complete block design with three replications was used with the intercropped system vs. monocrop system as main effects and four pesticide treatment options in each main plot. The pesticide treatments were: i) weekly sprays of the chemical pesticide, dimethoate; ii) weekly sprays of a biopesticide, Azadirachtin; iii) combination of the dimethoate and Azadirachtin treatment; and iv) the untreated control. Data was collected on plant attributes and aphid population dynamics on the test crops. Results indicated that intercropping the crops with cowpea had a significant reducing effect on aphid populations. Azadirachtin also lowered aphid populations but this effect was not consistent over the seasons. There was a yield penalty from intercropping with cowpea.

P190 Diversity in *Helicoverpa armigera* Nuclear Polyhedrosis Virus Isolates from Different Parts of India

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An experiment was designed to study the molecular characterization of HaNPV isolates collected from different geographical locations. There exist variation in the DNA profiling of different HaNPV isolates. The dendrogram constructed using symmetric matrix of different isolates resulted into two major clusters. The first major cluster comprised of Dharwad, Kalpavruksha, Coimbatore, BPM, PDBC and BPL isolates. The similarity matrix pertaining to different isolates revealed that the similarity co-efficient ranged from 0.38 to 0.82. The highest genetic similarity index of 0.82 was seen between the isolates from Raichur and Guntur followed by 0.77 between the isolates from Coimbatore and Raichur. The minimum genetic similarity of 0.38 was found between the isolates from PCI and Dharwad. Further an experiment was also designed to evaluate the virulence of HaNPV isolates collected from different geographical locations against *Helicoverpa armigera* (Hubner) population representing various locations on different host plants. The biological activity of isolates interms of LT50 and LC50 values was carried out. Among the various isolates included in the study, the isolates collected from Coimbatore and Gulbarga were found to be more virulent compared to other isolates. The pooled LT50 values for Coimbatore and Gulbarga isolates was 101.62 and 102.62 h, respectively whereas, the pooled LC50 values were 1.98 X104 and 2.04X104 POBs/ml, respectively. Dharwad isolate was the next best isolate after Coimbatore and Gulbarga isolates. Among the isolates, the HaNPV obtained from private firms was found to be inferior. Irrespective of the isolates tested, the population collected from Gulbarga representing pigeonpea ecosystem was found to be more susceptible followed by Guntur population collected from cotton ecosystem.

P191 Molecular Characterization of Sugarcane Woolly Aphid, *Ceratovacuna lanigera*, and Its Natural Enemies

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Experiments were carried out to study genetic diversity of sugarcane woolly aphid (SWA) and its natural enemies through molecular characterization at the Department of Agricultural Entomology, University of Agricultural Sciences, Dharwad Karnataka, India. The samples of SWA and its natural enemies (Dipha and Micromus) were collected from different locations in the country. The dendrogram constructed via clustering analysis indicated that the SWA population has been grouped into two major clusters A and B. A comprised of Dharwad, Sameerwadi and Assam population whereas, cluster B comprised of Pune and Bangalore population. Both cluster A and B separated at the similarity co-efficient of 0.28. Second major cluster constituted two populations viz., Pune and Bangalore which separated from first major cluster at the highest genetic similarity index of 0.6. While, the minimum genetic similarity of 0.20 was observed among Pune and Sameerwadi and Pune and Dharwad populations followed by (0.22) Pune and Assam populations.The dendrogram of *Micromus igorotus* resulted into two major clusters. The first cluster included Pune and Bangalore population and second cluster comprised of Bangalore and Pune population with a similarity index of 0.8 followed by Dharwad and Bangalore and Bangalore and Sameerwadi with a similarity index of 0.6. The minimum genetic similarity of 0.5 was recorded between Dharwad & Pune and Sameerwadi & Pune. The studies on genetic diversity of Dipha aphidivora indicated variation in the DNA profiling of different samples. The dendrogram constructed using symmetric matrix resulted into two major clusters. The first cluster consisted of Dharwad, Sameerwadi and Bangalore populations whereas, the second cluster included Pune and Assam populations. The highest

genetic similarity index of 0.8 was observed among Assam and Pune population. The variation in the genome level may be due to the difference in the sequence of nucleotides. All the selected populations were from different cropping patterns with diverse weather conditions in terms temperature, relative humidity and rainfall. Perhaps these factors might have strong bearing on the population and hence might be sharing more nucleotide similarity

P192 Conservation of Arthropod Natutal Enemies through Habitat Management In Mustard Crop

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Mustard crops suffer from mustard aphid, *Lipaphis erysimi* Kalt., in different mustard growing areas of India. In nature, bioagents Viz; lady bird beetles, syrphid fly, chrysoperla, braconid parasites play important role in regulating aphid population in mustard crop. Therefore,conservation of these bioagents is very important. Attempt was therefore been made at Agronomy Instruction Farm, C.P. College of Agriculture, S.D. Agricultural University, Sardarkrishinagar during rabi 2002-03 and 2003-04. Among border crops, the mustard bordered lucerne crop supported maximum coccinellid predators, Chrysoperla and syrphid fly population followed by mustard bordered Indian bean and fennel crops. Therefore these populations were shifted from these crops to mustard main crop. Lucerne crop grown around the mustard enhanced the population of arthropod natural enemies as compared to other border crops. Im case of *D. rapae* population, it was observed only in cabbage crop. So, cabbage crop was most beneficial for enhancing the *D. rapae* population in mustard when it was grown around the mustard. The minimum aphid index was observed in mustard bordered with lucerne (1.41 AI/plant) followed by mustard bordered with Indian bea (1.67AI/Plant),while it was maximum in mustard sole crop (2.64 AI/Plant). It was probably may be due to higher number of arthropod predators on these crop, which might have resulted in the regulation of aphid population in mustard crop. Lucerne grown around the mustard obtained higher seed yield as compared to other border crop as well as mustard sole crop also. Thus lucerne growing around mustard is helpful in managing mustard aphid both in pesticide sprayed as well as in organic mustard production systems.

P193 Santa Clara County's Integrated Pest Management Program

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Developing and managing a multijurisdictional sustainable pest management program requires an integrated operational management approach. Santa Clara County, the largest county in San Francisco Bay Area of California passed IPM and pesticide use ordinance in May 2002 and started the process of promoting reduced risk pest management practices. The multi-jurisdictional program has several components and implementation priority areas such as structural, turf and landscape, nuisance wildlife, right of way, aquatic and invasive vegetation management, development of IPM tool-kit and system automation, research, trials and demonstrations aiming at pesticide use reduction, training and outreach. The poster demonstrates how County's IPM program addressed wide spectrum program needs necessary for an effective, low-risk, sustainable and affordable outcome. The successful outcome, since 2002, not only reflects maintaining pest free status but also significant achievement in pesticide use reduction in all sectors of structural and non agricultural IPM projects. Total number of pesticides, applications, pesticide volume and toxicity pesticides has significantly reduced. Pesticide use in invasive weed management projects (45,000 acres), urban turf and landscapes (78 acres), recreational turf (200 acres) and structures (188 plus) can be stated as statistically insignificant. In right of way vegetation management, there is 73% reduction in acreage under herbicide management. No aquatic herbicides are used in ponds and lakes. Dependence upon and use of non-chemical alternatives has increased significantly. The management tool-kit, research and outreach components have also provided a foundation for continued success, improved employee and stakeholder participation, setting an example for other government/non-government agencies and industry.

P194 Exploration in Kazakhstan for Natural Enemies of Russian Olive, an Exotic Weed Invading Riparian Areas of the American West

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We have been conducting research in Kazakhstan on potential biological control agents of Russian olive since 2006. This work has two goals: 1) to find effective arthropod biological agents of Russian olive and 2) to study their biological characteristics under native conditions. Our research shows that there are at least 30 insect species that appear to be host-specific natural enemies of Elaeagnus angustifolia: 10 homopterans, 9 coleopterans, 8 lepidopterans, 2 hemipterans and 1 dipteran. Life histories of natural enemies and their potential for biological control of Russian olive in the U.S. will be discussed.

author index

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

notes