concurrent sessions

Tuesday, March 27

1 • Conducting IPM in schools demonstration projects: Perspectives and lessons learned

Room L2

This session will stimulate discussions about Integrated Pest Management (IPM) in Schools. Presentations will highlight demonstration projects in Nebraska, Iowa, Missouri, and South Dakota with a focus on tribal schools. Mike Daniels, Pesticide Circuit Rider for Winnebago and Omaha tribes of Nebraska, Erin Bauer and Clyde Ogg, University of Nebraska–Lincoln, Anastasia Becker, Missouri Department of Agriculture, and Darrell Deneke, South Dakota State University, will share their experiences in leading demonstration projects, including working with and educating school staff and Pest Management Professionals (PMPs), implementing IPM strategies, recordkeeping, monitoring, and reducing the use of pesticides. This session will encourage audience contribution and participation. The presentations will provide guidance about how to set up a demonstration project, develop and encourage involvement by local school participants, encourage cooperation between PMPs and schools, and recognize school successes through independent verification such as IPM STAR certification. In addition, the session will encourage discussions about the challenges associated with maintaining IPM practices after the demonstration is completed. Although University Extension, state agriculture departments, tribal representatives, and others can continue to serve as a resource, schools and their PMPs will ultimately be responsible for managing the IPM program and developing and/or maintaining an IPM policy.

Organizers: Erin Bauer, ebauer2@unl.edu, and Clyde Ogg, cogg@unl.edu, University of Nebraska–Lincoln, Lincoln, NE

1.1 10:00 IPM demonstrations in Nebraska public and tribal schools, Erin Bauer, ebauer2@unl.edu, and Clyde Ogg, cogg@unl.edu, University of Nebraska–Lincoln, Lincoln, NE

Clyde Ogg and Erin Bauer will share their experiences in leading IPM demonstration projects at public and tribal schools in Nebraska. This included educating and working with school staff and Pest Management Professionals (PMPs), implementing IPM strategies such as monitoring, recordkeeping, and reducing pesticide use. They will also provide guidance about developing a demonstration project and encouraging local school involvement and cooperation between PMPs and schools. Finally, they will discuss challenges associated with maintaining IPM practices after the demonstration is completed.

1.2 10:15 South Dakota pilot demonstrations, Mark Shour, mshour@iastate.edu, Iowa State University Extension, Ames, IA; Darrell Deneke, darrell.deneke@sdstate.edu, South Dakota State University, Brookings, SD

Public school districts in Brookings and Flandreau, South Dakota participated in a project that introduced and began implementation of integrated pest management procedures. A team of IPM specialists from South Dakota, Iowa, and Nebraska conducted five facility assessments and conducted staff training during the two-year period. Four IPM newsletters were created and distributed to staff. The project culminated with a Demonstration Day to benefit neighboring districts. Brookings showed 3% improvement over their initial assessment scores while Flandreau showed an 8% improvement. Each district adopted a school IPM policy. Funding was provided by an EPA PRIA2 grant through the IPM Institute of North America.

1.3 10:30 Perspectives on a rural school IPM demonstration project in Missouri, Anastasia Becker, Anastasia.Becker@mda.mo.gov, Missouri Department of Agriculture, Jefferson City, MO

A demonstration project was conducted over 2 years at a small rural school district in a state with no School IPM requirements. Strong administrative support led to rapid progress in implementation which resulted in an 80% reduction of pesticide applications. Successes and challenges during the project, opportunities that arose, and lessons learned that may be applicable to future efforts will be addressed.

1.4 10:45 Questions and answers

2 • Capacity building and short term training: Requirements for successful technology transfer for IPM

Room L3

Generation and transfer of Integrated Pest Management (IPM) packages can many times be hindered by the lack of easy to use and effective implementation tools and strategies. In order to be successful, an IPM technology should be carefully tailored to be: farmer-friendly, easily implemented, profitable, environmentally and ecologically sound, and gender-sensitive, among other characteristics. Capacity Building (including both short and long-term training) should be an integral part of an IPM goal and mission. One way to ensure success of implementation of an IPM program is by training local practitioners, project managers, and farmers on how to use and adopt these IPM technologies. Other approaches involve long tern training such as internships and undergraduate and graduate academic and professional degrees. Short-term trainings should be integrated in the design and implementation of IPM packages at the time of writing the proposals, during the pre-planning phase of the projects, and throughout the dissemination phase of the specific IPM technology. These are especially important in bridging gaps between research scientists, local practitioners, farmers and other stakeholders in order to successfully manage, supervise, and adopt IPM packages. Specific examples will be presented to highlight the importance of outreach and education in the successful dissemination of IPM knowledge programs in Latin America, Africa, and Asia with emphasis on innovative approaches to short term training, institutional capacity building, quality assurance, pesticide safety education, and gender equity.

Organizer: Amer Fayad, afayad@vt.edu, Integrated Pest Management Collaborative Research Support Program (IPM CRSP), Virginia Tech, Blacksburg, VA

2.1 10:00 Capacity building and short term training in Latin America and the Caribbean, Jeffrey Alwang, alwangj@vt.edu, Virginia Tech, Blacksburg, VA

IPM and IPM packages often require substantial outreach for widespread adoption. This requirement is due to several factors, including complexity and management intensity, competition with private-sector suppliers and messages, and evolving pest pressures. In LAC, the IPM CRSP faces vastly different conditions in Ecuador and Honduras. In Ecuador, public agricultural extension does not exist. In Honduras, agricultural extension is supported by the public sector and substantial investments by USAID in organizing farmers and linking them to markets. This presentation describes how the CRSP has adapted to each of these conditions and summarizes lessons learned.

2.2 10:20 IPM CRSP International Plant Disease Network: A gateway to IPM implementation, Sally Miller, miller.769@osu.edu, Ohio State University, Wooster, OH

Accurate and timely diagnosis of insect pests and diseases in plants is the primary step in crop health management. Diagnostics capacity building requires improvements in physical space and availability of equipment, reagents and reference materials, but more so the strengthening of human capacity. Focused regional workshops introduce classical and modern diagnostic methods at a reasonable cost, and provide much needed networking opportunities. Short-term intensive training results in greater knowledge acquisition through repeated practice and exposure to a wide array of plant problems. Both types of training also improve capacity to identify invasive species and therefore mobilize prevention and/or management efforts.

2.3 10:40 International Plant Virus Disease Network (IPVDN)—Training in plant virus detection and diagnosis, capacity building, and delivery of IPM packages, Sue A. Tolin, stolin@vt.edu, Virginia Tech, Blacksburg, VA

The IPVDN of the IPM CRSP was established to enhance virus diagnostics foundations required for successful for virus disease management. Analysis of host country capacity was followed by scientist training and facility enhancement to enable detection and diagnosis of viruses and epidemiological and ecological research on virus-vector-crop complexes. Information generated is used to design research toward developing strategies for IPM management packages in open field and controlled environment cropping systems. Training workshops have included lectures, hands-on practice with molecular and immunodiagnostic tests, traditional biological methods such as mechanical, seed and vector transmission, field research design and interpretation, and technology transfer.

2.4 11:15 Gender and participatory methods workshops in IPM CRSP, Maria Elisa Christie, mechristie@vt.edu, Virginia Tech, Blacksburg, VA

Over the past three years, the IPM CRSP has held workshops on gender and participatory methodologies with each of its Regional Programs. Formats ranged from 4-day workshops including fieldwork to a one-day Train-the-Trainers workshop in the US. Building on a network of gender experts developed through its Gender Global Theme cross-cutting project, the overall goal of each workshop was to build capacity in the IPM CRSP to achieve gender equity through technology transfer and to undertake gender research. This presentation describes the process and outcomes of the workshops, and makes recommendations for how to achieve greatest impact with similar efforts.

2.5 11:30 Outreach education and plant pest diagnostics in villages of Karnataka, India, Malvika Chaudhary, malvika.chaudhary@pcil.in, Bio-Control Research Laboratories (BCRL), Bangalore, Karnataka, India

In 2009 Bio-Control Research Laboratories began operating plant clinics -once in a month in 4 locations. The clinics were attended by 485 farmers from villages around Bangalore district of Karnataka. Out of the total, the clinics addressed 45.67% queries on insect pests and 43.44% on plant diseases. BCRL also supported the Government of the state of Karnataka by training over 400 farmers and extension agents as plant health workers in 18 districts. The three day courses focused on observing symptoms and the art of interviewing to make diagnoses and recommendations, including sustainable, biocontrol and appropriate use of chemicals.

2.6 11:45 Technology transfer through farmer field schools in Indonesia, Aunu Rauf, aunu@indo.net.id, Bogor Agricultural University, Indonesia

The Farmer Field School (FFS) is a participatory model that integrates farmers into the technology transfer process. It gives farmers the opportunity to not only observe the effects of new technologies, but also to discover the problems and solutions themselves. FFS, originally designed for rice, has now been expanded to horticulture and estate crops. IPM technologies disseminated through FFS include use of botanical pesticides, microbial insect pathogens such as Nucleopolyhedrovirus for armyworms, *Trichoderma harzianum* for soil-borne pathogens, screened-seed beds to avoid plant virus vectors; side-grafting and pod bagging on cacao; and use of *Beauveria bassiana* and attractants for the berry borer on coffee. In each FFS the farmer group compares local practice with practices that incorporate IPM tactics.

2.7 12:00 A perspective on gender issues and IPM CRSP activities in India, Krishnasamy Uma, umaap68@yahoo.co.in, Tamil Nadu Agricultural University, Coimbatore, India

Production and adoption of any input/ technology depends on its advantages in terms of technical and economic efficiency. Besides, an understanding of gender considerations is essential in ensuring the effectiveness and sustainability of technology adoption. This paper examines issues and suitability of IPM technologies in adoption by women in terms of different forms, farm size, cost, time and knowledge required. For better protection against risk of pest and diseases, knowledge and communication about pest surveillances must be thought to women who are taking care of a crop as their child. A number of specific strategies have been suggested for IPM already. Because IPM is a people-oriented and knowledge-based technology, it needs to be promoted through participatory approach by involving community as a whole. Institutions must be strengthened by creation of awareness through gender sensitization.

3 • Is IPM dead? What policymakers, taxpayers, consumers and practitioners need to know about IPM

Room L4

Since the inception of the Integrated Pest Management, the public sector – first the federal government, later some states – provided the preponderance of funding for IPM research and extension. Now elimination of IPM-dedicated Federal budget lines (including CAR, RAMP, PMAP, and Regional IPM Centers) signals an overall loss of federal IPM funding. Where will we find resources to continue important IPM work? Speakers will provide perspective on present and future prospects for IPM support.

Organizer: Leigh Presley, lpresley@ipminstitute.org, IPM Institute of North America, Inc., Madison, WI

3.1 10:00 Introduction, Carrie Koplinka-Loehr, ckk3@cornell.edu, Northeastern IPM Center, Cornell University, Ithaca, NY

3.2 10:05 IPM isn't dead...but we're working on killing it, Martin Draper, mdraper@nifa.usda.gov, U.S. Department of Agriculture, National Institute of Food and Agriculture, Washington, DC

Funding IPM programs has been a patchwork since its inception in the 1970s. Programs have largely been supported though a number of small specifically directed formula and competitive programs. With IPM being a transdisciplinary concept, identity has always been problematic. Recognition of the value of IPM has contributed to a firm following at the top of the "needs" list, but the vague identity that is not disciplinary, in and of itself, has prevented IPM from reaching the top priorities list. Nonetheless, there have been great IPM successes, so in some communities IPM has gained and retained traction. By its nature, IPM is a systems approach that requires some trial and error in development due to varying applications, production systems, and environments where IPM principles are used. Additionally, some product marketing promotes practices that are counter to IPM and encourage unsustainable approaches that favor pesticide resistance. Much of our research is focused on developing individual tactics, but integrated approaches require considerably more time to validate due to the complexity of the systems, the variability in annual environment, the obstacles mentioned above and the higher cost of longitudinal studies. As a result there is a perception that IPM is losing momentum. Recent USDA Natural Resources Conservation Service reports from the Conservation Effects Assessment Program (CEAP) indicate only about 7 percent of cropping acres are managed with intensive IPM. About another 43 percent are managed with some IPM elements. The remaining half of the production areas surveyed do not appear to be intentionally managed with IPM. Thus we have an opportunity to increase the benefits IPM can provide, but also a challenge for the IPM community to be analytical

about how IPM is branded, promoted, and packaged and how we can be intentional about improving adoption.

3.3 10:25 Successful campaigns for funding issues like IPM: Examples, prospects and how-to's, Ferd Hoefner, fhoefner@sustainableagriculture.net, National Sustainable Agriculture Coalition (NSAC), Washington, DC

3.4 10:45 IPM from the demand-side, Michael Rozyne, MRozyne@redtomato.org, Red Tomato, Plainville, MA

Demand for organic remains strong. Demand for local is *very* strong. And consumer awareness of diet-related health issues, social issues in agriculture, climate change, and food safety is growing. *Where does IPM fit into this picture?* And how can growers and marketers take advantage of public awareness and openness to improve their promotion and education of this ever-so-hard-to-communicate practice we call Integrated Pest Management.

3.5 11:15 Potential for commodity groups to maintain or increase support of IPM, David Wright, dwright@iasoybeans.com, North Central Soybean Research Program (NCSRP), Ankeny, IA

Insect pests are becoming more prevalent in Iowa as environmental conditions and cropping systems change. Minimizing yield loss using Integrated Pest Management (IPM) strategies is essential for sustainable and profitable soybean production. Funding from soybean checkoff organizations for research to build sound IPM principles and practices in soybean production remains strong as farmers continue to search for low-cost, highly effective insect management strategies. The key to a successful IPM program is a novel education program. Getting to the farmer with the right tool(s) and the right message is critically important. Priorities for soybean checkoff funded research and education activities in IPM will be discussed.

3.6 11:35 Expanding IPM awareness among users and potential users: IPM Voice's outreach priorities, Chris Wible, Chris.Wible@Scotts.com, Scotts Miracle-Gro, Marysville, OH

IPM Voice is a new organization, incorporated as an independent nonprofit in 2011. IPM Voice seeks to increase public and policy maker awareness of IPM and its benefits to agriculture and communities. In 2012 the group has started to focus on broader IPM advocacy issues among consumers, taxpayers, IPM users and potential users, seeking to increase awareness among those who benefit from IPM every day. This presentation will discuss the need to address these issues and the organization's strategies and planned activities for increasing IPM awareness.

3.7 11:55 Breakout Sessions

4 • Economics of IPM: Impact assessment, natural enemies, diffusion, and marketing

Room L5

This session addresses several economic issues with respect to IPM at home and abroad. It is organized around five brief presentations on a broad set of economic issues affecting IPM. One of the presentations discusses how a randomized experiment can be used to assess the economic impacts of an IPM program, with an example from the onion ipmPIPE. A second presentation illustrates methods for choosing an optimal approach to maximize diffusion of IPM practices. An example is given from Bangladesh. A third describes a method to adjust the standard economic threshold to account for the benefits of control by natural enemies. An example is given for soybean aphid in the USA. A fourth presents a model for optimizing landscape-level habitat set-aside for natural enemies of agricultural pests in parts of China. A fifth paper examines how access to markets affects adoption and impacts of IPM, with an example from Honduras. Time will be set aside after each presentation for questions and for general discussion at the end of each hour. Given the multidisciplinary nature of the audience, presentations will focus on lessons for applicability of the approaches in practical settings. A discussion leader will draw out key lessons from the five studies to lead off the general discussion. Three of the presentations will be made in the first hour and two presentations plus general discussion in the second. Presentations will be made by economists from Michigan State, Virginia Tech, and the International Food Policy Research Institute.

Organizer: George Norton, gnorton@vt.edu, Virginia Tech, Blacksburg, VA

4.1 10:00 Session introduction, George Norton, gnorton@vt.edu, Virginia Tech, Blacksburg, VA

4.2 10:05 Assessing the economic value of the Onion ipmPIPE, Will Secor, wsecor@vt.edu, Virginia Tech, Blacksburg, VA

The Onion ipmPIPE website was created to aggregate and distribute unique and already available information to onion growers, crop consultants, and extension agents to help them make better onion pest management decisions and recommendations. This study shows how different methods can be used to assess the value of the ipmPIPE website, or specific components of it. The most convincing assessments come from experiments in which access to the site or specific components of it are randomly assigned to individuals during the evaluation, but that approach is difficult to implement in practice. Tradeoffs associated with using randomization versus alternative evaluation methods are presented.

4.3 10:20 Modeling a cost-effective IPM dissemination strategy for vegetables in Bangladesh, Leah Harris, leahmh@msu.edu, Michigan State University, East Lansing, MI

Many tactics have been used to teach farmers in Bangladesh about IPM, yet the associated technologies have not been widely diffused in many areas. We evaluate the current IPM dissemination strategy being implemented by the Bangladesh Department of Agricultural Extension (DAE) and use an economic model to examine alternative strategies to expand the benefits of the extension program. Results suggest that more farmers could be effectively reached by reallocating funding from intensive interpersonal communications such as extension agent farm visits and farmer field schools to less-intensive methods such as mass media and field days.

4.4 10:35 Optimizing landscape-level habitat set-aside for natural enemies of agricultural pests, Wei Zhang, w.zhang@cgiar.org, International Food Policy Research Institute, Washington, DC

Manipulating habitat for natural enemies of crop pests can enhance natural pest control. Effective habitat design depends on the natural enemy-pest complex, local crop management, and the surrounding landscape. Landscape configuration is fundamentally shaped by the spatial pattern of landowner decisions. This study develops a bioeconomic model to aid landowners in optimizing collective land use at the landscape scale, taking into account the role of non-crop habitat in enhancing control services and the mortality effect of pesticides on natural enemies. We apply the model to a numerical example of smallholder cotton production in China.

4.5 10:50 General Discussion

4.6 11:15 Adjusting the economic threshold to account for natural enemies: The case of soybean aphids, Scott Swinton, swintons@msu.edu, Michigan State University, East Lansing, MI

This study introduces a new Natural Enemy-adjusted Economic Threshold (NEET). This threshold represents the pest population density at which insecticide control becomes optimal in spite of the opportunity cost of injury to natural enemies of the target pest. Using field data from Michigan, the model is applied to the case of soybean aphid. The NEET leads to fewer recommendations for insecticide use than economic threshold models that ignore natural enemies. It typically results in less insecticide use, while maintaining profitability for farmers who rely on chemical pest control methods.

4.7 11:30 IPM and distance to market: Conceptual model and example from Honduras, Amy Buckmaster, amydb8@vt.edu, Virginia Tech, Blacksburg, VA

In this presentation we present a conceptual framework linking distance to market with profitability and viability of IPM versus non-IPM techniques for vegetable production. In many areas of Central America, road coverage is uneven and some farmers find themselves isolated from markets. There is evidence that distance to market affects input use and farming intensity, yet there is little evidence about the effect of distance on IPM adoption. We consider the relationship between distance to market and input prices, output prices, overall profitability of different crops, and access to IPM information. Evidence from a model of Honduran farms is included.

4.8 11:45 Discussant for the 5 previous paper presentations, Jeffrey Alwang, alwangj@vt.edu, Virginia Tech, Blacksburg, VA

4.9 11:55 General discussion

5 • Doesn't the EPA regulate pesticide use? Why do we need the Pesticide Risk Mitigation Engine?

Room L6

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

Organizers: Thomas Green, ipmworks@ipminstitute.org, and Leigh Presley, lpresley@ipminstitute.org, IPM Institute of North America, Inc., Madison, WI

5.1 10:00 Beyond the label: Opportunities to reduce pesticide risk, Thomas Green, ipmworks@ipminstitute.org, IPM Institute of North America, Inc., Madison, WI

5.2 10:05 PRiME: Looking under the hood, Wade Pronschinske, wade@ipminstitute.org, IPM Institute of North America, Inc., Madison, WI

An introduction to the Pesticide Risk Mitigation Engine (PRiME) will discuss its current state of development and use, including a demonstration of the user interface, data requirements, user input and pesticide risk assessment.

5.3 10:20 PRiME in action–Opportunities to reduce non-target pesticide impacts, Pierre Mineau, pierre.mineau@ec.gc.ca, Carleton University/Environment Canada, Ottawa, Ontario, Canada

PRiME, the Pesticide Risk Mitigation Engine, provides the most accurate assessment of a field-specific pesticide environmental footprint by: 1) Addressing inter-species differences in toxicological susceptibility of non-targets; 2) Including local soil and pluviosity conditions for an individualised risk score; 3) Adjusting risk for different application methodologies and mitigation practices; and 4) Calibrating estimated risk scores against documented field impacts. This presentation will provide examples of typical outputs obtained with various in-use pesticides and show opportunities for risk reduction. We will analyse existing data from the California Pesticide Use Reporting (PUR) system to explore risk reduction opportunities.

5.4 10:35 Putting PRiME to work for specialty crop IPM, Paul Jepson, jepsonp@science.oregonstate.edu, Oregon State University, Corvallis, OR

A partnership between the Oregon, California and Arizona IPM programs is conducting extension outreach with PRiME to specialty crop producers, certifiers and consultants in the Western USA. Audiences are inquisitive about the science underlying the tool, and have responded positively to reviews of risks and mitigation options associated with locally-relevant pesticide application programs. Analyses conducted across a wide geographic and commodity range are revealing the probable distribution patterns of pesticide risks. This is enabling a watershed and an even larger scale perspective to emerge that should provide opportunities for state-wide pesticide risk management.

5.5 11:15 Assessing human dietary risk, presented by Susan Kegley, skegley@pesticideresearch.com, Pesticide Research Institute, Berkeley, CA on behalf of Chuck Benbrook, Organic Center

Dietary risks within PRiME are estimated using a Dietary Risk Index (DRI) that reflects the relationship between mean residue levels found in USDA testing of a given food/commodity, relative to the maximum levels of the pesticide that can be in a given food, consistent with a "reasonable certainty of no harm." DRI values can also be computed using State government or private residue datasets. A series of factors impacting the expected frequency and levels of residues can be taken into account via Use Pattern Adjustment Factors, e.g. extension of pre-harvest intervals.

5.6 11:30 Opportunities to reduce dermal and inhalation risk to workers and bystanders, Susan Kegley, skegley@pesticideresearch.com, Pesticide Research Institute, Berkeley, CA

Inhalation exposure from volatilized pesticides is a major contributor to exposure for bystanders and workers for certain high-volatility pesticides. Workers are also exposed through skin contact with treated plants when entering the field to perform tasks after the re-entry interval has expired. We used the PRiME tool to analyze pesticide use on grapes in California to assess the worker/bystander risk profile associated with current methods of production. This presentation will provide a brief background on the methods used by the PRiME tool to estimate inhalation and dermal risks and highlight the results of the analysis for grapes. The sensitivity of the exposure estimate to variables such as vapor pressure and application rate for inhalation exposure, and foliar half-life, dermal permeability, and task being performed for dermal exposure will be discussed in the context of approaches to risk reduction.

5.7 11:45 Discussion

Questions: Can pesticide risk be boiled down to a single number? Will the marketplace handcuff growers to PRiME? PRiME, WIN-PST, EIQ and PEAS: What are the applications and pros and cons of each?

6 • Managing IPM is not just bugs— An approach by two multi-disciplinary agencies: Australian Vegetables (Agriculture) and Santa Clara County (Non-Agriculture)

Room L8

IPM was initially conceived in the fifties for management of invertebrate pests in an agricultural environment. Today IPM potentially covers all 'pests' and is a strategy used in a variety of urban and amenity situations as well as the traditional agricultural environment. IPM is a paradigm that can operate in diverse and complex environments, and requires a customized and often innovative approach to orchestrate the many elements necessary for a successful program. Program sustainability requires the coordinated efforts of many individuals and groups, strong leadership, effective governing policy, resources, cooperation among user groups, and alliances among these groups and the wider community. It also requires benchmark surveys, regular inspections and monitoring, interoperable and immediately accessible digital information among stakeholders regarding pest traceability and prevalence, conducive-conditions, trends, and control practices critical to address pest issues rapidly in a sustainable way. In addition, forming alliances and collaborations helps to leverage financial

resources, and increases efficiencies in use of staff, as well as data and information sharing. Larger groups also have a greater ability to influence markets and research. Collaborations help with development of consistent messages and tools, and lower the possibility of conflicting practices in different communities. All of these factors contribute to low-risk, sustainable, and affordable alternatives. The two distinct multi-disciplinary agencies practicing IPM across the ocean; Australian Vegetables (Agriculture) and Santa Clara County (Non-Agriculture) share similar programmatic approach in managing successful IPM programs, not just bugs. The mini-symposium intends to give IPM managers an outlook on these elements, improving techniques for conducting various IPM projects.

Organizers: Sandra McDougall, sandra.mcdougall@dpi.nsw.gov.au, Yanco Agricultural Institute, Yanco, NSW, Australia; Naresh Duggal, Naresh.Duggal@ceo.sccgov.org, County of Santa Clara, San Jose, CA

6.1 10:00 IPM continuum—A useful tool to support IPM adoption?,Sandra McDougall, sandra.mcdougall@dpi.nsw.gov.au, Yanco Agricultural Institute, Yanco, NSW, Australia

Combining the concept of an 'IPM continuum' with an 'IPM cycle' is proposed as an approach to overcome barriers to adoption caused by a common mis-conception of what IPM is. The combination conveys a step-wise shift from a single tactic approach to a systems approach to pest management by defining pest management practices along a spectrum from intelligent pesticide management through to biointensive IPM. By including specific implementable practices within a continuous improvement cycle moving through Knowledge–Prevention–Monitoring–Intervention–Recording/reviewing/planning an adoption pathway is provided.

6.2 10:25 Essential elements of a communitywide multidisciplinary IPM program—A model approach, Naresh Duggal, Naresh.Duggal@ceo.sccgov.org, County of Santa Clara, San Jose, CA

Santa Clara County IPM Program is responsible for managing non-agricultural pests associated with public health, natural resource areas, turf and landscape. Concerned of non-point source pollution from pesticide use, the County adopted an IPM ordinance in 2002 and set goals for reduction of pesticide use. Program implementation has included a wide array of activities. The outcomes reflect significant reduction in pesticide use ranging from 89-99% in all non-agricultural projects. Dependence upon and use of non-chemical alternatives have increased significantly. The development of management, research outreach and best practices have provided a foundation for continued success and improved employee and stakeholder participation, setting an example for other government/non-government agencies and industry.

7 • State Extension IPM programs: Trials and triumphs

Room L9

This session will allow state IPM Coordinators and others to discuss the impact of declining state and federal financial support on maintenance of programs and personnel. It will also allow them to discuss program successes that have occurred in spite of the cut backs.

Organizer: Charles Allen, ctallen@ag.tamu.edu, Texas AgriLife Extension, San Angelo, TX

7.1 10:00 The Maine IPM program-Adapting to new challenges and partners, James Dill, james.dill@maine.edu, University of Maine Extension, Oronto, ME and Jim Dwyer, jimdwyer@maine.edu, University of Maine Extension, Presque Isle, ME

As federal funds supporting the Integrated Pest Management Programs in Maine have been reduced, University of Maine Cooperative Extension staff have explored creating new partnerships for funding and implementation of these programs. Extension staff have also explored some innovative methods of generating additional funding for programs. New partnerships to disseminate information, increase client contact and reduce costs are being developed.

7.2 10:15 Purdue's pest management program, keeping the focus while changing the view, Rick Foster, fosterre@purdue.edu, Purdue University, West Lafayette, IN

The conversion of Extension IPM funds from formula to competitive funds caused great consternation in Indiana, primarily because of the late notice that funds would not be arriving as expected and the eleven month gap without any IPM funds. Purdue administration was able to cover the shortfall, so no drastic cuts in operations resulted. Now, however, we reluctantly admit that the new system has improved our IPM program because we have been forced to forego "business as usual", re-evaluate what we do well, and look for more innovative approaches to IPM delivery.

7.3 10:30 Planning, Priorities and Partnerships: A key for UC IPM success in challenging times, Pete Goodell, pbgoodell@ucanr.edu, University of California Cooperative Extension, Parlier, CA

In an era of restricted resources, working effectively internally and externally is critical for continued success. The UC Statewide IPM Program (UC IPM) developed a strategic approach to planning, utilized a strategic plan to guide priority-setting and developed partnerships based on common priorities and issues. UC IPM has been delivering programs which leverage funds with engaged partners while addressing priority issues of stakeholders. Federal, state, and local agencies have been engaged as well as commodity boards, professional and

trade organizations, and NGOs. Innovative and traditional educational methods address the pest problems that are both relevant and accessible to our clients.

7.4 10:45 Texas Extension IPM programs: Coping with reduced resources–Yet delivering strong IPM programs, Charles Allen, ctallen@ag.tamu.edu, Texas AgriLife Extension, San Angelo, TX

Significant loss of staff has impacted Texas AgriLife Extension IPM programming, but the program continues to work with citizens and make a difference in their lives. Program successes in row crops, pecans, nursery and greenhouse, urban and school IPM will be discussed. Stakeholder input in program focus is critically important in this success. Improved collaborations and partnerships which bring focus and resources to bear on issues local stakeholders have prioritized completes this successful model.

7.5 11:15 Georgia IPM: A fresh outlook in a challenging political and economic landscape, Paul Smith, pfsmith@uga.edu, University of Georgia, Athens, GA

7.6 11:30 Alabama Extension IPM program: Successes, challenges and opportunities, Henry Fadamiro, FADAMHY@auburn.edu, Auburn University, Auburn, AL

The Alabama Integrated Pest Management (IPM) program at Auburn University is an inter-disciplinary, multi-departmental, collaborative effort within the Alabama Cooperative Extension System. The central mission of the program is to facilitate implementation and adoption of economically and environmentally sound IPM practices in traditional and non-traditional agriculture in Alabama. The program is a collaborative effort between Auburn University and the state's two 1890 land grant institutions: Alabama A&M University and Tuskegee University. It is driven by stakeholder needs and supported by faculty, extension specialists/agents, producers, and IPM Advisory committees. Key program activities, challenges and successes will be highlighted in this presentation.

7.7 11:45 What will state IPM programs look like in 2021: Is past prologue, Edwin George Rajotte, egrajotte@psu.edu, Penn State University, University Park, PA

The Pennsylvania Integrated Pest Management Program is a collaboration between Penn State University and the Pennsylvania Department of Agriculture. We have offices in three locations; Penn State Campus, PDA in Harrisburg and in Philadelphia. While PAIPM has a major focus in agriculture, we have devoted many of our resources to maintaining and urban IPM program, primarily in Philadelphia. As part of this effort we established the Philadelphia School and Community IPM Partnership, an organization of state and city agencies and more than 30 non-governmental organizations including neighborhood groups, churches, schools, preschools, etc. PSCIP focuses on IPM education for underserved communities including programs for the elderly and ethnic communities.

7.8 12:00 The Connecticut IPM program: People, partners and perseverance, Ana Legrand, ana.legrand@uconn.edu, University of Connecticut, Storrs, CT

The IPM program is the result of a joint effort between the University of Connecticut Cooperative Extension System and the Department of Plant Science & Landscape Architecture. The program is driven by the needs of commodity groups and those of the general public. In spite of staff funding challenges, the IPM program team has persevered in obtaining funds or in partnering with other groups to achieve the program's mission. Partnerships have been key to IPM program stability. Highlights of IPM program successes and of the challenges will be presented for on-going IPM program projects.

8 • IPM Delivery: Got an App for That?

Room L10

Smart devices (phones, tablets, etc) offer advanced connectivity and computing capacity that has led to accelerated adoption of these technologies. In the next few years, smart devices and similar technologies will play a major role in future public- and private-driven IPM delivery programs. Applications (Apps) have been developed with various tiers of end user benefits including static guides or identification keys, real-time decision aids and two-way, interactive data exchange mechanisms. Technological advances now create change in communications methods at a mind boggling pace – after all "Apps" was not a common term during the last IPM Symposium – so what can we expect or predict for future communications capabilities? This mini-symposium will feature current experiences with Apps and explore the near and long-term future of Apps for IPM delivery.

Organizer: Frank Louws, frank_louws@ncsu.edu, Center for Integrated Pest Management, North Carolina State University, Raleigh, NC

8.1 10:00 Introduction, Frank Louws, frank_louws@ncsu.edu, and Karl Suiter, karl_suiter@ncsu.edu, Center for Integrated Pest Management, North Carolina State University, Raleigh, NC

8.2 10:10 The "TickApp" for Texas and the Southern region, Pete D. Teel, pteel@tamu.edu, Texas A&M University, College Station, TX; Otto F. Strey, III; Janet A. Hurley

A mobile, smart phone application has been designed for needs of citizen consumers and professional practitioners who desire a simple tool to identify commonly encountered ticks

and access basic information about biology, pathogen associations, prevention, control and management. Smart phones and other similar devices provide a convenient method to access information quickly in a home or field setting, or in a clinical or client-based setting. The design, current and future applications, and evaluation of this app will be discussed. An interactive "TickApp" demonstration with the conference audience will illustrate cross-cutting interests impacting humans, livestock, companion animals, and wildlife.

8.3 10:25 Development of the "RiceScout" mobile application, Clayton A. Hollier, chollier@agcenter.lsu.edu, Louisiana State University, Baton Rouge, LA; A. Mészáros; R. Cartwright; S. Fiser; D.E. Groth; D.L. Harrell; N Hummel, F. Piazza; J.K. Saichuk; B. Schultz; M.O. Way; E.P. Webster

Farmers across the US are rapidly adopting smartphone technology to stay current with market trends and access critical information. Smartphones have become an excellent information delivery platform for Cooperative Extension Service resources. Development of mobile decision tools, such as crop-focused mobile apps, is an efficient way to aid with identification, deliver recommendations, and educate producers about best management practices. Our team has developed the beta version of the "RiceScout" app, a comprehensive mobile pest (arthropods, weeds, diseases) and nutritional deficiency identification and decision tool for use in southern rice production.

8.4 10:40 Power and ethics of information sharing in the Cloud, David W. Krueger, david@AgRenaissance.com, AgRenaissance Software LLC, Raleigh, NC

Ten years ago everyone was asking 'Who owns the data'. At that time information was mainly stored locally on a desktop computer or department servers. Today with the advent of smartphones, apps, and cloud technology the issues regarding data ownership have become more complicated. During this talk we'll take a brief look at the advantages of data sharing in the cloud, as well as ask again 'Who owns the data'.

8.5 11:15 Panel: Nuts and bolts of developing an App, Charles T. Bargeron, cbargero@uga.edu, Center for Invasive Species and Ecosystem Health (Bugwood Network), University of Georgia, Tifton, GA

Panel Members: Clayton Hollier, David Krueger, Karl Suiter, Pete Teel

How do you move from an idea, to a plan, development, testing, deployment, evaluation and then toward the next version? What platform(s) will serve your clientele the best? Who will develop the app? How does the app complement existing user-focused information and tools to serve your clientele? How will success be evaluated? What about funding? Beginning with an overview of technical development information, this panel will address common audience questions about app development.

8.6 11:40 Apps, social media, push notifications, and feedback loops, Charles F. Rattigan, cfrattigan@greenmtd.com, Green Mountain Digital, Woodstock, VT

How does Social Networking, Push Notifications, Multi Media, Building of Communities, and Feedback Loops (made possible by social media) fuel the ability of imaginative organizations to communicate with their constituents in real time through mobile technology? The proliferation of application-rich mobile devices, spearheaded by the introduction of the iPhone in 2007, has caused a culture-changing phenomenon not only in the way people communicate, but, more importantly, in the way they seek information. Increasingly, mobile devices are being used for data as much, if not more than, for voice communication. The iPhone, iPad, and iTouch and Android phones and tablets and creative developers are leading the way in mobile innovation and impact with the depth of applications and an enhanced user experience that allows for unprecedented interactivity.

8.7 12:05 Roundtable discussion: Question and answer period with audience and presenters

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9 • Applying the findings and recommendations of the 2011 OECD IPM workshop at a national level

Room L11

The Organization for Economic Co-operation and Development (OECD), made up of 34 member countries, has a mandate to promote co-operation for development and advancement in many economic areas including agriculture, environment, health and safety. A "Pesticide Risk Reduction Steering Group" operates as one of several activities under the auspices of the OECD's Pesticides Programme. In October of 2011, the OECD's Pesticide Programme facilitated a three day international workshop on IPM in Berlin, Germany. The event examined progress and on-going challenges in IPM adoption and measurement since the previous OECD Workshop on IPM and Pesticide Risk Reduction took place in 1998 in Neuchâtel, Switzerland. This session will briefly present the findings and draft recommendations which resulted from the discussions held in Berlin. It will then look at activities in a number of countries (Canada, Germany, United States, as well as more broadly in Europe), which are contributing to implement the recommendations. Finally, participants will introduce new approaches being planned or considered by countries to further respond to these recommendations to the OECD and its member countries. IPM programming, policy and pesticide

regulatory aspects will be addressed with an emphasis on recommendations pertaining to measurement and impact of IPM. This mini-symposium will provide an opportunity for information sharing, where differences in approach amongst countries and potential implications for growers can be highlighted. The format will be a series of short presentations, with a question and answer session during the last portion of each of the one-hour periods.

Organizer: Leslie Cass, leslie.cass@agr.gc.ca, Pest Management Centre, Agriculture and Agri-Food Canada, Ottawa, Canada

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9.1 10:00 OECD workshop on IPM recommendations and the implications of European pesticide legislation, Silke Dachbrodt-Saaydeh, Silke.Dachbrodt-Saaydeh@jki.bund.de, Julius Kühn-Institute (JKI), Federal Research Centre for Cultivated Plants, Kleinmachnow, Germany

The adoption of IPM is an ambition around the world and in Europe, where new regulatory documents related to pesticides were adopted in 2009. The 2011 Berlin OECD workshop on IPM reviewed international successes during the last decade. The main recommendations of the OECD workshop which related to fostering IPM adoption and its measurement will be discussed. The recommendations will be linked to implications of the EU-Directive on sustainable use of pesticides which include the mandatory implementation of general IPM principles by 2014 and encouragement of voluntary crop specific guidelines. Implications for growers and EU Member States will be presented.

9.2 10:20 Crop and sector specific IPM guidelines as tool in the German national action plan on sustainable use of pesticides, Bernd Hommel, Bernd.hommel@jki.bund.de, Julius Kühn-Institut (JKI), Federal Research Centre for Cultivated Plants, Kleinmachnow, Germany

German farmers have been applying for many years the eight general principles of IPM which will become mandatory in the European Union in 2014. To further reduce pesticide risk, these principles must be applied on a crop-specific basis, with concrete actions such as changes in rotational systems, choice of cultivars, use of decision support systems, etc. German grower organizations are responsible to develop and encourage uptake of crop-specific IPM guidelines. Several guidelines are available, and the voluntary use of these is supported by public incentives, and extension efforts. Metrics for use in evaluating impact of these guidelines have also been developed.

9.3 10:35 Implications of the findings of the OECD Workshop on Integrated Pest Management on planning and activities at Agriculture and Agri-Food Canada (AAFC), Leslie Cass, leslie.cass@agr.gc.ca, Pest Management Centre, Agriculture and Agri-Food Canada, Ottawa, Canada

The jurisdictional framework in which IPM policy and programming is developed and delivered in Canada will be briefly outlined, and will be used to provide context for a description of activities currently underway within the Canadian federal department of agriculture (AAFC) which are relevant to the findings of the OECD workshop. New approaches under consideration which could further respond to OECD findings will be presented. The emphasis of the talk will be on those activities and approaches related to OECD workshop findings pertaining to measurement and impact of IPM.

9.4 10:50 Question and answer, moderated by Lynnae Jess, jess@msu.edu, North Central IPM Center, East Lansing, MI

9.5 11:15 Federal implementation of IPM through FIFRA and the IPM Roadmap, Sheryl Kunickis, Sheryl.kunickis@ars.usda.gov, Office of Pest Management Policy, United States Department of Agriculture (USDA), Washington, DC

How ideas and recommendations from the OECD IPM Workshop support/strengthen the IPM mandate in the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the federal IPM Roadmap will be the focus of this presentation. FIFRA, as amended by the Food Quality Protection Act of 1996, directs USDA and EPA to jointly carry out certain IPM responsibilities. The goal of the federal IPM Road Map is to increase nationwide communication and efficiency through informational exchange among federal and non-federal IPM practitioners and service IPM experts, practitioners, and stakeholders.

9.6 11:30 IPM, the fun house, and the commons, Jim VanKirk, jim@sripmc.org, Southern Region IPM Center, Raleigh, NC

Implementation of IPM on all farms by 2014 will be mandatory in Europe, where the average farm derives two-thirds of its income from Coordinated Agriculture Policy payments. In the U.S. implementation for the most part remains optional. Although most of the economic benefits of IPM accrue to the farmer who uses it, environmental and health benefits are more likely distributed across society. Will IPM remain viable if potential implementers-e.g. farmers-only perceive part of the benefit but incur most of the cost?

9.7 11:45 Regulators: What do they have to do with IPM?, Debby Leblanc, debby.leblanc@hc-sc.gc.ca, Pest Management Regulatory Agency, Health Canada, Ottawa, Canada

The role of regulators is often overlooked in discussions of integrated pest management (IPM). This presentation will begin with highlighting some key areas where pesticide regulatory agencies, individually as well as collaboratively, contribute to and consider IPM within their regulatory functions. Examples

from Canada and North America of work in these key areas will be provided. Implications to regulators of the recommendations from the OECD IPM Workshop will be explored, followed by suggestions of potential future approaches which could be initiated or existing approaches which could be expanded upon to respond to the OECD recommendations.

9.8	12:00	Questions and answers, moderated by Lynnae Jess, jess@msu.edu, North Central IPM Center, East Lansing, MI

10 • Brainstorming: Effective IPM with Pesticide Prohibitions

Room L12

NYS Department of Environmental Conservation and Cornell NYS IPM program staff present experiences in New York State with pesticide prohibitions and minimum risk, organic and alternative pest management products in combination with IPM practices, audience discussion and brainstorming will follow regarding similar experiences and issues in their states and locales. This would include identifying benefits of IPM in prohibition situations and conveying those to the public, how to make IPM work with organic practices and 25b products and generating a list of solutions, ideas and partnerships for enhancing use of IPM in the these scenarios.

Organizer: Mary Roy, maroy@gw.dec.state.ny.us, New York State Department of Environmental Conservation, Albany, NY

10.1	10:00	Pesticide prohibitions, alternative products and IPM, Mary Roy, maroy@gw.dec.state.ny.us, New York State Department of Environmental Conservation, Albany, NY; Jennifer Grant, jag7@cornell.edu, NYS IPM Program at Cornell University, Geneva, NY
10.2	10:15	Discussion and brainstorming

Following speakers' presentation on experiences in New York State with pesticide prohibitions and the use of minimum risk, organic and alternative pest management products in combination with IPM practices, audience discussion and brainstorming would occur regarding similar experiences and issues in their states and locales. This would include identifying benefits of IPM in prohibition situations and conveying/promoting those to the public, and generating a list of solutions, ideas and partnerships needed for enhancing use of IPM in prohibition situations (e.g. schools, day cares) and for issues encountered when most conventional pesticides cannot be used (e.g. lack of centralized safety and efficacy info on alternative products).

11 • Government IPM partnerships for better public health

Room L13

Historically, efforts to promote integrated pest management (IPM) to control public health pests have largely been conducted by local government agencies. As resources become increasingly scarce, many communities are struggling to provide the most basic forms of pest control and education for their residents. While all communities are unique many public health pest issues confronting communities are similar, not only on a regional level but also on a national level. To address this problem, government agencies have been encouraging collaboration to help communities increase the efficiency and effectiveness of their IPM programs to control public health pests. During this session, we will discuss various efforts to enhance and promote interactions across all levels of government. Using these efforts for discussion, the session will describe two examples of formal IPM training programs the U.S. federal government is conducting at the local level. The session will also present a program being implemented in one federal agency to encourage communities to share information about their IPM control strategies and communication materials with each other. This session will discuss how public health pests are a problem shared by all communities and by working together, we can not only conserve resources, but also improve the public health outcomes in communities throughout the United States.

Organizer: Susan Jennings, Jennings.susan@epa.gov, US Environmental Protection Agency, Athens, GA

11.1	10:00	The Role of CDC's National Center for Environmental Health in promoting IPM, Michael E. Herring, mherring@cdc.gov, Centers for Disease Control and Prevention, National Center for Environmental Health, Atlanta, GA
11.2	10:12	IPM opportunities in the affordable housing industry, Rachel M. Riley, Rachel.M.Riley@hud.gov, Office of Healthy Homes and Lead Hazard Control (OHHLHC), U.S. Department of Housing and Urban Development, Washington, DC
11.3	10:24	IPM at USDA-NIFA: Outreach and Extension, Herbert T. Bolton, hbolton@nifa.usda.gov, U.S. Department of Agriculture, National Institute of Food and Agriculture, Washington, DC
11.4	10:36	Diffusion of IPM into the childcare sector, Debby F. Mir, debbymir@gmail.com, Migal-Galilee Technology Center, Kiryat Shmona, Israel

11.5 10:48 Collaborating for IPM across agencies and communities, Susan Jennings, Jennings.susan@epa.gov, US Environmental Protection Agency, Athens, GA

12 • Adventures in community IPM: Systems that work the bed bugs out

Room L14

In 2010 the US poverty rate rose to 15.1% (46.2 million). Low income families are far more likely to live in high-density housing, and consequently in densely populated area. Where there are lots of people, there will be pest conducive homes, which can act as reservoir sites for pest infestations that affect many residents. Bed bugs are the fastest-growing urban pest of significance in the United States, and the German cockroach remains the most common pest in low-income housing. Some housing management teams have embraced the IPM philosophy, and implement standards that operate at all levels, involving an extended cohort of stakeholders. This session will highlight several success stories. Bed bugs are embedded in mainstream American life for the long term. Infestations are spreading in urban and rural areas, and incident frequency is increasing at alarming rates in cities in the US, and in countries around the world. They are also becoming more severe in reservoir communities where the issue has been neglected or remediation costs limit successful eradication. Educating the public and raising community awareness are considered to be the most important aspects of limiting their spread. This session will include research updates and the development of best practices for various community environments. The latest outreach and risk communication efforts will be featured; especially those addressing sensitive environments (schools, child care, elder care) and non-traditional audiences (social and medical service providers). The results of coalition, task force, and other strategic management efforts, will be presented. The session will also address the issue of the cost of bed bug control and the ramifications for indigent communities.

Organizers: Jody Gangloff-Kaufmann, jlg23@cornell.edu, New York State IPM Program, Cornell University, Babylon, NY and Dawn H. Gouge, dhgouge@ag.arizona.edu, University of Arizona, Maricopa, AZ

12.1 10:00 Increases in bed bug incidence, outreach efforts, and diverse environments, Jody Gangloff-Kaufmann, jlg23@cornell.edu, New York State IPM Program, Cornell University, Babylon, NY

The story of bed bugs is an evolution. From their dramatic resurgence, to the spread, to changes in demographics and appearance in new environments, each day there is usually a headline-worthy story. This session will cover the progression of bed bug infestations and the reasons for their appearance in new and diverse settings. Many outreach efforts around the US and Canada will be discussed as well as the positive effect that outreach, advertising and media coverage may be having in the war on bed bugs.

12.2 10:20 Self-sustaining bed bug IPM for vulnerable residents, Molly Stedfast, msted14@vt.edu, Virginia Tech, Blacksburg, VA; Dini Miller

For some of our most vulnerable citizens, the cost of professional bed bug control is beyond what they can afford. A professional bed bug treatment for a single apartment unit typically costs between $500 (for a single application of both non-chemical and chemical methods; three treatments are recommended) and $2000 (whole unit heat treatment). Consequently, individual apartment residents often attempt to treat the infestations themselves. However, because the residents have no knowledge of how to control bed bugs effectively, they attempt a variety of useless or even dangerous practices in their homes. The goal of this research project is to teach our most vulnerable citizens how to protect themselves against bed bugs.

12.3 10:40 Bed Bugs—The gateway bug to better pest control, Allison A. Taisey, aat25@cornell.edu, Northeastern IPM Center, Cornell University, Ithaca, NY

Entire pest control budgets are being allocated to bed bug control. Public Housing Agencies (PHAs) are asking for help from entomologists. While we're working on bed bugs, why not manage all pests using an Integrated Pest Management (IPM) program? Safe, decent, healthy housing is pest-free. Learn how the Northeastern IPM Center at Cornell University works with PHAs nationwide to manage pests using IPM. Topics covered will include IPM basics, how to start an IPM program and strategies for residents who aren't doing their part in pest control-keeping the food, water and hiding places away from pests.

12.4 11:15 The impact of legislation and best management practices as an IPM societal response, Sam Bryks, sbryks@gmail.com, Integrated Pest Management Consultancy, Toronto, Ontario, Canada

The resurgence of bed bugs starting in the last few years of the 20th century and reaching "epidemic" proportions in major cities in North America and elsewhere, has highlighted difficulties of control of a serious pest in spite of extensive efforts. This has been attributed to loss of more effective products due to human health concerns, high pesticide resistance of bed bugs to current products and lack of awareness of appropriate control and preventive measures by many stakeholders. This presentation presents a brief overview of how this occurred and examines the importance of legislation in Quality of Life and Health Protection and of the Integrated Pest Management system/process in enabling a societal response. Causes of failure of control due to the corruption of IPM practice are discussed, as well as current efforts by various stakeholders and levels of government to address this issue.

12.5 11:55 Template for success: Putting the last first in Multnomah County, Oregon, Tim Stock, stockt@science.oregonstate.edu, Integrated Plant Protection Center, Oregon State University, Corvallis, OR

Like many urban areas in the United States, Multnomah County in Oregon has ongoing challenges with bed bug infestations. This presentation explores the components of a comprehensive approach to bed bug management based on the experiences of Home Forward (formerly Housing Authority of Portland) and the Multnomah County Bed Bug Task Force. A task force management team, countywide monitoring and mapping, website content, sustainable funding streams, outreach and training to multiple stakeholders, and assistance with pre-treatment preparation are discussed, with an argument for focusing first and foremost on low-income housing as the key element in successful management of bed bugs countywide.

Room L3

12.6 10:00 The missing link: How communication can win the war on bugs, Josh Vincent, standing in for Aimee Code, acode@pesticide.org, Northwest Center for Alternatives to Pesticides, Eugene, OR

A key component of urban integrated pest management is having a good system of communication between the various parties involved in the IPM program. Making sure there are effective communication lines open can be a significant hurdle for IPM programs. Focusing on k-12 schools and multi-family housing, this presentation will provide examples of why communications is so important for urban IPM and then provide concrete methods to make your urban IPM communication system stronger.

12.7 10:20 Crossing the street: Taking school IPM principles to the homes and families of our communities for better environmental health, Sherry Glick, Glick.Sherry@epa.gov, US EPA Office of Pesticide Programs, Washington, DC

Entire pest control budgets are being allocated to bed bug control. Public Housing Agencies (PHAs) are asking for help from entomologists. While we're working on bed bugs, why not manage all pests using an Integrated Pest Management (IPM) program? Safe, decent, healthy housing is pest-free.

12.8 10:40 Pesticide potpourri, Dawn H. Gouge, dhgouge@ag.arizona.edu, University of Arizona, Maricopa, AZ

When it comes to pests like blood feeding bugs infesting our nests, there is something very reasonable about human beings making pest control decisions under the influence of age old, life-saving instincts and emotions. Neuropsychologists agree that the more primitive emotions have a physiological basis and may be caused by visual stimuli as well as chemical stimuli. Bed bugs trigger strong fear, disgust, and rage emotions, causing significant chemical changes in the brain and body. This session introduces preliminary work focusing on instincts as prime determinates of pest control choices. Entomologists accepting the commanding role of the unconscious in human motivation and behavior, investigate ways of using instinctual responses to encourage individuals to select safer management options.

13 • Creative monitoring and natural resources

Room L2

This presentation will contain several different segments. It starts with creative monitoring and how to utilize every department in a school district, then blend into teaching everyone from the students to the Superintendant, as well as parents about the district's IPM program. Different departments are essential for a successful IPM program include Building and Planning, Operations, Nursing/Health, Safety and Environmental, Transportation, Maintenance, Child Nutrition, and even the Vendors. We work with students and teachers of agriculture to involve them in monitoring and using natural non-chemical methods for flies and rodents and assisting with the manure management program. We involve the horticulture classes by having the students and teachers take care of all the interior plants and trees, along with proper greenhouse management. Involve The wood shop classes are involved by having them build bat houses for schools and then having the students monitor and document observations as a learning tool.

Organizers: Erin Bauer, ebauer2@unl.edu, and Clyde Ogg, cogg@unl.edu, University of Nebraska–Lincoln, Lincoln, NE

13.1 11:15 Creative monitoring and natural resources, David Henderson, Dhenders@springisd.org, and CG (Charles) Cezeaux, Charlesc@springisd.org, Spring Independent School District, Houston, TX

Turn the "I Cant's into I Cans" by understanding that no matter what environment you are needing to place monitors for pests, that it can be done. Using creativeness and utilizing the variety of proper monitors, pheromones, and attractants, there is no place you cannot place a monitor unless it could become a fire hazard. You will also see how to make non chemical applications by utilizing our natural resources that are available to the IPM industry that include citrus oils, spices, and even natural predators to manage all pest issues.

13.2 12:05 Questions and answers

14 • Marketing IPM: Integrating IPM with local, sustainable, safe and fair

Room L8

Presentation of Red Tomato successful Eco Apple and Stone Fruit program, to developing marketing programs/strategies that promote IPM and add value in the marketplace for fresh fruit and vegetables. Focus on integrating IPM message with other important sustainability elements such as food safety, farm viability, fair labor practices, local/regional identity and farm identity; and on important role of farmer/scientist network in providing information and peer support for adoption of IPM practices. Presentation of the RT program as an example will be a springboard leading to participatory discussion of key current issues encountered in marketing and promoting IPM in food marketing. Topics that are especially timely may include: relationship of IPM to organic in marketing; value of 3rd party certification vs peer review/self-certification; incorporating continuous improvement and adaptation to emerging pest challenges and technologies into marketing messages, relationship of IPM to quality control in marketing product.

Session Organizer: Michael Rozyne, mrozyne@redtomato.org, Red Tomato, Canton, MA

14.1	11:15	Advanced IPM fruits and vegetables: Fifteen years of scaling up in the marketplace, Michael Rozyne, mrozyne@redtomato.org, Red Tomato, Canton, MA
14.2	11:45	Advancing IPM: Opportunities for integrated messages, Susan Futrell, sfutrell@redtomato.org, Red Tomato, Canton, MA

15 • Making the handoff: Moving invasive species from regulation to management

Room L12

The last decade has brought with it numerous new, invasive insect pest species. Some of these species have elicited nation, rapid eradication responses while the regulatory response to others has varied. Which species will trigger which response is not always clear to researchers or stakeholders. For example, the light brown apple moth (Epiphyas postvittana) is a highly regulated pest, while the spotted wing drosophila (Drosophila suzukii) and brown marmorated stink bug (Halyomorpha halys) are not subject to national regulations and have rapidly spread throughout the country. The decision to impose regulations and provide support to monitor some pests and not others is out of the hands of cooperative extension personnel and research scientists. However, these groups are at the front lines of dealing with invasive species once they become established. This brainstorming session will bring together USDA APHIS risk assessment, state plant protection, university, and county-based personnel to develop a framework to improve the transition from detection and regulation to establishment and management. The session will include a ten-minute presentation by a representative of each stakeholder group (four in total) which will contextualize their roles and responsibilities in invasive species management. The remainder of the session will be devoted to developing a draft work plan to enhance connections between these groups and smooth the transition from invasive species regulation to management. During the following year, this work plan will be submitted for review by professional societies, state and federal agencies, and land grant universities. The outcome of this session will be a durable document that fosters collaboration between invasive species regulators and managers.

Organizer: Hannah Burrack, hannah_burrack@ncsu.edu, North Carolina State University, Raleigh, NC

15.1	11:15	The handoff: The need for invasive species coordination between regulators, researchers, and stakeholders, Hannah Burrack, hannah_burrack@ncsu.edu, North Carolina State University, Raleigh, NC
15.2	11:20	The National Plant Diagnostic Network: National level invasive species detection and coordination, Martin Draper, mdraper@nifa.usda.gov, U.S. Department of Agriculture, National Institute of Food and Agriculture, Washington, DC
15.3	11:25	USDA APHIS: Invasive risk assessment and national regulation, Philip Berger, Philip.h.berger@aphis.usda.gov, USDA APHIS PPQ Center for Plant Health Science and Technology, Raleigh, NC
15.4	11:30	From regulation to research: Developing large scale monitoring and management efforts, Paul C. Jepson, jepsonp@science.oregonstate.edu, Integrated Plant Protection Center, Oregon State University, Corvallis, OR
15.5	11:35	On the front lines: Cooperative extension as first detectors, Mark Bolda, mpbolda@ucdavis.edu, University of California Cooperative Extension, Watsonville, CA
15.6	11:40	The follow through

Key questions include: 1) How do regulatory, research, extension, and end users determine which invasive species are important? 2) What are the implications of the differences in invasive species priorities for stakeholders? 3) What are the possible trajectories for invasive species policy, research, and management (e.g. detection, regulation, research, management), and are these the most appropriate? 4) How can we improve communication between invasive species regulatory, research, extension, and stakeholder groups?

16 • Use of weather-based pest, crop and natural resource information systems to facilitate effective IPM decision-making world-wide

Room L13

Weather is arguably the most important influence on the occurrence and severity of insect, weed and disease pests in agriculture worldwide. The ability to use integrated pest management strategies effectively and efficiently depends on an intimate knowledge of current local and regional weather conditions affecting the pest, the crop and the management measures to be used. Current technology allows weather information to be disseminated quickly, easily and inexpensively through the worldwide web, cell phones, etc. Moreover, current programming capabilities enable current, local and regional weather data to be used in applications that facilitate IPM decision making by farmers and other pest managers. Several weather networks and associated information distribution programs exist throughout the United States and elsewhere. These programs provide easy access to current weather conditions and weather summaries that help users compare conditions across a region or historically. Specialized weather summaries for specific crops or livestock, insect, disease and crop predictive models that help producers make decisions about efficient, effective crop management, and aids for natural resource managers exist. This program session will explore the use of weather networks for IPM programs. Existing programs will be detailed, including Michigan State University's Enviro-weather program, which provides decision-making information for Michigan and elsewhere. Other speakers will discuss alternative programs. Comparisons between programs and potential synergistic cooperation between programs will be discussed. Finally, we will explore the benefits of and barriers to expansion of these systems to other locations throughout the world.

Organizer: Beth Bishop, bishopb@msu.edu, Michigan State University, East Lansing, MI

Moderator: Larry Olsen, olsenl@cns.msu.edu, Michigan State University, East Lansing, MI

16.1 11:15 Enviro-weather: A Weather-based pest and crop management information system for Michigan, Jeff Andresen, Andresen@msu.edu, Michigan State University, East Lansing, MI

The overarching mission of the Michigan State University-based Enviro-weather Project is the provision of relevant, dependable, and sustainable weather-based information to support agricultural pest, production, and natural resource management decision-making in Michigan. Enviro-weather integrates near-real-time weather data from a network of 70 stations around the state with modeling tools and other IPM resources (www.enviroweather.msu.edu). Data from a recent survey suggest that use of Enviro-weather information resulted in lower use of pesticides, increased crop yields and quality, and more efficient and profitable farming operations than for non-users.

16.2 11:35 User-friendly tools for predicting pest phenology based on degree-days and biological calendars, Dan Herms, herms.2@osu.edu, OARDC, The Ohio State University, Wooster, OH

Plant phenology can track degree-day accumulation and predict insect development. A 7-year study demonstrated that a phenological sequence of 54 arthropods and 75 ornamental plants varied little from year-to-year. Degree-day models for each species generated the "Growing Degree-Day and Phenology for Ohio" website (www.oardc.ohio-state.edu/gdd), which provides real-time or historical degree-day data and phenological predictions for any location in Ohio. By scrolling up or down the Biological Calendar, it is possible to see what events have occurred, and what has yet to occur. The phenological sequence provides a user-friendly Biological Calendar for anticipating and timing pest management decisions.

16.3 11:55 Wetness sensing for disease-warning systems: Are we on the wrong road?, Tracy Rowlandson, trowland@uoguelph.ca, University of Guelph, Guelph, Ontario, Canada; Mark Gleason, mgleason@iastate.edu, Iowa State University, Ames, IA

Leaf wetness sensors have been useful IPM tools for nearly 50 years, and have facilitated development of many disease-warning systems. But are they the best choice for future IPM research and implementation? Relative humidity measurements are much less subject to within-canopy heterogeneity than leaf wetness sensors, and unlike wetness sensors they can be calibrated objectively. Regional networks of weather stations can support site-specific weather estimation for warning systems, but almost all of these stations deploy relative humidity sensors rather than wetness sensors. Should we be moving towards using relative humidity as a surrogate for leaf wetness?

17 • Exploring the international flavors of benchmarking IPM

Room L2

This mini-symposium of 3 speakers will bring two international perspectives of IPM benchmarking to the 7th IPM Symposia. Millions of dollars are spent on protecting crops, developing technologies and associated practice change activities and crop protection remains a high priority. Stakeholders, including investors want to know the level of adoption of integrated pest management (IPM) in crops. Monitoring of IPM implementation seems to be fragmented, being measured at project, farm and national levels, without linkages between the activities. The Australian and European perspectives in developing and implementing measures on IPM implementation in horticulture and field crops will be presented ins this session followed by an informal discussion of other experiences from the

audience. The presentations will explore the supporting and influencing roles that policy, evaluation and market can play in providing a benchmarking IPM framework and measures.

Organizer: Bronwyn Walsh, bron.walsh@gmail.com, Industry Development, Duncraig, WA, Australia

17.1 2:45 The hint of possibility: Benchmarking IPM in Australian vegetables, Bronwyn Walsh, bron.walsh@gmail.com, Industry Development, Duncraig, WA, Australia

The Australian vegetable industry wanted to know the level of adoption of integrated pest management (IPM) by its members. Previous monitoring of IPM implementation has been fragmented in Australia. This presentation builds on a report that describes five activities undertaken to prepare for a Benchmarking IPM Adoption exercise. It became evident that the apparently simple task of benchmarking IPM adoption in the Australian vegetable industry is a complex task because of the various interpretations of IPM and the diversity of the vegetable industry. Recommendations for implementing the ambitious benchmarking initiative were made to provide a common language and measures of IPM in vegetables in Australia.

17.2 3:00 Setting the mood: Policy, legislation and IPM benchmarking, Silke Dachbrodt-Saaydeh, silke.dachbrodt-saaydeh@jkl.bund.de, Julius Kuhn-Institute, Federal Research Centre for Cultivated Plants, Kleinmachnov, Germany

As IPM implementation becomes more widespread in Europe and globally, the question of how to measure IPM uptake across various sectors and countries is gaining increasing importance. European Member States have recently adopted the Directive on sustainable use of pesticides which requires the mandatory adoption of general IPM principles and encourages the setup of voluntary crop specific IPM guidelines. An overview of the current European situation is given and the implications of the new legislation are discussed. Approaches on how to measure pesticide use and IPM uptake in Europe and Germany in particular are presented.

17.3 3:15 Building credence: By stealth

Quality assurance standards are part of entry into many markets. In Australia, in developing one code of practice, the term IPM wasn't used, due to negative perceptions from some growers; however the primary concepts of IPM underpinned the practices that were included. In meeting the code of practice, growers built preventative measures into their pest management strategy rather than reactive approaches, and so IPM was achieved by stealth. The practices included in the code can be the measures that are used for benchmarking IPM and so can provide a dual purpose of providing market access and benchmarking IPM.

71.4 3:30 Exploring the senses: Q and A sharing learnings and steps forward of IPM benchmarking, facilitated by Bronwyn Walsh

18 • Impact of bioenergy crops on pests, natural enemies and pollinators in agricultural and non-crop landscapes

Room L3

Researchers from Arkansas, Oklahoma State, Kansas State, and USDA (Arizona) are examining the impact that biofuel crops have on areawide population dynamics of insect pests, natural enemies and pollinators. The sustainability of the nation's biofuel feedstock production systems rely on the selection and placement of energy crops that efficiently generate biomass without compromising existing agricultural systems. Pest and beneficial organisms will certainly occur in these feedstock crops, but the net effect of this utilization is unknown due to the lack of expansive monocultures of these crops. These crops may serve as a nursery producing pests or beneficial organisms (source), or may attract or trap these organisms (sink). These source/sink relationships can be beneficial or deleterious to the feedstock crop or to the surrounding agricultural production systems. We are studying these source/sink relationships in canola and switchgrass by identifying the arthropods using the energy crops, evaluating the importance of the beneficial organisms in maintaining the pests in the energy crops, and determining the extent and timing of the movement of the important pest and beneficial species among the energy and agricultural crops in the landscape. These determinations are being accomplished through intensive insect sampling in and around the energy crops, conducting exclusion studies to evaluate natural enemy efficacy, and evaluating arthropod intercrop dispersal through protein mark-recapture type studies. Our reseach team is providing significant information regarding the risks or benefits from the placement of large canola and switchgrass monocultures into established agricultural landscapes.

Organizer: James R. Hagler, james.hagler@ars.usda.gov, USDA-ARS, Arid-Land Agricultural Research Center, Maricopa, AZ

18.1 2:45 Opening remarks, James R. Hagler, james.hagler@ars.usda.gov, USDA-ARS, Arid-Land Agricultural Research Center, Maricopa, AZ

18.2 2:55 Habitat shifts induced by expansion of biofuel crops and the potential impact on associated arthropods, Timothy J. Kring, tkring@uark.edu, University of Arkansas, Fayetteville, AR; Robert N. Wiedenmann; David S. Akin

Rapid changes in agricultural crop production practices at the landscape level can have profound economic, societal and

biological impacts on the surrounding communities. Historically, shifts in agricultural production occur over decades or longer, and the resulting changes appear subtly. The projected increases in biofuel acreage are unprecedented in scale and speed of implementation. Previous shifts in agricultural production provide some insight into the potential benefits and complications that may arise from the expansion of biofuel crops novel to agricultural and natural ecosystems.

18.3 3:15 Optimizing arthropod protein mark-capture protocols for area-wide dispersal research in biofuel crops, James R. Hagler, james.hagler@ars.usda.gov, USDA-ARS, Arid-Land Agricultural Research Center, Maricopa, AZ; Steve E. Naranjo

The impact that biofuel crops have on arthropod demography is unknown. We are studying regional source/sink relationships in crops to determine the extent and timing of the movement of pests, natural enemies and pollinators among biofuel feedstock and conventional crops. These determinations are being accomplished, in part, by evaluating arthropod intercrop dispersal through protein mark-recapture studies. A multi-protein mark capture method is described that is being used to quantify the dispersal patterns of arthropods. Ultimately, this method will help provide information regarding the risks or benefits from the placement of large canola and switchgrass monocultures into established agricultural landscapes.

18.4 3:35 Predator activity in winter canola within diversified landscapes, Sarah L. Donelson, s.l.donelson@okstate.edu, and Kristopher L. Giles, kris.giles@okstate.edu, Oklahoma State University, Stillwater, OK

Among oilseed crops, canola (*Brassica napus*) has the greatest potential as a sustainable biodiesel source. The expansion of winter canola in the South Central US was followed by severe infestations of aphids that utilize the abundant energy available in these biofuel plants. Aphids in canola attract a diversity of insect predators, but because of intensive insecticide use this crop may function as a sink habitat for natural enemies in the landscape. Data describing the late-spring activity of common insect predators in diverse canola landscapes will be presented and the implications of increased insecticide use will be discussed.

18.5 4:00 Challenges of evaluating and integrating natural enemy impacts on pests of bioenergy crops at a landscape level, Brian McCornack, mccornac@ksu.edu, Kansas State University, Manhattan, KS; Ximena Cibils

The introduction of large acreages of biofuel crops into an agroecosystem will likely alter crop pest and natural enemy demographics. The key to successful monitoring of these changes will largely depend on developing reliable methods to quantify the impacts that ecosystem services have on arthropod pest populations. For example, in soybean there is increasing evidence that biological control services regulate herbivore populations using both direct (consumptive) and indirect (non-consumptive) pathways. Lessons learned from other intensive cropping systems like soybean may provide some insights and directions for researching these complex interactions between natural enemies and their prey in a changing landscape.

18.6 4:20 Pollinators in a changing agricultural landscape: Implications of increased biofuel crop production, Kimberly A. Hays, khays@shorter.edu, Shorter University, Rome, GA; Kristen A. Baum, kristen.baum@okstate.edu, Oklahoma State University, Stillwater, OK

Increased biofuel crop production is changing agricultural landscapes, with the potential to modify the distribution and abundance of pollinators through changes in resource availability. Winter canola production is increasing in the South Central US, where canola is highly attractive to bees because it produces large amounts of nectar during the early spring when floral resources are scarce. We estimated the diversity of bees in simple (canola and wheat) and diverse (canola, wheat, and pasture) landscapes in Oklahoma. Bee abundance and species richness were higher in diverse than simple landscapes.

18.7 4:40 Closing remarks, Rob N. Wiedenmann, rwieden@uark.edu, University of Arkansas, Fayetteville, AR

19 • Rest in peace: USDA Section 406 IPM programs—Research contributions from CAR, RAMP and IPM Centers

Room L4

President Obama's FY 2011 and FY 2012 budget proposals each eliminated funding for IPM programs previously funded under AREERA Section 406. Regional IPM Centers were included as the result of Congressional action in budgets enacted for both years, but two other key IPM programs Crops at Risk (CAR) and Risk Avoidance and Mitigation Program (RAMP) have been discontinued. A decade after inception of these programs, we are in position to evaluate the value of these programs. This mini-symposium comprises presentations highlighting research contributions of projects funded by each of the IPM Centers, CAR and RAMP programs, and an overview of prospects for future USDA funding for research in IPM.

Organizer: Jim VanKirk, jim@sripmc.org, Southern Region IPM Center, Raleigh, NC

19.1 2:45 Session overview, Jim VanKirk, jim@sripmc.org, Southern Region IPM Center, Raleigh, NC

CAR and RAMP funding seems to be gone entirely, and Regional IPM Centers were only granted last minute reprieves

(twice). Has the decade-old Section 406 IPM funding produced value in IPM research? This symposium will describe projects funded by each of the 406 IPM programs.

19.2 2:51 Contributions by IPM Centers to the IPM research, Rick Melnicoe, rsmelnicoe@ucdavis.edu, Western IPM Center, Davis, CA

Funding from Regional IPM Centers for research is available only in small amounts, so we tend to focus on support roles such as identifying priorities, facilitating collaboration, and catalyzing new approaches. This presentation will include examples from the four regions.

19.3 3:09 Research impacts from our RAMP project: Soybean aphid in the North Central US: Implementing IPM at the landscape scale, Doug Landis, landisd@msu.edu, Michigan State University, East Lansing, MI; Christina DiFonzo; Michael Brewer; Scott Swinton; David Ragsdale; George Heimpel; Robert Venette; Kent Olson; Claudio Gratton; Craig Grau; Tom German; Matt O'Neal

This RAMP project brought together researchers from Michigan, Wisconsin, Minnesota and Iowa to collectively address IPM research needs. Replicated trials across multiple locations and years demonstrated that a single at-threshold insecticide application worked best for at-risk soybean production. These recommendations were disseminated and surveys confirmed widespread knowledge and adoption of the 250 aphid/plant threshold. Economic analyses showed that threshold-based IPM generated a projected economic net benefit of $1.3 billion over five years, for an internal rate of return of 180%. Contributing modeling showed that natural enemies provide producers an average of $238 M/yr in biocontrol services against the soybean aphid.

19.4 3:27 Research impacts from our RAMP project: Development of cost-competitive programs using reduced-risk tactics to manage arthropod pests in Eastern apple and peach production regions, Jim Walgenbach, jim_walgenbach@ncsu.edu, North Carolina State University, Mills River, NC

The loss of organophosphate insecticides due to regulatory decisions is causing the eastern tree fruit industry to adopt new approaches to managing arthropod pests. This project investigated development and implementation of cost-effective, reduced-risk approaches to managing arthropods in eastern apple and peaches including evaluation of pheromone dispensers for mating disruption of two key pests. Reduced-risk insecticides were readily adopted by growers over the course of the project, while use of mating disruption varied by state and crop.

19.5 4:00 Research impacts from our RAMP project: Developing and implementing field and landscape level reduced-risk management strategies for *lygus* in Western cropping system, Peter Ellsworth, peterell@ag.arizona.edu, University of Arizona, Arizona Pest Management, Maricopa, AZ; Peter B. Goodell; Megha Parajulee; Scott Bundy; Steven Naranjo; Yves Carriere; Alfred Fournier; Larry Godfrey; James Hagler; John Palumbo; Jay Rosenheim; David Kerns; Andrew Corbett

Our RAMP goal was to develop, improve and deliver sustainable, areawide management strategies for *Lygus* in the West and to reduce all forms of risk. Complementary field- and landscape-level research and education supported areawide pest reduction and improved *Lygus* management. Exploration of *Lygus* crop and non-crop source-sink relationships informed landscape management recommendations. Extension programs taught, demonstrated, and measured the use of innovative management tools, reduced-risk chemistries, and field and landscape level recommendations. Through Western IPM Center leverage, we measured impacts including 74% reduction in broadly toxic insecticide use in Arizona cotton and adoption of landscape-level management recommendations in California.

19.6 4:15 Research impacts from our CAR project: Diversifying weed management options by using alternative rice establishment methods, A J Fischer, ajfischer@ucdavis.edu, University of California-Davis, Davis, CA

Widespread herbicide resistance in the major weeds of rice is a serious threat to the sustainability of rice production in California. Alternative stand establishment techniques changed the weed recruitment environment and reduced weed seedbanks. Water seeded systems favored aquatic weeds while drill seeding favored dryland weeds. In addition, weed pressure on the crop was dramatically reduced as long as the soil surface is not disturbed after a stale seedbed technique was employed. This integrative approach is being adopted by California growers and is the basis of sustained rice cropping in spite of widespread herbicide resistance in the major weeds.

19.7 4:30 Research impacts from our CAR project: Building an area-wide IPM perspective for stalk borers threatening sugarcane and rice, T.E. (Gene) Reagan, treagan@agcenter.lsu.edu, Louisiana State University, Baton Rouge, LA

Diatraea saccharalis and *Eoreuma loftini* are stem boring pests of sugarcane and rice. Experiments showed the potential for sugarcane planted in early August to harbor 4.7-19.0-fold greater *D. saccharalis* infestations than September plantings. Sentinel plant experiments confirmed that weeds are important stem borer hosts. Transect sampling showed that *E. loftini* densities in non-crop areas ranged 0.3-5.7 immatures/m^2 throughout a 2-yr period. Rice is more preferred for *E. loftini* oviposition than non-crop hosts, and larval development is 1.7-fold longer on johnsongrass and vaseygrass than on rice. Lowering rice

cutting height from 40 to 20 cm reduces *E. loftini* infestations by 70-81%.

19.8 4:45 What's the future of USDA funding for IPM research?, Mike Fitzner, mfitzner@nifa.usda.gov, U.S. Department of Agriculture, National Institute of Food and Agriculture, Washington, DC

Predicting what will happen in future budgets is risky at best. Dr. Fitzner will present what is known now about IPM and the USDA budget.

20 • Pesticide resistance in arthropods, plant pathogens, and weeds: A growing threat to IPM and U. S. agriculture

Room L5

Integrated Pest Management (IPM) and Resistance Management are inseparable. Resistance Management begins with IPM to minimize the number of pesticide applications to those that are absolutely essential. However, due to the failure to minimize pesticide applications, rotate mechanisms of action, or lack of effective alternatives, many arthropod pests, plant pathogens and weeds have developed resistance to pesticides. Most pest management scientists, in the public sector, the pesticide industry, and in government regulatory agencies, agree that pesticide resistance is making pest control increasingly difficult in human health, agriculture, animal production systems, and structural and urban pest management. An early estimate of the economic impact of pesticide resistance on crop protection in the U.S. exceeds $4 billion annually. Due to resistance and reduced chemical arsenal used against pests, it is essential to better manage those that are available and to encourage development and registration of new alternatives. Current information on pesticide resistance and resistance management must be readily available to managers at the local, national and international levels. To help address this need, we will hold a mini-symposium describing current issues in pesticide resistance and development of global resistance to xenobiotics by arthopod pests, plant pathogens and weeds.

Organizers: David Mota-Sanchez, motasanc@msu.edu, Michigan State University, East Lansing, MI; Andy Wyenandt, wyenandt@aesop.rutgers.edu, Rutgers University, Bridgeton, NY; Robert L. Nichols, BNichols@cottoninc.com, Cotton Incorporated, Cary, NC; Mark E. Whalon, whalon@msu.edu, Michigan State University, East Lansing, MI

20.1 2:45 Global arthropod pesticide resistance, Mark E. Whalon, whalon@msu.edu, Michigan State University, East Lansing, MI; David Mota-Sanchez; Robert M. Hollingworth

The occurrence of pesticide resistance frequently leads to the increased use, overuse, and even misuse of pesticides resulting in a risk to the environment, market access, and public health. Arthropods have been evolving for millions of years to defeat natural toxins, and now 574 species and 10,000 cases of pesticide resistance have been counted, most of which have been recorded over the last 65 years of intensive pesticide use. Development of global arthropod resistance to xenobiotics occurring in agriculture, medical, veterinary, and forest areas will be discussed, as well as resistance cases by insecticide mode of action and taxonomic group.

20.2 3:05 GMO's and instances of insect resistance development, Blair D Siegfried, bsiegfried1@unl.edu, University of Nebraska–Lincoln, Lincoln, NE

Transgenic crops producing *Bacillus thuringiensis* (Bt) toxins for insect pest control have been successful in managing a variety of pest insects. However, widespread adoption of this technology is thought to impose considerable selection pressure on target pests and the risk of resistance evolution is perceived to be high. Successful management of resistance to Bt crops has been achieved in a number of instances. However, the list of pest species that have evolved resistance to Bt crops conditions is growing. Identifying the factors that contribute to both the successful and unsuccessful management of resistance is important to future resistance management recommendations.

20.3 3:25 Fungicide resistance: Current situation and management challenges, Margaret T. McGrath, mtm3@cornell.edu, Long Island Horticultural Research and Extension Center, Cornell University, Riverhead, NY

Managing resistance is an important component of IPM programs because most fungicides have medium to high risk of resistance development, many important pathogens have demonstrated ability to develop resistance, and with a goal of delaying development, rather than managing resistant strains, implementation is always needed. Targeted activity of modern fungicides imparts low potential non-target impacts, but also resistance risk. These fungicides have resistance risk because of single-site mode of action. Challenges include predicting risk (for pathogen and fungicide), identifying best anti-resistance strategies (especially fungicide mixtures versus alternations), lack of tools (other fungicides, resistant varieties), detecting resistance, and increased management costs.

20.4 4:00 Strobilurin fungicide use in field crops: The road to resistance?, Carl A. Bradley, carlbrad@illinois.edu, University of Illinois, Urbana, IL; Venkat Chapara; Dianne Pedersen; Guirong Zhang

Strobilurin foliar fungicide use in field crops has increased dramatically recently. Factors that have driven this increase include favorable commodity prices, new fungicide products, and marketing of fungicides for yield and plant health enhancement. Results of a survey of extension meeting attendees indicated that one of the most important criteria used in making

fungicide application decisions was the potential for higher yields without considering disease risk or scouting observations. The impact of the increasing use of strobilurin fungicides on fungicide resistance will be discussed with emphasis on the current situation of strobilurin resistance in the soybean pathogen *Cercospora sojina*.

20.5 4:20 How the interaction of plant factors, crop management, and herbicide chemistry affect the development of herbicide resistance, W.K. Vencill, wvencill@uga.edu, University of Georgia, Athens, GA; R.L. Nichols; T.M. Webster; I. Heap

The apparent rate of evolution of resistance of weeds to herbicides has increased substantially over the past decade. Data suggests phenotypic expression is affected by the mechanism of action of the herbicide, the taxonomy of the weed, the extent and frequency of selection and the agronomic context of herbicide use that contribute to the development of herbicide resistance. The ability to identify weed and herbicide combinations that are most likely to develop herbicide resistance can aid in education and management systems to delay herbicide resistance.

20.6 4:40 Reducing the risks of herbicide resistance: Best management practices and recommendations, David Shaw, DShaw@research.msstate.edu, Mississippi State University, Mississippi State, MS; Jason Norsworthy; Sarah Ward; Rick Llewellyn; Robert Nichols; Ted Webster; Kevin Bradley; George Frisvold; Steve Powles; Nilda Burgos; Bill Witt; Michael Barrett

Herbicide resistance in plants has become a pressing issue in agriculture, brought to the fore with the development of glyphosate-resistant weeds. Federal agencies, industry, non-governmental organizations, commodity groups, and academia have begun dialog at an unprecedented level on how to best preserve invaluable herbicide technologies. The Weed Science Society of America has been working to develop educational tools that promote sustainable weed management practices. These include training modules, special reports, and a jointly hosted National Resistance Management Summit with the National Academy of Science. WSSA has worked closely with stakeholders to disseminate this information widely.

21 • Opportunities for public and private-sector IPM specialists to collaborate, strengthen and enhance USDA NRCS Farm Bill conservation programs for IPM

Room L6

The Natural Resources Conservation Service and its predecessor the Soil Conservation Service have been fulfilling the mission, "Helping People Help the Land" since the dust bowl of the 1930's by building the capacity of farmers and landowners ability to implement innovative conservation solutions which benefit the land. The Environmental Quality Incentive Program (EQIP) is one of several programs which provides technical and financial assistance to farmers and landowners to adopt conservation measures and includes IPM among its many eligible practices. However, funding of IPM practices in EQIP has remained low with 54% of states spending, on average, less than 2% of annual EQIP allocations on IPM from 2002 to 2007. In anticipation of reductions in federal funding for conservation programs in the 2012 Farm Bill, NRCS may face additional constraints to satisfy the diverse conservation needs of farmers and landowners. Maintaining support for IPM in EQIP and other USDA Farm Bill programs creates an opportunity for IPM specialists, conservation professionals, Extension, state lead agencies and private sector crop advisors who support IPM to collaborate with NRCS to maximize the potential of these programs which support farmer adoption of IPM. During this symposium we will review and discuss and identify IPM successes, challenges and next-steps to help farmers overcome perceived barriers and impediments to successful adoption of IPM through participation in NRCS conservation programs.

Organizer: Peter Werts, pwerts@ipminstitute.org, IPM Institute of North America, Inc., Madison, WI

21.1 2:45 Introduction, Thomas Green, ipmworks@ipminstitute.org, IPM Institute of North America, Inc., Madison, WI

So why does IPM still matter? Many opportunities and challenges still exist to ensure wide-spread adoption of IPM in agriculture. Dr. Green will introduce accomplishments of IPM and success of conservation efforts to date.

21.2 2:55 Overview of NRCS Technical Service Provider Program for EQIP 595 and USDA Farm Bill program support of grower adoption of IPM, Bill Kuenstler, Bill.Kuenstler@ftw.usda.gov, Central National Technology Support Center, Fort Worth, TX

The USDA Natural Resources Conservation Service (NRCS) is the federal agency responsible for helping land owners implement conservation on working lands. Annually, the USDA Farm Bill provides over $1 billion dollars to fund these conservation efforts. Funding to support IPM and other practices is provided through the Environmental Quality Incentives Program (EQIP). The NRCS also relies on private-sector Technical Service Providers to help farmers implement conservation practices funded through EQIP. This presentation will discuss the role of the Farm Bill in funding conservation on working lands and how the private-sector can help ensure successful adoption of IPM and other conservation practices.

21.3 3:25 Crop advisors and conservation driven on-farm IPM planning and decision making, Peter Goodell,

pbgoodell@ucanr.edu, University of California Cooperative Extension, Parlier, CA

The primary of focus of IPM has been on crops and pests. In recent years, environmental and resource conservation issues have become increasingly important drivers of IPM programs. Even more recently, publicly supported conservation programs which encourage the adoption of practices that enhance soil, water, air, plant and animal resources have incorporated IPM into its suite of practices, including EQIP and Conservation Activity Planning (CAP) for IPM. The linkage between conservation planning, IPM and environmental quality, is providing an opportunity to increase the number and diversity of IPM practices while engaging additional audiences and partners and creating new consulting opportunities.

21.4 4:00 IPM certification opportunities for crop consultants, Blaine Viator, blaineviator@gmail.com, National Association of Independent Crop Consultants, Labadieville, LA

The primary mission of the independent crop consultants, researchers and agricultural professionals represented by the National Alliance of Independent Crop Consultants (NAICC) is to implement scientific and technological advances to enhance environmental sustainability and profitability on clients' farms. The NRCS is heavily reliant on these private-sector consultants to provide Technical Assistance to farmers enrolled in USDA conservation programs, including EQIP. This presentation will focus on current opportunities for IPM consultants to become involved in NAICC certification programs which will provide opportunities to provide Technical Assistance to growers through the NRCS Technical Service Provider Program.

21.5 4:10 NRCS and IPM WG: Impacts on NRCS programs for IPM, Peter Werts, pwerts@ipminstitute.org, IPM Institute of North America, Inc., Madison, WI

USDA NRCS Environmental Quality Incentives Program 595 practice standard provides farmers access to technical and cost-share assistance to support adoption of IPM among growers. Unfortunately, EQIP has not always accommodated the needs of all crops produced by America's farmers. IPM specialists, Extension and NRCS personnel participating in the NRCS and IPM Working Group have developed a model to support collaborations which can assist NRCS in making improvements to EQIP at the state and regional level. This presentation discusses the impacts of EQIP 595 and discusses opportunities to facilitate additional improvements to support grower adoption of IPM through participation USDA conservation programs.

21.6 4:20 Motivating advanced IPM growers with a market-based program, Michael Rozyne, MRozyne@redtomato.org, Red Tomato, Canton, MA

USDA-funded conservation programs provide important capacity-building resources to enable and speed up IPM adoption. Market-based programs are a perfect complement, encouraging farmers to strengthen their commitment to IPM. Red Tomato's Eco Apple and Eco Peach programs are rigorous examples which emphasize important relationships between farmers, scientists, consumers and ecological growing practices. This presentation will discuss how growers have harnessed the marketplace to establish an IPM learning community, strengthen local food economies, and protect resources through IPM eco labeling and marketing.

21.7 4:35 Panel discussion, moderated by Wade Moder, wmoder@ipminstitute.org, and Peter Werts, pwerts@ipminstitute.org, IPM Institute of North America, Inc., Madison, WI

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22 • Success in integrated management of head blight of wheat in the U.S.

Room L8

Fusarium Head Blight (FHB), caused predominantly by *Fusarium graminearum* in North America, and its associated toxins, especially deoxynivalenol (DON), continue to be causes for concern in every sector of the wheat and barley industries. No single management strategy has been fully effective against FHB and DON. Recognizing this fact, as well as the fact that FHB and DON can be considered critical issues nationally and internationally, the U.S. Wheat and Barley Scab Initiative has placed great emphasis on integrated research and extension activities to improve management recommendations for control of FHB. In this two-hour symposium, speakers will highlight advances made in the integrated management of FHB. In particular, talks will focus on research and extension activities in the following areas: (i) advances in genetics and breeding for FHB resistance, (ii) advances in the development of fungicides to improve control of FHB, (iii) contributions of cereal debris management to reduction of FHB and mycotoxins, (iv) improvements in forecasting for FHB, (v) the use of regionally based integrated management trials and the role of variety selection in combination with foliar fungicide applications, and (vi) the level of adoption of these integrated management techniques by growers. This symposium would have broad interest to IPM practitioners especially those interested in the development of team-oriented research and extension.

Organizer: Marcia McMullen, Marcia.Mcmullen@ndsu.edu, North Dakota State University, Fargo, ND

22.1 2:45 Advances in breeding and genetics for head blight resistance, Fred Kolb, f-kolb@illinois.edu, University of Illinois, Urbana, IL

Over the past 15 years wheat breeders have followed two pathways towards resistance: 1) incorporation of exotic

resistance genes or quantitative trait loci from Asian wheats and 2) utilization of resistance genes native to the adapted wheat gene pools. Success of each strategy varies over market classes: in HRS wheat where native resistance is scarce, Asian resistance genes have been used successfully. In SRW wheat native resistance has been more effective. All breeding programs are using doubled haploids and other techniques to speed delivery of resistant varieties. The challenge is to combine scab resistance with high yield and superior quality.

22.2 3:05 Advances in the development of fungicides to improve control of head blight, Don Hershman, dhershma@uky.edu, UKREC, Princeton, KY

Interest in using fungicides to manage head blight gained momentum in the mid- to late-1990's when research showed that tebuconazole applied at early anthesis provided modest, but consistent, head blight and DON suppression in both spring and winter wheat. Subsequently, a multi-state, multi-year research effort funded by the USWBSI indicated that other triazole fungicides (prothioconazole, metconazole, and prothioconazole + tebuconazole) provided somewhat improved performance compared to tebuconazole applied alone. Recently, these fungicides have been successfully used to suppress light to moderate head blight epidemics on millions of acres, annually. However, fungicides frequently provide unacceptable results when epidemics are severe.

22.3 3:25 New insights on cereal debris management for the reduction of head blight and mycotoxins, Gary C. Bergstrom, gcb3@cornell.edu, Cornell University, Ithaca, NY

Effects of crop sequence and plowing of cereal debris on head blight and mycotoxin reduction in wheat will be discussed. Wheat planted into cereal debris (source of Fusarium spores) is at increased risk for head blight and mycotoxins, but atmospheric inoculum from spores released over a wider geographic region presents an even greater risk. Cultural practices that promote residue decomposition and decrease Fusarium survival could reduce atmospheric spore levels significantly, but only if implemented over a wide production region. Wheat rotation (following a non-cereal crop) seldom achieves satisfactory head blight control, but it remains a useful component of integrated management.

22.4 4:00 Improvements in forecasting for head blight in the U.S., Erick DeWolf, dewolf1@ksu.edu, Kansas State University, Manhattan, KS

During the past decade a multistate effort has made significant progress in quantifying the role of weather in head blight epidemics. Models developed by this effort are now deployed in 30 states and provide daily estimates of disease risk via web-based tools. The maps of disease risk provided by the tools are accompanied by commentary developed by the disease specialists. This commentary is also distributed by email and text messages sent to mobile devices further enhancing access to the information. These forecasting models are now a useful part of the integrated management of head blight in the U.S.

22.5 4:20 Use of regionally based integrated management trials and the role of variety selection in combination with foliar fungicide applications, Pierce A. Paul, paul.661@osu.edu, Ohio State University, Wooster, OH; Katelyn T. Willyerd

Over 40 unique trials conducted from 2007 to 2010 in 12 U.S. states, representing four wheat market classes, were used to evaluate the efficacy and stability of integrating host resistance and prothioconazole + tebuconazole fungicide application at anthesis to manage Fusarium head blight (FHB) and deoxynivalenol (DON). Meta-analyses showed that all combinations of host resistance and fungicide significantly reduced FHB and DON relative to the susceptible-untreated check. Nonparametric analyses determined that management combination efficacy was stable across environments. The fungicide application x moderate resistance combination was effective, stable, and additive in terms of percent control for both FHB and DON.

22.6 4:40 Adoption of integrated management methods for head blight, Joel K. Ransom, joel.ransom@ndsu.edu, North Dakota State University, Fargo, ND; Marcia McMullen; Greg McKee

The level of adoption of integrated FHB management practices was obtained from a survey of more than 1000 wheat growers in ND and MN. The rate of adoption of the three most effective control practices was very high, with about half of respondents using all three methods. Farmers ranked extension information sources for FHB control as more valuable (72%) than professional sources (20%) and media sources (7%). The use of the forecasting model for making fungicide decisions was low among respondents. The availability of multiple sources of information has been vital to the high level of adoption of an integrated management approach to FHB.

23 • Killing two threats with one stone: The co-management of phytopathogens and food safety risks in greenhouse tomatoes

Room L9

Nearly 40% of tomatoes sold in U.S. grocery stores are produced in greenhouses, and are valued for high quality and year-round availability. The greenhouse tomato industry identified disease management as its most serious production problem and better, more cost-effective disease management practices its highest priority need. Further, foodborne human pathogens pose a significant risk to the industry at large. A systems approach that considers all phases of tomato production can identify key problems and obstacles, set priorities, develop solutions and assess their economic impact, and maximize the effectiveness of outreach to the broad community of

greenhouse tomato growers. This mini-symposium will address the following areas: 1) Grower perceptions and knowledge of tomato diseases and management practices, food safety and GAPs; 2) Identification of critical points for tomato disease and food safety interventions; 3) Development of Best Management Practices; and 4) Disease management and food safety from the industry perspective. Case studies will be presented on modern diagnostic processes and techniques to diagnose diseases and detect and track pathogens throughout the tomato production system, including Real-time PCR as a viable technology for general disease diagnosis (a case study with tomato viruses) and modern fingerprinting techniques to monitor pathogens (a case study with Clavibacter michiganensis subsp. michiganensis, causal agent of bacterial canker). Speakers will be academic and USDA ARS researchers, outreach specialists and industry leaders who collaborate in the Specialty Crops Research Initiative Project "A Systems Approach to Managing Microbial Threats to Greenhouse Tomatoes".

Organizer: Sally A. Miller, miller.769@osu.edu, The Ohio State University, OARDC, Wooster, OH

Moderator: David Ingram, davidi@ext.msstate.edu, Mississippi State University, Raymond, MS

23.1 2:45 An industry perspective of disease management and food safety issues in greenhouse tomatoes, Michael Bledsoe, mbledsoe@villagefarms.com, Village Farms International, Inc., Heathrow, FL

Food safety and IPM management of our insects and diseases are two of the most important challenges facing our industry. The US Greenhouse Hydroponic vegetable large scale (>10 acre) market has grown from 10 acres in 1989 to over 800 acres today. This monoculture industry continues to face significant issues, but is stepping up to the challenge. While the greenhouse vegetable industry leads in food safety procedures, new pest problems are always a challenge.

23.2 3:05 Grower perceptions and knowledge of tomato diseases and management practices, food safety and GAPs, Beth Fausey-Scheckelhoff, scheckelhoff.11@osu.edu, The Ohio State University, Bowling Green, OH

Greenhouse tomato propagators and growers of varying sizes were surveyed to determine perceptions and baseline knowledge of greenhouse tomato diseases and food safety issues; practice of greenhouse tomato food safety GAPs, disease management practices, and chemical control measures. The survey identified commonly used resources and resource needs and estimated the economic impact of various management practices. While initial findings are presented here, the survey will be repeated in the project final year to assess short-term changes in producer knowledge, skills, abilities, adoption of research-based tools, as well as the potential economic impacts of the research conducted and educational materials developed.

23.3 3:25 Preventing the attack of the killer tomatoes, Sanja Ilic, ilic.2@osu.edu, The Ohio State University, Wooster, OH; Sally Miller; Melanie Lewis Ivey; Xuilan Xu; Fulya Baisal-Gurel; Jeff LeJeune

A multidisciplinary team including plant pathologists, food safety and IPM experts performed on-site assessment of production methods and practices in propagation, growing, and post-harvest stage of production. Process flow diagrams were constructed for large/medium/small growers and points of pathogen entry, dissemination and proliferation were identified. Risk-ranking criteria were developed for assessment of microbial hazards. Expert stake-holder group performed impact analysis for plant-pathogens. The results were merged into operational risk profiles to be used in conjunction with human pathogen profiles to identify critical points for simultaneous control of human and plant pathogens.

23.4 4:00 Identifying critical points for tomato bacterial canker interventions, Sally A. Miller, miller.769@osu.edu, The Ohio State University, Wooster, OH; Melanie Lewis Ivey; Fulya Baysal-Gurel; Xiulan Xu; Warren Arinaitwe; Michael E. Bledsoe

Outbreaks of bacterial canker in greenhouse tomatoes can be devastating. *Clavibacter michiganensis* subsp. *michiganensis* (Cmm) is seedborne and easily spread mechanically. Molecular fingerprinting tools that exploit Cmm genetic diversity offer the ability to trace strains within production systems. We designed a multivariate matrix using geographical information, propagation and production flow diagrams and varietal and seed source data superimposed with repPCR fingerprints and dnaA sequence analysis of Cmm strains. The multivariate matrix allows Cmm phenotypic and genotypic information to be recorded and transmitted at any point in a production system and the point of origin of each strain can be identified.

23.5 4:20 Identifying bacterial canker in greenhouse tomatoes: Molecular fingerprinting and rapid diagnostics of *Clavibacter michiganensis* subsp. *Michiganensis,* Anne Alvarez, alvarez@hawaii.edu, University of Hawaii, Honolulu, HI; Jarred Yasuhara-Bell

Development of diagnostic tests requires a large representative collection of strains from different geographical locations and environmental samples. Primer sets were designed based on regions of the fully-sequenced Cmm genome, including *chpC*, *tomA*, and *micA,* and a loop-mediated amplification (LAMP) assay using primers in the *micA* region was developed. A collection of 356 Cmm strains was screened using PCR and LAMP, and results were compared with previously developed immunodiagnostic tests and molecular fingerprinting assays. Diversity within the Cmm population with respect to these and other PCR assays was revealed and gives new insights on pathogen detection.

23.6 4:40 Understanding the introduction and spread of key viruses and viroids in greenhouse tomatoes using advanced diagnostics, Kai-Shu Ling, kling@saa.ars.usda.gov, USDA, ARS, U.S. Vegetable Laboratory, Charleston, SC

Effective disease management in plants depends on timely and accurate pathogen identification. Most plant virus detection methods are based on virus-specific serological (i.e., ELISA) or molecular properties (PCR or real-time PCR). I will demonstrate the development and application of immunocapture Real-time RT-PCR systems for tomato virus survey. I will also discuss application of deep sequencing and assembly of small RNA technology for virus (pepino mosaic virus) and viroid (potato spindle tuber viroid) identification in tomato. Using this technology, we were able to identify a novel potyvirus without prior knowledge and then obtain its complete genome sequence for the first time.

24 • Advanced technologies in IPM programs

Room L10

The session will constitute of eight presentations covering various aspects of advanced technologies in IPM programs. Among the subjects that will be presented are: novel insecticides with selective properties such as juvenile hormones, ecdysone agonists and antagonists and chitin synthesis inhibitors; potential target sites in insects that are useful for discovering novel insecticides; natural products as additional tools for insect pest control; implementation of new IPM tactics in vegetables and other crops; and, resistance management aimed at optimizing the use of biorational insecticides and other novel technologies for controlling insect pests.

Organizers: Isaac Ishaaya, vpisha@volcani.agri.gov.il, The Volcani Center, Bet Dagan, Israel; A. Rami Horowitz, hrami@volcani.agri.gov.il, Gilat Research Center, M. P. Negev, Israel

24.1 2:45 Biorational insecticides: Selectivity and importance in IPM programs, Isaac Ishaaya, vpisha@volcani.agri.gov.il, The Volcani Center, Bet Dagan, Israel; Galina Lebedev; Murad Ghanim; A. Rami Horowitz

Efforts have been made during the past three decades to develop insecticides with selective properties that act specifically on biochemical sites present in particular insect groups, but whose properties differ from other insecticides. This approach has led to the discovery of compounds that affect the hormonal regulation of molting e.g., ecdysone agonists, juvenile hormone mimics, and chitin synthesis inhibitors. One of the recent chitin synthesis inhibitors is the novaluron (Rimon) which is a powerful suppressor of diversity of insect species. We will discuss its activity on diversity of insect species and its importance in IPM programs.

24.2 3:00 Novel targets for insecticide action, Subba Reddy Palli, rpalli@uky.edu, University of Kentucky, Lexington, KY

We employed large-scale RNA interference screen in the model insect, the red flour beetle, Tribolium castaneum and identified several novel target sites belonging to nuclear receptor, bHLH transcription factor and G protein-coupled receptor (GPCR) superfamilies. Some of the identified target sites could be used to develop screening assays that are useful for discovering novel chemicals for use as insecticides. The nature of target sites identified and the screening assays that are being developed for insecticide discovery will be discussed.

24.3 3:15 Insect cell lines as tools for developing novel insecticides, Guy Smagghe, guy.smagghe@ugent.be, Ghent University, Ghent, Belgium

To date an average of ~10 billion USD is spent per year for synthetic insecticides to control pest insects of importance in agriculture and human health. At early screening stages for novel insecticides and targets, there is an increasing interest in the development of *in vitro* methods to replace conventional animal toxicity tests. In this paper, a review on the contributions of established insect cell lines, joined with high throughput screening procedures, will be given to rapid screening of many synthetic and natural materials and accelerate the discovery of novel environmentally-safe control agents. Significant recent examples and advances will focus on EcR-reporter systems as a paradigm, Bt, and insecticidal lectins.

24.4 3:30 Natural plant products: Important source for pest management, Yasmin Akhtar, yasmin.akhtar@ubc.ca, University of British Columbia, Vancouver, BC, Canada; Claus Passreiter; Murray B. Isman

Roots of *Meum athamanticum* are used in Germany for the production of special traditional liquor ("Baerwurz") through ethanolic distillation. The essential oil is not distilled quantitatively by this process; hence, considerable amounts of compounds can be found in the residue. We have tested the insecticidal and feeding deterrent effects of ethanolic residue of *M. athamanticum* against two important agricultural pests. The residue demonstrated residual toxicity against third instar nymphs of green peach aphids, *Myzus persicae*. It exhibited contact toxicity against second instar cabbage looper, *Trichoplusia ni,* inhibited growth of the larvae and was a strong feeding deterrent. Residue of *M. athamanticum* has potential to be used as a crop protectant in an IPM scheme.

24.5 4:00 Resistance management: An important tool in IPM programs exemplified by *Bemisia tabaci,* A. Rami Horowitz, hrami@volcani.agri.gov.il, Gilat Research Center, M. P. Negev, Israel; Isaac Ishaaya

The Israeli IPM-IRM strategy is a unique attempt to combat insecticide resistance against cotton pests, especially the whitefly, *Bemisia tabaci.* The species *B. tabaci* is defined as a species complex composed of many biotypes. A link between *B. tabaci* biotypes B and Q and insecticide resistance was observed under field and laboratory conditions. Recently, we identified a significant shift in the biotype dynamics: the B biotype is currently predominating in open fields, reaching up to 90-100%. Concurrently, resistance to pyriproxyfen and neonicotinoids has reduced considerably. The implications of the dynamics of *B. tabaci* biotypes on resistance management are discussed.

24.6 4:15 Advances in insecticide development for vegetable pest management, John Palumbo, jpalumbo@ag.arizona.edu, University of Arizona, Yuma, AZ

American vegetable growers have the reputation of delivering produce to the marketplace that is both aesthetically appealing and safe to the consumer. In recent years, they have accomplished this by using novel insecticides with reduced-risk attributes to control a number of important insect pests. Presently, there are several new insecticide compounds in the developmental process that when registered will provide safe and effective alternatives for insect management in fresh-market vegetable and melon crops. This presentation will summarize the activity and unique qualities of these new active ingredients, and how they may be implemented within vegetable pest management programs upon registration.

24.7 4:30 Studies on the efficacy of chlorantniliprole against white grubs in cool season turfgrass, Roger R. Youngman, youngman@vt.edu, Virginia Tech, Blacksburg, VA; Curt Laub; Shaohui Wu

White grubs (WG) (Coleoptera: Scarabaeidae) are the most widespread and destructive turfgrass pests in the U.S. In VA, WG cause an estimated $234 million in damage each year—$78 million for control costs and an additional $156 million for sod replacement (Anonymous). We found that in recent years masked chafers (MC) have largely replaced Japanese beetles. Over 80% of the WG species detected in our trials were MC grubs. For the past several years we have been generating efficacy data on chlorantniliprole, an insecticide belonging to a new Class, in addition to a novel mode of action against WG.

24.8 4:45 Progress in sweet corn IPM: Challenges ahead, William D. Hutchison, hutch002@umn.edu, University of Minnesota, St. Paul, MN; Shelby Fleischer; Brian Flood; Galen Dively

The corn earworm, *Helicoverpa zea* (Boddie), continues to be a significant pest of sweet corn, and several other vegetable crops in the eastern U.S., particularly tomato and snap bean. During the past decade, two significant trends have impacted *H. zea* dynamics and IPM; increasing use of transgenic Bt corn, and increasing resistance by the pest to pyrethroid insecticides. In response, new tactics were developed to improve IPM systems, including a private-public sector network of pheromone trap cooperators (>450 traps), and expansion of an interactive web site, *PestWatch,* for rapid reporting and mapping of moth catch data. Developing trends and challenges will be discussed

25 • Development of IPM packages for vegetable crops in developing countries

Room L11

Several countries in Asia, Africa, Latin America and the Caribbean have been developing IPM packages for vegetable crops such as tomato, eggplant, okra, onion, cabbage, broccoli, potato, beans, bitter melon, cucumber, watermelon, naranjilla and others with the support of the IPM CRSP. The packages involve identifying pest problems from the time of seeding to the harvest of the crop and developing IPM components to address them. Some of the components developed and adopted include soil solarization, soil application of Vesicular arbuscular mycorrhizae, seed treatment with Trichoderma sp., Pseudomonas fluorescens, and Bacillus subtilis, use of seedling trays and blocks, screening the nursery, use of yellow sticky and pheromones traps, grafting on disease resistant rootstocks, inundative release of natural enemies such as Trichogramma sp., adoption of classical biological control where necessary, use of biopesticides such as neem, Metarhizium, Beauveria, Nucleopolyhedroviruses, Bt and others.

Organizer: Karim M. Maredia, kmaredia@msu.edu, Michigan State University, East Lansing, MI

25.1 2:45 USAID's agricultural research strategy and the role of IPM, John E. Bowman, jobowman@usaid.gov, Office of Agricultural Research and Policy (ARP), USAID, Washington, DC

The United States Agency for International Development (USAID) Office of Agricultural Research and Policy manages a global portfolio that supports President Obama's Global Hunger and Food Security Initiative, known as "Feed the Future" (FTF). Research on IPM and dissemination of proven IPM technologies feature prominently in FTF's overarching goal to sustainably reduce global hunger and poverty. The IPM

CRSP has been working in 17 countries in six regions of the tropical world. It is developing and implementing IPM packages for high-value vegetable crops by collaborating with 15 U.S. universities and 60 national and private institutions.

25.2 3:00 Vegetable IPM in Indonesia, Aunu Rauf, aunu@indo.net.id, Bogor Agricultural University, Bogor, Indonesia

Several IPM tactics have been developed to control vegetable pests and diseases in Indonesia. These include the application of *Trichoderma harzianum* to control club root disease in crucifers, spot treatments with Bt-insecticide to control *Crocidolomia pavonana*, dipping seedlings in PGPR to reduce infection by plant pathogens, and screened-seed beds to suppress virus infection on tomatoes and chili pepper. IPM tactics for the control of *Spodoptera exigua* in shallots include hand-picking larvae, the use of a Nucleopolyhedrovirus, fine-mesh netting and black-light traps. Cultural methods aimed at reducing the incidence of diseases include crop rotation, soil liming, plastic mulching, and removal of crop debris.

25.3 3:15 IPM packages for cruciferous crops in the Philippines, Hermie Rapusas, hermierapusas@yahoo.com, Philippine Rice Research Institute (PhilRice), Maligaya, Muñoz, Nueva Ecija, Philippines

Among the cruciferous crops planted in the Philippines, the head cabbage is economically the most important species and represents the largest vegetable industry in the country. The diamondback moth is the most destructive pest of crucifers in both the highland and lowland environments. Farmers relied heavily on chemical insecticides for the control of the pest until the introduction of biological control methods like microbial insecticides and the parasitoids, *Diadegma semiclausum* and *Cotesia plutellae*. Likewise, Clubroot is the most damaging disease noted. The most recent management practices for the disease are the use of biological agents and cultural management.

25.4 3:30 IPM packages for vegetable crops in Ecuador and Honduras, Jeffrey Alwang, alwangj@vt.edu, Virginia Tech, Blacksburg, VA

IPM research in Honduras and Ecuador has led to several promising technologies for the management of pests and diseases in solanaceous and cucurbit crops. Challenges in assembling individual technologies into IPM packages are numerous. Practices are pest-specific and spatial variation in pest severities may dictate that certain practices are needed while others are not. Pests adapt, and IPM, particularly biological controls, may have limited shelf life. Packages have additional outreach requirements; while individual practices may be disseminated with simple messages, packages require substantial training. This paper discusses these issues and outlines progress toward development of IPM packages in the two countries.

25.5 4:00 Development of IPM package for vegetable crops specially cucumber and tomato in Nepal, Bishnu K. Gyawali, bkgyawali@idenepal.org, IDE/Nepal, Bakhundole, Lalitpur, Nepal; Luke A. Colavito; Gopal Thapa

Nepal, a country in the South Asian Region, is successful in developing IPM packages for vegetable crops, especially cucumber and tomato, with the support of IPM CRSP. The packages involve identifying pest problems from the time of seeding to the harvesting of the crop and developing IPM components to address them. Some of the components developed and adopted include mulching, the selection of resistant variety (against wilt) as a scion and grafting resistant rootstock (against root knot nematode), seed treatment with microbial consortium, raising seedlings in poly bags containing solarized soil, bio-fertilizers, and bio-pesticides amended with compost. Regular monitoring & scouting of major pests using pheromones & traps for need based control decision using economic threshold level (ETL).

25.6 4:15 IPM packages for vegetable crops in Bangladesh, Yousuf Mian, yousuf.mian96@gmail.com, Bangladesh Agricultural Research Institute, Gazipur, Bangladesh

Several vegetable crops grown in Bangladesh suffer serious losses due to different diseases and insects. To combat these pests' problems, four pest resistant varieties of eggplant and two virus resistant varieties of pumpkin were developed. A grafting technique was developed to combat wilting problem in eggplant and tomato. A mass production technique of tricho-compost and other soil amendments techniques were developed to control soil borne diseases. Pheromone traps were developed to control fruit flies in cucurbit crops and IPM packages were developed to control leaf eating caterpillars in cauliflowers and cabbages. Bio-control agents were utilized to control several vegetable pests.

25.7 4:30 IPM packages for vegetable crops in Central Asia, Frank Zalom, fgzalom@ucdavis.edu, University of California-Davis, Davis, CA; Barno Tashpulatova; Ravza Mavlyanova; George Bird; Karim Maredia

Michigan State University, University of California-Davis and Kansas State University in collaboration with ICARDA and AVRDC regional programs are implementing a collaborative research and capacity building program in the Central Asia region through an IPM CRSP project. The project's overall goal is to develop and deliver ecologically-based IPM packages for three food security crops, wheat, potato and tomato. The IPM packages under development for tomatoes targets both open field and greenhouse cultivation with the specific goals of reducing pest damage and use of chemical pesticides. The tomato IPM packages include suites of IPM practices including cultural controls, soil and seed treatment with *Trichoderma,*

seed and seedling treatment with Bacillus *subtilis,* grafting on fusarium and nematode-resistant rootstock, use of pheromone traps and sticky traps, augmentation biological control, and application of biopreparations to enrich soil, stimulate growth and induce plant immunity. The project includes training and capacity building through in-country workshops, student training, and outreach to local farmers and NGOs. Cross-cutting components include diagnostics, viruses, gender issues, communications, and socio-economic impact assessment.

25.8 4:45 IPM packages for vegetable crops in India, G. Gajendran, ggajendran@yahoo.com, Agriculture College and Research Institute, Navalurkuttapattu, Trichy, India; D. Dinakaran; S. Mohan Kumar; G. Karthikeyan; C. Durairaj; S. Ramakrishnan; E.I. Jonathan; R. Samiyappan; V. Jayabal

Insect pests, diseases and nematodes limit the production and productivity of vegetable crops in India. To mitigate the negative impact of synthetic pesticides, efforts were made to develop cost effective and environmentally acceptable IPM packages for vegetable crops through USAID funded IPM-CRSP project at TNAU, India. Adoption of IPM packages in vegetables *viz*., the use of biopesticides like *Pseudomonas flourescens* and Trichoderma *viride,* application of neem cake, selection of virus free seedlings for planting, growing border / trap / barrier crops, use of sex pheromone traps and sticky traps, timely release of natural enemies and need based application of neem pesticides and chemical pesticides has resulted in significant pest control coupled with higher yields and economic returns. The validated IPM packages have been popularized among the growers through Field days/Seminars.

26 • Are ecologically-based IPM strategies relevant for sustainable management of virus diseases in the 21st century?

Room L12

Virus diseases continue to be of great economic significance to the production of agricultural, horticultural and agronomic crops worldwide. Dynamic agricultural practices, globalization of trade and commerce and fluctuations in climatic conditions are exacerbating several virus disease problems and contributing to the emergence of new diseases with severe economic implications in both developed and developing countries. Due to the lack of therapeutic agents, analogous to fungicides against fungal diseases, alternative management tactics have to be implemented to control virus diseases in an environmentally benign manner. Since virus diseases are spread via insect vectors, seed and germplasm, a one-size-fits-all approach do not provide sustainable solutions for the management of virus diseases across a wide-range of cropping systems. An understanding of each virus pathosystem, from accurate diagnosis of the virus to ecology and epidemiology of the disease, in a holistic manner will provide science-based knowledge and avenues for deploying ecologically-based management strategies appropriate to a specific crop or cropping system. Implementation of basic concepts in virus management, such as rouging, host-free period, mode(s) of spread, use of resistant/tolerant cultivars to delay infection and reduce rate of disease spread, in combination with other cultural and sanitation practices have provided avenues to shift from pesticide-based approaches to non-pesticidal measures for mitigating negative impacts of virus diseases in developing and developed countries. Specific case studies will be presented in this mini-symposium to showcase successful implementation of ecologically-based IPM strategies for controlling virus diseases in a variety of cropping systems in developed and developing countries.

Organizer: Naidu Rayapati, naidu@wsu.edu, Department of Plant Pathology, Washington State University, Irrigated Agriculture Research and Extension Center, Prosser, WA

26.1 2:45 Preparing the next generation of virologists for addressing plant virus diseases, John Sherwood, sherwood@uga.edu, University of Georgia, Athens, GA

The stealth nature of viruses limits the effectiveness of contemporary strategies and tactics to prevent dissemination of viruses and to effectively manage the diseases caused by viruses. Additionally, the lack of cost effective therapeutic agents prevents a curative approach to control. In conjunction with the disciplines allied to plant virology, much information has been obtained on the etiology and ecology of virus pathosystems. Will a pragmatic outcome of the unveiling of the biology of viruses be a singular approach to sustainable management of virus diseases? The challenge in the education and development of the next generation of plant virology practitioners to meet this challenge will be discussed.

26.2 3:00 An integrated approach for managing spotted wilt disease in peanuts in the Southeastern U.S., Albert Culbreath, spotwilt@uga.edu, University of Georgia, Tifton, GA; R. Srinivasan; R. C. Kemerait

In the 1990s, spotted wilt disease of peanut (*Arachis hypogaea*), caused by *Tomato spotted wilt virus*, became a major limiting factor for peanut production in the southeastern U.S. Control of thrips vectors typically has not resulted in control of spotted wilt, and no single measure has provided adequate control. However, an integrated program that utilizes field-resistant cultivars combined with chemical (phorate insecticide) and cultural (optimal planting date, increasing plant population, twin row patterns, and conservation tillage) factors which suppress spotted wilt, has been very successful for managing this disease.

26.3 3:15 An integrated approach for managing a virus disease in a perennial crop, Kent Daane, DAANE@uckac.edu, University of California, Berkeley, Berkley, CA; R.P.P. Almeida; M.L. Cooper; A. Sial; C.M. Wistrom; G.K. Blaisdell; V.M. Walton; D.B. Walsh

In wine grapes (*Vitis vinifera*), most mealybug species pose little economic concern as direct pests simply through their feeding damage. Moreover, there are effective biological controls for some mealybug species, and excellent pesticides that suppress all vineyard mealybugs to levels which are nearly undetectable. However, as vectors of grapevine leafroll-associated viruses, very low mealybug population densities have been implicated in the movement of grapevine leafroll disease. Here, we discuss aspects of mealybug vector ecology that impact IPM program development as well as possible control strategies that should be considered for mealybugs as vectors of grapevine leafroll-associated viruses.

26.4 3:30 An integrated approach for managing *Peanut bud necrosis virus* disease in tomato in India, Naidu Rayapati, naidu@wsu.edu, Department of Plant Pathology, Washington State University, Irrigated Agriculture Research and Extension Center, Prosser, WA; G. Karthikeyan

A disease caused by *Peanut bud necrosis virus* (genus *Tospovirus*, family *Bunyaviridae*) is a major constraint to tomato production in India. It affects fruit yield and quality leading to reduced income to farmers and affecting availability of nutritionally inferior tomatoes for consumers. Due to the lack of genetic sources of resistance in tomato, minimal effectiveness of thrips vector control measures and broad host-ranges of the virus and thrips vector, strategies alternative to pesticide-based tactics are being pursued. A combination of IPM approaches evaluated in farmers' fields is providing beneficial technologies to subsistence farmers for reducing virus incidence and avoiding crop losses.

26.5 4:00 Role of pesticides in management of virus diseases, Doug Walsh, dwalsh@wsu.edu, Washington State University, Irrigated Agriculture Research and Extension Center, Prosser, WA; Keith Dorschner

Many viruses require a nematode or arthropod vector for transport among hosts and to successfully infect new hosts. Pesticide intervention targeted against vectors has been recognized as a break point in the disease cycle and is a common control tactic against viral spread. Traditional pesticides include organochlorines, organophosphates, and carbamates. Regulatory actions have cancelled the use of most of these pesticides while promoting risk-averse, target-specific and environmentally benign pesticides. New pesticides include neonicotinyls, insect growth regulators, spinosyns, antihelminthics, and metabolic inhibitors. The mechanisms by which these pesticides kill can influence the vector's ability to transmit virus and prevent new infections.

26.6 4:15 Genetically engineered resistance for management of virus diseases, Mike Deom, deom@uga.edu, University of Georgia, Athens, GA

While there is no definitive estimate of crop losses due to virus diseases, viruses are generally considered the second most important plant pathogens behind fungi. Due to the lack of therapeutic agents to treat virus-infected plants, the concept of pathogen-derived resistance has been exploited for developing genetically engineered resistance against plant virus diseases. Although several strategies have been used to genetically engineer tolerance or immunity to viruses in transgenic plants, protein- and RNA silencing-mediated resistance offers several possibilities for the development of control strategies against virus diseases. The current status of these strategies will be discussed.

26.7 4:30 Genetics, genomics and R genes for virus disease management, Sue Tolin, stolin@vt.edu, Virginia Tech, Blacksburg, VA

Genetically heritable resistance to viruses was recognized over a century ago and widely used since by breeders for management of specific virus diseases, exploiting natural innate immunity. The molecular nature and mechanisms of action are known for several dominant and recessive resistance (*R*) genes. Specific molecular markers have facilitated selection of virus-resistant plants from progeny and enabled pyramiding *R* genes. Advanced genomic approaches have permitted fine structure mapping of some *R* genes to host plant genomes and revealed novel resistance mechanisms. Examples of successes and challenges of exploiting classical and molecular genetics for sustainable virus disease management will be presented.

26.8 4:45 Discussion

27 • Plant health management in a thirsty world

Room L13

Plant pathogens in irrigation water are recognized as a significant crop health issue and their impacts are growing quickly as the agricultural industry increasingly depends upon recycled water for irrigation in the light of global water scarcity. To effectively counteract this growing crop health issue, there is an urgent need to examine, synthesize and communicate the current knowledge within the science communities and with plant health management practitioners as well as the agricultural industry, and prioritize future research needs. The 7th International IPM symposium is a perfect platform for such an initial discussion of this important crop health issue.

Specifically, we would like to propose a mini-symposium to (i) examine the diversity and aquatic biology of plant pathogens found in water to date and assess the health risk that these pathogens may pose to plants at production facilities, landscape and surrounding natural forests, (ii) highlight major mechanisms by which irrigation water increases the severity and frequency of plant disease epidemics, (iii) evaluate existing pathogen detection technologies and call attention to the presence of multiple pathogens in a irrigation system, (iv) provide insight into the current water decontamination technologies and emphasize the importance of a systems approach for sustainable management of plant pathogens in irrigation systems and plant health in a thirsty world, and (v) assess the economics, social and environmental benefits of waterborne pathogen management.

Organizers: Chuanxue Hong, chhong2@vt.edu, Hampton Roads Agricultural Research and Extension Center, Virginia Tech, Virginia Beach, VA; Gary Moorman, gmoorman@psu.edu, The Pennsylvania State University, University Park, PA

27.1 2:45 Plant pathogens in irrigation water: A growing threat to global agricultural biosecurity, Gary Moorman, gmoorman@psu.edu, The Pennsylvania State University, University Park, PA

The presence of plant pathogens in irrigation water has been known for over 100 years. Fungi, fungal-like organisms, bacteria, viruses, and nematodes have all been detected in water supplies used to grow crops in a wide variety of production systems. Rules and regulations requiring the capture and recycling of irrigation water as a means of preventing fertilizer and pesticide runoff have the unintended effect of increasing the potential for the accumulation and dispersal of plant pathogens via water. Examples of important plant pathogens that pose a threat to agriculture through irrigation water will be presented.

27.2 3:15 Pathogen risk mitigation with good system design and best management practices, John Lea-Cox, jlc@umd.edu, University of Maryland, College Park, MD

The majority of ornamental plants are produced in very intensive nursery and greenhouse production systems throughout the US and the world. Clean production practices and active pathogen management are therefore crucial to prevent disease development and dissemination, to maintain the economic vitality of these industries. Key basic principles are necessary (e.g. clean stock, good substrate formulation); additionally, good nursery design (freely-draining production areas, runoff water conveyance, recycling pond design and pump inlet placement), and precision irrigation scheduling all combine to form a suite of essential best management practices to maintain pathogen-free environments.

27.3 4:00 Water decontamination technology: Today and tomorrow, Walter Wohanka, walter.wohanka@fa-gm.de, Forschungsanstalt Geisenheim, Geisenheim, Germany

Due to the rising cost of good quality irrigation water growers will be forced to apply recycling techniques with a certain risk of disseminating plant pathogens. Consequently water decontamination technology will gain more importance as a valuable tool in Integrated Pest and Disease Management. Commonly-used techniques to eliminate plant pathogens from irrigation water are: chemical treatments, pasteurization, UVc irradiation and slow filtration. Sometimes combinations such as slow filtration and UV irradiation are applied. These established technologies as well as some emerging water treatments will be demonstrated and discussed.

27.4 4:45 Discussion

28 • Remote sensing and GIS applications to pest monitoring and management

Room L14

During the recent decades, remote sensing and associated Geographic Information Systems (GIS) are used to map pest habitats and to assess vegetation damage resulted from insect outbreaks. Traditional, ground survey methods are often inefficient to adequately address the distribution of pests with large spatial scale, such as locusts. Remotely-sensed information allows to optimize the locust monitoring, providing timely and reliable data to assess the risk of impending pest outbreaks. Based on the improved surveys, it becomes possible to implement targeted locust control operations in key areas of locust concentrations, preventing the further population build-up. Such approach is consistent with preventative locust management in an IPM context. However, the operational use of geospatial tools is currently limited to only two locust species, the Desert locust in Africa and the Australian Plague locust in Australia. Elsewhere in the world it is often impeded by the lack of relevant training and technical capacities of plant protection services, especially in developing countries. Hence, after a period of over-enthusiastic claims and views of the remote sensing as a panacea for solving locust problems, the recent reports sound more cautious, if not skeptical. The mini-symposium will discuss the advances, challenges and opportunities for further integrating remote sensing and geospatial technologies into the current IPM practices of locust pest monitoring and management in different geographic settings. It will demonstrate opportunities and limitations of the geospatial tools and provide insights on the use of this methodology for international plant protection specialists.

Organizer: Alexandre Latchininsky, latchini@uwyo.edu, University of Wyoming, Laramie, WY

28.1 2:45 Geospatial tools and locust IPM: The current state of the art, Alexandre Latchininsky, latchini@uwyo.edu, University of Wyoming, Laramie, WY

Satellite images became a routine part of forecasting the trends in locust distribution in Africa and Australia. The use of the remotely sensed data combined with GIS allows to improving habitat monitoring and, consequently, to better targeting the control operations. As such, the remote sensing becomes a key factor in the preventative locust management strategy consistent with IPM. Although this is the case for the Desert and Australian Plague locusts, the application of geospatial tools to other locust species lacks behind. The introduction to the mini-symposium discusses the relevance of these tools to IPM approaches in different geographic settings.

28.2 3:05 Satellites and GIS in desert locust monitoring worldwide: Lessons learned, Keith Cressman, keith.cressman@fao.org, Food and Agriculture Organization of the United Nations, Desert Locust Information Service at FAO-AGPP, Rome, Italy

The UN Food and Agriculture Organization (FAO) operates an early warning system to keep the international donor community and some 30 affected countries informed of the Desert Locust situation and potential developments concerning breeding and migration. The system is the basis of the preventive control strategy to reduce plagues. Remote sensing products are used operationally to help detect rainfall and green vegetation in locust habitats and to guide survey teams. Custom GIS applications are utilized in affected countries and at FAO for data analysis. An overview of these technologies, including lessons learned during the past two decades, is presented.

28.3 3:25 Remote sensing data application for locust monitoring in Kazakhstan, Nadya Muratova, nmuratova@rambler.ru, National Center of Space Research and Technologies of Kazakhstan, Almaty, Kazakhstan

Permanent breeding areas of Asian Migratory locust (*Locusta migratoria migratoria* L.) are situated in the Lake Balkhash area in Kazakhstan. The locust habitat monitoring method was developed using remote sensing data. The task of habitat mapping was to select classes of reeds and submerged land. Classification of Terra / MODIS during the growing season 2005-2010 revealed the reduction in water surface area from 2005 to 2009 followed by its expansion in 2010. Increase of the area of sandy surfaces and areas with reed vegetation affected the growth of locust pest population in 2008-2009, which was confirmed by ground data.

28.4 4:00 Remote sensing applications to locust monitoring and management in the Aral Sea region of Central Asia, Furkat Gapparov, furkat_g@mail.ru, Uzbek Institute for Plant Protection (UzNIIZR), Tashkent, Uzbekistan; Ramesh Sivanpillai; Alexandre Latchininsky

Hydrological regimen in the River Amudarya delta near the Aral Sea in Uzbekistan is the main factor impacting the distribution and growth of the common reed (*Phragmites australis*) stands. Reeds are the preferred habitat of the Asian Migratory locust (*Locusta migratoria migratoria* L.), providing it with food, shelter and oviposition sites. Regular monitoring of the delta's hydrological regimen and reed growth is essential for evaluating risks of seasonal locust population changes and potential crop infestations. Satellite images taken at critical times of the locust annual cycle provide reliable information for assessing reed distribution and predicting the spatio-temporal dynamics of locust populations.

28.5 4:20 Remote sensing data and GIS use in forecasting, monitoring and managing locusts in Australia, Ted Deveson, ted.deveson@daff.gov.au, Australian Government Department of Agriculture, Fisheries and Forestry, Canberra, Australia; Haikou Wang

The Australian Plague Locust Commission (APLC) has a mandated role in monitoring, forecasting and managing populations of key locust species across a number of Australian states. The range of relevant environmental, land use, tenure, infrastructure and species distribution information, and the large geographic distribution of the target species, make the use of geospatial technologies crucial to fulfilling these roles at a number of levels and scales. The integration of mapping and spatial modeling software with earth observation imagery, insect monitoring radar and modeled meteorological data from is used routinely to support forecasting and operations within the IPM framework of risk management and strategic control intervention.

28.6 4:40 Remote sensing for pest habitat monitoring and management, Ramesh Sivanpillai, sivan@uwyo.edu, University of Wyoming, Laramie, WY

Locust habitats often spread across vast geographic areas that are also not easily accessible for surveys. Under these circumstances remote sensing technology is often viewed as a panacea for obtaining data rapidly and also at relatively low-cost. When products derived from remotely sensed images are combined with other spatial data in a geographic information system (GIS), one would expect to have all the data necessary for pest management. This is seldom the case. Using examples from Central Asia, this presentation is an overview of the potential and limitations of remote sensing technology to provide information useful for managing pest populations.

29 • Use of *Trichoderma* in Agriculture

Room L2

Trichoderma is an antagonistic fungus used for biological control of fungal diseases of plants. It occurs in all agricultural and forest soils and root ecosystems. It is an avirulent plant symbiont and a parasite of other fungi. It produces and releases a variety of compounds that provide systemic resistance to inhabited plants. Root colonization by this fungus enhances root growth, crop productivity, resistance to abiotic stresses and nutrient uptake. *Trichoderma harzianum, T. viride* and *T. hamatum* are common species used in biological control. In India, several Universities and private companies produce and sell Trichoderma to farmers. The Tamil Nadu Agricultural University built a plant pathology building out of the money it made from sale of the fungus. Seed treatment with Trichoderma results in protecting the seedlings from the attack of pathogenic fungal diseases. In India, Trichoderma is used against Fusarium wilt and Pythium rot, which attack vegetable crops. In Indonesia, it is used against clubroot of broccoli. It is also tested on diseases of tomato and pepper. And in the Philippines, it is used to combat anthracnose bulb rot, damping off, and pink rot of onions. In Bangladesh and Indonesia, Trichoderma is mixed with compost and applied in the field to combat soil-borne diseases of vegetable crops, oil palm, citrus, vanilla, langsat, durian and cacao. In India and the Philippines, the fungus is sprayed on seedlings as a treatment for vegetable crops. And in Honduras, it is used on watermelon for the control of Fusarium wilt.

Organizer: Rangaswamy Muniappan, rmuni@vt.edu, Integrated Pest Management Collaborative Research Support Program (IPM CRSP), Virginia Tech, Blacksburg, VA

29.1 4:00 *Trichoderma* in Asian agriculture, Rangaswamy Muniappan, rmuni@vt.edu, Integrated Pest Management Collaborative Research Support Program (IPM CRSP), Virginia Tech, Blacksburg, VA

IPM CRSP has been promoting production and application of *Trichoderma* in agriculture in Asia. *Trichoderma* spp. are endophytic plant symbionts. Recently IPM CRSP conducted a South-South technology transfer by organizing a workshop on *Trichoderma* production and use in India for participants from Bangladesh, Indonesia, Honduras and Central Asia. This technology is being field tested in Kenya and it is hoped other African countries to adopt it in the near future.

29.2 4:15 Use of *Trichoderma* in India, Sevugapperuamal Nakkeeran, nakkeeransingai@yahoo.com, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Bio-control agents like *Trichoderma spp*., are harmless, cheaper and highly effective throughout the crop growth. Tamil Nadu Agricultural University has developed mass production technology for *Trichoderma viride* with eight months shelf life. Eighty six firms have purchased the technology and registered with Central Insecticide Board, New Delhi. *Trichoderma* is delivered through seed treatment and soil application for the management of seed and soil borne diseases of crop plants and was popularized by the Government and private stakeholders. The grants from DBT, DST, NHM and Technology Mini Mission in Cotton also assisted in large scale adoption in India.

29.3 4:30 Status of *Trichoderma* research and development in Bangladesh, Md. Abdur Rahman, arahman_bari@yahoo.com, Bangladesh Agricultural Research Institute, Gazipur, Bangladesh

Research on development and use of *Trichoderma* in Bangladesh was started in 1998 at Bangladesh Agricultural Research Institute and Bangladesh Agricultural University. *Trichoderma* isolates from the roots and rhizosphere soils and screening them against pathogenic fungi under pot culture and seedbed were made. Trials have been conducted on the effect of temperature, pH and tolerance to fungicides. Currently compost is used as a carrier material to incorporate *Trichoderma* in the field. Some NGOs have started commercial production of tricho-compost and farmers have adopted this technology for controlling various soil borne diseases. Tricho-leachate is used for control of foliar diseases.

29.4 4:45 Status of *Trichoderma* research and development in the Philippines, Hermie Rapusas, hermierapusas@yahoo.com, Philippine Rice Research Institute (PhilRice), Nueva Ecija, Philippines

Trichoderma sp (ipm crsp isolate) is a beneficial fungus used as biological control agent for vegetable diseases. It is a very effective biological fungicide and provides plant resistance and tolerance against fungal pathogens. It can be used as spray, soil drench, or seedling root dip. It is easy to mass produce hence, farmers can do the mass production by themselves. Medium for mass production is boiled cracked corn. The use of *Trichoderma* sp. can reduce cost of fungicide by 43%. This technology is now adopted by vegetable farmers in the Philippines to manage damping-off, anthracnose, purple blotch, and bulb rots.

30 • IPM at the U.S. Environmental Protection Agency

Room L2

EPA highlights the IPM efforts of partners and stakeholders in a ceremony featuring Innovator, Shining Star, and Excellence in IPM Awards. The Agency's School IPM Initiative and Pesticide Environmental Stewardship Program will also be publicized.

Organizer: Sherry Glick, Glick.Sherry@epa.gov, US EPA Office of Pesticide Programs, Washington, DC

30.1 6:30 IPM at the U.S. Environmental Protection Agency, Sherry Glick, Glick.Sherry@epa.gov, US EPA Office of Pesticide Programs, Washington, DC

31 • The impact of invasive insect pests on IPM

Room L3

Invasive insect pests are a growing threat to crop production around the world as a result of the increased trade of fresh fruit and other produce. Aside from the direct and immediate threat to crop yield and quality, and trade barriers created to limit the spread of invasive species, the control measures required to control invasive insect pests may alter or even disrupt existing integrated pest management programs. These IPM programs have often required years of research to develop and optimize. Recent examples of such situations in the United States include spotted-wing drosophila (*Drosophila suzukii*), brown marmorated stink bug (*Halyomorpha halys*), European grapevine moth (*Lobesia botrana*), light brown apple moth (*Epiphyas postvittana*), tomato/potato psyllid (*Bactericera cockerelli*), and Asian citrus psyllid (*Diaphorina citri*). New invasive species such as European pepper moth (*Duponchelia fovealis*), Mediterranean fruit fly (*Ceratitis capitata*), and several *Bactrocera* species (peach fruit fly, *B. zonata*); guava fruit fly, *B. correcta*; and oriental fruit fly, *B. dorsalis*) have been detected in the continental United States and represent a continuous threat to the US agriculture. The objective of the symposium is to compare and contrast several of these recent situations in order to better understand how invasive insect pests can be managed effectively while minimizing the impact on existing IPM programs. The desired outcome is to understand how university, extension, government, and industry scientists can best work together to meet the threat posed by these and future invasive insect pests.

Organizers: James E. Dripps, jedripps@dow.com, and Luis Gomez, egomez2@dow.com, Dow AgroSciences, Indianapolis, IN

31.1 6:30 Introduction—The growing threat of invasive insect pests, Luis Gomez, egomez2@dow.com, Dow AgroSciences, Indianapolis, IN

Exchange of goods across geographies has been one of the main means to introduce pests to new geographical areas. The increase of food and other goods import has resulted in a larger number of invasive species reported in the US in recent years. Detection of new pests represents a significant problem to the local agriculture, causing an increase in control costs and reduction of market due to quarantine programs. Short-term control tactics may also disturb IPM programs developed through years of research. This symposium will present a selected list of examples of invasive species and their impact on IPM program.

31.2 6:40 Impact of invasive fruit flies on IPM programs in the U.S., Roger I. Vargas, roger.vargas@ars.usda.gov, Pacific Basin Agricultural Research Center, United States Department of Agriculture, Agricultural Research Service, Hilo, HI; Ronald F. L. Mau; Jaime C. Piñero; Luc Leblanc

Fruit flies (Diptera: Tephritidae) are among the most important economic pests of soft fruits worldwide. *Bactrocera* is a genus of at least 440 species distributed primarily in tropical Asia, the south Pacific, and Australia. These species have spread throughout the world at an alarming rate over the past 20 years: for example, *B. dorsalis* (oriental fruit fly) throughout French Polynesia, *B. carambolae* (Carambola fruit fly) throughout areas of South America, *B. invadens*, *B. latifrons*, *B. curcurbitae* (melon fly) and *B. zonata* (peach fruit fly) throughout Africa and the Mediterranean region. Every year, *Bactrocera* species are accidentally introduced into California, requiring expensive treatment programs. We will examine novel area-wide management approaches against *Bactrocera* fruit flies.

31.3 7:05 Asian Citrus Psyllid (*Diaphorina citri* Kuwayama) impact on IPM programs in Florida citrus, Michael E. Rogers, mrgrs@ufl.edu, Citrus Research and Education Center, University of Florida, Lake Alfred, FL

Florida citrus has a rich history of successful classical biological control programs. Until recently, citrus growers have relied primarily on the use of petroleum oil applications to control pests of importance such as eriophyid mites and foliar-fungal diseases. The introduction of the Asian citrus psyllid and the subsequent discovery of citrus greening disease, caused by a bacterium spread by psyllids, have resulted in significant increases in pesticide use not only to manage vector populations but also to manage secondary pest outbreaks resulting from an increased use of broad-spectrum insecticides. The current situation of Florida citrus IPM programs will be discussed.

31.4 7:30 Spotted-wing Drosophila impact on IPM programs in Pacific Northwest cherries, Peter Shearer, peter.shearer@oregonstate.edu, Mid-Columbia Agricultural Research and Extension Center, Oregon State University, Hood River, OR

The spotted wing drosophila, *Drosophila suzukii*, is a new invasive pest in the United States. It attacks berries, cherries and other thin-skinned fruits. It was first discovered in California in 2008, damaged California cherries in 2009, and threatened crops in Oregon and Washington State in 2010. It has spread north into Canada, to the eastern United States and is now a pest in Europe. Currently, this insect is monitored with traps baited with apple cider vinegar. Field and laboratory assays indicate that organophosphorus, pyrethroid and spinosad/spinetoram-based products are the most efficacious insecticides to control it.

31.5 7:55 Brown marmorated stink bug impact on IPM programs in Eastern U.S. apples, Greg Krawczyk, gxk13@psu.edu, Fruit Research and Extension Center, The Pennsylvania State University, Biglerville, PA

Brown marmorated stink bug *Halyomorpha halys* (Stäl) is an exotic pest introduced into North America in mid- 1990's. Currently the BMSB is reported from 35 states. During last three seasons, BMSB injured up to 60 percent of fruit. Only broad spectrum, contact insecticides provide adequate BMSB management. However, additional insecticide applications contributed to increase in the number of observed outbreaks of mites, wooly apple aphids or scale insects in orchards. There is immediate and urgent need to develop and evaluate other methods and products that are effective against BMSB so softer, more sustainable methods can be utilized in the future.

31.6 8:20 Closing comments and discussion—Managing the impact of invasive insect pests on IPM programs, James E. Dripps, jedripps@dow.com, Dow AgroSciences, Indianapolis, IN

When invasive insect pest species are detected, IPM programs must be adapted or developed quickly in order to slow the spread of the pest and minimize grower losses caused by crop damage and quarantine. Finding ways to bring together the knowledge and experience of basic and applied entomologists, crop and pest management consultants, government regulators, and manufacturers of insecticides and other management tools will facilitate making the best short-term and long-term choices in adapting existing IPM programs or developing completely new IPM approaches to manage new invasive insect pest species.

32 • Two Extension outreach projects: Adoption of proper mowing height and using educational posters on sustainable lawn care, low-input plants, and outdoor pests

Room L4

The Sustainable Landscape IPM Working Group has started a pilot project on the adoption of a single lawn care practice: correct mowing height. This project is a collaborative effort among University of Maryland, Cornell University, Penn State University, a large lawn care company, a small lawn care company, Audubon International, and the Smithsonian Institution. Educational outreach tools included a mowing guide with correct mowing height indicated, 8 sustainable lawn care posters, and revised Growing Green Lawns Magnets. Project protocols and evaluation survey data will be presented. The second outreach project was the creation of posters for 5 trees, 5 shrubs, and 5 herbaceous perennials that are considered relatively pest-free and low maintenance. These 15 plants are widely adaptable across the mid-Atlantic, Northeast, and North Central regions. Another set consists of 5 posters focused on common pest control issues in the home and around the yard including rats, brown marmorated stink bugs, mosquitoes, stinging insects and spiders. These pest issues are among the most important landscape-structure interface. All posters are available for download on the University of Maryland's Plant Diagnostic web site: http://plantdiagnostics.umd.edu/. An order form on the web site requests statistics and feedback on poster usage. Speakers will discuss the value of the posters as outreach tools to raise awareness about IPM and good choices for plantings, maintenance and pests. A discussion about these projects will include statistics, demographics, feedback, etc. This should provide valuable impact data on the poster outreach project.

Organizers: Mary Kay Malinoski, mkmal@umd.edu, and David L. Clement, clement@umd.edu, University of Maryland Extension, Home and Garden Information Center, Ellicott City, MD

32.1 6:30 Adoption of proper mowing height as an important lawn care practice, Mary Kay Malinoski, mkmal@umd.edu, University of Maryland Extension, Home and Garden Information Center, Ellicott City, MD

32.2 7:00 "Expert Plant Picks": Diversifying the landscape with low input plants, project development and successes, David L. Clement, clement@umd.edu, University of Maryland Extension, Home and Garden Information Center, Ellicott City, MD

32.3 7:30 Pest posters that address the indoor-outdoor interface, Jody Gangloff-Kaufmann, jlg23@cornell.edu, New York State IPM Program, Cornell University, Babylon, NY

32.4 8:00 Panel discussion

Wednesday, March 28

33 • Integrating biological and conventional pest and disease management strategies in greenhouse and outdoor horticulture

Room L2

Integrated Pest Management (IPM) is a concept that has been around for many years. But what does IPM actually mean to growers whose bottom line really is their bottom line? How can educators, researchers, end-users, and manufacturers appeal to the variety of motivating factors behind the successful adoption of IPM practices? When deployed properly, biopesticides serve integral roles in the IPM model. Increases in the availability and improvements in the quality of biopesticides achieved over the past ten years have led to greater integration of biologicals into conventional chemical management strategies in commercial horticultural production. Furthermore, fewer introductions of new pesticide chemistries and the rapid development of resistance to existing pesticides have spawned the need to better sustain the effective lives of existing chemistries. Hence, IPM practitioners can proactively extend the availability of effective chemistries by expanding the role of biopesticides in IPM programs. This symposium will address some of the IPM strategies and tactics that are being utilized by greenhouse and outdoor vegetable and ornamental growers to combat insect pests and diseases.

Organizer: Randy Martin, rmartin@bioworksinc.com, BioWorks, Inc., Victor, NY

33.1 10:00 Introduction, Randy Martin, rmartin@bioworksinc.com, BioWorks, Inc., Victor, NY

33.2 10:05 Integration strategies for insect management, Raymond Cloyd, rcloyd@ksu.edu, Kansas State University, Manhattan, KS

Biopesticides are increasingly being used in commercial greenhouse and nursery production systems. One of the proposed benefits of applying biopesticides is their supposed minimal harm to biological control agents or natural enemies including parasitoids and predators. However, this claim is still controversial. As such, this presentation will address specifically the issues associated with integrating biological control agents with biopesticides by discussing both the direct and indirect effects of biopesticides on natural enemies, which may impact the "sustainability" of biological control programs. Finally, this presentation will provide insight on the feasibility of incorporating natural enemies with biopesticides.

33.3 10:20 Integration strategies for disease management, Ann Chase, archase@chaseresearch.net, Chase Horticultural Research, Cottonwood, AZ

Biological control agents have become an integral part of ornamental disease control. The driver toward organic production, introduction of herbs and vegetables into ornamental production and lack of viable alternatives each contribute. In some cases, such as crown gall control on roses, use of the biological control agent *Agrobacterium radiobacter* strain K84 (Galltrol) has become the backbone of an IPM program. In other cases, fungicide resistance to mefenoxam has led to a more integrated approach to control of some soil-borne pathogens like *Pythium*. *Trichoderma harzianum* strain T-22 (RootShield®) is used in such important crops as poinsettia where it prevents Pythium and Rhizoctonia root rots when used alone or in conjunction with cultural and chemical controls.

33.4 10:35 Integration from the grower's perspective, Michael Bledsoe, mbledsoe@villagefarms.com, Village Farms International, Inc., Heathrow, FL

The US large scale (>10 acre) Greenhouse Hydroponic Vegetable Market has grown from 10 acres in 1989 to over 800 acres today. This monoculture industry continues to face significant issues, but is stepping up to the challenge. The US Greenhouse Vegetable industry has a very active biocontrol program beginning with introduction of arthropods like *Encarsia formosa* and *Eretmocerus mundus*, and continues with biopesticides such as *Bacillus thuringiensis* and Cease (*Bacillus subtilis* strain QST 713).

33.5 10:50 Wrap-up and conclusions, Matthew Krause, mkrause@bioworksinc.com, BioWorks, Inc., Victor, NY

34 • Herbicide-resistant weeds and the need for sustainable systems: The benchmark study-a field-scale multi-year multi-state project

Room L4

The evolution of herbicide-resistant weeds, particularly those with resistance to glyphosate have significantly impacted the sustainability of major crop production systems across the midwest, Mississippi Delta, south and southeast. Importantly, this problem has also attracted the attention of regulators. Efforts by weed scientists to address the sustainability of these production systems while recognizing the cultural and economic limitations are of critical importance. The Benchmark Study and other related studies will address the sustainability of crop production while giving due consideration to commercial agriculture.

Organizer: Micheal D. K. Owen, mdowen@iastate.edu, Iowa State University, Ames, IA

34.1 10:00 Economics of glyphosate-based weed management programs, Bryan Young, bgyoung@siu.edu, Southern Illinois University, Carbondale, IL

Since the introduction of glyphosate-resistant (GR) crops, growers have often relied on glyphosate exclusively, resulting in the evolution of glyphosate-resistant species. When

a grower makes decisions about weed control strategies, economics is a primary criterion. Studies across six states, initiated in 2006, compared economics of using weed resistance best management practice (BMP) systems with grower systems. Resistance BMP systems were more costly but provided similar net returns. Thus, growers can implement weed resistance BMPs with confidence that their net returns will be equivalent initially, and should delay the onset and impact of GR weeds in their fields.

34.2 10:15 Seedbank/population dynamics of glyphosate-based weed management programs, Stephen Weller, weller@purdue.edu, Purdue University, West Lafayette, IN

Glyphosate weed management systems have dramatically altered weed management in the U.S. and impacted the spectrum of emerged weeds and levels and diversity of weed seed in the soil seedbank. Diverse weed management techniques avoid dependence on glyphosate and the inherent increased selection for resistant weeds that become major problems in these systems. Our research showed that soil seedbanks in crops using the glyphosate based weed management program with a diversity of weed and crop management techniques had a dramatic effect on soil seed presence, position in the soil and prevalence and avoided the development of problematic weeds.

34.3 10:30 Ecological and environmental implications of glyphosate-based weed management programs, Micheal D. K. Owen, mdowen@iastate.edu, Iowa State University, Ames, IA

Given the unprecedented adoption of glyphosate-resistant crops and the concomitant use of glyphosate for weed control, weeds with evolved glyphosate resistance have become a significant economic problem. The glyphosate-resistant biotypes have become the norm rather than the exception and are extremely difficult and costly to manage. Greater use of alternative herbicides has occurred and these herbicides may represent greater risks to the environment. Furthermore, aggressive tillage may be used and thus increase the use of petroleum fuels. Another consequence of more aggressive tillage is greater soil erosion which will negatively impact water quality.

35 • IPM and transgenic Bt maize: Current issues, future needs

Room L5

Transgenic Bt maize for control of insect pests has become a major control tactic in the IPM toolbox for many corn producers in North and South America, yet there are still many issues surrounding its use and questions that need to be answered if use of Bt maize is to be sustainable. This symposium will address integrated pest management from the perspective of current issues and future needs surrounding the use of transgenic Bt maize, specifically as it relates to other aspects of IPM. This will include presentations on: 1) decision-making processes for determining when and where to implement transgenic maize; 2) influences of transgenic maize on field scouting and pest surveys; 3) combining entomopathogens with transgenic maize for multiple mode-of-action pest control; 4) area-wide suppression of major pests with transgenic maize; 5) benefits and risks to other crops from transgenic maize; 6) challenges and successes of transgenic maize in Latin America; and 7) research needs to more precisely model the sustainable deployment of transgenic maize as an IPM tool.

Organizer: Marlin E. Rice, marlin.rice@pioneer.com, Pioneer Hi-Bred International, Johnston, IA

35.1 10:00 Introduction, Marlin E. Rice, marlin.rice@pioneer.com, Pioneer Hi-Bred International, Johnston, IA

35.2 10:00 Transgenic maize and the IPM decision-making process: Deciding when and where to plant, Clint Pilcher, clint.pilcher@pioneer.com, and Laura S. Higgins, laura.higgins@pioneer.com, Pioneer Hi-Bred International, Johnston, IA

Bt maize brings significant benefits for insect control: season-long plant protection, implementation ease, environmental and handler safety. The rapid adoption of Bt maize indicates growers appreciate these benefits and value this technology. However, the intensive use of Bt maize brings with it the increased risk of insect resistance. Insect resistance management (IRM) plans were proactively deployed with the commercialization of Bt maize–but is IRM (refuge) enough? This talk explores what drives insect control decisions by growers, how they assess risk, and how we might think differently about the use of Bt maize in the context of IPM.

35.3 10:15 Transgenic maize and entomopathogens: Multiple mode of action pest control, Aaron J. Gassmann, aaronjg@iastate.edu, Iowa State University, Ames, IA; Jennifer L. Petzold-Maxwell; Missy L. Rudeen; Eric H. Clifton

We report the results of studies that test interactions among a community of entomopathogens, maize engineered with event DAS-59122-7 that produces the insecticidal Bt protein Cry34/35Ab1, and larval western corn rootworm *Diabrotica virgifera virgifera* LeConte (Coleoptera: Chrysomelidae), an obligate root feeder and a serious pest of maize. We tested interactions with a fully crossed design consisting of two maize treatments (Cry34/35Ab1 maize and non-Bt maize) and two entomopathogen treatments (present or absent). The entomopathogen community included both entomopathogenic nematodes and entomopathogenic fungi. Entomopathogens and Bt maize acted in an independent and complementary manner to reduce survival of western corn rootworm.

35.4 10:30 Transgenic maize in Latin America: Challenges and successes, Celso Omoto, celomoto@esalq.usp.br, Universidade de São Paulo, Piracicaba, SP, Brazil

Argentina and Brazil are the leading countries in the use of transgenic maize in Latin America. Although this technology was initially designed against North American pests, the rate of adoption of transgenic maize has been very high by reaching up to 80% of total maize-grown area after 13 years in Argentina and only after 4 years in Brazil. Annual cropping systems are very diverse and complex in some regions in Argentina and mainly in the tropical Brazilian agriculture. Understanding the spatial and temporal variability of different crops in major agricultural ecosystems is crucial for designing a reliable pest management program.

35.5 10:45 Transgenic maize and major pest species: Implications of area-wide suppression, Michael E. Gray, megray@uiuc.edu, University of Illinois, Urbana, IL

In 2011, 88%, 90%, and 94% of all maize, upland cotton, and soybean acres, respectively, were planted to genetically engineered plants in the United States (USDA ERS). Over the past 15 years, producers have increased their use of Bt maize hybrids and the once prominent insect pest, the European corn borer, *Ostrinia nubilalis* (Hübner), has been reduced to near non-pest status across much of the North Central Region of the United States. Other insects, pests and non-pests, may also experience this area-wide suppression. Increasingly, the relevance of traditional IPM tactics within a transgenic agroecosystem is being questioned.

35.6 11:15 Transgenic maize and other crops: Benefits and risks, Galen Dively, galen@umd.edu, University of Maryland, College Park, MD; William D. Hutchison

Widespread commercial deployment of transgenic maize has resulted in yield increases, reductions in insecticide applications, and lower mycotoxin levels. Apart from these direct effects, areawide suppression of key target insects has indirectly led to economic benefits for non-transgenic maize, as well as substantial reductions in insecticide use in other crops. Conversely, the high efficacy of transgenic maize could have a negative effect by removing a key pest and thus providing a vacated ecological niche for secondary pest populations to expand and cause increased damage to other crops. Addressed here are the benefits and risks to other crops from transgenic maize.

35.7 11:35 Transgenic maize and corn earworm: Influences on scouting and pest surveys, William D. Hutchison, hutch002@umn.edu, University of Minnesota, St. Paul, MN; Shelby Fleischer; Brian Flood; Galen Dively

Corn earworm, *Helicoverpa zea*, continues to be a significant pest of field corn, sweet corn, and several other vegetable crops in the eastern U.S., particularly tomato and snap bean. During the past decade, two significant trends have impacted *H. zea* dynamics and IPM; increasing use of transgenic Bt corn, and increasing pest resistance to pyrethroid insecticides. In response, new tactics were developed to improve IPM systems, including a private-public sector network of pheromone trap cooperators (>450 traps), and the expansion of an interactive web site, *PestWatch,* for rapid reporting and mapping of moth catch data. Future needs will be discussed.

35.8 11:55 Transgenic maize and sustainable deployment: Research needs for simulation models, David Onstad, david.onstad@CGR.DuPont.com, DuPont Experimental Station, Wilmington, DE

Transgenic crops are ideally suited as IPM tools. They have narrow pest spectrums and little or no impact on natural enemies. However, transgenic crop IPM programs have been slow to develop and in some cases the successful use of transgenic crops has decreased pest monitoring and diverse tactics to control the primary maize pests. This presentation will discuss simulation modeling used to predict transgenic maize durability under different selection scenarios and the benefits of multiple and diverse methods of pest control for extending trait durability. Biological data needed to make these predictions more accurate and biologically relevant will be highlighted.

36 • Going green: The role of IPM in green building

Room L6

Integrated Pest Management (IPM) is an important piece of the Green Building puzzle. Yet, for green building certification programs such as the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) program, it has been difficult to get all parties on the same page regarding IPM standards. The purpose of this workshop is to examine how IPM fits into green building management and brainstorm solutions for the confusion over the role of IPM standards within green building certification programs. The workshop will be divided into three parts. First, we will outline the Green Shield Certified program metrics and criteria, as well as the program's benefits and opportunities for it to work in green facility management. Next we will cover past and future LEED IPM standards and challenges and successes green facility managers face when utilizing IPM. The workshop will conclude with a panel to discuss the challenges of defining IPM standards, adoption of IPM in green building and utilizing the Green Shield Certified program to benefit green buildings. A 15 minute QandA session will follow to allow attendees to ask questions and provide panelists the opportunity to comment on future trends of IPM in green building.

Organizer: Caitlin Seifert, cseifert@ipminstitute.org, IPM Institute of North America, Inc., Madison, WI

36.1 10:00 Green Shield Certified metrics: What are they and what do they show?, Caitlin Seifert, cseifert@ipminstitute.org, IPM Institute of North America, Inc., Madison, WI

As an introduction to the workshop presenters, we will describe the metrics and criteria of the Green Shield Certified program and how the program can apply to green building. Green Shield Certified is an independent, non-profit certification program that promotes practitioners of effective, prevention-based pest control while minimizing the need to use pesticides. Green Shield Certification is available to pest management professionals, landscape companies, facilities and programs.

36.2 10:05 Green Shield Certification: What does the data say? A before and after snapshot, Thomas Green, ipmworks@ipminstitute.org, IPM Institute of North America, Inc. Madison, WI

Green pest management practices among companies and facilities vary widely according to their definition of IPM. The difference between IPM practices before participants have been evaluated by Green Shield Certified and after their certification can be dramatic. After meeting Green Shield Certified criteria, participants reduce or eliminate the use of toxic pesticides and practice more non-chemical, prevention-based approaches to pest management. To date Green Shield Certified has certified 37 services, three facilities and three programs across the country with many more participants currently involved in the certification process.

36.3 10:15 The evolution and future of IPM in LEED standards, Sara Cederberg, scederberg@usgbc.org, U.S. Green Building Council, Washington, DC

There have been few changes to IPM standards since LEED for Existing Buildings: Operations and Maintenance certification's introduction in 2004. Since the beginning the LEED IPM credit has focused on creation of an IPM team and establishment of an IPM plan, without fully addressing the proper definition of 'least-toxic' products. LEED is now in the process of revising IPM standards for its 2012 standard revisions. This presentation will take a look at the past and explore the future of LEED's IPM standards. This is an excellent opportunity to get a sneak-peek at the IPM standard revisions, ask questions and voice any concerns.

36.4 10:30 Being Green Shield Certified: Bottom line benefit in green building, Jack Marlowe, jackmarlowe@edenpest.com, Eden Advanced Pest Technologies, Olympia, WA

This presentation will cover the benefits of Green Shield Certification for facilities and opportunities for PMP companies that service green buildings. Green Shield Certified facilities and facilities contracting with Green Shield Certified service providers are well placed to earn the two Integrated Pest Management points offered by the USGBC toward LEED certification. As more and more facility managers turn to IPM, Green Shield Certified PMPs have the opportunity to act as educators for IPM practices and advocate the benefits of their Green Shield Certified services.

36.5 10:45 IPM from a green facility manager's perspective: Challenges and successes, Wayne Walker, waynew@housing.ufl.edu, University of Florida Department of Housing and Residential Education, Gainesville, FL

Integrated pest management is a vital element of sustainable building operations and green facility managers have a unique responsibility to manage pests in an environmentally friendly way. This presentation will discuss the challenges green facility managers face when trying to manage pests, especially while maintaining LEED's IPM standards. We will explore the strategies employed for successful pest management, including evaluation of new technologies and sustainable solutions.

36.6 11:15 Panel discussion

Panel Topics: What strategies can be utilized to get green facility managers and pest management professionals on the same page? How can we enhance adoption of IPM practices in the green building industry? What are effective ways to better document the impact of IPM in green buildings? Is there a way to better utilize the Green Shield program to benefit green facilities? Question and Answer session.

37 • Semiochemicals in IPM and semiochemical technology in IPM systems in developing countries: IPM CRSP in South Asia, West Africa and East Africa

Room L8

Semiochemicals, and particularly insect sex pheromones, are a useful part of many detection, monitoring, and control programs for agricultural crops. There are three main uses of semiochemicals in the IPM of insects. One important application is in monitoring a population of insects to determine the presence or absence in an area. This monitoring task is the basis of IPM. Monitoring is used extensively in urban pest control, in the management of stored grain pests, and to track the invasive species. A second major use of semiochemicals is to mass trap insects to eradicate huge numbers of insects. Massive reductions in the population density of pest insects ultimately help to protect resources such as food or fiber for human consumption. A third major application of pheromones is in the disruption of mating in populations of insects. This has been most effectively used with agriculturally important

moth pests. The Integrated Pest Management Collaborative Research Support Program (IPM CRSP) is involved in six regional projects across the globe. Semiochemical technology is the subject of research in three of these: South Asia, West Africa and East Africa. Monitoring systems are being assessed for population monitoring of pests of cabbage, tomato, eggplant and coffee in these regions. In conclusion, semiochemicals are species-specific chemicals that affect insect behavior, but are not toxic to insects. Semiochemicals can play an important role in IPM for urban, structural, landscape, agricultural, or forest pest problems. Adoption of semiochemical technology by local farmers will be addressed.

Organizers: Gadi V.P. Reddy, reddy@uguam.uog.edu, University of Guam, Mangilao, Guam; Douglas G. Pfeiffer, dgpfeiff@vt.edu, Department of Entomology, Virginia Tech, Blacksburg, VA

37.1 10:00 Sex pheromones and other semiochemicals in IPM, Peter Witzgall, peter.witzgall@slu.se, Swedish University of Agricultural Sciences, Alnarp, Sweden

Insects use pheromones for mate-finding and other semiochemicals, such as plant volatiles, for host finding. These behavior-modifying chemicals are environmentally safe and they are active at very small amounts. Hundreds of pheromones and other semiochemicals have been discovered that are used to monitor the presence and abundance of insects and to control insect populations in agriculture, horticulture, forestry, stored products, and for insect vectors of diseases. Pheromones become increasingly efficient at low population densities, they do not adversely affect natural enemies, and they can, therefore, bring about a long-term reduction in insect populations that cannot be accomplished with conventional insecticides.

37.2 10:15 Semiochemical-based IPM applications for stored products, Thomas W. Phillips, twp1@ksu.edu, Kansas State University, Manhattan, KS

IPM for stored-products often depends on insect numbers from pheromone traps for decision-making. Pheromone-baited monitoring traps are routinely used for stored-product moths, the cigarette beetle, the warehouse beetle and the *Tribolium* flour beetles. A recent breakthrough in pheromone-based suppression was the registration of a common moth pheromone for mating disruption if Indianmeal moth and its relatives. Mating disruption shows promise for control of the cigarette beetle. Thus pheromone-based methods contribute greatly to monitoring and IPM decision-making for stored-product pests, and population suppression via mating disruption may be able to replace aerosol and fumigation treatments for key pests in the near future.

37.3 10:30 Assessment of mass trapping with kairomones and pheromones: Efficacy, mechanisms and future directions, Maya L. Evenden, mevenden@ualberta.ca, University of Alberta, Edmonton, Alberta, Canada; V.M. Aurelian; G.J.R. Judd

Semiochemical-baited mass trapping was tested against the apple clearwing moth (*Synanthedon myopaeformis* (Borkhausen) using pheromone-and kairomone-baited traps. Mass trapping significantly reduced the number of moths captured in assessment traps positioned in treated plots. Pheromone and kairomone-based mass trapping can be achieved at trap densities of between 25 and 50 traps / ha and 50 and 100 traps / ha, respectively. The mechanism of action of pheromone-based mass trapping is disruption of male moth orientation. Traps targeting the apple clearwing moth also captured non-target arthropods. Non-target effects should be considered in future development of semiochemical-based management of the apple clearwing moth.

37.4 10:45 Pheromone antagonists as potential agents in IPM, Angel Guerrero, angel.guerrero@cid.csic.es, Institute of Advanced Chemistry of Catalonia (CSIC), Barcelona, Spain

The catabolism of insect sex pheromones occurs in Lepidoptera by the action of enzymes present in insect antennae. These enzymes, mainly esterases, degrade the pheromone components in more polar and inactive metabolites, and their inhibition may lead to the disruption of the chemical communication between sexes. In the last years, we and others have shown that fluorinated ketones are good reversible inhibitors of these enzymes, and as pheromone antagonists have been proposed in a new pest control strategy. In this talk, I will present an overview of our latest results on different moth species in this field and the prospects of this strategy in IPM.

37.5 11:15 Semiochemical-based strategies for management of yellow margined leaf beetle *Microtheca ochroloma* in crucifer vegetable production, Rammohan R. Balusu, balusrr@auburn.edu, Auburn University, Auburn, AL; Henry Fadamiro

The yellowmargined leaf beetle, *Microtheca ochroloma* Stål (Chrysomelidae) is the most damaging pest of organic crucifer production in Alabama and other parts of the southern United States. The goal of this study was to develop organically acceptable practices, particularly in semiochemical-based strategies for managing *M. ochroloma*. We studied mechanisms of host plant selection and preference among crucifer hosts in laboratory and greenhouse conditions. The results showed that turnip and napa cabbage are highly preferred hosts over cabbage and collards. Preliminary results of field trials with these preferred host plants as trap crops were highly encouraging in protecting the main crop. Semiochemical-based host plant attract in preferred host plants was further identified with GC-EAD and GC-MS techniques as a novel isothiocyanate.

38.6 11:30 Pheromone-based trapping method for the weevil pests on Guam, Jesse Bamba, jpbamba@uguam.uog.edu, Western Pacific Tropical Research Center, University of Guam, Mangilao, Guam; G.V.P. Reddy

The banana root borer, *Cosmopolites sordidus,* is cosmopolitan and is one of the main pests occurring in banana plantations throughout the world. The New Guinea Sugarcane Weevil, *Rhabdocelus obscurus,* is a serious pest found in ornamental nursery and coconut plantations that has been introduced to Guam and its neighboring islands. Similarly, the sweetpotato weevil, *Cylas formicarius,* is recognized as the most destructive pest of sweetpotato worldwide. This weevil can cause considerable damage, with losses reportedly ranging from 5-100%. All three weevils are economically detrimental pests on Guam and other Micronesian Islands. Pheromone-based trapping techniques have been developed on Guam by evaluating various trap types, dimensions, color and placement of the traps in the field. The results will be discussed.

37.7 11:45 Monitoring of *Leucinodes orbonalis* and *Plutella xylostella* in India, Chinnasamy Durairaj, c_durairaj@yahoo.com, Tamil Nadu Agric. Univ. (TNAU), Coimbatore, Tamil Nadu, India; J. Rajeshkumar; S. Mohankumar; A. R. Prasad; G. Gajendran; Douglas Pfeiffer; P. Karuppuchamy; E. I. Jonathan

Lepidopteran pests (*Helicoverpa armigera, Spodoptera litura, Earias* spp., *Plutella xylostella, Leucinodes orbonalis*) are constraints limiting vegetable production. Pheromone monitoring is limited and farmer awareness is low in India. Studies on blends, persistence, cost effective pheromone dispensers and monitoring of *Helicoverpa* and *Leucinodes* were performed. Electrophysiological studies were made during 2009-2011. Monitoring of adult *Plutella* is important in designing IPM practices especially for releasing egg parasitoids and adopting eco-friendly controls. Popularization of pheromone technology was done among farmers in vegetable regions. The limitations of slow dissemination of this technology and ways to enhance adoption rate by resource poor farmers are discussed.

37.8 12:00 Potential use of pheromones in biocontrol based IPM programs in Senegal (West Africa), Dienaba Sall, dieynaba_sall_sy@yahoo.fr, Senegalese Institute for Agricultural Research, ISRA/CDH, Dakar, Senegal; Galo Sow; Emile Coly; Douglas Pfeiffer

Cabbage is a crop that is grown worldwide and is a major crop in West Africa. The most frequently applied insecticides in Senegal are organophosphates (39%) with pyrethroids and other classes used. The most important pests are the lepidopterans, *Plutella xylostella* (DBM), *Hellula undalis*, and *Crocidolomia pavonana*, and an aphid complex. Monitoring through pheromone traps should aid in reducing pesticide use. Pheromone-mediated mating disruption has shown some success against DBM but is limited in subsaharan agricultural settings because of block size required. Parasitism is low and unable to suppress DBM. New pheromones dispensing technology may be helpful in Senegal.

37.9 12:15 Monitoring of *Helicoverpa* and *Spodoptera* in tomato in South Asia, K. R. M. Bhanu, bhanu.krm@pcil.in, Bio-Control Research Laboratories (BCRL), Bangalore, Karnataka, India

Helicoverpa armigera and *Spodoptera litura* are major pests on vegetables and pheromones are used as a component of IPM to monitor the pest population in most of the South Asian countries. The potential of pheromone trapping is very high and practically the usage is limited only to monitor these pests. It is known that Spodoptera pheromone lures can reduce the pest populations through mass trapping but practically not in use. The present status of the usage in different South Asian countries, practical problems and possibilities will be discussed during the presentation.

37.10 2:45 Semiochemical-based IPM of insect pests on tree fruit crops, Jay F. Brunner, jfb@wsu.edu, Washington State University Tree Fruit Research and Extension Center, Wenatchee, WA; Larry Gut; Don Thomson

The commercial use of pheromone-mediated mating disruption for the control of agricultural pests has been successfully deployed since 1978. In tree fruits, mating disruption was first developed for *Grapholita molesta*. Given the outstanding level of control of *G. molesta*, technologies for other tree fruit pests were soon developed. In the USA, the pheromone for *Cydia pomonella* was registered in 1991. Over the last 21 years mating disruption for *C. pomonella* has been adopted worldwide and has dramatically impacted IPM programs in pome fruit. This presentation will chronicle the critical role semiochemicals have played in transforming tree fruit IPM programs.

37.11 3:00 S. Kyamanywa, skyamanywa@agric.mak.ac.ug, Makerere University, Kampala, Uganda

Coffee twig borer and coffee berry borer management in East Africa

37.12 3:15 Coffee stem borer monitoring in Nepal and India, K. R. M. Bhanu, bhanu.krm@pcil.in, Bio-Control Research Laboratories (BCRL), Bangalore, Karnataka, India

Coffee white stem borer *Xylotrechus quadripes* is a major pest on Arabica coffee in India, Nepal and South East Asia. In India, it is used as a component of IPM to monitor the borer. Through an international project funded by Common Fund for Commodities to International Coffee organization in collaboration with Coffee Board of India, Coffee Research Station Zimbabwe; and MAI Malawi; it was standardized that 25 traps per hectare is required for trapping these beetles. The present

status of usage, practical problems from the planters' point of view and future possibilities will be discussed during the presentation.

37.13 3:30 Pheromone traps as a component of bitter gourd pest management in Bangladesh, Syed Nurul Alam, Bangladesh Agricultural Research Institute (BARI), Joydebpur, Bangladesh

38 • Golf course IPM: Pushing the envelope

Room L9

Several golf courses are leading the way in exemplifying how golf and environmental stewardship go hand-in-hand. Golf courses are targeted by some as environmental pariahs, and highly valued by others for providing green space. Pesticide-restricting laws and policies often exempt golf courses because little is understood about the feasibility and impacts of pesticide reduction. Golf course managers can be slow to change because of this lack of knowledge, high standards for playability, and precariousness of their jobs. However, good examples exist and should be discussed to help reconcile management of acceptable playing surfaces with minimal inputs. Three case studies are presented: Chicago-The North Shore Country Club, the Chicago District Golf Association and the University of Illinois have teamed up to conduct on-site golf course research. Successes with testing dollar spot resistant varieties of bentgrass, bentgrass tolerance to newer herbicide products, and use of new and experimental herbicides will be discussed. NY-A long-term (11yr) systems-based project that researches reducing chemical use on golf courses serves as an extension base to teach progressive IPM practices to other golf course managers throughout NY State. San Francisco-Reducing pesticide use on their 8 golf courses since 1996, they've learned many ways to minimize pesticide use, but feel that the high expectations for aesthetic quality and perfection on golf course turf must change before more progress can be made.

Organizers: Jennifer Grant, jag7@cornell.edu, New York State IPM Program, Geneva, NY; Derek Settle, dsettle@cdga.org, Chicago District Golf Association, Lemont, IL

38.1 10:00 On-site collaborative research between the North Shore Country Club and the Chicago District Golf Association, Derek Settle, dsettle@cdga.org, Chicago District Golf Association, Lemont, IL; Dan Dinelli, DDinelli@aol.com, North Shore Country Club, Glenview, IL

The North Shore Country Club, the Chicago District Golf Association and the University of Illinois have created a unique partnership to conduct on-site golf course research. A university researcher and a golf course superintendent will describe the collaboration and highlight research successes. Management of Dollar Spot (*Sclerotinia homoeocarpa*), a chronic fungal disease of fine turfgrass that requires more pesticide input than any other pest in many cool season turfgrass regions is a focal area. Pest resistant varieties of bentgrass, bentgrass tolerance to newer herbicide products, and use of new and experimental herbicides will also be discussed.

38.2 10:45 From 11 years of golf systems research to IPM implementation across New York State, Jennifer Grant, jag7@cornell.edu, New York State IPM Program, Geneva, NY

A long-term systems-based research project on reducing chemical use on golf courses has been running at Bethpage State Park on Long Island New York since 2001, in collaboration with the NYS IPM Program and Cornell University. Golfer quality ratings along with visual quality and ball roll measurements are used to monitor acceptability of pest management systems. Biologically-based and IPM approaches have reduced environmental impact by as much as 96%. A manual outlining successful practices was produced. The project serves as an extension base to teach progressive IPM practices to other golf course managers throughout NY State and beyond.

38.3 11:15 From 11 years of golf systems research to IPM implementation across New York State–part 2, Jennifer Grant, jag7@cornell.edu, New York State IPM Program, Geneva, NY

38.4 11:35 Pesticide reduction on San Francisco city golf courses: Changing golfer expectations to reach the next level, Chris Geiger, chris.geiger@sfgov.org, City of San Francisco, San Francisco, CA

The strict cosmetic requirements imposed by international golf tournaments are key contributors to pesticide use in golf courses. On San Francisco's non-tournament courses, where cosmetic requirements are more flexible, golf course pesticide use (lbs.) has declined by 82% since 1998, whereas pesticide reductions at the City's tournament course (Harding Park) were 46%. In an effort to reduce the environmental impact of these tournaments, the City has refined Harding Park's IPM plan and updated its toxicity reviews of golf fungicides. However, further pesticide reductions depend largely on changes in golfers' and tournaments' definitions of the ideal course.

38.5 12:05 Panel Discussion

39 • Biological control of ruderal species: The search for champions

Room L10

Highly disturbed, abandoned or highly compacted lands and roadsides are often colonized by invasive ruderal species that are rarely considered as a nuisance, if considered at all, by the public. Some of these invasive weeds are targets of biological control attempts when they occur in agricultural environments, but the same weed species are largely ignored in areas where they pose little threat to agricultural production (e.g.,

knapweed is a significant target for management as a rangeland weed in the northwestern US, but its expansion as a roadside weed in the central US is receiving little attention). Other highly invasive species that pose little direct threat to agricultural production are largely ignored and funding to support their management is insufficient and sporadic (e.g., teasel). This session would explore the challenges of managing weeds in roadside and other disturbed environments. The session will especially focus on biological control of these weeds as this strategy provides the lowest long-term costs for invasive species management. Speakers would provide examples of successful management efforts of these invasive weed species, as well as present challenges and opportunities for those weeds without advocacy groups.

Moderator/organizer: Timothy J. Kring, tkring@uark.edu, University of Arkansas, Fayetteville, AR

39.1 10:00 Introduction, Timothy J. Kring, tkring@uark.edu, University of Arkansas, Fayetteville, AR

39.2 10:05 Is saltcedar biological control at the beginning of the end or the end of the beginning?, Gerald J. Michels, Jr, asychis@aol.com, Texas AgriLife Research, Texas A&M University System, Amarillo, TX; Erin N. Jones; Rachel A. Lange; Johnny B. Bible

Biological control of saltcedar using *Diorhabda* sp. has been successful in a number of geographical areas. As the beetles spread throughout saltcedar-infested lands, questions exist as to where we will go next. We look at the history of the project's implementation, roadblocks past and present, and its current status.

39.3 10:25 Spotted knapweed biological control: Transition from rangeland to roadside, Carey R. Minteer, minteer7@gmail.com, University of Arkansas, Fayetteville, AR; Robert N. Wiedenmann; Timothy J. Kring

Biological control programs targeting knapweeds are among the oldest of any such terrestrial weed programs in North America. Management efforts have largely been focused in northwestern North America where the weeds have a significant impact on rangeland agricultural systems. However, several species of the weed occur in many other habitats, including forest glades, abandoned and/or highly disturbed lands and along roadsides and adjacent lands. Biological control programs for knapweed are only recently targeting these habitats, largely due to the lack of constituents to support weed management in these areas.

39.4 10:40 Classical biological control of invasive teasels (*Dipsacus* spp.) and other weeds in areas of limited or restricted weed management, Brian Rector, Brian.Rector@ars.usda.gov, USDA-ARS Great Basin Rangelands Research Unit, Reno, NV; Atanaska Stoeva; Vili Harizanova; Radmila Petanovic

Invasive teasels (*Dipsacus* spp.) are considered noxious in five states and listed as invasive in more than a dozen others, despite having little effect on agriculture. They are problematic in areas of limited weed management such as along highways and railroads and in ditches, wetlands and parks. A classical biological control program established by USDA-ARS has identified several candidate agents for teasel control including a sawfly, an eriophyid mite, a flea beetle, and a leaf-mining fly. The mite and sawfly show promise; however development of this research program has stalled due to inconsistent stakeholder support.

39.5 11:15 Swallow-worts: Developing biological control for these viny milkweeds, Lindsey R. Milbrath, lrm32@cornell.edu, USDA-ARS Robert W. Holley Center for Agriculture and Health, Ithaca, NY

Pale and black swallow-wort (Vincetoxicum spp.) are herbaceous, perennial, viny milkweeds from Europe that have become invasive in a variety of natural and managed habitats in the northeastern United States and southeastern Canada. Biological control is considered the only long-term control option for swallow-worts, and identifying host-specific biological control agents from Europe and Asia appears promising. Information will be presented on potential agents discovered to date. Plant demography models are also being developed to identify potentially effective guilds of natural enemies, and they may indicate the need for an integrated approach to swallow-wort management.

39.6 11:35 Purple loosestrife: success at several levels, Robert N. Wiedenmann, rwieden@uark.edu, University of Arkansas, Fayetteville, AR

Communicating success for biocontrol projects with defined agricultural or environmental constituencies is often easier than for projects with diverse constituent groups, as happens with ruderal species. Often, constituents include scientists interested in using project details to help understand ecological processes. Because the wetland weed, purple loosestrife, grows in multiple habitat types, so too it has a diverse set of constituents—from federal, state and municipal land managers, to private homeowners and scientists. I will discuss the project's successes at several levels, the importance of recognizing and including those varied constituencies, and communicating to them at appropriate levels.

39.7 11:55 EDDMapS Biocontrol: Mapping biocontrol agent releases, Rebekah D. Wallace, bekahwal@uga.edu, Center for Invasive Species and Ecosystem Health, University of Georgia, Tifton, GA; Charles T. Bargeron

The Early Detection and Distribution Mapping System (EDDMapS) is focused on recruiting invasive species distribution data, an important step in Early Detection and Rapid Response programs. With the launch of EDDMapS Biocontrol, an expansion of the primary EDDMapS website, we are able to offer mapping distribution of biocontrol efforts to combat the spread of invasive species. EDDMapS Biocontrol is focused on reporting biocontrol agent release and displaying maps by agent species and intended invasive host. Future plans include development of a smartphone application which will allow for identification and reporting for agent release and monitoring in the field.

39.8 12:10 Summary, Timothy J. Kring, tkring@uark.edu, University of Arkansas, Fayetteville, AR

40 • Challenges and solutions for IPM in the Mid-Southern U.S.

Room L11

Agriculture in the Mid-South has seen significant changes over the last decade. Crop diversity has increased as commodity values have changed. In the early 2000's, cotton prices remained low while grain prices increased. As a result, mid-South producers increased their acreage of corn and soybeans. Prior to this shift, corn and soybean in the region were planted on marginal soils, and production practices revolved around cotton. As the value of the grain crops increased, production became more intensive. In the mid-South, determinate soybeans were the primary varieties grown and they were planted late in the spring. Currently, indeterminate varieties are more common and soybeans are planted much earlier in the spring on more productive soils. Transgenic Bt field corn has been adopted on the majority of acreage across the mid-South, but IPM issues in this region are drastically different from those in the Northern Corn Belt. Insecticide resistance in several species is another factor that is influencing crop production. Cotton aphid, tarnished plant bug, corn earworm, and bean leaf beetle are examples of insects that are more difficult to control with insecticides. All of these factors have made it necessary to evaluate IPM strategies in all crops. Land-Grant Universities across the region have faced reduced funding and significant reductions in personnel. To address this, the Entomologists in Arkansas, Louisiana, Mississippi, Missouri, and Tennessee formed a working group to address common IPM issues across state lines. The current symposium will highlight research and extension programs that have resulted from these collaborations.

Organizers: Jeff Gore, jgore@drec.msstate.edu, Mississippi State University, Delta Research and Extension Center, Stoneville, MS; Scott D. Stewart, sdstewart@utk.edu, University of Tennessee, Western Tennessee Research and Extension Center, Jackson, TN

40.1 10:00 Overview of Mid-South Entomology Working Group projects, Gus Lorenz, glorenz@uaex.edu, University of Arkansas Extension Service, Lonoke, AR

Insect pests are an important limiting factor of crop production in the Mid-South and a sound integrated pest management plan is needed. Developing IPM strategies has become difficult in recent years due to the downsizing that Land-Grant Universities have experienced. As a result, university and USDA-ARS entomologists across the Mid-South states have formed a working group to address changes in cropping systems and pest spectrums. Through these collaborative efforts, research and extension personnel have been able to revise and improve IPM programs in a shorter period of time and disseminate information to their clientele in a timely manner.

40.2 10:15 Philosophy of standardizing field experiments across states, B. Rogers Leonard, rleonard@agctr.lsu.edu, Department of Entomology, Louisiana State University, Northeast Research Station, Winnsboro, LA

Applied entomologists representing the Mid-Southern Land-Grant Universities in Arkansas, Louisiana, Mississippi, Missouri, and Tennessee have collaborated as an informal working group to evaluate IPM strategies in several crops. The development of field trial protocols, data summaries, and presentation of results has been accomplished with the cooperation of individual scientists functioning as a team. The benefits of this collaboration has been to increase the frequency of trials in multiple environments within a single season, confirm results across trials, distribute the workload for data analyses and interpretation of results, coordinate the delivery of information to stakeholders, and share authorship for academic publications.

40.3 10:30 Insecticide resistance in the Mid-South: An evolving problem, Ryan Jackson, ryan.jackson@ars.usda.gov, USDA-ARS, Southern Insect Management Research Unit, Stoneville, MS; Gordon Snodgrass; Jeff Gore; Fred Musser; Roger Leonard

Insecticide resistance is common in several insect species across the Mid-South. Tarnished plant bug resistance to several classes of insecticides has had an impact on cotton production. Bollworm resistance to pyrethroids has made decision makers more proactive with regard to the timing of applications. Cotton aphid resistance to the neonicotinoids has caused producers to move to the highest labeled rates in combination with adjuvants and rotatations with other chemistries. Because these pests are common in the mid-South, decision makers often must consider multiple pests that are potentially resistant to insecticides when making management decisions.

40.4 10:45 Tarnished plant bug sampling and thresholds: The "Bell-Cow" of the MSEWG, Fred Musser, fm61@msstate.edu, Mississippi State University, Department of Biochemistry, Molecular Biology, Entomology, and Plant Pathology, Starkville, MS; Angus Catchot; Jeff Gore; Don Cook; Chris Daves; Roger Leonard; Ralph Bagwell; Gus Lorenz; Scott Akin; Glenn Studebaker; Jeremy Greene; Scott Stewart

Tarnished plant bugs have emerged during the last 10 years as the primary pest of cotton in the mid-South. Common monitoring methods were not efficient for tarnished plant bug sampling and there was uncertainty about the validity of action thresholds for this pest, so a series of research projects were undertaken by numerous Mid-South entomologists using common protocols in each state. With the range of pest pressure found from working in multiple locations, a robust data set was quickly developed that has changed monitoring methods and increased confidence in action thresholds throughout the Mid-South.

40.5 11:15 Cultural control of tarnished plant bug: Cashing in on ecology, Don Cook, dcook@drec.msstate.edu, Mississippi State University, Delta Research and Extension Center, Stoneville, MS; Brian Adams; Jeff Gore; Angus Catchot; Fred Musser

The tarnished plant bug is the target of more insecticide applications than any other insect in the Mid-South. Because current plant bug management practices are not sustainable, additional management alternatives are being examined. An area-wide tarnished plant bug management program that utilizes a selective herbicide to minimize spring hosts can reduce tarnished plant bug populations well into the growing season. Additionally, managing for earliness through the use of early maturing varieties and planting date reduces the impact of tarnished plant bug on cotton yields and also improves management. These practices will be discussed in an overall IPM program.

40.6 11:30 Coordinated research to address changes in spider mite infestations in cotton, Angus Catchot, acatchot@entomology.msstate.edu, Mississippi State University Extension Service, Starkville, MS; Jeff Gore; Don Cook; Fred Musser; Scott Akin; Scott Stewart; Gus Lorenz; Ryan Jackson; Glenn Studebaker; B. Rogers Leonard

Experiments were conducted across the Mid-South to investigate the impact of two-spotted spider mite infestation timing on cotton yields. Mites were infested at the third true leaf stage, first flower, and at 200 heat unit increments after first flower. Two-spotted spider mites significantly reduced yields of cotton when infestations were initiated first flower plus 400 heat units. Additional experiments were conducted to determine the response of eight varieties. No consistent differences in mite injury ratings or yield impacts were observed among the varieties tested. These data will be used to refine current IPM strategies for spider mites in Mid-South cotton.

40.7 11:45 An overview of research in field corn, Scott D. Stewart, sdstewart@utk.edu, University of Tennessee, Western Tennessee Research and Extension Center, Jackson, TN; Don Cook; Angus Catchot; Jenny Bibb; Glenn Studebaker; Scott Akin; Fred Musser; B. Rogers Leonard

Nearly all corn seed are treated with neonicotinoid insecticides. Rates and vary among these products. Insecticide seed treatments are usually company specific and largely determined by hybrid selection. Bt corn options are changing rapidly and also largely determined by hybrid selection. Hybrids with stacked Bt corn technologies boast better control of ear feeding pests, potential reduction in mycotoxins, and reduced refuge requirements. This paper will review regional efforts to evaluate IPM strategies in field corn with emphasis on the evaluation of seed treatments and Bt corn options and how hybrid/technology selections potentially influence insect pests, risk management and crop value.

40.8 12:00 Evaluations of insecticidal seed treatments in Mid-South crops, Scott Akin, sakin@uaex.edu, University of Arkansas, Department of Entomology, Monticello, AR

Insecticidal seed treatments have been available to growers for several years, but their importance has recently been a topic of discussion due to increased "up-front" seed costs and the loss of aldicarb (Temik®) for in-furrow use in cotton. Numerous data across the Mid-south have shown that increased yields in cotton, soybean, corn, rice, and wheat can result, largely due to the early-season insect protection provided by seed-applied insecticides. Increased vigor, leaf area, plant height, and overall health have also been observed in replicated field trials. Insecticide seed treatments, when used at correct rates, can be valuable insurance across various crops.

41 • Natural products in weed management

Room L12

Interest in natural products for pest management has grown with the desire for more natural, environmentally friendly, and toxicologically benign pesticides, especially for organic farmers. Approximately 30% of conventional insecticides and fungicides registered by EPA over the past 15 years are natural products of natural product-derived materials, whereas only 8% of conventional herbicides registered during this period were natural product-derived. Most of the approved weed management products for organic use are natural essential oils and organic acids. Some of these products have other pest management uses that have not been examined in an IPM context. Organic farmers have no truly efficacious natural products for weed

management compared to some of the relatively effective products available to them for insect and plant disease control. This symposium will address promising new natural herbicides and bioherbicides, as well as the efficacy and economics of currently available natural weed management products. Finally, the role of IR-4 in gaining approval of natural weed management products will be covered.

Organizers: Stephen Duke, Stephen.duke@usda.ars.gov, and Franck Dayan, fdayan@olemiss.edu, United States Department of Agriculture, Agricultural Research Service, Natural Product Utilization Research, University, MS

41.1 10:00 Current state of natural products for weed management, Stephen Duke, Stephen.duke@usda.ars.gov, United States Department of Agriculture, Agricultural Research Service, Natural Product Utilization Research, University, MS

Interest in natural products for pest management has grown with the desire for more natural, environmentally friendly, and toxicologically benign pesticides, especially for organic farmers. Approximately 30% of conventional insecticides and fungicides registered by EPA over the past 15 years are natural products of natural product-derived materials, whereas only 8% of conventional herbicides registered during this period were natural product derived. Organic farmers have no truly efficacious natural products for weed management, compared to the product available for insect and plant disease control. This presentation will cover available products and potential new natural products for weed management.

41.2 10:20 New microbial bioherbicides for weed management, Marja Koivunen, marjakoivunen@eurofins.com, Eurofins Agroscience Services, Sanger, CA

Microorganisms, especially host-specific fungal pathogens, have been widely studied as potential bioherbicides. However, their commercial success has been limited due to problems in efficacy, host specificity, formulation or storage stability. Encouraged by the increased interest in biopesticides and promising results from studies testing microbial products together with synthetic herbicides, there is a new interest in developing herbicidal microbes into commercial products. Besides fungi, such as *Phoma macrostoma*, products based on bacteria (*Burkholderia* sp.) and actinomycetes (*Streptomyces* sp.) are scheduled for registration with the US EPA. Herbicidal activity of these new products is based on secondary metabolites, not on selective pathogenicity.

41.3 10:40 Natural triketones for weed management, Franck Dayan, fdayan@olemiss.edu, United States Department of Agriculture, Agricultural Research Service, Natural Product Utilization Research, University, MS; Daniel K. Owens; J'Lynn Howell

Herbicides are a key component of successful IPM programs. The recent dominance of glyphosate has had a negative impact on the number of other herbicides available. Environmentally friendly natural herbicide alternatives have so far not been very good alternatives because they are primarily non-selective burn-down essential oils applied POST. Multiple applications are often required due to their low efficacy. Manuka oil, the essential oil distilled from manuka (*Leptospermum scoparium*, J.R. et G. Forst) shrubs, is different from other oils in that it has interesting PRE activity, providing control of crabgrass seedlings at a rate of 3 L ha^{-1}. Manuka oil and its main active ingredient, leptospermone, were stable in soil for up to 7 days and had half-lives of 18 and 15 days, respectively. The systemic activity of manuka oil addresses many of the major limitations normally associated with natural herbicides. Additionally, its soil persistence opens up a multitude of new possibilities for the use of manuka oil as a tool for weed management and may be a potential bridge between traditional and organic agriculture and new options in IPM programs.

41.4 11:15 Managing weeds in turf without synthetic herbicides, François J. Tardif, ftardif@uoguelph.ca, University of Guelph, Ontario, Canada; Cynthia Siva; Eric Lyons; Katerina S. Jordan

The Ontario Cosmetic Pesticide Ban implemented in 2009, restricts the use of conventional pesticides in urban settings. We examined the effectiveness of various weed management treatments as potential alternatives to conventional herbicides for turf weed control. Acetic acid and flame-weeding as site-preparation treatments were compared to glyphosate. Alternative products greatly differed in their efficacy: while some were as efficient as conventional products, others were severely lacking. The cost of applying sufficient product to gain desired effects may become quite expensive for a home lawn owner.

41.5 11:35 The IR-4 projects efforts in development of natural products in weed management, Mike Braverman, braverman@aesop.rutgers.edu, Biopesticide and Organic Support Program, IR-4 Project, Rutgers University, Princeton, NJ; Jerry Baron

The IR-4 Biopesticide and Organic Support Program has three main methods of assisting natural product developmen including grants to fund biopesticide efficacy research, a regulatory support program to obtain registration with the U.S. Environmental Protection Agency and a label database to find out what biopesticides are available to manage particular pests within a crop. More specifically, for natural product weed control, IR-4 has been involved in the registration of acetic acid and *Chondrosterum purpureum* as a herbicide and funded efficacy studies on acetic acid, pelargonic acid, clove oil, lemongrass oil, *Phoma macrostoma,* Fe-HEDTA and thaxtomin.

41.6 11:55 Use of corn gluten and related products for weed management, Nick Christians, nchris@iastate.edu, Iowa State University, Ames, IA

Corn gluten meal is a coproduct of the wet milling of corn (*Zea mays*). It contains approximately 60% protein and 10% nitrogen (N) by weight. The protein fraction contains compounds that inhibit root formation at the time of germination of a variety of plant species, whereas it has no effect on rooting of mature plants. It is also a good N source for mature plants, such as lawn grasses. It is used as a natural weed and feed product applied before the germination of annual weeds into perennial turf. It is widely used in the United States and Canada for that purpose.

42 • Getting results with best management practices

Room L13

Nationwide, IPM educators and scientists apply effective and innovative protocols to make IPM work. Learn how best management practices (BMPs) are improving the environment and saving money. Three presenters will show how they got BMPs in motion, thanks to support from Regional IPM Centers. Michael Rozyne (Red Tomato) develops supply chains that reward growers in the marketplace for the added value of IPM adoption. In 2011, 21 growers representing 1100 acres participated in the Eco Apple and Stone Fruit programs. They follow a required protocol for advanced IPM and provide detailed production records that are audited annually. Allison Taisey (Northeastern IPM Center) has been coordinating a 4-year joint USDA-HUD project in public housing authorities. The team working on the project based protocols for practicing IPM on guidance provided by the U.S. Department of Housing and Urban Development. Allie will share about the success of BMPs in 20 urban settings where agency leaders now have a simple tool that enables them to clarify team member responsibilities and make informed decisions. Jim Jasinski (Ohio State University) helped develop a set of IPM guidelines in 2000 that covered pre-plant to post harvest activities for specific field, fruit, and vegetable crops. These "Elements" were revised in 2009 for growers participating in a Natural Resource Conservation Service Environmental Quality Incentive Program. Thirty participating growers received $600,000 in the first two years of using these BMPs and they are still a key factor in the ranking process to determine contracts.

Organizer: Carrie Koplinka-Loehr, ckk3@cornell.edu, Northeastern IPM Center, Cornell University, Ithaca, NY

42.1 10:00 Introducing our line-up of best-managed speakers!, Carrie Koplinka-Loehr, ckk3@cornell.edu, Northeastern IPM Center, Cornell University, Ithaca, NY

42.2 10:05 Getting results with BMPs: Eco-Apple, Michael Rozyne, mrozyne@redtomato.org, Red Tomato, Plainville, MA

42.3 10:20 Getting results with BMPs in public housing authorities, Allison Taisey, aat25@cornell.edu, Northeastern IPM Center, Cornell University, Ithaca, NY

42.4 10:35 Working with NRCS is the best!, Jim Jasinski, jasinski.4@osu.edu, Champaign County Extension Office, Urbana, OH

42.5 10:50 Discussion

43 • IPM challenges in the urban landscape: Implementation, establishment and evaluation

Room L14

Pest management in the landscape continues to challenge us and in particular the implementation, establishment and evaluation of IPM. There is clearly a critical need for IPM practices in the landscape because it is here where new pests are often first established and build to high populations; there is often overuse or misuse of pesticides, there is a general lack of pest management information, tools and training for landscape problems; and there is an emotional relationship between people and their landscapes. These challenges continue to increase with the onslaught of invasive pests, the critical need to reduce pesticide and other inputs into the environment, and the rising costs of management and maintenance of our landscapes. The landscape is unique due to the unpredictable risks associated with loss of aesthetic value and close ties with human views. But the need to move towards sustainability and long-term, biologically based management is really no longer a choice but a necessity. The purpose of this program is to bring together experts in research, extension and the industry to identify, discuss and prioritize challenges in implementing, establishing and evaluating IPM in the landscape and to identify where we can work together locally, regionally, nationally and globally to make IPM the norm for our landscapes.

Organizers: Catharine Mannion, cmannion@ufl.edu, University of Florida, Tropical Research and Education Center, Homestead, FL; S. Kristine Braman, kbraman@uga.edu, University of Georgia, Department of Entomology, Center for Urban Agriculture, Griffin, GA

43.1 10:00 Managing invasive pests in the urban landscape, Catharine Mannion, cmannion@ufl.edu, University of Florida, Tropical Research and Education Center, Homestead, FL

43.2 10:20 Conservation of natural enemies to improve pest management in the urban landscape, S. Kristine Braman, kbraman@uga.edu, University of Georgia, Department of Entomology, Center for Urban Agriculture, Griffin, GA

43.3 10:40 Optimizing plant breeding for sustainable landscapes, Carol Robacker, croback@griffin.uga.edu, University of Georgia, Department of Horticulture, Griffin, GA

43.4 11:15 Environmental and cultural opportunities for maximizing sustainability in the urban landscape, Svoboda V. Pennisi, bpennisi@uga.edu, University of Georgia, Department of Horticulture, Griffin, GA

43.5 11:35 IPM and the urban landscape: Fact or myth?, Catharine Mannion and Kris Braman

44 • Evolving pest complexes and IPM strategies in transgenic cotton

Room L2

Genetically-modified Bt cotton was first introduced in the mid-1990's and resulted in significant reductions in pesticide applications targeted for control of Lepidopteran species. It is generally recognized that this has led to higher yields and increased profits for cotton farmers. As pesticide use has declined, however, there is evidence that insects previously regarded as minor or secondary pests, such as true bugs in the families Miridae and Pentatomidae, have become more of a limiting factor in cotton production and may require increased inputs to control. This symposium will examine the changing pest complex in transgenic cotton and discuss IPM needs in response to those changes.

Organizers: James Thomas, jdthomas@dow.com, and Melissa Siebert, mwillrichsiebert@dow.com, Dow AgroSciences, Greenville, MS

44.1 11:15 Recognizing and adapting to Mid-South cotton arthropod pest shifts, B. Rogers Leonard, rleonard@agcenter.lsu.edu, Louisiana State University, Winnsboro, LA

Across the Mid-South US region, an extended list of arthropod pests includes one or more species that attacks cotton during nearly every stage of crop development. In addition, as new technologies have been adopted and crop production practices evolved, the primary pest spectrum has changed. The adoption of transgenic crops, successful boll weevil eradication, conservation tillage, weed resistance, highly selective pesticides, and fewer broad-spectrum chemical products are all associated with shifts in pest diversity and severity. IPM practitioners must consider the contribution of these factors when modifying current cotton IPM strategies.

44.2 11:32 Evolving pest complexes and technologies revolutionize IPM strategies in Arizona cotton, Peter Ellsworth, peterell@ag.arizona.edu, University of Arizona, Maricopa Agricultural Center, Maricopa, AZ; Steven Naranjo; Yves Carriere; Bruce Tabashnik; Al Fournier; Wayne Dixon; Larry Antilla; Leighton Liesner; Jack Peterson

Introduced in Arizona in 1996 and initially adopted on ca. two thirds of the cotton acreage, Bt cotton now peaks at over 98% as part of pink bollworm (the primary target) eradication. Bt cotton was only one of several key advances made in the last 16 years; pink bollworm is just one of three key pests driving cotton IPM since 1990. While other cotton production regions have experienced new difficulties in management, Arizona has seen a revolution of IPM practice in cotton resulting in a reduction in all insecticide usage from 9.0 to just 1.5 sprays in recent years.

44.3 11:49 IPM then, now and beyond: A mid-southern perspective, Scott Stewart, sdstewart@utk.edu, University of Tennessee, West Tennessee Research and Education Center, Jackson, TN; Gus Lorenz; Angus Catchot; Don Cook; Jeff Gore; Scott Akin; Glenn Studebaker; Fred Musser; Ryan Jackson; B. Rogers Leonard

Significant changes during the last 10-15 years have changed the face of IPM in cotton. New chemistries, boll weevil eradication and the wide scale adoption of Bt transgenic cotton have dramatically changed the key insect pest complexes that occur across the US Cotton Belt. While some pests have been eradicated or relegated to a relatively minor status, others have emerged as major IPM issues. This paper will address new pest complexes and IPM strategies have evolved in a cotton production system dominated by Bt cotton, with special emphasis on the mid-southern U.S.

45 • Integrated vegetation management

Room L3

Integrated vegetation management (IVM) encompasses the broad array of weed control and suppression techniques, including those which are often employed for purposes other than weed management per se, such as prescribed fire, livestock grazing, and mowing. The impacts of IVM activities on both vertebrate and invertebrates can be ameliorated via a working framework of "dual goals": 1) the driving purpose for the management activity and 2), wildlife. Driving purposes include economic and VM activities such as livestock grazing, ditch clearance, power transmission ROW maintenance, and invasive plant control. The second goal is to reduce the direct negative impacts of the driving purpose and in some

cases, improve wildlife habitat. The second goal can often be achieved by modifying the timing, intensity, and scale of IVM and weed management activities. Where possible, these activities should be carried out when animals are not present or not active. Case studies and best practices will be discussed.

Organizers: Rick Johnstone, ivmpartners@comcast.net, Integrated Vegetation Management Partners, Inc., Newark, DE; John Vickery, jvickery@mcg.net, Colorado Native Plant Society, Denver, CO

Moderator: Chow-Yang Lee, chowyang@usm.my, Universiti Sains Malaysia, Penang, Malaysia

45.1 11:15 Integrated vegetation management with wildlife in mind, John Vickery, jvickery@mcg.net, Colorado Native Plant Society, Denver, CO

The impacts of vegetation management (VM) activities on wildlife can be ameliorated via changes in the timing, intensity, proportion, and/or scale of the treatment. These changes are predicated on two things. First is a working framework of "dual goals": 1) the driving purpose for the management activity and 2), wildlife. The second is knowledge of the species present and their natural history-including the ecological services of weeds. In this presentation, examples are given of modifications employed for each of a number of types of VM categories such as livestock grazing, mechanical control, prescribed fire, biocontrol, and chemical control.

45.2 11:40 IVM and ecosystem management best practices, Rick Johnstone, ivmpartners@comcast.net, Integrated Vegetation Management Partners, Inc., Newark, DE

Multi-year botanical and photo documentation of integrated vegetation management (IVM) case studies on utility rights-of-way (ROW), tribal rangeland, wildlife refuges and parks are reviewed to demonstrate how primary and secondary management objectives can be obtained with systematic use of best practices. IVM allows utilities, public agencies and conservationists to form partnerships that meet ROW primary objectives of safe, accessible, reliable, and economical energy services to the public; while also meeting secondary objectives of invasive weed control, lower risk of wildfire, improved wildlife and pollinator habitat, restored ecosystems that benefit threatened or endangered species, and lower environmental costs.

45.3 12:05 Discussion

46 • Implications for "insurance is the new IPM" in field crops

Room L4

Integrated pest management has taken a back seat for farmers of many field crops especially as grain prices have risen and new management tools become available. This symposium will include expertise from several academic disciplines, including entomology, plant pathology, and economics. Topics will revolve around the increasing popularity of prophylactic use of pesticides to increase yield in corn, soybean, and other crops, and the increasing use of pesticides regardless of pest pressure. The goal of this symposium is to highlight current research and discuss implications for why pesticides are now considered "insurance" as IPM is brushed aside.

Organizers: Daren Mueller, dsmuelle@iastate.edu, and Erin Hodgson, ewh@iastate.edu, Iowa State University, Ames, IA; Robert Wright, rwright2@unl.edu, University of Nebraska–Lincoln, Lincoln, NE

46.1 11:15 Pesticide use and marketing from the perspective of ag retailers-pushing the boundaries of IPM, Clarke McGrath, cmcgrath@iastate.edu, Iowa State University, Harlan, IA

With the recent tremendous volatility in both grain markets and crop production and protection costs, producers are looking for risk management on multiple fronts. Retailers are an increasing part of the "risk management" equation. In the last few years, pesticide use has emerged as a risk management tool utilized by retailers and producers. A challenge has been how to reconcile Integrated Pest Management with the use of seed applied, soil applied and foliar applied pesticides. This session will discuss Iowa's perspective on this challenge.

46.2 11:35 Economics vs. IPM-Has the value of crops has increased pesticide use?, Paul Mitchell, pdmitchell@wisc.edu, University of Wisconsin, Madison, WI

46.3 11:55 Fungicides in corn: Replacing IPM with insurance?, Kiersten Wise, kawise@purdue.edu, Purdue University, West Lafayette, IN

The increased use of foliar fungicides in U.S. corn is the result of several factors: increased demand and market value, a shift in corn production practices that favor disease development, and the promotion of quinone-outside inhibitor (QoI) fungicides. QoI fungicides are marketed for management of biotic and abiotic stresses, and are promoted to increase yield even in the absence of disease. These factors have resulted in many fungicide applications occurring for insurance purposes rather than disease control, and are in direct contrast to IPM. An analysis of 10 years of corn fungicide data indicates that when final foliar disease severity is greater than 5%, the average yield response from a fungicide application is 9.6 bu/A. In contrast,

fungicide applications made in low disease pressure environments resulted in an average yield response of only 1.5 bu/A. This analysis reinforces recommendations to use fungicides in response to disease pressure for optimum efficacy and profitability.

46.4 2:45 Perceived risk or economic return-What drives soybean aphid management decisions?, Ian MacRae, imacrae@umn.edu, University of Minnesota, Crookston, MN; Bruce Potter; Fritz Breitenbach; Kenneth Ostlie

The relatively short presence of soybean aphid in N. America, combined with its rapid ascension to the most important insect pest in north central soybean systems presents an opportunity to speculate on and investigate the driving motivation behind management decisions. Multiple trials have demonstrated that foliar treatments, used in combination with the well-established and supported thresholds and effective scouting techniques established for this insect, provide the most economical control of soybean aphids. Yet, applications of prophylactic treatments persist and have increased over the past 5 years. The economic benefit of IPM has always been one of the driving factors behind its acceptance. Is economics still the motivating factor behind treatment decisions or is return being supplanted by perceived risk?

46.5 3:05 Nematode seed treatment protectants: Do growers need that type of insurance?, Greg Tylka, gltylka@iastate.edu, Iowa State University, Ames, IA

Plant-parasitic nematodes can be serious soil-borne pathogens of many field crops. These microscopic worms are usually managed by growing nonhost crops, resistant varieties and using soil-applied nematicides, if available. A relatively new nematode management option is protectant seed treatments. At least three different nematode-protectant seed treatments are available for use by corn and soybean farmers in the U.S. The nature of these products and their effects on nematode densities and crop yields will be presented, concluding with discussion of the availability of the materials as stand-alone pest management options and possible use of the products as insurance against nematode-induced crop yield loss.

46.6 3:25 Combating automatic sprays in small grains, Dominic Reisig, dominic_reisig@ncsu.edu, North Carolina State University, Plymouth, NC; Jack Bacheler; Ames Herbert; Frances Reay-Jones; Tom Kuhar; Randy Weisz; Chris Philips

Cereal leaf beetle, *Oulema melanopus* L., is effectively managed in southeastern U.S. wheat, *Triticum aestivum*, with scouting and a single insecticide treatment. However, many growers eschew this approach for a prophylactic treatment. These approaches were compared for two years using small plot studies, regional surveys across North Carolina and Virginia, and economic analyses. The prophylactic approach was riskier, because when cereal leaf beetle densities were high, economic loss was also high. However, fields under the prophylactic approach did not exceed threshold as often as fields using integrated pest management and the total cost of management was $5.33 less per hectare.

46.7 4:00 Using Bt as not-so-cheap insurance for insect management, Michael E. Gray, megray@illinois.edu, University of Illinois, Urbana, IL

A new form of "IPM" dominates commercial maize and soybean production in the Corn Belt of the United States. This insurance pest management platform maximizes crop protection inputs (use of transgenic Bt plants, insecticide/fungicide seed treatments) to minimize risk and potential yield loss. The conventional use of scouting and economic thresholds is often ignored in favor of prophylactic treatments. An interaction of factors have contributed to this scenario, including: larger farm sizes, high commodity prices, increasing number of absentee land owners who rent land to farm managers in a very competitive arena, the significant reduction in extension faculty and educators within our land grant system, and the effectiveness of the private sector in marketing crop production inputs.

46.8 4:20 Effects of fungicides under low-disease conditions, Paul Vincelli, pvincell@uky.edu, University of Kentucky, Lexington, KY

Use of fungicides for field crop disease control has increased, with little controversy when significant disease risk exists. However, strobilurin fungicides are also marketed based on potentially improving crop performance even when disease development is minimal, attributed to improved growth efficiency or stress tolerance. Most claims of specific physiological benefits have been documented experimentally in one or more crops, and significant yield increases are sometimes observed under low-disease conditions. A review of field performance data for corn will be presented, along with some of the complexities of field trials testing for these effects.

46.9 4:40 Evaluating fungicide efficacy and accounting for yield response variations, Nick Dufault, nsdufault@ufl.edu, University of Florida, Gainesville, FL

Validating the effectiveness of new fungicide products is a key component in developing plant disease management programs for integrated pest management systems. Every experimental trial that examines fungicide efficacy will have a certain amount of error associated with environmental and physical factors that cannot be regulated by researchers. Accounting for these errors and limiting biases within field trial designs are essential components to producing quality comparisons between fungicide products. This presentation will attempt to examine the concepts of experimental design as they apply to fungicide efficacy trials and their importance in plant disease management.

47 • Educating the next generation: Strategies to promote IPM literacy

Room L13

There is a well-documented need for enhancing science literacy to deepen understanding of human nutrition, environmental conservation issues, food and fiber production systems, and the linkages between pest management and human and environmental health. K-12 schools are the best venue for improving literacy about environmental science, agriculture and integrated pest management. Increasingly, K-12 education is the best avenue for reaching parents, particularly in households where English is not the primary language spoken. IPM lessons can readiily be included into K-12 curricula at any grade level and curricula are available, but educators need guidance, support and training to effectively teach IPM in the classroom.

Organizer: Kathy Murray, Kathy.murray@maine.gov, Maine Department of Agriculture, Food and Rural Resources, Augusta, ME

47.1 11:15 Session Introduction: Improving IPM literacy among the next generation of earth's stewards, Kathy Murray, Kathy.murray@maine.gov, Maine Department of Agriculture, Food and Rural Resources, Augusta, ME

The Northeast School IPM Working Group, with funding from the Northeast IPM Center, has completed a 3-year project to survey youth educators, demonstrate IPM curricula, document how educators incorporate IPM lessons into classroom teaching, develop new lessons for use in school greenhouse settings, and to develop an IPM Literacy Plan. IPM lessons were demonstrated in more than 160 classrooms in 107 schools, in Connecticut, Maine, and Pennsylvania. Through collaborations with partners we have engaged with more than 20,000 children and almost 2,000 teachers throughout the northeast.

47.2 11:20 IPM—It's not just for farmers anymore, Donna Ellis, donna.ellis@uconn.edu, Department of Plant Science and Landscape Architecture, University of Connecticut, Storrs, CT

The IPM Curriculum developed at the University of Connecticut promotes IPM literacy by providing K-8 students with hours of enjoyable, active, inquiry-based learning experiences with plant and animal pests and beneficial organisms. Decision-making tools enable students to manage pest populations, safeguard human health, and protect the environment. The curriculum integrates IPM into existing science and other core curriculum areas taught in schools to introduce the concepts of IPM to youth and their families. Curriculum lessons address science standards and are available online at the University of Connecticut IPM website. The IPM Curriculum has been enthusiastically received by area teachers.

47.3 11:30 Engaging youth in learning about IPM: Pest Private Eye, Clyde Ogg, cogg@unl.edu, University of Nebraska–Lincoln Extension, Lincoln, NE

Let's make learning about IPM fun! What children learn early in life often stays with them well into adulthood. When the learning is fun, children are more likely to remember concepts. An educational role-playing game, Pest Private Eye, will be discussed. Ideas about how it can be used to teach children and educators in K-12 schools about IPM, pests and low-toxic control methods will be the focus. Teachers can use the game in the classroom to meet science curriculum requirements and others can use it in after school, 4-H, or library programs.

47.4 11:40 Partnership opportunities for supporting youth IPM education, Chris Fleming, cfleming@tfbf.com, TN Ag in the Classroom Program, Tennessee Farm Bureau Federation, Columbia, TN; David Cook, dcook5@utk.edu, University of Tennessee Extension, Nashville, TN

Partnering with a University Extension Department is one approach in which youth educational programs can employ area specialists to provide expertise with issues concerning Integrated Pest Management. In partnership with Tennessee Foundation for Agriculture in the Classroom and the Tennessee Farm Bureau, UT Extension personnel set up and maintain an interactive entomology exhibit for the annual Agriculture in the Classroom program conducted at the Middle Tennessee Research and Education Center. The exhibit and lectures consist of insect collections, live insects, posters and large insect models to educate youth on principles of IPM with regards to both beneficial and pest insects.

47.5 11:50 Opportunities and challenges: The Pennsylvania experience, Lyn Garling, ljg5@psu.edu, Pennsylvania Integrated Pest Management Program, Penn State University, University Park, PA

Ecological and practical aspects of IPM make it a natural fit for K-12 discussions of sustainability. IPM encompasses "green" practices, applied science, new technologies and a multitude of biological, ecological, economic and social concepts. There are opportunities for and challenges to embedding IPM into curricula. PA IPM Program has 10 yr experience providinglessons and activities to teachers. We discuss the potential role(s) of IPM educators in reaching K-12 audiences. Besides, we have way too much fun engaging teachers and students with "Haulin' Pollen", "Maggot Races", "Mouthpart Madness" and "The Cricket Hop", and all contain basic information for IPM understanding.

47.6 12:00 Facilitated discussion, moderated by Kathy Murray

Participants and presenters are invited to discuss needs and opportunities for promoting and supporting IPM literacy

among the next generation of decision-makers, especially through the teaching of IPM concepts to educators of youth audiences. What role can IPM specialists and educators play in advancing IPM literacy? Goal of the discussion is to develop a network and identify potential actions, partnerships and collaborations to advance IPM literacy among youth. Resource table in the room will be available to display and share resources. Participants are urged to bring materials to share.

48 • Creating and improving stakeholder-driven IPM programs using conventional, digital, and social media delivery system

Room L2

Federal funding for research and extension programs continues to decline and is being reallocated with a greater reliance on competitive grants. It is critical to develop extension programs and optimize technology transfer opportunities with ongoing dialogue and input from stakeholders. Traditional extension programs continue to serve as a foundation for information delivery, yet non-traditional methods of training, education and communication are increasingly important and have been very effective. Many of our stakeholders represent a younger generation and require "near real-time" answers to their questions and more comprehensive training that has been used in traditional integrated pest management (IPM) extension education. IPM is often referred to as "common sense," yet the key concepts are not well integrated into related disciplines such as indoor air quality, poison prevention, food safety, building standards and environmental stewardship. Often, IPM content is presented in separate publications, rather than incorporating IPM practices and values into diverse publications and Extension consultations. By integrating the basics of IPM into conversations and publications on disparate topics, we put IPM directly in the path of information seekers who never intended to learn about IPM, pest identification, least-toxic methods or action thresholds. Our hope is that we will encourage Extension educators to adopt new educational methods and communication tools that are highly effective. We hope that stakeholders in attendance will leave emboldened to participate in the advisory process in their state, thereby enhancing local extension service programs.

Organizers: Natalie A. Hummel, nhummel@agcenter.lsu.edu, LSU AgCenter, Baton Rouge, LA; Kaci Buhl, buhlk@ace.orst.edu, Oregon State University, Corvallis, OR; B. Rogers Leonard, RLeonard@agcenter.lsu.edu, Macon Ridge Research Station, LSU AgCenter, Macon Ridge, LA

48.1 2:45 Identify a gap in stakeholder education and fix it!, B. Rogers Leonard, RLeonard@agcenter.lsu.edu, Macon Ridge Research Station, LSU AgCenter, Macon Ridge, LA

One of the most difficult tasks that IPM practitioners encounter in their daily jobs is the diagnosis of crop disorders. In many instances, this diagnosis must be done in the absence of the causal agent such as an insect or pathogen or previous abiotic stress. Workshops were to provide an interdisciplinary examination of crop symptomology resulting from pathogens, arthropods, nutrient deficiencies/toxicity, herbicide injury, and environmental effects. Visual symptoms associated with crop disorders were presented using a series of slides delivered by a team of scientists. Each participant was provided a bound copy of slides used in the workshops.

48.2 3:05 Social media integration into traditional extension programs—From the farm to online delivery, B. Rogers Leonard, RLeonard@agcenter.lsu.edu, Macon Ridge Research Station, LSU AgCenter, Macon Ridge, LA

The Louisiana rice entomology program has a long and rich history of effectively partnering with stakeholders to increase adoption of integrated pest management practices. Observations and recommendations have traditionally been delivered via in-field meetings, newsletters and email. With increasing access to the internet, computers, and mobile communication devices (e.g. tablets and smartphones), CES faculty have adapted their communication strategy. The first transition was the use of a wordpress.com blog, followed by a facebook group page and twitter feed. Survey results indicate that the blog is most effective, but social media is also a critical connection to the rice industry.

48.3 3:25 Integrating IPM as a core concept in diverse, web-based publications, Kaci Buhl, buhlk@ace.orst.edu, Oregon State University, Corvallis, OR

It's time to integrate "core" messages and "IPM" messages. A series of diverse examples will be presented from the National Pesticide Information Center (NPIC), demonstrating ways to infuse IPM concepts into website content, fact sheets, podcasts and social media platforms. Lessons learned include: 1) it is often unnecessary to use or define the term IPM; 2) actionable steps are preferable to abstract ideas; and 3) familiar examples build confidence in the information.

48.4 4:00 Using dramatizations and social media in IPM and PSEP programs, Erin Bauer, ebauer2@unl.edu, University of Nebraska–Lincoln, Lincoln, NE

This presentation will focus on how the University of Nebraska–Lincoln Extension's Pesticide Safety Education Program (PSEP) uses dramatization in developing video segments for pesticide applicator training and IPM programs. PSEP's use of social media, such as Facebook, Twitter, You Tube, and Blogs, to deliver science-based educational information about controlling pests, pesticide safety, and Integrated Pest Management also will be discussed. In addition, research results, event announcements, photos, contests, and links to other PSEP and IPM related resources are included.

48.5 4:20 Electronic delivery of information-How extension specialists and research faculty can improve communication with agricultural media, Owen Taylor, owen@agfax.com, AgFax Media, Brandon, MS

Blogs and other social media tools open new channels that Extension and University personnel can use to put timely, relevant information in front of agricultural magazine editors and broadcasters. This allows rapid distribution of information to farmers and their advisors. The presentation reviews how these tools can be employed on an ongoing basis to gain exposure for advisories, newsletter content, meeting announcements and research data. It includes a review of social media approaches and how they can be further enhanced with proper use of email lists and existing public relations efforts.

48.6 4:40 Independent agricultural consultant perspective on extension education priorities–PIPE programs, app development and mobile decision tools, Blaine Viator, blaineviator@gmail.com, National Association of Independent Crop Consultants, Labadieville, LA

49 • Bed Bugs and Book Bags: Using classroom curriculum to reach the community

Room L3

How better to support Community IPM than to provide high quality educational information to teachers and students, reduce pest sightings and pesticide applications for bed bugs, and effectively demonstrate knowledge transfer from the classroom into the home and community? Bed bugs are quickly becoming a challenge for the adoption and implementation of IPM programs nationwide. In the spring of 2011, a 3rd, 4th and 5th grade school enrichment curriculum entitled Bed Bugs and Book Bags (BB&BB) was created for health educators to use in Florida's Duval County classrooms. The curriculum has been unanimously approved by Duval County Public Schools for use by health educators in the school system during the 2011–2012 school year and uses the experiential learning model to provide hands-on activities to increase students' understanding and awareness of bed bugs. Children in 3rd-5th grades are old enough to learn about bed bugs and communicate identification and prevention to their parents, but these children are still young enough for parents to be intimately involved with their education. Bed bug awareness gained from the curriculum can be transferred from the school population to parents and ultimately the community. As a result, the spread of bed bugs into schools from the community can be reduced and pesticide contamination of schools can be curtailed through this education and prevention program.

Organizer: Rebecca Baldwin, baldwinr@ufl.edu, University of Florida/ IFAS, Gainesville, FL

49.1 2:45 Teamwork: Forming a local bed bug IPM taskforce, Erin Harlow, erine@coj.net, Duval County Extension—City of Jacksonville, Jacksonville, FL

49.2 3:25 Evaluation: Measuring educational transfer from the classroom into the community, Rebecca Baldwin, baldwinr@ufl.edu, University of Florida/ IFAS, Gainesville, FL

49.3 4:00 Training: Effective use of the Bed Bugs and Book Bags curriculum, Corraine McNeill, cascott@ufl.edu, University of Florida/IFAS Entomology and Nematology Department, Gainesville, FL

50 • IPM challenges and opportunities in fruit and vegetable crops for processing: New invaders, drift, new options and novel approaches

Room L5

IPM in fruit and vegetable production for processing in the US and internationally faces daunting challenges. Limited control options for devastating new invaders threaten long-established bio-control for other pests. Current and proposed herbicide uses in neighboring production creates drift concerns. Processors face strong competition for acres from high-priced commodity grain crops, disrupting production economics. At the same time, the marketplace continues to call for improved stewardship, documentation and transparency. Growers, processors, distributors, consultants and others are working together to address these challenges and respond to market opportunities with innovative approaches. In this session, we'll hear from participants in the processing fruit and vegetable supply chain about these challenges, opportunities, needs and novel approaches to maintain improve economic and environmental sustainability.

Organizers: Thomas Green, ipmworks@ipminstitute.org, and Leigh Presley, lpresley@ipminstitute.org, IPM Institute of North America, Inc., Madison, WI

50.1 2:45 Introduction, Thomas Green, ipmworks@ipminstitute.org, IPM Institute of North America, Inc., Madison, WI

50.2 2:50 IPM and sustainability at Sysco: The world's largest food distributor drives IPM adoption in fruit and vegetable production, Craig Watson, watson.craig@corp.sysco.com, Sysco Corporation, Houston, TX

With the support of our branded suppliers the Sysco Sustainable/Integrated Pest Management Initiative has reached a new level of program maturity. This presentation will include a

review of last growing season economic and environmental indicators. Additional comments will highlight the need to remain focused on legislative agendas to further strengthen the IPM infrastructure. Closing remarks will underscore the need to sharpen our message to consumers through the power of supply chain engagement and relationships.

50.3 3:05 What does IPM have to do with life cycle assessment?, William Russell, wrussell@allens.com, Allen Canning, Siloam Springs, AR

Sustainability is a major priority at Allens Inc. We believe focusing on our customers' needs, environmental stewardship, and the needs of the communities in which we operate will provide us the means necessary to supply a safe and healthy product today and into the future. Allens Inc. has identified six sustainability priorities which are described in the company's sustainability vision plan available on our corporate website, www.allens.com/sustainability. In 2009, Allens Inc. was involved in a Life Cycle Assessment (LCA) for green beans from three different regions of the US. The LCA was invaluable in showing how a specific crop and its production, processing, shipping, and arrival onto a consumer's plate impacts the environment.

50.4 4:20 A processor's perspective on advancing IPM, Yves Leclerc, ynlecler@mccain.ca, McCain Foods (Canada), Florenceville-Bristol, NB, Canada

In response to the marketplace, several organizations cooperated to develop a new Potato IPM Survey. This internet application is free to growers, requires once yearly reporting and involves an extensive set of questions about best IPM practices. Each practice is categorized as a Basic, Steward, Expert, or Master, allowing for practice reporting by low-management to high-management IPM. Participating in this survey allows growers to report their level of IPM adoption to customers. Various reports allow growers to 1) compare their farm performance to the average for the country, region, or market, 2) track their IPM adoption results over a five-year history, and 3) identify IPM practices of others they might also adopt.

50.5 4:00 Healthy Grown: A grower's outlook on IPM in the potato industry, Andy Diercks and Steve Diercks, cffarms@uniontel.net, Coloma Farms, Coloma, WI

Coloma Farms is a 2,700-acre sustainable farm run by third and fourth generation growers, Steve and Andy Diercks. Research done at Coloma Farms was integral to the development of Healthy Grown, a collaborative effort to produce potatoes grown according to reduced-pesticide, environmentally friendly standards. Healthy Grown potato growers are certified and audited to ensure adherence to these sustainable agriculture standards. This presentation will provide an overview of the Diercks' participation in the program, including pest challenges, IPM solutions, and their successes in producing Healthy Grown potatoes.

50.6 4:15 PRiME: A new tool for assessing pesticide risk in specialty crop production, Wade Pronschinske, wade@ipminstitute.org, and Thomas Green, ipmworks@ipminstitute.org, IPM Institute of North America, Inc., Madison, WI

The Pesticide Risk Mitigation Engine (PRiME) is a user-friendly web application designed to help mitigate the environmental impacts of pesticide use by improving the selection of pest management options and conservation practices. Using state-of-the-art pesticide fate and transfer modeling and a suite of environmental risk indicators, PRiME can be useful in supporting IPM programs by helping to minimizing the environmental risks when chemical suppression is necessary. This introduction to PRiME will discuss its current state of development and use, including a demonstration of the user interface, data requirements, user input and pesticide risk assessment.

50.7 4:30 Utilizing the PRiME tool in winegrape production, Agustin Lammoglia, Agustin.Lammoglia@ejgallo.com, Gallo Winery, Kenwood, CA

Ernest & Julio Gallo Winery's commitment to protecting and enhancing the land and wildlife habitat through sustainable agriculture originated in the late 1930s. Julio Gallo introduced an innovative approach to land conservation known as the "50/50 Give Back" plan; for every acre of land planted in vineyard, Julio set aside one acre of property to help protect and enhance wildlife habitat. Today, Gallo continues Julio's approach to land stewardship and it is considered the first principle of Gallo's Sustainable Practices. All operational decisions at Gallo reflect our firm belief in sound environmental management. The Pesticide Risk Mitigation Engine is a system that will help us gather more accurate information about our pesticide use which will help us reduce potential adverse impacts and improve environmental stewardship.

50.8 4:45 Sustainability of tomato processing in the Midwest: Economics, environment and pesticide risk due to drift, Steve Smith, ssmith@redgold.com, Red Gold, Elwood, IN

With the upcoming release of new GM traits in soybeans and cotton that will allow for the application of growth regulator herbicides, the Midwestern and Southern specialty crop industry will be challenged with a new threat. While preventing drift has always been a major concern, volatilization along with exponentially increasing use patterns gives all sensitive crops a new level of exposure we've never experienced before. What will our response be? How will growers and processors deal with loss of production and income?

51 • Networking approaches for IPM research and extension

Room L6

The successful application of IPM is notoriously site-specific. Furthermore, differences in biophysical, social and economic contexts coupled with the organizational difficulties of coordinating a large and heterogeneous group make IPM networking over large regions challenging. Nevertheless, pooling research and extension resources and capacities as well as sharing knowledge and experiences promise to bring added value to existing initiatives. The impact of research and extension efforts can be strengthened by working at multi-national, multi-disciplinary, and systems level. We will present examples of existing national and international strategies and approaches to develop IPM and look at the added value, challenges and feasibility of networking for IPM research and extension over large regions: (1) The ENDURE network, boosted by the favourable context set up by the European Union "Framework Directive on the sustainable use of pesticides", initiated integration of IPM research and extension efforts in Europe; (2) Recent establishment of regional IPM consortia in Argentina; (3) The well-established nation-wide network of state IPM Coordinators in the USA. With session participants, we will also look forward and discuss prospects for new coordination efforts over large geographical regions.

Organizer: Marco Barzman, Marco.Barzman@grignon.inra.fr, ENDURE, INRA—Unité ECO-INNOV, Thiverval-Grignon, France

51.1 2:45 Update on IPM implementation in Europe, Marco Barzman, Marco.Barzman@grignon.inra.fr, ENDURE, INRA—Unité ECO-INNOV, Thiverval-Grignon, France

In 2009, the European Union adopted pesticide legislation restricting the range of available pesticides and striving to make IPM the new standard for crop protection in Europe by January 2014. All Member States are currently reconsidering their domestic crop protection policies and the research and extension efforts needed to implement IPM. ENDURE was launched in 2007 to create a permanent European-level network that contributes to these efforts by pooling research capacities and providing scientific and technical support to extension and policy. ENDURE faced the challenge of engaging institutions and individuals from diverse disciplines, sectors and national situations in a collective process.

51.2 2:55 Networking IPM research efforts in Europe: The ENDURE experience, Per Kudsk, Per.Kudsk@agrsci.dk, ENDURE, Aarhus University, Slagelse, Denmark

The research activities of ENDURE aimed at 1) developing common tools such as models and DSS's and 2) carrying out jointly planned research to fill gaps in the IPM knowledge and to provide input to the common tools. A series of "case studies" were initiated covering the major European crops and crop types. The case studies focussed on immediate changes in crop protection practices, e.g. replacing pesticides by non-chemical and cultural practices and using resistance varieties and their applicability under contrasting agro-ecological conditions. Subsequently a number of "system case studies" were conducted designing innovative cropping systems that could minimise pest problems and hence reduce the use and reliance on pesticides.

51.3 3:05 Facilitate IPM learning with farm advisers across national boundaries in Europe, Jens Erik Jensen, jnj@vfl.dk, ENDURE, Knowledge Centre for Agriculture, Crop Production, Aarhus, Denmark

Swift and broad uptake of IPM practices by European growers requires active involvement of advisers. Advisers know local options and challenges. They are able to engage farmers and stakeholders in the transition and learning process towards IPM. We are building a European advisory network to facilitate exchanges of information, tools, and experiences among advisers. The most important challenges are 1) language barriers which are a major obstacle under European conditions and 2) the fragmentation of advisory systems across countries and non-existence of advisory services in some EU member states. A strategy to overcome these barriers is to identify and link with key advisers in different European countries.

51.4 3:15 Discussion

51.5 4:00 IPM initiatives in Argentina: One more chance for IPM, Jorge Frana, jfrana@rafaela.inta.gov.ar, INTA, Estación Experimental Agropecuaria Rafaela, Santa Fe, Argentina

Many efforts have been made worldwide to increase adoption of IPM in field crops. However, at least for Argentina, a low percentage of the area with crops like soybean, corn, sunflower and wheat is managed under IPM principles. In the last two years INTA allocated resources toward the establishment of regional IPM Consortiums with the objective of bringing stakeholders together at the same table to share the same language and discuss different strategies of IPM to reach a main goal that is to change farmers' behaviour on pest management maximizing profit, preserving human health and protecting the environment.

51.6 4:15 Coordinating and networking IPM research and extension in the United States, Paul Jepson, jepsonp@science.oregonstate.edu, Integrated Plant Protection Center, Oregon State University, Corvallis, OR

The US-wide network of state IPM Coordinators is one of the longest standing and largest-scale IPM extension programs in the world. Continental scale coordination has been achieved through a national roadmap policy for all federally funded IPM

programs. This policy enabled development of four regional IPM Centers and a suite of needs-driven national and regional research and extension grant programs. At its best, this system is characterized by rapid and focused responses to new and emerging threats and accelerated adoption of IPM with benefits in the marketplace and to human health and environmental risk reduction. It is however being eroded, and this presentation will illustrate the strengths and weaknesses of the current system, the opportunities that it has provided and the threats that face it.

51.7 4:30 Discussion

52 • Developing and disseminating Hermetic Cowpea storage technology in West and Central Africa

Room L9

Purdue University initiated research on non-chemical cowpea storage in West and Central Africa in early 1987 with funding from the USAID Bean/Cowpea CRSP. Researchers and smallholder farmers had identified storage pests as the key constraint to increasing cowpea production and availability. After systematic participatory testing in villages and improving the technologies, the team began extending recommendations with regard to: 1) storage in ash; 2) solar heater; 3) hermetic storage in triple-layer plastic bags; and; 4) storage of cowpea in pod form. A 2003-2004 adoption study found intensive interest in hermetic storage for cowpea, but adoption was sporadic due to two key constraints: a) farmers did not know how to properly use hermetic storage and b) the heavy duty plastic bags were not available in local markets. In 2007, the Bill & Melinda Gates Foundation funded the Purdue Improved Cowpea Storage (PICS) project to address the two problems identified in the adoption study of triple-layer plastic bags. The project has implemented outreach activities in more than 30,000 villages across 10 countries in West and Central Africa and has worked with plastics manufacturers and local entrpreneurs to produce and sell over 1.5 million bags. This session will share the nearly five years of experience of the PICS project in disseminating and creating markets for PICS bags in WCA; and cover (1) the development of the technology, (2) the partnership model for large-scale outreach activities, and (3) the public-private partnerships needed to sustain the availability of PICS bags.

Organizers: Dieudonne Baributsa, dbaribu@purdue.edu, and Jess Lowenberg-DeBoer, lowenbej@purdue.edu, International Programs in Agriculture, Purdue University, West Lafayette, IN

52.1 2:45 Research and development of the Purdue Improved Cowpea Storage technology, Larry Murdock, murdockl@purdue.edu, Purdue University, West Lafayette, IN; Baoua Ibrahim, baoua.ibrahim@gmail.com, Institut National de Recherche Agronomique du Niger, INRAN Maradi, Niger

Purdue Improved Cowpea Storage (PICS) technology is chemical-free simple, low cost airtight technology that uses multiple-layer plastic bags for protecting postharvest cowpea grain against losses to bruchids. When bruchid infested grain is sealed in PICS bags, oxygen levels fall due to insect respiration. Growth, development and reproduction cease, as does bruchid population growth. Oxygen deprivation blocks the insects' main water supply, which contributes to eventual mortality. Low resource farmers in Niger and other cowpea growing nations of West/Central Africa have quickly begun to adopt the technology and have shed new light on its mode of action and utility.

52.2 3:15 Conducting a large scale promotion of an improved IPM technology: IITA-PICS in Nigeria, Tahirou Abdoulaye, t.abdoulaye@cgiar.org, International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria

The International Institute of Tropical Agriculture (IITA) and its partners implemented extension activities to disseminate hermetic triple layer bags for cowpea storage in more than 11,000 villages in Nigeria from 2008 to 2010. Partners included government extension services, agricultural projects, non-governmental organizations, farmers based organizations and women associations. Village-level training, media, and other approaches were used to build technology awareness among farmers. The presentation will cover the opportunities and challenges in implementing large-scale extension activities targeting millions of farmers. Preliminary results of adoptions study show rapid diffusion of the non-chemical storage technology in rural areas of Northern Nigeria.

52.3 4:00 Public-private partnerships approach in developing a sustainable supply chain of PICS bags, Jess Lowenberg-DeBoer, lowenbej@purdue.edu, and Dieudonne Baributsa, dbaribu@purdue.edu, International Programs in Agriculture, Purdue University, West Lafayette, IN

Purdue Improved Crop Storage (PICS) is developing a supply chain for triple layer plastic bags in West and Central Africa. In collaboration with its partners, PICS trained farmers in over 30,000 villages on use of the bags. PICS is working with manufacturers, distributors, wholesalers and vendors to create a supply chain. A key constraint has been developing a dense retail network. Adoption drops sharply if farmers must travel to obtain bags more than the distance they usually travel to weekly markets. Lessons learned working with the private and public sectors to develop markets for new IPM technology for smallholder farmers will be discussed.

52.4 4:30 Panel Discussion, Larry Murdock; Tahirou Abdoulaye; Baoua Ibrahim; Jess Lowenberg-DeBoer; Dieudonne Baributsa; Utiang Ugbe, utiang.ugbe@researchintouse.com, Nigeria Country Programme Office, Abuja, Nigeria; Iliyasu Gital, iliyasualiyu.gital@yahoo.com, Bauchi State Agricultural Development Project, Bauchi State, Nigeria

53 • eOrganic: The eXtension CoP for organic agriculture

Room L10

The growth in organic market opportunities has increased the demand across the country for information on all aspects of organic agricultural production. Until recently there has been little published Extension information on organic agricultural practices as science-based information was scarce. In addition, science-, experience- and regulation-based organic agriculture information must be integrated to produce information of the greatest utility to farmers and agricultural professionals. eOrganic works to fill this need and become an important national source of organic agriculture information by 1) convening a national community of researchers, extension and other agricultural professionals, farmers, and certifiers at eOrganic.info, 2) facilitating project management, networking and co-learning, 3) supporting collaborative development and publication of peer-reviewed articles, FAQs, and videos at eXtension.org/organic_production, and 4) facilitating engagement with farmers and agricultural professionals through webinars, short courses, Ask-an-Expert, and other interactive tools and activities. Join us for a tour of eOrganic's community portal (eOrganic.info) and eOrganic's public content for farmers, extension professionals and others. Learn about eOrganic's current content on organic weed, insect and disease management, and brainstorm ideas for future content development. Learn how to use the Ask-an-Expert system, access our videos at eXtension (http://www.extension.org/pages/18726) and Youtube (http://www.youtube.com/user/eOrganic) and listen to some webinar clips http://www.extension.org/pages/24989. Discuss how you and others in the IPM community can get more involved – as individuals, as projects, and as working groups.

Organizer: Alex Stone, stonea@hort.oregonstate.edu, Oregon State University, Corvallis, OR

53.1 2:45 Brainstorming session, Alex Stone, stonea@hort.oregonstate.edu, Oregon State, Corvallis, OR; Sally Miller, miller.769@osu.edu, OARDC, Wooster, OH; Meg McGrath, mtm3@cornell.edu, Cornell University Long Island Horticultural Research and Extension Center, Riverhead, NY

53.2 4:00 Brainstorming session, Alex Stone, stonea@hort.oregonstate.edu, Oregon State University, Corvallis, OR; Sally Miller, miller.769@osu.edu, OARDC, Wooster, OH; Meg McGrath, mtm3@cornell.edu, Cornell University Long Island Horticultural Research and Extension Center, Riverhead, NY

54 • Using self-assessment, surveys, and certification to document, incentivize and implement IPM in specialty crops

Room L11

SureHarvest is a company that provides a complete set of solutions for growers, grower groups, and agrifood companies interested in developing sustainable programs. IPM is a critical component of the sustainable farming paradigm and the challenges to implementing IPM in main-stream agriculture are very similar to those experienced in implementing sustainable farming in main-stream agriculture. Many of the challenges relate to answering the most common grower question 'What is in it for me?' In an effort to answer this question, SureHarvest has developed innovative programs, tools and software platforms for outreach and implementation of IPM and other sustainable farming approaches to the grower community and, in turn, used by the grower community for outreach to their buyers and other stakeholders. The symposium will discuss how SureHarvest, working with growers of winegrapes, almonds, cut flowers, hazelnuts, citrus, potatoes and other specialty crops, have designed and implemented programs and used self-assessments as an IPM educational outreach tool and to increase IPM implementation. The symposium will also discuss the design and implementation of grower surveys for several specialty crops, the results of which have been used for benchmarking of practices as well as outreach to stakeholder groups like government, Universities, and consumers. SureHarvest has partnered with Protected Harvest to design and implement certification programs that provide incentives to implement IPM in potatoes, winegrapes, citrus and stone fruit. The session will end with a group discussion on answers to the growers' question "What is in it for me?"

Organizer: Clifford P. Ohmart, cohmart@sureharvest.com, SureHarvest, Davis, CA

54.1 2:45 Using self-assessment and surveys to document and incentivize IPM implementation, Joe Browde, jbrowde@sureharvest.com, SureHarvest, Petaluma, CA

Grower participation in the documentation of on-the-farm practices is a key step for understanding the status of IPM adoption, conveying alternative practices and technologies, developing subsequent educational activities, and as the basis to incentivize improvement. A self-improvement model will be

characterized that integrates assessments, the interpretation of performance, action planning, and the implementation of change. Adaptation of the model for various specialty crops, relevant incentives for individual farmers and crop commodities, and resultant successes and challenges will be addressed.

54.2 3:15 The role of certification in incentivizing IPM implementation, Clifford P. Ohmart, cohmart@sureharvest.com, SureHarvest, Davis, CA

Certification is necessary when an audience receiving a message about a product needs validation and verification that the message is true and accurate. IPM certification programs are very uncommon as are sustainable farming certification programs. Protected Harvest is a non-profit organization that certifies sustainably-grown food according to rigorous, science-based farming standards. The presentation describes Protected Harvest and how farming standards are developed. IPM implementation is a very important part of Protected Harvest's standards. The presentation discusses how Protected Harvest certification is an incentive for implementing IPM.

54.3 4:00 Using Sustainability Management Information Systems to document and incentivize IPM implementation, Andrew Arnold, aarnold@sureharvest.com, SureHarvest, Modesto, CA

Data collection, management and analysis is at the heart of successful IPM programs utilizing a continuous improvement framework to incent grower practice changes. A software platform supports collection of annual self-assessment results by growers to track progress over time as well as anonymous aggregate data to show growers how their practices compare to their peers. Analysis of the aggregate data can also inform the program administrators of practice areas in need of targeted education and outreach efforts. Over time, the software provides the documentation for "telling the good story" of IPM adoption.

55 • The role of education in IPM

Room L12

Education is an essential step in the practice of IPM. This mini-symposium tackles this from two standpoints. First, it looks at developing the IPM technician using a performance based training program that includes Standard Operating Porcedures (SOP's) and follow-up performance evaluations. Next, as a case study, it will showcase the results of effective IPM education by looking at the public/private partnership San Francisco has developed for West Nile Virus Prevention, Rodent Abatement, and Bed Bug management.

Organizers: Ted Snyder, ted.snyder.ltd@gmail.com, Batzner Pest Management, Inc., New Berlin, WI; Luis Agurto, luis@pestecipm.com, Pestec IPM Providers, San Francisco, CA

55.1 2:45 Educating urban pest management technicians to perform IPM: Techniques, challenges, and the future, Ted Snyder, ted.snyder.ltd@gmail.com, Batzner Pest Management, Inc., New Berlin, WI

A key component in any IPM program is having a technician who is capable of performing IPM. This requires three steps. First, defining what IPM means to your organization or community, including developing IPM standard operating proceedures or plans. Second, developing a perfomance based training program around your definition of IPM. Third, on-going training, development, and evaluation of technician performance. We'll look at best practices for each of these steps and challenges that exist along the way, some of which come from sources that you may not expect.

55.2 3:15 Innovative IPM solutions to public health threats in the City and County of San Francisco, Luis Agurto, luis@pestecipm.com, Pestec IPM Providers, San Francisco, CA; Phil Calhoun, phil.calhoun@sfdph.org, City and County of San Francisco Dept. of Public Health, San Francisco, CA

The City and County of San Francisco's pioneering IPM Ordinance in 1996 established the framework in which emerging pest related health threats have since been addressed. This systems based approach has necessarily called for the on-going education and partnership of various stakeholders from the public and private spheres. We will examine three of San Francisco's vector management programs, specifically identifying the challenges and innovative solutions to protecting the "City by the Bay" from pest borne diseases.

56 • Feeding 9 billion people sustainably: The case for biopesticides

Room L13

Sustainability: Highly productive Integrated Pest Management (IPM) and sustainable food production and processing systems are necessary to meet the demands of a growing world population. Population growth means we must produce more food from finite natural resources. With over 9 billion people anticipated by the year 2050, farm productivity must double, according to World Bank, FAO and IFPRI. People will demand affordable and plentiful food supplies, growers and processors will require value in the food chain and improved farm income is necessary to drive production improvements. All of this must be done within the finite resources of the planet—sustainably. Quality: Ever expanding population and consumer demands for quantity and for quality requires a productive and sustainable system that delivers food that is high quality, nutritious, and safe to eat—healthy and clean food that is attractive and marketable. Reduced Impact: While increasing productivity, farming and food processing practices have

to improve efficiency for consumers, our neighbors, and our planet. This means low impact, high yield solutions must be developed with sustainable practices. Agricultural inputs must be safer for workers, farm neighbors and consumers; preserving our natural resources and lowering our reliance on non-renewable resources.This symposium will focus on biological pesticides, there impact, their role in IPM and applications to improve production outcomes sustainably. Discussion will also focus on integration of biopesticides into agricultural production systems and their benefits to resistance management and meeting reduced tolerance limits.

Organizers: Pam Marrone, pmarrone@marronebio.com, Marrone Bio Innovations, Davis, CA; Bill Stoneman, bstoneman@biopesticideindustryalliance.org, Biopesticide Industry Alliance Inc. (BPIA), McFarland, WI

56.1 2:45 Feeding 9 billion people sustainably: The case for biopesticides, Bill Stoneman, bstoneman@biopesticideindustryalliance.org, Biopesticide Industry Alliance Inc. (BPIA), McFarland, WI; David Cary, david.cary@IBMA-global.org, International Biocontrol Manufacturers Association (IBMA), Switzerland

While increasing productivity, farming and food processing practices have to improve efficiency for consumers, our neighbors, and our planet. This means low impact, high yield solutions must be developed with sustainable practices. Agricultural inputs must be safer for workers, farm neighbors and consumers; preserving our natural resources and lowering our reliance on non-renewable resources. This presentation will focus on biological pesticides, there impact, their role in IPM and applications to improve production outcomes sustainably. Discussion will also focus on integration of biopesticides into agricultural production systems and their benefits to resistance management and meeting reduced tolerance limits.

56.2 3:15 Biopesticides come of age, Dr. Timothy Johnson, tjohnson@marronebio.com, Marrone Bio Innovations, Davis, CA

When discussing how we are going to feed the world population of 6 billion, growing to 9 billion by 2050, genetically modified crops and new chemical pesticides dominate. Biopesticides are rarely part of the conversation. But they should be. Biopesticides, 3.5% of the global pesticide market, are growing at more than 15% per year and are projected to reach $3 billion by 2014. When integrated into IPM programs, biopesticides can provide higher yields and quality than chemical-only programs. 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. This talk will discuss the market, trends, best use of biopesticides and the discovery and development processes for microbial and biochemical biopesticides.

56.3 4:00 Biology + Chemistry = Sustainable Collaboration, Daniel Krohn, daniel.krohn@beckerunderwood.com, Sustainability Lead, Becker Underwood Inc., Ames, IA

Welcome to the 21st century! Pleased to announce advancements are being made every day in IPM systems with the use of biopesticides due to the collaboration between chemistry and biology. It wasn't long ago, in the 20th century, when it was all about chemistry. As research continues, it's increasingly apparent that biologicals will play an integral role in making agriculture sustainable. And with chemistry companies introducing "green chemistry" formulations, we're on the right track towards a sustainable future for agriculture.

56.4 4:40 Panel discussion

57 • Changing the product selection in retail stores-How agencies in California are working together to make green products more mainstream

Room L14

In California, urban pesticide use contributes to widespread contamination of surface water and stiff fines for local agencies. Education of those who use and sell pesticides-including consumers and retail store employees-will help people choose IPM practices. Retail store employees often give consumers incorrect information leading them to purchase and apply the wrong product, misuse the product, and possibly cause damage to their health and the environment. This symposium will highlight the innovative IPM Advocates program that educates consumers and retail store employees about IPM practices and green products (reduced-risk pesticides such as baits, traps, and tools). We'll also discuss how store managers, pesticide buyers, and pesticide manufacturers are changing how consumers manage pests.

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

57.1 2:45 A regulatory agency's role in helping retailers expand use of green products, Nita A. Davidson, ndavidson@cdpr.ca.gov, Department of Pesticide Regulation, Cal/EPA, Sacramento, CA

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57.2 2:55 The university's role in helping retailers expand use of green products, Mary Lou Flint, mlflint@ucdavis.edu, University of California–Davis, Davis, CA

The University of California Statewide IPM Program (UC IPM) has been exploring ways to help retailers expand use of green products and IPM practices. Stores are hungry for information about product efficacy and environmental and health impacts, and need assistance diagnosing customer pest problems. UC IPM uses traditional delivery methods such as leaflets and books but has also created a web portal for retailers, a quarterly newsletter, and a stand-alone IPM Kiosk computer for store placement. Expanding educational efforts for retail employees include online training, hands-on train-the-trainer courses, and development of curriculum for IPM Advocates who serve as consultants for retailers.

57.3 3:20 Our Water Our World's role in helping retailers expand use of green products, Annie Joseph, anniejoseph@ix.netcom.com, Our Water, Our World, Benicia, CA

Since 1997 the Our Water Our World (OWOW) Program has partnered with retail nursery, hardware, and home centers that sell pesticides to reduce toxic runoff into local waterways. This partnership includes educating store employees and consumers about IPM and green products. OWOW also works with pesticide manufacturers and distributors, who are now more willing to promote green products because this helps the environment and gives them an edge in the marketplace. In the past few years, the demand for green product information and in-store support has grown exponentially, calling for skilled consultants, the IPM Advocates, to work with stores and the pesticide industry. Learn about the IPM Advocates and how they influence the product mix in California retail stores.

57.4 4:00 Local government's role in helping retailers expand use of green products, Naresh Duggal, Naresh.Duggal@ceo.co.santa-clara.ca.us, County of Santa Clara IPM Program, San José, CA

Santa Clara County's IPM Program supports local landscaping and gardening programs, giving hands-on workshops to train professionals and residents in IPM practices. Since 2002, the County has implemented green landscaping practices, reducing pesticide use in County-owned landscapes and parks almost completely. The County also supports another program that trains maintenance gardeners in green practices. An offshoot of the same program, the Increasing Shelfspace Project, has trained almost 300 retail store employees in the principles of IPM to extend this information to consumers. IPM Advocates continue this work encouraging pesticide buyers and distributors to stock green products, which has resulted in an increase of green product sales.

57.5 4:20 Marketing effective, green pesticides to consumers, Rainer Lausmann, R.Lausmann@neudorff.de, W. Neudorff GmbHKG, Emmerthal, Germany

Neudorff, a large chemical company based in Germany, manufactures reduced-risk active ingredients included in several green gardening products sold throughout the United States. As Global Marketing Director of Neudorff, Rainer Lausmann helped launch a partnership with American packagers, distributors, and environmental outreach programs such as Our Water Our World. Rainer encourages his sales team to educate retail partners about IPM, passing on information to consumers about the efficacy and environmental safety of Neudorff products. Rainer will discuss how the iron phosphate molluscicide Sluggo has gained popularity in the U.S., how it's marketed, and how it fits in with retail education programs such as the IPM Advocates.

57.6 4:40 Discussion

58 • Productivity increase by using IPM modules with indigenous practices for managing pests in different cropping systems

Room L8

This session will discuss research on IPM practices and pests in three different crops in India.

58.1 4:00 Development, evaluation and demonstration of IPM practices for the management of podborers of pigeonpea in Southern Karnatakea, India, C. S. Jagadeesh Babu, jagadeesh5k@rediffmail.com, University of Agricultural Sciences, GKVK, Bangalore, Karnataka State, India

Earlier, legume crop pigeonpea was grown only as a intercrop with millets and other cereals in Southeren parts of our state, Karnataka. But after introduction of new varieties from our University of Agricultural Sciences, Bangalore, India, farmers started growing this crop as pure crop in large areas. Heavy infestation of podborers was the one of the main problems for low production of this crop. Varities of insecticides were being used indiscriminately to control these podborers in Northeren Karnataka where this crop was grown extensively. To avoid this, an integrated pest management module was developed for effective management of the podborers of pigeonpea in

Southern part of our state. This module was evaluated in our centre and in farmer's fields for quite some time. The developed module was then demonstrated in fields of farmers and in large areas over past decade in some districts of Southern Karnataka state. It has evoked good respose from the farmers and the productivity of this crop has increased.

58.2 4:20 The effect of eriophyid mite damage on the out-turn and quality of coconut fiber, Pretheep Kumar Ponnusamy, retheepkumar_phd@yahoo.co.in, Tamil Nadu Agricultural University, Tamil Nadu, India

India is one of the leading producer of coconut in the world and the eriophyid mite *Aceria guerreronis* Keifer is a serious coconut pest in several states of India. Coconut fiber is obtained from the fibrous husk (mesocarp) of the coconut (*Cocos nucifera*) and the coir industry depends on this versatile natural fiber. Though several studies have been done on coconut eriophyid mite and its management aspects, no detailed research has been focussed to assess its damage trend on the by-products of coconut, especially the coconut fiber. Hence, efforts were taken in this study to evaluate the effect of eriophyid mite damage on the out-turn and quality of coconut fiber.

58.3 4:40 Development, field testing and validation of non-chemical IPM components for managing root-knot disease in vegetable cropping systems, K. K. Verma, kkv@hau.ernet.in, CCS, Haryana Agricultural University, Hisar, India; R. K. Jain

Plant parasitic nematodes cause 12.3 per cent losses to crops globally; losses to vegetable crops are much higher. In India's commercial vegetable cultivation system root-knot nematode, Meloidogyne spp. is a perpetual problem and yield reductions are significant amounting over Rs. 240 billion annually. Use of nematicides is hazardous, particularly in vegetable cropping systems. The other ecologically safe integrated nematode management practices such as land management using crop rotations, non-host/poor host, and resistant cultivars are being preferred. The objectives of this study were development of improved integrated cropping sequences for suppression of nematode population below economic threshold level in okra-based vegetable system, making production profitable to the growers. Results demonstrated that okra-wheat/mustard-fallow, okra-garlic-cluster bean and okra-potato-onion/cluster bean were most effective cropping sequences.

59 • Building IPM programs for Native Americans

Room L12

First Nations control over 100 million acres of tribal lands. Members of FALCON (First American Land-Grant Colleges and Organizations Network) and the EPA Tribal Pesticide Program Council are providing leadership to increase the availability of educational and outreach resources to foster IPM adoption on reservations. These groups have sponsored projects involving school IPM, pesticide risk mitigation, community gardens and small farm production systems. A long-term goal is to increase IPM resources for Tribal members through collaborative efforts with other groups including the Federally-recognized Tribal Extension Program, IPM Coordinators, Master Gardener Coordinators, Pesticide Safety Education Program Coordinators, Sustainable Agriculture Coordinators and Invasive Species Programs. This session will highlight these projects and discuss future programming efforts to meet the needs of 561 Federally-recognized Tribes including opportunities to participate in Tribal IPM activities.

Organizers: Fred Corey, fcorey@micmac-nsn.gov, Aroostook Band of Micmacs, Presque Isle, ME; Virgil Dupuis, virgil_dupuis@skc.edu, Salish Kootenai Tribal College, Pablo, MT; Susan Ratcliffe, sratcliffe@illinois.edu, North Central IPM Center, University of Illinois, Urbana, IL

59.1 4:00 Implementing education, prevention and response to aquatic invasive species (AIS) in a multi-jurisdiction headwaters region, Virgil Dupuis, virgil_dupuis@skc.edu, Salish Kootenai Tribal College, Pablo, MT

Implementing AIS plans with effective prevention strategies and response actions is a complicated process involving individuals, public and private utilities, tribal, state, and federal jurisdictions, and questions of ownership responsibilities. Managers often lack the training to detect invaders early. There is a lack of monitoring and early detection capacity, and absence of response plans, technical capacity, management plans, environmental studies, and permits. In western Montana, headwaters of the Columbia River, Eurasian water milfoil and flowering rush have established populations that had received no real attention until the last few years. Eurasian is present in the Missouri River headwaters as well. Largely due to the efforts of a few committed citizens, Montana legislators, tribal, state and agency representatives, and tribal college and university researchers there is an emerging and developing effort to prevent AIS, increase awareness and knowledge of AIS, and build the capacity, regulatory and environmental processes to respond to existing populations of AIS. We will present our experiences being a part of this process and discuss the environmental, social, and economic pitfalls that AIS present to the future of North American waterways.

59.2 4:15 Tribal Pesticide Program Council Integrated Pest Management (IPM) education and outreach promotional activities, Fred Corey, fcorey@micmac-nsn.gov, Aroostook Band of Micmacs, Presque Isle, ME

Tribal Pesticide Programs are among the oldest Tribal environmental programs in existence, dating back to the mid-1970's. Over the course of the 35+ year history of Tribal pesticide

programs, they have evolved into successful and efficient programs that protect human health and the environment through utilization of a blend of indigenous knowledge and the latest scientific techniques. In particular, integrated pest management (IPM) represents an excellent example of how indigenous knowledge can be blended with modern western science for the implementation of highly successful and innovative Tribal environmental programs, and as such is enthusiastically support by Tribes and Tribal pesticide programs. In 2000 the Tribal Pesticide Program Council (TPPC) was established with support of the U.S. Environmental Protection Agency (EPA) to provide an opportunity for Native American Tribes to communicate Tribal pesticides issues to EPA, and to serve as a resource for other Tribes with pesticide issues and concerns. This presentation will provide an overview of current and planned TPPC efforts to promote IPM, including workshops and educational and outreach activities.

59.3 4:30 Tribal school IPM, Michael Daniels, nativeipm@yahoo.com, Native IPM, Winnebago, NE

Tribal School IPM addresses several tribal school problems: Air Quality, Outdated products that can potentially be used on children, the ability to make sure your PMP is practicing IPM, One of the biggest problems that needs to be addressed is the amount of respiratory problems of children on the reservations. A large number of homes have a nebulizer in them. Through an IPM assessment the school can make a sound decision on whether or not a program is needed. The approach that I have taken is that a little IPM is better than no IPM. IPM that happens in Indian country is as unique as each individual tribe. Every tribe will not buy into IPM, but I think that every tribe should be informed of what IPM can do for them. By at least conducting an assessment by an IPM team, a school can be made aware of personal insecticide. Many of the tribal schools that I have been to have cases of outdated lice control spray.

59.4 4:45 Discussion

60 • IPM education: Required knowledge, educational options and applications

Room L3

A brainstorming session, "Education and Training in IPM," was conducted at the 6th international IPM Symposium with the goal of addressing both the required knowledge and sources of IPM education and training. To build on the outcome, this session will describe core competencies that were identified and types of curricula that have become available for delivering IPM knowledge. Included will be Extension programming, on-line education, training of private consultants, and undergraduate and graduate academic programs. Descriptions will be provided for novel approaches to providing IPM education, including Plant Medicine and Plant Health programs, and a "Living Extension IPM Field Laboratory." These sources of IPM training and education, and others, will be associated with potential applications in pest management industries, crop advisor organizations, federal and state agencies, international agricultural programs, and a variety of educational institutions. Our goal is to gather the participant's knowledge and experience on IPM education, define current capabilities, and provide directions for the future.

Organizers: Norman C. Leppla, ncleppla@ufl.edu, University of Florida, IFAS, Gainesville, FL; Gary L. Hein, ghein1@unl.edu, University of Nebraska, Lincoln, NE

60.1 6:30 Education and training required of IPM practitioners, Norman C. Leppla, ncleppla@ufl.edu, University of Florida, IFAS, Gainesville, FL

60.2 6:40 IPM knowledge put to use, H. Charles Mellinger, cmellinger@gladescropcare.com, Glades Crop Care, Inc., Jupiter, FL

60.3 6:55 IPM^3 on-line IPM education for the workforce, Robert Nowierski, Rnowierski@nifa.usda.gov, U.S. Department of Agriculture, National Institute of Food and Agriculture, Washington, DC

60.4 7:10 Hands-on training through the University of Florida Living Extension IPM Field Laboratory, Robert C. Hochmuth, bobhoch@ufl.edu, Suwannee Valley Agricultural Extension Center, Live Oak, FL

60.5 7:25 Addressing IPM education through undergraduate curriculum and California pest control adviser licensing, Mary L. Flint, mlflint@ucdavis.edu, University of California-Davis, Davis, CA

60.6 7:40 IPM requirements for the Certified Crop Advisor and Certified Professional Agronomist programs, Luther Smith, lsmith@agronomy.org, American Society of Agronomy, Madison, WI

60.7 7:55 Overcoming the educational constraints of IPM implementation with interdisciplinary practitioners-Doctor of Plant Health/Medicine, Gary L. Hein, ghein1@unl.edu, University of Nebraska, Lincoln, NE

60.8 8:15 Discussion

61 • NIFA IPM programs: Legacy and impacts

Room L5

In recent years Project Directors' Workshops have been instituted to provide a forum for grantees to share significant, positive impacts resulting from their projects funded by

the National Institute of Food and Agriculture (NIFA). The requirement for a Project Directors' Workshop was initiated approximately three years ago but this 2012 Workshop will be the first such reporting opportunity for applied researchers and extension specialists in IPM-oriented programs including the Pest Management Alternatives Program (PMAP), the Crops at Risk Program (CAR), the Risk Avoidance and Mitigation Program (RAMP), and the Extension IPM Coordination and Support Program (EIPM-CS). Projects featured in the Workshop demonstrate the potential for implementation of project results, findings, and outcomes and include an economic analysis that addresses the feasibility of implementation. They also evaluate the feasibility for commercialization (including product registration, if necessary) of technologies developed as a result of the project. Projects selected for the Workshop demonstrate that objectives are responsive to pest management needs and priorities of stakeholders as identified through Pest Management Strategic Plans, Crop Profiles, documented Regional IPM Center priorities (www.ipmcenters.org/pmsp/index.cfm), Interregional Research Project #4 (IR-4) priorities (http://ir4.rutgers.edu/), and/or similar citable documents. Most importantly, projects funded through these grant programs are likely to result in outcomes that will provide a direct benefit to producers, leading to substantial near term impacts.

Organizers and Moderators: Monte P. Johnson, mpjohnson@nifa.usda.gov, U.S. Department of Agriculture, National Institute of Food and Agriculture, Washington, DC; Robert Nowierski, rnowierski@nifa.usda.gov, U.S. Department of Agriculture, National Institute of Food and Agriculture, Washington, DC; Martin Draper, mdraper@nifa.usda.gov, U.S. Department of Agriculture, National Institute of Food and Agriculture, Washington, DC

61.1 6:30 A pest management program using reduced-risk pesticides, Eco-Apple protocols, and value added marketing for NY and New England growers, Daniel R. Cooley, dcooley@microbio.umass.edu, University of Massachusetts, Amherst, MA; Michael Rozyne; Thomas Green; Art Agnello; Harvey Reissig

Since 2005, university researchers, a nonprofit produce marketing corporation and a private non-profit IPM institute have developed and implemented a program producing and marketing "Eco Apples", an eco-label for Northeastern apples. The goal has been to create a market for apples grown using advanced IPM methods, resulting in premium prices and reliable market demand. Growers use the least toxic, effective management options as defined by the Eco Apple protocol. There has been steady growth in the program, from 6 growers selling 18,000 cases for $400,000 in 2005 to 22 growers selling 58,363 cases for $1.4 million in 2010.

61.2 6:50 Biologically based integrated management of bacterial leaf diseases on leafy brassica greens, Anthony P. Keinath, tknth@clemson.edu, Coastal Research and Education Center, Clemson University, Clemson, SC

Fertility, fungicides, and host-plant resistance were tested to manage bacterial blight, caused by *Pseudomonas cannabina* pv. *alisalensis*, and a leaf blight caused by unique strains of *Xanthomonas campestris* pv. *campestris*. High nitrogen enhanced symptoms and increased weights of harvested leaves and diseased leaves. Acibenzolar-S-methyl reduced disease severity on a susceptible cultivar but not on a resistant line of mustard. Plant Introduction lines *Brassica juncea* G30988 and *B. rapa* G30499 were significantly more resistant to *Pseudomonas* than susceptible mustard and turnip cultivars and had higher marketable yields. Resistance in G30988 appears to be controlled by two recessive genes.

61.3 7:10 Integrating mating disruption, phenological models, and selective Insecticides for sustainable grape berry moth management, Rufus Isaacs, isaacsr@msu.edu, Michigan State University, East Lansing, MI; L. Teixeira; K. Mason

The vineyards of eastern North America are at risk of infestation by a complex of insect pests, with grape berry moth being the most economically important. The biology of this insect coupled with the grape industry's transition away from long-lasting organophosphate insecticides has led to increased damage, reduced yield, and in some cases rejection of the crop by processors. This project tested tools to enable integrated management of grape berry moth, including a novel mating disruption formulation applied using a mechanical applicator, pest development models, and integration of new insecticide classes. Successes and challenges with technology adoption will be discussed. This work was supported in part by the USDA-Pest Management Alternatives Program with agreement # 2008-34381-19262.

61.4 7:50 Reduced-risk IPM strategies for livestock production, Coby Schal, coby_schal@ncsu.edu, North Carolina State University, Raleigh, NC; Richard G. Santangelo; S. Michael Stringham; Ludek Zurek

Cockroaches have long been recognized as important pests in human-inhabited structures, and infestations are associated with disease transmission and allergen dissemination. Swine production is an important component of the agricultural economy of several states, and most swine are raised in confinement in structures. The favorable indoor habitat and an abundance of food and water can sustain large populations of pest cockroaches. Our specific objectives included identification of available pest management alternatives for

broad-spectrum pesticides, developing and evaluating these alternative IPM approaches, demonstrating the efficacy of this program, and quantifying reduction in risks to animal and human health and the environment. This work was supported in part by the USDA-Risk Avoidance and Mitigation Program, #2005-51101-02388, and the Blanton J. Whitmire endowment at North Carolina State University.

61.5 8:10 Outcomes and successes from an established Extension IPM program, Dean Polk, polk@rce.rutgers.edu, Rutgers Cooperative Extension, New Brunswick, NJ; George Hamilton

The Rutgers Fruit IPM Program is a statewide educational delivery program for commercial fruit growers, based on farm scouting and partially supported by participation fees and industry grants. 'Primary participants' have their farms scouted, while 'secondary participants include those and all other fruit growers getting summarized information and recommendations. It is a multidisciplinary team approach supported by specialist research and county agents. Direct participant farms are modeled and GIS mapped. Weekly arthropod and disease data, and fruit quality surveys are collected. Grower submission of pesticide use records is mandatory. Grower practices and pesticide use is measured from the data collected.

61.6 8:30 Enhancing capacity for IPM practice and assessment in Arizona, Peter Ellsworth, peterell@ag.arizona.edu, University of Arizona, Arizona Pest Management Center, Tucson, AZ; Alfred Fournier; John C. Palumbo; Dawn H. Gouge; Jack Peterson; Wayne Dixon

Measuring and communicating environmental, economic and social impacts of IPM are key to recruiting and leveraging support of our programs. Arizona IPM programs are planned, developed and implemented by the Arizona Pest Management Center. An IPM Assessment Leadership team oversees development of data and documentation of IPM impacts. Our programs, leveraged through federal grants such as USDA-RAMP, have documented impressive impacts. For example, Arizona cotton growers have reduced broadly toxic insecticide inputs by 74% compared to pre-2005 levels, much of this due to grower implementation of *Lygus* management recommendations developed and extended through a collaborative EIPM / RAMP effort.

61.7 8:50 Discussion

author index

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