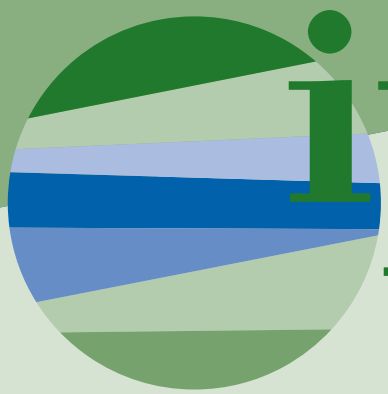

ipm

Integrated Pest Management

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7th International

Integrated Pest Management Symposium

IPM on the World Stage

March 27–29, 2012

Memphis, Tennessee

ipm Integrated Pest Management

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7th International IPM Symposium
coordinated by Online &
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welcome

IPM on the World Stage

It is our great pleasure to welcome you to the Seventh International IPM Symposium in Memphis! Our all-volunteer planning committees have worked long and hard to bring you an exciting event focusing on solutions to global pest challenges in agriculture and communities.

The program committee has designed a format that will bring us together for stimulating plenary sessions throughout our three days together. We'll hear keynotes from international experts from government, academia, Extension and industry, interspersed with informative breakouts, poster sessions and social events.

Our goal is to send you home refreshed and invigorated by the energy created by having so many friends and colleagues in one place, and by the research, implementation and outreach challenges and opportunities we'll explore together.

We hope you will enjoy the many cultural and outdoor offerings, including the opening reception at the Memphis Rock 'n' Soul Museum and the special tours of the Memphis Zoo and Shelby Farms Park. Finally, we thank all of our sponsors, contributors, volunteers, presenters and attendees for the time and resources you have all committed to make this event possible!

Welcome and enjoy!

Margaret Appleby, Rubella Goswami, Thomas Green and Jill Schroeder
Co-chairs, Seventh International IPM Symposium

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

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exhibitors

Exhibits are located in the Grand Lobby, on the Lobby (ground) level of the Memphis Cook Convention Center. Poster sessions, continental breakfasts, and breaks will be located in the exhibit room.

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committees

Steering Committee

Margaret Appleby, Co-chair, Margaret.appleby@ontario.ca, Ontario Ministry of Agriculture, Food and Rural Affairs, Brighton, ON, Canada

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

Jill Schroeder, Co-chair, jischroe@nmsu.edu, Department of Entomology, Plant Pathology and Weed Science, New Mexico State University, Las Cruces, NM

Rubella S. Goswami, Co-chair, Rubella.S.Goswami@usa.dupont.com, DuPont Crop Protection, Stine Haskell Research Center, Newark, DE

Anastasia Becker, Anastasia.Becker@mda.mo.gov, Missouri Department of Agriculture, Jefferson City, MO

Kaci Buhl, buhlk@ace.orst.edu, National Pesticide Information Center, Oregon State University, Corvallis, OR

Martin Draper, mdraper@nifa.usda.gov, U.S. Department of Agriculture, National Institute of Food and Agriculture, Washington DC

Naresh Duggal, Naresh.Duggal@ceo.co.santa-clara.ca.us, County of Santa Clara IPM Program, San José, CA

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

Dawn H. Gouge, dhgouge@ag.arizona.edu, University of Arizona, Maricopa, AZ

Janet A. Hurley, ja-hurley@tamu.edu, Texas AgriLife Research & Extension Center, Department of Entomology, Dallas, TX

Lynnae Jess, jess@msu.edu, North Central IPM Center, East Lansing, MI

Norman C. Leppla, ncleppla@ufl.edu, University of Florida, IFAS, Gainesville, FL

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

Brenna Wanous, Assistant Coordinator, bwanous@uwyo.edu, Berry Biodiversity Conservation Center, University of Wyoming, Laramie, WY

Elaine Wolff, Conference Coordinator, wolff1@illinois.edu, Online & Continuing Education, University of Illinois at Urbana-Champaign, Urbana, IL

Robert Wright, rwright2@unl.edu, University of Nebraska–Lincoln, Lincoln, NE

Awards

Peter Goodell, Co-chair, pbgoodell@ucanr.edu, University of California Cooperative Extension, Parlier, CA

Janet A. Hurley, Co-chair, ja-hurley@tamu.edu, Texas AgriLife Research & Extension Center, Department of Entomology, Dallas, TX

Short Heinrichs, eheinric@vt.edu, University of Nebraska–Lincoln, Lincoln, NE

Clayton Hollier, chollier@agcenter.lsu.edu, Louisiana State University, Baton Rouge, LA

Xing Ping Hu, huxingp@auburn.edu, Department of Entomology and Plant Pathology, Auburn University, Auburn, AL

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

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

Finances/Exhibits

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

Brenna Wanous, Co-chair, bwanous@uwyo.edu, Berry Biodiversity Conservation Center, University of Wyoming, Laramie, WY

Anastasia Becker, Anastasia.Becker@mda.mo.gov, Missouri Department of Agriculture, Jefferson City, MO

Mike Lees, Dow AgroSciences, mdlees@dow.com, Granite Bay, CA

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

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

Media/Outreach

Kaci Buhl, Chair, buhlk@ace.orst.edu, National Pesticide Information Center, Oregon State University, Corvallis, OR

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

Joy Landis, landisj@msu.edu, Department of Entomology, Michigan State University, East Lansing, MI

Jack Marlowe, jackmarlowe@edenpest.com, Eden Advanced Pest Technologies, Olympia, WA

Marion Murray, marion.murray@usu.edu, Department of Biology, Utah State University, Logan, UT

Ted Snyder, ted.snyder.ltd@gmail.com, Batzner Pest Management, Inc., New Berlin, WI

Operations/Local Arrangements

Carrie Foss, cfoss@wsu.edu, Extension IPM Program, Washington State University, Puyallup, WA

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

Lynnae Jess, jess@msu.edu, North Central IPM Center, East Lansing, MI

Pat Livingston, livingston.patricia@epa.gov, US EPA Region 4, Atlanta, GA

Marion Murray, marion.murray@usu.edu, Department of Biology, Utah State University, Logan, UT

Karen Vail, kvail@utk.edu, University of Tennessee, Knoxville, TN

Posters

Anastasia Becker, Co-chair, Anastasia.Becker@mda.mo.gov, Missouri Department of Agriculture, Jefferson City, MO

Robert Wright, Co-chair, rwright2@unl.edu, University of Nebraska–Lincoln, Lincoln, NE

Sharon Clay, Sharon.Clay@sdstate.edu, South Dakota State University, Brookings, SD

Silvia Rondon, Silvia.Rondon@oregonstate.edu, Hermiston Agricultural Research and Extension Center, Oregon State University, Hermiston, OR

Program

Margaret Appleby, Co-chair, Margaret.appleby@ontario.ca, Ontario Ministry of Agriculture, Food and Rural Affairs, Brighton, ON, Canada

Naresh Duggal, Co-chair, Naresh.Duggal@ceo.co.santa-clara.ca.us, County of Santa Clara IPM Program, San José, CA

Dawn H. Gouge, Co-chair, dhgouge@ag.arizona.edu, University of Arizona, Maricopa, AZ

Lynnae Jess, Co-chair, jess@msu.edu, North Central IPM Center, East Lansing, MI

Norman C. Leppla, Co-chair, ncleppla@ufl.edu, University of Florida, IFAS, Gainesville, FL

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

Carlos Bogran, c-bogran@tamu.edu, Texas A&M University Riverside Campus, Bryan, TX

Lynn Braband, lab45@cornell.edu, NYS Community IPM Program, Cornell University, Rochester, NY

David L. Clement, clement@umd.edu, University of Maryland Extension, Home and Garden Information Center, Ellicott City, MD

Seth Dibblee, dibblee.seth@epa.gov, US EPA Region 5, Chicago, IL

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

Mary Kay Malinoski, mkmal@umd.edu, University of Maryland Extension, Home and Garden Information Center, Ellicott City, MD

Site Selection

Martin Draper, Chair, mdraper@nifa.usda.gov, U.S. Department of Agriculture, National Institute of Food and Agriculture, Washington, DC

David L. Clement, clement@umd.edu, University of Maryland Extension, Home and Garden Information Center, Ellicott City, MD

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

Joy Landis, landisj@msu.edu, Department of Entomology, Michigan State University, East Lansing, MI

Mary Kay Malinoski, mkmal@umd.edu, University of Maryland Extension, Home and Garden Information Center, Ellicott City, MD

Daren Mueller, dsmuelle@iastate.edu, Iowa State University, Ames, IA

Paul Neese, paul.neese@basf.com, BASF Corporation, Research Triangle Park, NC

Steve Toth, Steve_Toth@ncsu.edu, North Carolina State University, Southern Region IPM Center, Raleigh, NC

Thank you to the NSF Center for Integrated Pest Management (CIPM) at North Carolina State University for developing the IPM7 Symposium mobile app.

session organizers

Luis Agurto, luis@pestecipm.com, Pestec IPM Providers, San Francisco, CA

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

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

Dieudonne Baributsa, dbaribu@purdue.edu, International Programs in Agriculture, Purdue University, West Lafayette, IN

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

Erin Bauer, ebauer2@unl.edu, University of Nebraska–Lincoln, Lincoln, NE

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

S. Kristine Braman, kbraman@uga.edu, University of Georgia, Department of Entomology, Center for Urban Agriculture, Griffin, GA

Kaci Buhl, buhlk@ace.orst.edu, National Pesticide Information Center, Oregon State University, Corvallis, OR

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

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

David L. Clement, clement@umd.edu, University of Maryland Extension, Home and Garden Information Center, Ellicott City, MD

Fred Corey, fcorey@micmac-nsn.gov, Aroostook Band of Micmacs, Presque Isle, ME

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

Franck Dayan, fdayan@olemiss.edu, United States Department of Agriculture, Agricultural Research Service, Natural Product Utilization Research, University, MS

Martin Draper, mdraper@nifa.usda.gov, U.S. Department of Agriculture, National Institute of Food and Agriculture, Washington, DC

James E. Dripps, jedripps@dow.com, Dow AgroSciences, Indianapolis, IN

Naresh Duggal, Naresh.Duggal@ceo.sccgov.org, County of Santa Clara, San Jose, CA

Stephen Duke, Stephen.duke@usda.ars.gov, United States Department of Agriculture, Agricultural Research Service, Natural Product Utilization Research, University, MS

Virgil Dupuis, virgil_dupuis@skc.edu, Salish Kootenai Tribal College, Pablo, MT

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

Jody Gangloff-Kaufmann, jlg23@cornell.edu, New York State IPM Program, Cornell University, Babylon, NY

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

Luis Gomez, egomez2@dow.com, Dow AgroSciences, Indianapolis, IN

Jeff Gore, jgore@drec.msstate.edu, Mississippi State University, Delta Research and Extension Center, Stoneville, MS

Dawn H. Gouge, dhgouge@ag.arizona.edu, University of Arizona, Maricopa, AZ

Jennifer Grant, jag7@cornell.edu, New York State IPM Program, Geneva, NY

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

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

Gary L. Hein, ghein1@unl.edu, University of Nebraska–Lincoln, NE

Erin Hodgson, ewh@iastate.edu, Iowa State University, Ames, IA

Chuanxue Hong, chhong2@vt.edu, Hampton Roads Agricultural Research and Extension Center, Virginia Tech, Virginia Beach, VA

A. Rami Horowitz, hrami@volcani.agri.gov.il, Gilat Research Center, M. P. Negev, Israel

Natalie A. Hummel, nhummel@agcenter.lsu.edu, LSU AgCenter, Baton Rouge, LA

Isaac Ishaaya, vpisha@volcani.agri.gov.il, The Volcani Center, Bet Dagan, Israel

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

Monte P. Johnson, mpjohnson@nifa.usda.gov, U.S. Department of Agriculture, National Institute of Food and Agriculture, Washington, DC

Rick Johnstone, ivmpartners@comcast.net, Integrated Vegetation Management Partners, Inc., Newark, DE

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

Timothy J. Kring, tkring@uark.edu, University of Arkansas, Fayetteville, AR

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

B. Rogers Leonard, RLeonard@agcenter.lsu.edu, Macon Ridge Research Station, LSU AgCenter, Macon Ridge, LA

Norman C. Leppla, ncleppla@ufl.edu, University of Florida, IFAS, Gainesville, FL

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

Jess Lowenberg-DeBoer, lowenbej@purdue.edu, International Programs in Agriculture, Purdue University, West Lafayette, IN

Mary Kay Malinoski, mkmal@umd.edu, University of Maryland Extension, Home and Garden Information Center, Ellicott City, MD

Catharine Mannion, cmannion@ufl.edu, University of Florida, Tropical Research and Education Center, Homestead, FL

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

Pam Marrone, pmarrone@marronebio.com, Marrone Bio Innovations, Davis, CA

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

Sandra McDougall, sandra.mcdougall@dpi.nsw.gov.au, Yanco Agricultural Institute, Yanco, NSW, Australia

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

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

Gary Moorman, gmoorman@psu.edu, The Pennsylvania State University, University Park, PA

David Mota-Sanchez, motasanc@msu.edu, Michigan State University, East Lansing, MI

Daren Mueller, dsmuelle@iastate.edu, Iowa State University, Ames, IA

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

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

Robert L. Nichols, BNichols@cottoninc.com, Cotton Incorporated, Cary, NC

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

Robert Nowierski, rnowierski@nifa.usda.gov, U.S. Department of Agriculture, National Institute of Food and Agriculture, Washington, DC

Clyde Ogg, cogg@unl.edu, University of Nebraska–Lincoln, Lincoln, NE

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

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

Douglas G. Pfeiffer, dgpfeiff@vt.edu, Department of Entomology, Virginia Tech, Blacksburg, VA

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

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

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

Gadi V.P. Reddy, reddy@uguam.uog.edu, University of Guam, Mangilao, Guam

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

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

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

Derek Settle, dsettle@cdga.org, Chicago District Golf Association, Lemont, IL

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

Melissa Siebert, mwillrichsiebert@dow.com, Dow AgroSciences, Greenville, MS

Ted Snyder, ted.snyder.ltd@gmail.com, Batzner Pest Management, Inc., New Berlin, WI

Scott D. Stewart, sdstewart@utk.edu, University of Tennessee, Western Tennessee Research and Extension Center, Jackson, TN

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

Bill Stoneman, bstoneman@biopesticideindustryalliance.org, Biopesticide Industry Alliance Inc. (BPIA), McFarland, WI

James Thomas, jdthomas@dow.com, Dow AgroSciences, Greenville, MS

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

John Vickery, jvickery@mcg.net, Colorado Native Plant Society, Denver, CO

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

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

Mark E. Whalon, whalon@msu.edu, Michigan State University, East Lansing, MI

Robert Wright, rwright2@unl.edu, University of Nebraska–Lincoln, Lincoln, NE

Andy Wyenandt, wyenandt@aesop.rutgers.edu, Rutgers University, Bridgeton, NY

general information

Registration and Information Desk

The Registration Desk will be located in the Grand Lobby, on the Lobby (ground) level of the Memphis Cook Convention Center.

The desk will be open:

Monday, March 26, 1:00–5:00 PM

Tuesday, March 27, 7:00 AM–5:00 PM

Wednesday, March 28, 7:30 AM–5:00 PM

Thursday, March 29, 7:30 AM–12:00 NOON

Abstracts, Presentations, and Posters

Complete abstracts can be found at the Web site: www.ipmcenters.org/ipmsymposium12

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

Wireless Access

Look for the network name: IPM. Password: ecological

IPM7 Symposium App

The IPM7 Symposium mobile app was developed by the NSF Center for Integrated Pest Management (CIPM) at North Carolina State University in cooperation with the organizers of the symposium.

Both Android and iOS versions of this app are available from the Android Marketplace (Android) and from the Apple iTunes App Store (iOS).

Poster Sessions

Two poster sessions will be held: Tuesday, March 27, 5:30–7:00 PM and Wednesday, March 28, 5:30–7:00 PM in the Grand Lobby, on the Lobby (ground) level of the Memphis Cook Convention Center. While all posters will be displayed throughout the symposium, authors are asked to be by their posters according to their final poster number: odd numbers on Tuesday and even numbers on Wednesday.

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

If you would like to have your poster posted on the 2012 IPM Symposium web site, copy your poster as a .pdf file and send to the symposium email address: ipmsymposium@ad.uiuc.edu.

Poster Session Receptions

All registered participants and their registered guests are invited to attend the receptions, held during the poster sessions on Tuesday, March 27 and Wednesday, March 28 from 5:30–7:00 PM each night in the Grand Lobby, on the Lobby (ground) level of the Memphis Cook Convention Center. Hors d'oeuvres and a cash bar will be provided during the reception.

Presenter Preview Room

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

Media

The Registration Desk will serve as the media desk, located in the Grand Lobby, on the Lobby (ground) level of the Memphis Cook Convention Center. Reporters and other members of the media should register upon arrival.

Session Moderators

If you have technical difficulties during your session, please find the volunteer monitors with red ribbons in the hallways or come to the Registration Desk.

Continuing Education Credits

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

Symposium Evaluation

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

daily schedules

Monday, March 26

Title	Room	7AM 8 9 10 11 12 1PM 2 3 4 5 6 7 8 9
IPM CRSP Technical Meeting	L10	
Multi-Region IPM Coordinator Meeting	L2	
WERA-1017 (formerly WERA-069) Meeting	L6	
SERA-3 Meeting	L4	
NEREAP Meeting	L5	
NCERA 222 Meeting	L3	
ARM 9 Overview	L8	
Native American Small Farm Working Group	L9	
Internal EPA School IPM Meeting	L9	
Tours		
Memphis Zoo	Meet by registration desk in Grand Lobby	
International AgriCenter & Shelby Farms Park	Meet by registration desk in Grand Lobby	
Functions		
Reception at Memphis Rock 'n' Soul Museum	Transportation on own	
Registration	Grand Lobby	
		7AM 8 9 10 11 12 1PM 2 3 4 5 6 7 8 9

Tuesday, March 27

Title	Room	7AM 8 9 10 11 12 1PM 2 3 4 5 6 7 8 9
Plenary Sessions		
Opening Plenary Session—Management	Ballroom B	
Plenary Session—Research	Ballroom B	
Concurrent Sessions		
M1 • Conducting IPM in schools demonstration projects: Perspectives and lessons learned	L2	
M2 • Capacity building and short term training: Requirements for successful technology transfer for IPM	L3	
M3 • Is IPM dead? What policymakers, taxpayers, consumers and practitioners need to know about IPM	L4	
M4 • Economics of IPM: Impact assessment, natural enemies, diffusion, and marketing	L5	
M5 • Doesn't the EPA regulate pesticide use? Why do we need the Pesticide Risk Mitigation Engine?	L6	
M6 • Managing IPM is not just bugs: An approach by two multi-disciplinary agencies—Australian vegetables and Santa Clara County	L8	
M7 • State extension IPM programs—Trials and triumphs	L9	
M8 • IPM delivery: Got an app for that?	L10	
M9 • Applying the findings and recommendations of the 2011 OECD IPM workshop at a national level	L11	
M10 • Brainstorming: Effective IPM with pesticide prohibitions	L12	
M11 • Government IPM partnerships for better public health	L13	
M12 • Adventures in community IPM: Systems that work the bed bugs out	L14	
M13 • Creative monitoring and natural resources	L2	
M14 • Marketing IPM: Integrating IPM with local, sustainable, safe and fair	L8	
M15 • Making the handoff: Moving invasive species from regulation to management	L12	
M16 • Use of weather-based pest, crop and natural resource information systems to facilitate effective IPM decision-making world-wide	L13	
R17 • Exploring the international flavors of benchmarking IPM	L2	
R18 • Impact of bioenergy crops on pests, natural enemies and pollinators in agricultural and non-crop landscapes	L3	
R19 • Rest in peace: USDA Section 406 IPM programs—research contributions of CAR, RAMP and IPM Centers	L4	
R20 • Pesticide resistance in arthropods, plant pathogens, and weeds: A growing threat to IPM and U.S. agriculture	L5	
R21 • Opportunities for public and private-sector IPM specialists to collaborate, strengthen and enhance USDA NRCS Farm Bill conservation programs for IPM	L6	
R22 • Success in integrated management of head blight of wheat in the United States	L8	
R23 • Killing two threats with one stone: The co-management of phytopathogens and food safety risks in greenhouse tomatoes	L9	
R24 • Advanced technologies in IPM programs	L10	
R25 • Development of IPM packages for vegetable crops in developing countries	L11	
R26 • Are ecologically-based IPM strategies relevant for sustainable management of virus diseases in the 21st century?	L12	
R27 • Plant health management in a thirsty world	L13	
R28 • Remote sensing and GIS applications to pest monitoring and management	L14	
R29 • Use of *Trichoderma* in agriculture in Asia	L2	
		7AM 8 9 10 11 12 1PM 2 3 4 5 6 7 8 9

Title	Room	7AM	8	9	10	11	12	1PM	2	3	4	5	6	7	8	9
M30 • IPM at the U.S. Environmental Protection Agency	L2															
R31 • The impact of invasive insect pests on IPM	L3															
B32 • Two Extension outreach projects: Adoption of proper mowing height and using educational posters on sustainable lawn care, low-input plants, and outdoor pests	L4															
Poster Sessions																
Poster Setup	Grand Lobby															
Poster Session—odd numbered posters	Grand Lobby															
Functions																
Continental Breakfast	Grand Lobby															
Luncheon and Integrated Pest Management Achievement Awards Presentation	Ballroom A															
Poster Session Reception	Grand Lobby															
Related Meetings																
IPM Voice	L2															
NCERA 184	L8															
WERA060	L5															
Registration	Grand Lobby															
		7AM	8	9	10	11	12	1PM	2	3	4	5	6	7	8	9

Wednesday March 28

Title	Room	7AM	8	9	10	11	12	1PM	2	3	4	5	6	7	8	9
Plenary Sessions																
Plenary Session—Best Practices	Ballroom B															
Plenary Session—Outreach	Ballroom B															
Concurrent Sessions																
B33 • Integrating biological and conventional pest and disease management strategies in greenhouse and outdoor horticulture	L2															
M12 • Adventures in community IPM: Systems that work the bed bugs out	L3															
B34 • Herbicide-resistant weeds and the need for sustainable systems: The benchmark study—a field-scale multi-year, multi-state project	L4															
B35 • IPM and transgenic Bt maize: Current issues, future needs	L5															
B36 • Going green: The role of IPM in green building	L6															
B37 • Semiochemicals in IPM and semiochemical technology in IPM systems in developing countries: IPM CRSP in South Asia, West Africa and East Africa	L8															
B38 • Golf course IPM: Pushing the envelope	L9															
B39 • Biological control of ruderal species: the search for champions	L10															
B40 • Challenges and solutions for IPM in the mid-southern U.S.	L11															
B41 • Natural products for weed management	L12															
B42 • Getting results with best management practices	L13															
B43 • IPM challenges in the landscape: Implementation, establishment and evaluation	L14															
B44 • Evolving pest complexes and IPM strategies in transgenic cotton	L2															
B45 • Integrated vegetation management	L3															
B46 • Implications for "insurance is the new IPM" in field crops	L4															
B47 • Educating the next generation: Strategies to promote IPM literacy	L13															
O48 • Creating and improving stakeholder-driven IPM programs using conventional, digital and social media delivery systems	L2															
O49 • Bed bugs and book bags: Using classroom curriculum to reach the community	L3															
O50 • IPM challenges and opportunities in fruit and vegetable crops for processing: New invaders, drift, new options and novel approaches	L5															
O51 • Networking approaches for IPM research and extension	L6															
O52 • Developing and disseminating hermetic Cowpea storage technology in West and Central Africa	L9															
O53 • eOrganic, the eXtension CoP for organic agriculture	L10															
O54 • Using self-assessment, surveys, and certification to document, incentivise and implement IPM in specialty crops	L11															
O55 • The role of education in IPM	L12															
O56 • Feeding 9 billion people sustainably: The case for biopesticides	L13															
O57 • Changing the product selection in retail stores—How agencies in California are working together to make green products more mainstream	L14															
O58 • Productivity increase by using IPM modules with indigenous practices for managing pests in different cropping systems	L8															
O59 • Building IPM programs for Native Americans	L12															
O60 • IPM education: Required knowledge, educational options and applications	L3															
M61 • NIFA IPM programs: Legacy and impacts	L5															
		7AM	8	9	10	11	12	1PM	2	3	4	5	6	7	8	9

Title	Room	7AM 8 9 10 11 12 1PM 2 3 4 5 6 7 8 9
Poster Sessions		
Poster Session—even numbered posters	Grand Lobby	
Functions		
Continental Breakfast	Grand Lobby	
Poster Session Reception	Grand Lobby	
Related Meetings		
School IPM Round Table Discussion	L2	
Registration	Grand Lobby	

Thursday, March 29

Title	Room	7AM 8 9 10 11 12 1PM 2 3 4 5 6 7 8 9
Plenary Session		
Closing Plenary Session	Ballroom B	
Functions		
Continental Breakfast	Grand Lobby	
Related Meetings		
EPA Tribal Pesticide Program Council	L3	
Urban Community of Practice	L4	
Registration	Grand Lobby	

Friday, March 30

Title	Room	7AM 8 9 10 11 12 1PM 2 3 4 5 6 7 8 9
EPA Tribal Pesticide Program Council	L3	

plenary sessions

Tuesday, March 27

Management Plenary

Ballroom B

8:30 Welcome from symposium program committee, Norman C. Leppla, ncleppla@ufl.edu, University of Florida, IFAS, Gainesville, FL

Welcome from steering committee co-chairs, Jill Schroeder, Co-Chair, jischroe@nmsu.edu, Department of Entomology, Plant Pathology and Weed Science, New Mexico State University, Las Cruces, NM

9:00 U.S. EPA and IPM: Reviewing the past, assessing the present, and looking towards the future, Steven P. Bradbury, Bradbury.Steven@epa.gov, Office of Pesticide Programs, Office of Chemical Safety and Pollution Prevention, U.S. Environmental Protection Agency

Research Plenary

Ballroom B

1:45 Introduction, Megha Parajulee, m-parajulee@tamu.edu, Texas AgriLife Research and Extension Center, Lubbock, TX

Embracing laboratory and field definitions of resistance and reconciling the IRM proactivity paradox, Timothy Dennehy, timothy.dennehy@bayer.com, Bayer CropScience-BioScience, Research Triangle Park, NC

In spite of disparities in definitions of resistance, producers of Bt crops are committed to proactively manage insect resistance, and to fulfill US-EPA imperatives to define triggers for remedial action. This commitment to proactivity represents a scientific paradox because actions must be taken in advance of confirmation of field-relevant resistance. A solution lies in practical interpretations of resistance data. I will describe a framework that promotes coexistence of both laboratory- and field-based definitions of resistance. Claims of field-relevant resistance should be based on demonstration that the resistance is increasing through time and has the potential to appreciably increase pest survival.

Wednesday, March 28

Best Practices Plenary

Ballroom B

8:45 Introduction, Naresh Duggal, Naresh.Duggal@ceo.co.santa-clara.ca.us, County of Santa Clara IPM Program, San José, CA

Emergency fly management operation in the aftermath of March 11 earthquake and tsunami in northeast Japan: Lessons learnt and best practices, Chow-Yang Lee, Chow-Yang Lee chowyang@me.com, Urban Entomology Laboratory, Vector Control Research Unit, School of Biological Sciences, Universiti Sains Malaysia, Penang, Malaysia

Pest managers are interested in knowing how to develop best practices, an integrated approach that includes addressing pest issues from sudden outbreaks to chronic infestations resulting in safe and healthy outcome, while taking into account economical, social and environmental sustainability. No best practice is best for every pest control operation, and every situation will change as individuals find better ways to reach the end result. However, principles involved in developing best practices for achieving a stated goal or objective remain the same. Through a "real world" example of a serious outbreak of blow flies, blue bottle flies and houseflies following March 11, 2011 mega-scale earthquake in the north-east coastal region of Japan; the keynote will address on the importance of developing a project management mindset—and therefore a best practice for a pest management project or program as a whole; including the steps necessary to take to reach the end goal. The earthquake triggered tsunami waves damaging the 400 km coastal line where seafood and marine product processing industries once thrived. Following the tsunami, thousands of tons of seafood products in these processing plants were strewn all over the coastal cities. In early May 2011,

large number of flies began to appear in the affected cities. Emergency pest management operation has to be executed to intercept possible public health issues. This involved coordination efforts made during the operation, chemical treatment and source removal operation, and the eventual success of fly populations, as well the challenges faced. A core set of best practices from this experience can be considered and adopted for area-wide management of insect pests during natural disaster.

Outreach Plenary

Ballroom B

1:45 Introduction, Margaret Appleby, Co-chair, Margaret.appleby@ontario.ca, Ontario Ministry of Agriculture, Food and Rural Affairs, Brighton, ON, Canada

Tailoring outreach to maximize impact in the era of information overload, David A. Rosenberger, dar22@cornell.edu, Department of Plant Pathology, Cornell University, Ithaca, NY

Modern communication systems and networks provide novel options for disseminating IPM information to various audiences, but those same systems are creating information overloads that can diminish the impact of the IPM message. Experience with fruit IPM programs in New York suggests that, for maximum sustained impact, outreach programs must (1) come from credible sources; (2) be directly relevant to the target audience; (3) reach the audience at critical junctures in decision-making processes; (4) be brief and easily understood, but still detailed enough to satisfy new audience members; (5) promote action plans that are economically and managerially feasible; (6) involve enough repetition over time and location to ensure that the message penetrates the audience consciousness; and (7) have enough entertainment value or visual impact to sustain audience interest. A looming problem for IPM will be accessing credible and relevant information as public funding for applied research and extension programs evaporates. Private entities will increasingly assume responsibility for applied research and on-farm implementation of pest management programs, but their discoveries and innovations may remain cloaked in shrouds of proprietary protectionism unless we can devise new IPM coalitions where everyone benefits from sharing resources and information.

Thursday, March 29

Closing Plenary

Ballroom B

8:30 Welcome, Thomas Green, ipmworks@ipminstitute.org, IPM Institute of North America, Inc., Madison, WI

8:50 Introduction, Lynnae Jess, jess@msu.edu, North Central IPM Center, East Lansing, MI

Management: In your hands, Carrie Koplinka-Loehr, ckk3@cornell.edu, Northeastern IPM Center, Insectary, Cornell University, Ithaca, NY

How will you manage yourself and your work in 2012 to make a difference? That's the question I will explore in this plenary. We know that IPM management is more than roles and responsibilities. It exceeds policies and practices, strategic planning and skill development. Derived from the Latin "manus," meaning hand, the word "management" is human action that produces useful outcomes. I'll summarize highlights from this Symposium's management sessions, share useful resources and experiences from the Northeastern IPM Center, and describe new directions managers are taking to bring about change in a world of challenges. Management. It's in your hands.

9:25 Introduction, Thomas Green

IPM Voice, James R. VanKirk, jim@sripmc.org, Southern Region IPM Center, Raleigh, NC

IPM Voice is a new nonprofit organization that unites diverse IPM stakeholders in a common cause: to advocate for IPM that is genuinely progressive and continuously improves environmental, social and economic conditions through application of accepted scientific principles. It invites participation by stakeholders with differing philosophies and approaches. IPM Voice doesn't claim to *speak* for all of IPM, but rather to *speak up* for IPM.

9:45 Introduction, Kaci Buhl, buhlk@ace.orst.edu, National Pesticide Information Center, Oregon State University, Corvallis, OR

Research informs the practice of IPM, the critical link that separates fad from science-based application, Peter C. Ellsworth, peterell@arizona.edu, University of Arizona, Arizona Pest Management Center, Maricopa, AZ

Integrated Pest Management is not in the public eye or consciousness. It is, however, the science-based worldwide standard for solving society's problems with pest organisms in a manner that protects people, property, resources and the environment. The achievements of the IPM community presented at the 7th International IPM Symposium will be briefly synthesized as testament to meeting our goal of maintaining this critical link between IPM research and practice. The balance of this presentation will focus on a case study of 20-yr effort to manage insect pests of and stabilize the cotton agroecosystem of Arizona. To meet future challenges in IPM, we must invest in the next generation of scientists and build our technological arsenal while adhering to the basic tenets of IPM that drive the application of current and new tools for sustainable management.

Contributing Author: Steven E. Naranjo, USDA-ARS Arid-Land Agricultural Research Center

10:30	Break
10:45	Introduction, Carlos Bogran, c-bogran@tamu.edu, Texas A&M University Riverside Campus, Bryan, TX
	Urban and community IPM: Best practices, Robert M. Corrigan, rcorriga@health.nyc.gov, RMC Pest Management Consulting, Richmond, IN

Across the seven or so broad categories of urban and community IPM, one common thread is apparent: the global public wishes for minimal future applications of pesticides in and around structures, turf and landscapes, urban parks and certainly our interiorscapes. For the immediate future, the best practices direction of urban IPM indicates that IPM professionals will not be those who are best at using sprays, traps, or poison baits, but rather those whom are best at keen observation, source finding, analyzing each unique pest situation, pest exclusion design and being able to quickly assimilate and implement emerging research and effective IPM technology. This plenary session will focus on how this new direction repeatedly emerged along side of other global urban IPM innovations here in Memphis during the symposium.

11:30	Introduction, Norman C. Leppla, ncleppla@ufl.edu, University of Florida, IFAS, Gainesville, FL
	Rethinking outreach in the 21st century, Susan T. Ratcliffe, sratclif@illinois.edu, North Central IPM Center, University of Illinois at Urbana-Champaign, Urbana, IL

IPM outreach has depended primarily on face-to-face Extension programming but can this continue, given the growing clientele population and expanded Extension roles, e.g., traditional agricultural production and pest management, family and community health programs, and pest management on non-agricultural lands? Through use of the Internet, we can reach millions of people who we will never meet and we can communicate with each other 24/7 using our mobile devices. These technologies have helped to shape methods of rapidly communicating in our society. Younger generations do not remember life without computers and wireless telephones. With these changes in communication, we need to ask ourselves: have we lost the ability to develop relationships with our clientele? Will the information superhighway preserve and further our IPM outreach efforts or will it lead to the end of structured outreach programs such as Extension? What is the future of outreach? I believe the future of outreach lies in the IPM communities' creative ability to deliver IPM practices that prevent or manage pests in ways that increase global food security, sustain the environment, and protect human health. The outreach sessions at this Symposium included not only delivery of information via the internet but also green products in retail stores, insurance and IPM, responses to invasive species, Extension for organic agriculture and specialty crops, classroom curriculum and other kinds of education, sustainable agriculture, reaching different clientele groups, and increasing food production and delivery. This diversity of topics highlights the many ways we engage new clientele and promote IPM by using technology in addition to maintaining face-to-face relationships. We have benefited from the insights shared in the outreach sessions on how to address pest management issues by using a variety of tools, including technology to meet the specific needs of our clientele. Technology has changed the way we conduct outreach and, as a result of the innovativeness of the IPM community, we have drawn on both modern and traditional delivery methods to educate the masses about the value of IPM in the 21st century.

12:15	Closing remarks, Thomas Green

Tuesday, March 27 • 12:15

International Integrated Pest Management Achievement Awards Presentation

Ballroom A

Presiding: Peter Goodell, pbgoodell@ucanr.edu, University of California Cooperative Extension, Parlier, CA; Janet A. Hurley, ja-hurley@tamu.edu, Texas AgriLife Research & Extension Center, Department of Entomology, Dallas, TX

The **International IPM Awards of Excellence** will be given to:

- Soybean Rust—Pest Information Platform for Extension and Education (PIPE)
- Purdue Improved Cowpea Storage Team
- Dr. Alexandre V. Latchininsky
- Regional Integrated Pest Management Centers, USDA National Institute of Food and Agriculture
- Eco Apple Program, Red Tomato
- Spring Independent School District IPM Team, Harris County, TX

The **International IPM Lifetime Achievement Award** will be given to:

- Mr. Walter J. Bentley

The **International IPM Awards of Recognition** will be given to:

- Dr. Thomas A. Green
- Ms. Sherry Glick
- Mr. Ashraf Saber Alhawamdeh
- Integrated Plant Protection Center

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

poster abstracts

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

Best Practices—Agriculture

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

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

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

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

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

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

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

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

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

Sunil K. Pathak, skpathak3@gmail.com

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Best Practices—Natural Resources

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

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

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

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

Management—Agriculture

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

P021 Effective habitat protection: A consultative and cooperative process

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

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

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

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

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

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

TamilNadu Agricultural University, Coimbatore, India

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

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

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

Oregon State University, Corvallis, OR

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

P024 Site-specific technology to better manage nematodes in cotton

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

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

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

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

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

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

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

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

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

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

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

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

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

*M. Babadoost

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

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

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

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

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

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

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

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

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

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

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

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

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

Zonal Horticultural Research Station, Karnataka, India

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

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

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

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

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

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

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

M.L.Chatterjee, chatterjee_monilal@rediffmail.com

Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidlaya, India

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

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

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

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

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

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

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

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

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

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

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

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

Texas AgriLife Research and Extension Center, Lubbock, TX

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

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

D. N. Kambrekar, kam_ent@rediffmail.com

Regional Agricultural Research Station, Bijapur, Karnataka, India

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

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

P037 Mediterranean fruit fly in Iran and proposal for its eradication

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

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

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

P038 Responding to spotted wing drosophila-The Michigan experience

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

P042 Papaya mealybug on mulberry and its management through classical biocontrol

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

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

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

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

P043 Pest management scenario under IPM in Northeastern part of India

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

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

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

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

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

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

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

P045 Pymetrozine–A novel insecticide for planthopper management

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

CPPS, TNAU, Coimbatore, India

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

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

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

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

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

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

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

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

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

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

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

Pioneer Hi-Bred, Johnston, IA

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

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

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

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

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

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

P050 The University of Maine Cooperative Extension strawberry IPM program

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

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

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

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

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

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

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

P052 FAO Desert Locust early warning system

Keith Cressman, keith.cressman@fao.org

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

P057 Pesticide use and risks in horticultural farm enterprises in Uganda

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

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

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

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

Stepanka Radova, stepanka.radova@srs.cz

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

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

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

Management—Natural Resources

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

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

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

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

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

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

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

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

P061 Theoretical basis of pest management

V.B. Sapunov, sapunov@rshu.ru

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

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

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

Management—Urban

P062 School IPM program impact assessment

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

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

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

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

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

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

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

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

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

IPM Institute of North America, Madison, WI

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

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

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

Hazrat Bilal, bilalento@yahoo.com

Health Services Academy, Pakistan

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

Outreach—Agriculture

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

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

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

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

P067 Preparing for the brown marmorated stink bug in Iowa

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Fred Fishel, weeddr@ufl.edu

Department of Agronomy, University of Florida, Gainesville, FL

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

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

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

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

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

P080 Giving IPM a VOICE

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

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

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

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

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

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

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

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

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

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

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

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

P083 IPM Internships-Training IPM Professionals for the Future

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

Texas AgriLife Extension Service, College Station, TX

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

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

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

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

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

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

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

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

Oklahoma State University, Stillwater, OK

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

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

Jaime C. Pinero, pineroj@lincolnu.edu

Lincoln University of Missouri, Jefferson City, MO

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

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

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

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

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

P088 Natural enemies of vegetable crop pests workshop

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

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

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

P089 NEWA resources for implementation of IPM in Lake Erie vineyards

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

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

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

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

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

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

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

P091 Online educational modules for disseminating IPM information

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

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

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

P092 Online phenology and infection risk modeling system–2012 update

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

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

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

P093 Partnering with ScoutPro for developing field scouting applications

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

Integrated Pest Management, Iowa State University, Ames, IA

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

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

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

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

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

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

P095 Success of University of Kentucky Wheat IPM Team

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

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

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

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

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

Texas AgriLife Research and Extension Center, Amarillo, TX

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

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

P097 Bird cherry-oat aphid bionomics in the Pacific Northwest

David Bragg, braggd@wsu.edu

Washington State University, Pomeroy, WA

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

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

Kenneth Wise, klw24@cornell.edu

Cornell University, Albany, NY

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

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

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

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

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

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

P100 Thirty years of IPM in Maine

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Department of Biology, Utah State University, Logan, UT

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

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

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

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

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

P105 Global Herbicide Resistance Challenge Conference

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

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

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

Outreach—Urban

P106 Integrated pest management in public housing works!

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

The Northeastern IPM Center, Cornell University, Ithaca, NY

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

BASF, Raleigh, NC

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

P113 Sustainable Places Information Network (SPIN)

Josh Vincent, jvincent@pesticide.org

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

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

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

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

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

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

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

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

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

University of California Statewide IPM Program, Davis CA

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Research—Agriculture

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

James Hutton Institute, Dundee, UK

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

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

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

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

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

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

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

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

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

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

P127 Isothermal amplification of insect DNA

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

*Patchanee Chaiyawat, patchanee@ricethailand.go.th

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

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

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

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

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

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

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

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

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

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

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

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

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

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

P137 Exploration, identification and pathogenicity tests of entomophatogenic fungi

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

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

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

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

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

TamilNadu Agricultural University, Coimbatore, India

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

P139 Integrated control of spider mites on greenhouse roses in Thailand

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

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

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

P140 Grandevo® biopesticide for managing insects and mites

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

Marrone Bio Innovations, Inc., Davis, CA

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

P144 Improving biological control on equestrian farms

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

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

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

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

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

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

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

P146 Not presented

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

TamilNadu Agricultural University, Coimbatore, India

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

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

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

TamilNadu Agricultural University, Coimbatore, India

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

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

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

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

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

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

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

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

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

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

P158 Pruning techniques for managing bacterial canker of sweet cherry

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

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

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

P159 Regalia® biopesticide in plant disease management

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

Marrone Bio Innovations, Inc., Davis, CA

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

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

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

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

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

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

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

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

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

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

T.S. Rajpurohit, rajpurohitts@rediffmail.com

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

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

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

P163 Investigating a tomato virus on Guam

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

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

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

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

Margaret T. McGrath, mtm3@cornell.edu

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

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

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

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

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

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

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

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

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

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

P167 Management of major pests of small Cardamom in Karnataka

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

Zonal Horticultural Research Station, Karnataka,India

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

P168 Not presented

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

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

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

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

P170 Plant bioregulators enhance aphid control in pecan orchards

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

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

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

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

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

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

Virginia Tech, Blacksburg, VA

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

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

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

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

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

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

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

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

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

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

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

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

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

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

P175 Microbial control in strawberry IPM

Surendra Dara, skdara@ucdavis.edu

University of California Cooperative Extension, San Luis Obispo, CA

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

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

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

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

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

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

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

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

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

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

Research—Natural Resources

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

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

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

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

P179 Not presented

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

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

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

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

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

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

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

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

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

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

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

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

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

Research—Urban

P183 A demonstration project using IPM principles for subterranean termite management

Brian T. Forschler, bfor@uga.edu

University of Georgia, Department of Entomology, Athens, GA

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

P184 Sound landscaping forestall termite invasion to homes

Xing Ping Hu, huxingp@auburn.edu

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

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

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

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

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

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

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

P186 IPM alternatives for stored-product insects

Rizana M. Mahroof, rmahroof@scsu.edu

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

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

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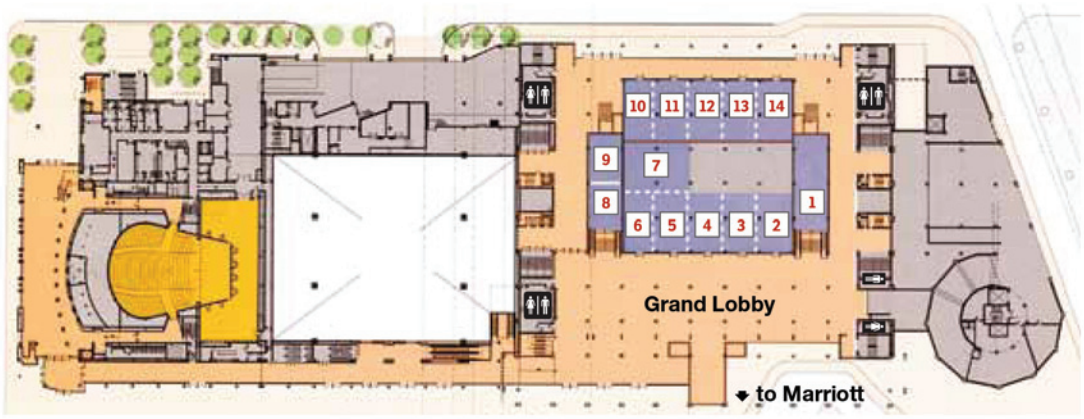
Note: *Numbers preceded by a "P" indicate a poster; other numbers refer to oral sessions.*


notes

memphis cook convention center

LOBBY LEVEL



BALLROOM LEVEL