ipm
Integrated Pest Management
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Office of Continuing Education

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

foreword

Welcome to the Fourth National Integrated Pest Management Symposium, "Building Alliances for the Future of IPM." As IPM adoption continues to increase, challenges facing the IPM systems' approach to pest management also expand. The IPM community has responded to new challenges by developing appropriate technologies to meet the changing needs of IPM stakeholders.

Organization of the Fourth National Integrated Pest Management Symposium was initiated at the annual meeting of the National IPM Committee, ESCOP/ECOP Pest Management Strategies Subcommittee held in Washington, DC, in September 2001. With the 2000 goal for IPM adoption having passed, it was agreed that it was again time for the IPM community, in its broadest sense, to come together to review IPM achievements and to discuss visions for how IPM could meet research, extension, and stakeholder needs. A steering committee was self-selected from among the meeting attendees to coordinate the initial symposium. Representatives from IPM, IR-4, SARE, EP, OPMP, ARS, and the Regional Pest Management Centers, all present at the meeting, have been active participants in the symposium development, and their programs are among the symposium cosponsors. Once site selection and other operations such as soliciting meeting sponsorship commenced, the steering committee was expanded for the operations phase of planning, which included developing the program—the key element of the IPM Symposium. The steering committee is now comprised of a number of individuals representing many organizations nationally active in IPM. Their collaborative efforts have developed a program that expands on the theme of Building Alliances by offering a diversity of session topics.

The First National IPM Symposium was held on April 25–28, 1989, in Las Vegas. A focus for this initial meeting was to bring scientists from across disciplines together to discuss common interests and to interact with a broader community of colleagues involved in IPM. No less important was the goal of bringing IPM researchers together with public policy makers, university and federal agency administrators, and other decision makers. An evaluation of the meeting from the 500 participants indicated an overwhelming desire for periodic national meetings with a greater focus on sessions where research and extension colleagues involved in IPM could meet and share knowledge, experiences, and interdisciplinary successes.

The Second National IPM Symposium followed the theme "IPM Programs for the 21st Century: Food Safety and Environmental Stewardship." The meeting explored the future of IPM and its role in reducing environmental problems; ensuring a safe, healthy, plentiful food supply; and promoting a sustainable agriculture. The meeting was organized with poster sessions and workshops covering 22 topic areas that provided numerous opportunities for participants to share ideas across disciplines, agencies, and affiliations. More than 600 people attended the Second National IPM Symposium. Based on written and oral comments, the symposium was a very useful, stimulating, and exciting experience.

The Third National IPM Symposium shared two themes, "Putting Customers First" and "Assessing IPM Program Impacts." These two dominant themes provided the unifying focus for more than three days of presentations and research contributions. It was agreed that putting customers first required developing or strengthening skills involved in building diverse teams for program design and implementation. Furthermore, IPM programs oriented toward the twin objectives of enhanced profitability and better environmental and public health performance provided the potential for win-win strategies for agriculture, society, and both rural and urban interests.

The planning and development of this year's symposium has been a collaborative effort from numerous individuals that represent the diverse interests of the IPM community. The Fourth National IPM Symposium plenary session will address "Building Alliances for the Future of IPM" by featuring speakers who have been successful in developing collaborative relationships. The keynote speaker, Harold Coble, will unveil the National Roadmap for Integrated Pest Management. This symposium provides an exciting opportunity for you to share in the latest IPM developments through participation in more than 60 breakout sessions and more than 200 poster presentations. Indeed, the expectations and thereby the opportunities for IPM are changing, but they can be realized by alliances of individuals and organizations sharing their knowledge, experiences, and a common vision for IPM.

Frank Zalom
Michael Hoffmann
Susan Ratcliffe
Co-chairs, Fourth National IPM Symposium

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Michael Hoffmann, Cornell University
Susan Ratcliffe, University of Illinois

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Harold Coble
Jerry DeWitt
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Posters

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Web Site/Public Information

Carrie Koplinka-Loehr
Ron Stinner
James VanKirk, Chair
Elaine Wolff

Special Thanks

Janet Garlick
Diana Harmon
Michele Kaufman

Topic Coordinators

A. IPM Recognition and Incentive
Tom Green, Curt Petzoldt

B. Marketing IPM
Bill Hutchison, Mary Woodsen

C. New Management Technologies
Gary Felton, Michael Stout

D. Evaluation and Impact Assessment
Esther Day, Thomas Greitens

E. Building Partnerships; Examples and the Necessary Skills
Carrie Koplinka-Loehr

F. Community (Urban) IPM
Tim Gibb, Jennifer Grant

G. IPM Education and Outreach
Lyn Garling

H. Biological Control and Bio-Based IPM
Bob Nowierski

I. Vertebrate and Wildlife IPM
Michael Hoffman

J. IPM in Perspective
Kim Crum, Allison Jones

K. Strategic Planning and Visioning for IPM: The Roadmap and Beyond
Ed Rajotte

L. Invasive Species
Janet Clark, Chris Dionigi

M. Risk Assessment and Management
Tom Green

N. Biotechnology
Graham Head, Rick Hellmich

O. International IPM
Doug Pfeiffer

P. Systems Approach and Landscape Interactions
Jerry DeWitt

Q. IPM in Organic Systems
Jerry DeWitt, Geoff Zehnder

R. Successes in Agricultural and Urban IPM
Michael Hoffman

S. Commodity Related Topics
Tom Fuchs

program schedule

Pre-Symposium Meetings

Sunday, April 6	8 AM–5 PM	S1010, Dynamic Soybean Pest Management for Evolving Agricultural Technologies and Cropping Systems	Grand I
Monday, April 7	8 AM–4 PM	CropLife International IPM Project Team	Caucus
	8 AM–5 PM	WCC 69–WRIPMC Meeting	Council
		SERA–IEG3 Meeting	Grand I
		NC IPM	Congress
		Certification Advisory Council	Cabinet
	8 AM–5:30 PM	NEREAP	Senate I & II
	5–8 PM	Registration	Grand Ballroom Lobby

Fourth National Integrated Pest Management Symposium

Tuesday, April 8	7–8 AM	Continental Breakfast and Informational Meeting for Session Organizers and Steering Committee	Grand I
	7–8:30 AM	Continental Breakfast	Grand Ballroom Lobby
	7:30 AM–6 PM	Registration	Grand Ballroom Lobby
	8:30–10:10 AM	**K1** Plenary Session—"Building Alliances for the Future of IPM"	Grand IV
	8:30 AM	Welcome and Introductions, Eldon Ortman, USDA	
	8:40 AM	IPM: Perceptions, Pitfalls, and Promises, Harold Coble, USDA	
	9:10 AM	How Hippos Learn to Dance: Building Public-Private Partnerships, Paul Helliker, California State Department of Pesticide Regulation	
	9:30 AM	Balancing the Landscape, Jack Erisman, Past Chair, Illinois Council on Food and Agricultural Research (C-FAR)	
	9:50 AM	Global Agriculture and the Environment—Lessons Learned about Reducing the Environmental Impacts of Agriculture at the Farm and Landscape Levels, Jason Clay, Center for Conservation Innovation, World Wildlife Fund	
	10:10–10:40 AM	Break	Grand Ballroom Lobby
	10:40 AM–12:30 PM	**K1** Plenary Session (continued)	Grand IV
	10:40 AM	Building IPM Alliances with Industry, Frederick A. Hegele, General Mills	
	11 AM	Technology and Service Innovation as a Unifying Focus for the Future of IPM, Scott H. Hutchins, Dow AgroSciences	

	11:20 AM	The Next Level: Return on Investment for IPM, Madeline Mellinger, Glades Crop Care Inc.	
	11:40 AM	Discussion	
	11:50 AM	The National IPM Roadmap, Eldon Ortman, USDA	
	12:05 PM	Whole Systems Thinking Applied to IPM	
	12:20 PM	Announcements	
	12:30–1:45 PM	Lunch on your own	
	12:30–5 PM	Poster Setup	Grand V
	1:45–3:15 PM	**A1*** Building Alliances between IPM Practitioners and Consumers	Grand I
		Q1 Integrated Pest Management in Organic Systems	Senate
		L1 Application and Prioritization of IPM Projects in Natural Areas	Congress
		I1 IPM and Urban Wildlife Pest Situations	Cabinet
		H2 Biological Control of Plant Pathogens	Caucus
		F4 IPM Issues in Urban Communities	Council
		B1 Marketing IPM	Convention Center 208
		E6 From Grower to Lab and Back: Advancing Orchard IPM through a Coordinated Program that Builds Partnerships	Convention Center 209
		S1 Nursery & Floriculture IPM: New Bridges to Tomorrow	Convention Center 210
		G6 Tools and Training Innovations	Convention Center 211
	3:15–3:30 PM	Break	Grand Ballroom Lobby and Convention Center
	3:30–5 PM	**A1** Building Alliances between IPM Practitioners and Consumers (continued)	Grand I
		G1 Federal Agency IPM Training and Certification	Senate
		L1 Application and Prioritization of IPM Projects Areas (continued)	Congress
		I2 Developing Training Materials for Nuisance Wildlife Control Operators	Cabinet
		H4 IPM and APHIS PPQ Regulatory Safeguarding Effort	Caucus
		F7 Good IPM in Wake of Legislation and Policies	Council
		B1 Marketing IPM (continued)	Convention Center 208
		E7 Barns, Bays, and Beans: Dynamic and Successful Partnerships	Convention Center 209
		S2 IPM in Commercial Greenhouses: How Can Biological Control Play a More Prominent Role?	Convention Center 210
		G7 Instructional Approaches K–16	Convention Center 211
	5–7 PM	Poster Session #1 and Reception Posters to be presented: D–Evaluation and Impact Assessment, F–Community (Urban) IPM, G–IPM Education and Outreach, and Q–IPM in Organic Systems	Grand V
	5–8 PM	Executive Committee of CICP Board of Directors	Cabinet

**Refers to session descriptions. See pages 14–29.*

	7–9 PM	**E9** "That Looks Great!" Rapport among IPM Communicators	Council
		National Pest Management Association Committee for IPM Certification for Pest Management Professionals Working in Schools	Congress
	7:30–9:30 PM	Southern Region Pest Management Center Advisory and Steering Committee	Senate
Wednesday, April 9	7 AM–5 PM	Registration	Grand Ballroom Lobby
	7–9 AM	Poster Session #2 and Continental Breakfast Posters to be presented: A–IPM Recognition and Incentive, B–Marketing IPM, H–Biological Control and Bio-based IPM, I–Vertebrate and Wildlife IPM, J–IPM in Perspective, K–Strategic Planning and Visioning for IPM, L–Invasive Species, M–Risk Assessment and Management, N–Biotechnology, R–Successes in Agricultural and Urban IPM	Grand V
	9:00–10:30 AM	**A2** The Role of Distributors, Wholesale and Institutional Buyers, Consumer Groups, and Retailers in IPM and Eco-labeling	Grand I
		G8 Developing IPM Education for Younger Audiences K-6	Senate
		E12 Building a National Plant Pest and Disease Diagnostics Network in Response to Potential Biological Attacks on U.S. Agriculture	Congress
		C1 Precision Agriculture, GPS/GIS	Cabinet
		E3 Face to Face: Fundamentals of Collaboration	Caucus
		P1 A Cropping Systems Centric View of the Landscape: IPM Centers without Borders	Council
		H1 Barriers to the Adoption of Biocontrol Agents and Biological Pesticides	Convention Center 208
		S3 Disease, Dispersal, Disaster—Animal Agriculture IPM at the Crossroads	Convention Center 209
		N1 Images of Sustainable Agriculture: Landscapes, Pest Management, and Biotechnology	Convention Center 210
		F6 IPM in Outdoor Environments	Convention Center 211
		D1 IPM Evaluation and Impact Assessment	Convention Center 212
	10:30–10:45	Break	Grand Ballroom Lobby and Convention Center
	10:45 AM–12:15PM	**A2** The Role of Distributors, Wholesale and Institutional Buyers, Consumer Groups, and Retailers in IPM and Eco-labeling (continued)	Grand I
		G11 Innovations in School and Community IPM Education	Senate
		C2 Dubious Products for Integrated Pest Management	Cabinet
		E4 You Can Do It Too: Necessary Skills for Building Collaborations	Caucus
		E11 Keys to Successful Partnerships—Develop Integrated Pest and Crop Management: Some Lessons from California	Congress
		H1 Barriers to the Adoption of Biocontrol Agents and Biological Pesticides (continued)	Convention Center 208

	G4 WeedSOFT: A New Approach in Integrated Weed Management	Convention Center 209
	N1 Images of Sustainable Agriculture: Landscapes, Pest Management, and Biotechnology (continued)	Convention Center 210
	F5 Delivering IPM to Community Residents	Convention Center 211
	D1 IPM Evaluation and Impact Assessment (continued)	Convention Center 212
12:15–1:45PM	Lunch on your own	
1:45–3:15PM	**N2** Role of CRW Transgenics in Corn IPM	Grand I
	J1 IPM Perspectives	Senate
	C3 Biorational Insecticides—Selectivity and Importance in IPM Programs	Congress
	P2 Global Climate Change and Its Implications for IPM	Cabinet
	G10 IPM Education: Takin' It to the Street	Caucus
	H3 Assessing the Impact of Inundatively-Released Biocontrol Fungi	Council
	A3 Opportunities for IPM Implementation in the New Farm Bill	Convention Center 208
	F1 School IPM: What Should be the Role of the Federal Government?	Convention Center 209
	O1 IPM CRSP	Convention Center 210
	E5 Beyond Partnerships: How Growers Really Adopt New IPM Technologies	Convention Center 211
	D1 IPM Evaluation and Impact Assessment (continued)	Convention Center 212
3:15–3:30 PM	Break	Grand Ballroom Lobby and Convention Center
3:30–5 PM	**J1** IPM Perspectives (continued)	Senate
	C3 Biorational Insecticides—Selectivity and Importance in IPM Programs (continued)	Congress
	G9 New Messages; New Messengers	Caucus
	P3 Putting Whole System Pest Management into Practice	Council
	A3 Opportunities for IPM Implementation in the New Farm Bill (continued)	Convention Center 208
	F2 Progress in State and Local School IPM Programs	Convention Center 209
	O2 Panel—The Future of Global IPM	Convention Center 210
	E1 Building Partnerships through Regional Pest Management Centers	Convention Center 211
	D1 IPM Evaluation and Impact Assessment (continued)	Convention Center 212
5–7 PM	Poster Session #3 and Reception Posters to be presented: C–New Management Technologies, E–Building Partnerships, O–International IPM, P–Systems Approach and Landscape Interactions, S–Commodity Related Topics. Remove posters after 7 PM—posters must be removed by 9 PM.	Grand V
6–9 PM	WCC-060	Congress

	6:30–8:30 PM	WRIPMC-PNW Coalition	Caucus
	7–9 PM	**E10** Coordinator to Coordinator: Sharing Expertise About State IPM Programs	Council
		Pest Management Centers Tech Group — Important Topics for IPM Webmasters	Cabinet
		IPM Schools Meeting for Implementers	Senate
		Synthesis Facilitators	Grand I
Thursday, April 10	7–8 AM	Continental Breakfast	Grand Ballroom Lobby
	7–9:30 AM	Registration	Grand Ballroom Lobby
	7:30–9:30 AM	**E8** Local Field Trip to a Certified Audubon Cooperative Sanctuary, Smock Golf Course. Space limited, sign up at symposium registration desk—meet in The Westin Lobby, bus leaves at 7:30 AM.	
	8–9:30 AM	**F3** Partnerships in School IPM	Grand I
		O3 Regulatory/Export Issues in International IPM	Senate
		G3 Delivering IPM Message through Service and Sales	Congress
		G5 University of Florida's Plant Medicine Program	Cabinet
		P3 Putting Whole System Pest Management into Practice (continued)	Council
		K2 Funding IPM	Convention Center 208
		D2 Countering IPM Adoption Risk in Agriculture	Convention Center 209
		G2 Aggregating IPM News: Navigating the Information Tsunami Efficiently with RSS	Convention Center 210
	9:30–9:45 AM	Break	Grand Ballroom Lobby
	9:45 AM–12 Noon	General Session Building Partnerships, Michael Fitzner, USDA-CSREES Synthesis: What Did We Learn?	Grand IV
	12 Noon	Adjournment	

Post-Symposium Meetings

	1–5 PM	**D1** IPM Evaluation and Impact Assessment	Council
	1–9:30 PM	CAST Management of Pest Resistance: Strategies Using Crop Management, Biotechnology and Pesticides	Grand I
	1–5:30 PM	IPM CRSP Technical Committee Meeting	Senate
Friday, April 11	8 AM–4 PM	CAST Management of Pest Resistance: Strategies Using Crop Management, Biotechnology and Pesticides	Capitol I
	8 AM–9 PM	IPM CRSP Technical Committee Meeting	Senate
Saturday, April 12	8 AM–6 PM	IPM CRSP Technical Committee Meeting	Senate

For information from specific sessions, including abstracts, summaries, and presentations, visit cipm.ncsu.edu/symposium.

To view symposium photos, visit www.ps.uiuc.edu and click on banner "Fourth National Integrated Pest Management Symposium."

roadmap

National Roadmap for Integrated Pest Management (IPM)

February 25, 2003

Introduction

The National Roadmap for the Integrated Pest Management (IPM) Program identifies strategic directions for research, implementation, and measurement activities needed to insure that the full benefits of IPM adoption are realized. Development of this roadmap began in February 2002 with a facilitated meeting attended by a broad range of stakeholders. Since then, the resulting document has evolved from continuous input from numerous IPM experts, practitioners, and stakeholders. This document represents, in part, a response to the recommendations made in the U.S. General Accounting Office (GAO) report on IPM that was issued in August 2001 (Agricultural Pesticides: Management Improvements Needed to Further Promote Integrated Pest Management).

Global markets for agricultural products demand high quality at competitive prices. Growers are challenged with meeting these market demands in the face of increasing production costs coupled with decreasing or unstable commodity prices. A diverse and evolving pest complex requires enhanced management skills on the part of IPM practitioners and may contribute to increased production costs. The implementation of new technologies such as genetically engineered innovations and precision agriculture will also increase the complexity of the competitive production systems of the future.

Pest management systems are under substantial pressure to change. Growers face uncertainty as to which conventional pesticides will continue to be available. Recent regulatory actions have restricted, or are phasing out, the use of several broad-spectrum insecticides and fungicides. Several widely used herbicides are being detected in drinking water supplies. Numerous pest species have developed resistance to commonly used pesticides, and some pest species have evolved and have overcome cultural management tactics such as crop rotation. Also, exotic, invasive species are creating unanticipated challenges in both agricultural and non-agricultural environments. Finally, consumer demands and public opinion are driving changes in the marketplace related to pest management practices. All of these clearly signal the need for the increased development and adoption of IPM practices in agriculture.

In recent years, federal and state governments have focused more attention on the interface of pests, pest management, and people in non-agricultural environments, including residential, recreational, and institutional facilities. The impact of exotic, invasive species in natural environments has received increased attention, and a highly successful IPM in Schools program has been developed through state and federal cooperation. These and other programs need major enhancement in order to adequately protect human health and the environment from pest impact and the attendant management tactics.

While there has been dramatic improvement in pest management practices during the last three decades, there continues to be a critical need to devise new options that serve user needs for economical management of pest populations while simultaneously protecting public health and the environment.

National IPM Program Goals

The goals of the National IPM Program are to improve the economic benefits related to the adoption of IPM practices and to reduce potential human health risks and unreasonable adverse environmental effects from pests and from the use of pest management practices. Each component of this goal is further described below.

Improve the economic benefits related to the adoption of IPM practices • A major determining factor in adoption of IPM programs is whether the economic benefit outweighs the cost to implement an IPM practice. While there may be many benefits from adoption of IPM practices, if new IPM programs are not as economically beneficial as practices already in place, new IPM programs are not likely to be adopted. Therefore, improving the overall economic benefit resulting from the adoption of integrated pest management practices is a critical component of the National IPM Program.

Reduce potential human health risks from pests and the use of IPM practices • Reducing potential risks to human health from pests as well as from practices used to manage pests has long been a goal of IPM programs. IPM programs need to be designed with the goal of reducing potential human health risks by reducing exposure of both the general public and workers to pests as well

as high-risk pest management practices, whether mechanical, chemical, or biological in nature. In the past, success in achieving the goal of reduced risk from pest management practices was measured by the annual amount of pesticides used in the United States. While pesticide use information is relatively easy to collect, without additional information, it is a poor indicator of human health risk.

Minimize adverse environmental effects from pests and the use of IPM practices • Natural resources may be adversely impacted by pests or by pest management practices. IPM programs need to be designed to protect natural resource environments from invasive species encroachment while minimizing unreasonable adverse effects on soil, water, air, and beneficial biological organisms.

National IPM Program Leadership and Coordination

The National IPM Program is a broad partnership of governmental institutions working with many stakeholders on diverse pest management issues. Leadership, management, and coordination of these IPM efforts will occur at several levels to more completely address the needs of program stakeholders.

At the federal level, the IPM program is a multi-agency effort and demands multi-agency coordination and collaboration. The National IPM Coordinating Committee will provide oversight of the program. This committee will be made up of representatives of the major participating federal agencies and departments. The role of the committee will be to establish overall goals and priorities for the program. The USDA IPM Coordinator will be responsible for preparing an annual report documenting IPM program initiatives and their performance. This report will be distributed to Congress, federal and state IPM partners, and the general public.

Regional IPM Centers will play a major role in implementation of this National IPM Roadmap. These regional centers will have a broad coordinating role for IPM and will invest resources to enhance IPM development and adoption.

National IPM Program Focus Areas

The National IPM Program will focus its efforts in three areas—production agriculture, natural resources, and residential and public areas. Priorities for each of these focus areas are identified below.

Production agriculture • Efforts are needed to advance IPM programs in major grain and fiber crops to reduce negative off-target impacts on the environment, particularly water quality. Minor acreage crops such as fruits, vegetables, and other specialty crops also need additional program focus to help maintain high quality produce while protecting agricultural workers and keeping dietary pesticide exposure within acceptable safety standards. Priorities in this area include the development and implementation of economical, effective IPM programs for crops and commodities consumed by humans. These crops, typically fruits and vegetables, make up a major portion of the human diet and require high human labor inputs for production. However, they generally have fewer effective pest management alternatives than the major acreage crops. This priority could have major impact on economic benefits and protection of public health, including worker protection.

Natural resources and recreational environments • Americans spend large amounts of leisure time in natural and recreational environments such as lakes, streams, parks, and athletic and sports facilities. Greater IPM efforts are required to maintain functional and aesthetic standards in these environments within a framework designed to minimize unreasonable adverse environmental effects on natural areas and protect public health.

The priority is the development and implementation of IPM programs that reduce off-target impacts. This priority could have major impact on reducing pesticide residues in water used for human consumption or for recreational purposes, as well as minimizing the effects of pesticides on non-target species.

Residential and public areas • The greatest general population exposure to pests and the tactics used to control them occurs where people live, work, and play. Initial IPM programs in these areas (IPM in Schools, IPM Program for Public Buildings) have been very successful and are excellent examples of education and model implementation programs designed for the institutional arena.

Priorities in this area include enhancing collaboration and coordination to expand these programs to other institutions and residential environments. There is broad agreement that expanding IPM programs in these areas would reduce potential human health risks and unreasonable adverse environmental effects from pest management practices.

Research Needs

Needed research in IPM ranges from basic investigations about pest biology to applied pest management tactics in specific crops or settings. The following list illustrates some of the research needs for a National IPM Program.

- Clarify pest biology and host/pest/climate interactions to identify cropping system and pest vulnerabilities.
- Develop advanced management tactics in specific settings (e.g., crops, parks, etc.), particularly those tactics related to prevention and avoidance of pests.
- Develop economical high-resolution environmental and biological monitoring systems to enhance our capabilities to predict pest incidence, estimate damage, and identify valid action thresholds.
- Develop new diagnostic tools, particularly for plant diseases and for detection of pesticide resistance in pest populations, including weeds.

- Improve the efficiency of suppression tactics and demonstrate least-cost options and pest management alternatives.
- Develop new generation, low risk suppression tactics, including products of biotechnology.
- Develop new delivery methods designed to expand the options for pest management systems.

Implementation Needs

In order to reach their full potential, IPM programs must be willingly adopted by agricultural producers, natural resource managers, homeowners, and the general public. The following activities will contribute to the adoption of IPM.

- Develop user incentives for IPM adoption reflecting the value of IPM to society and reducing risks to users. Work with existing risk management programs including federal crop insurance, and incentive programs such as NRCS Environmental Quality Incentive Program (EQIP) and other farm program payments to fully incorporate IPM tactics as rewarded practices.
- Provide educational opportunities for IPM specialists to learn new communication skills that enable them to engage new and unique audiences having specific language, location, strategy, or other special needs.
- Create public awareness and understanding of IPM and IPM programs through creative use of mass media and public service advertising.
- Leverage federal resources with state and local public and private efforts to implement collaborative projects.
- Ensure a multi-directional flow of pest management information by expanding existing and developing new collaborative relationships with public and private sector cooperators.

Measuring Performance of the National IPM Program

The Government Performance and Results Act of 1993 (GPRA) requires that federally funded agencies develop and implement an accountability system based on performance measurement, including setting goals and objectives and measuring progress toward achieving them. Accordingly, the performance of federally funded IPM program activities must be evaluated.

The establishment of measurable IPM goals and the development of a method to measure progress toward achieving the goals should be appropriate to the specific IPM activity undertaken. Performance measures may be conducted on a pilot scale or on a geographic scale and scope that corresponds to an IPM program or activity. Examples of performance measures follow.

Goal: To improve the economic benefits related to the adoption of integrated pest management practices.

Performance Measures:

- In cooperation with the National Agricultural Statistics Service (NASS), design a national IPM practices adoption survey based on IPM protocols designed for specific commodities or sites within program priorities.
- Evaluate IPM programs on their ability to improve economic benefits using pilot studies within specific program priority sites and project these economic results to a regional or national basis to predict large-scale impacts using results of the practices adoption survey.

Goal: To reduce potential human health risks from pests and the use of pest management practices.

Performance Measures:

- Using EPA's reduced risk category of pesticides as the standard, document changes in pesticide use patterns over time and relate the changes to IPM practice adoption.
- Relate dietary exposure to pesticides to IPM practice adoption using USDA Agricultural Marketing Service (AMS) Pesticide Data Program (PDP) and any other available data.
- Relate cases of negative human health impacts caused by pest incidence (ex. asthma cases related to cockroach infestation, insect vectored diseases, allergic reactions to plants) to IPM practice adoption.

Goal: To reduce unreasonable adverse environmental effects from pests and the use of pest management practices.

Performance Measures:

- Document and relate pesticide levels in specific ground and surface water bodies, including community water supplies, to IPM practice adoption using data from U.S. Geological Survey (USGS), the Natural Resource Conservation Service (NRCS), and others.
- Document and relate national indicators of natural resource health such as proportion of ground and surface water bodies with pest management-related contaminants and level of contamination to IPM practice adoption using data from EPA and others.
- Measure the impact of IPM practice adoption on encroachment of selected invasive species in national park lands and other sites where data are available.

whole systems

Whole Systems Thinking Applied to IPM

Two Conferences in One

We welcome you enthusiastically to the Fourth National IPM Symposium and pledge that it will be different than other conferences you've attended. Why? In addition to an extraordinary lineup of speakers and session organizers from around the country, plus hundreds of posters on successful IPM projects, we'll be offering you an opportunity to discover Whole Systems Thinking as it relates to IPM. You will be invited to participate in ways that relate your individual actions to intended actions at the national level, as described by the IPM Roadmap.

The *structure* of this symposium—how we use our time together and integrate our thoughts—will itself demonstrate a method of scientific inquiry that you can take back with you and put to work. So you'll gain knowledge on two levels: **content** (e.g., which IPM practices work, who does them, and why) *and* **form** (the "how-to" methodology of Whole Systems Thinking). Both will contribute to the future of IPM for yourself and for the nation.

What is Whole Systems Thinking?

Whole Systems Thinking is a process of inquiry that begins with the whole and integrates parts by naturally considering relationships and interactions within a whole system. As people explore a system, they focus on one part while automatically considering impacts, outcomes, consequences, and how one part influences other parts of the system. Let's examine this concept and how we are going to experience it during this symposium.

Whole systems inquiry relies on participants being involved in ways that are relevant, experiential, and collaborative. People draw a system, consider relationships, and look for "leverage"—or what part seems to create the greatest impact within the system, either positive or negative. We assumed that symposium topics might represent the whole system of this event, so we grouped biological topics in the center, with social and process topics around the outside (see the diagram). During the symposium, you will help develop functional relationships with arrows and feedback loops, perhaps also layering topics according to hierarchy and more.

The purpose of Whole Systems Thinking is to recognize the internal dynamics and complexity of most systems. The result focuses our attention on recognizing ways to improve decisions, systems, agencies, or groups, and to define ways to improve functional systems. Practicing IPM is a perfect example of a complex system that functions dynamically over time. The question is, "How do we research or deal with dynamic systems?" You will explore this aspect within the realm of the National IPM Roadmap and your personal involvement in IPM when you return home.

How You'll Apply Whole Systems Thinking to IPM

In your packet are two pads of sticky notes. You'll actually provide the symposium with data on these notes. After each session, poster, or conversation you have, we invite you to summarize your own "Aha!" experience or one you've shared with other participants.

The first question to answer (please use a green note) is "What novel idea(s) did you gain?" Attach the note with your answer to the appropriate newsprint sheet in your session, poster room, or hallway (there are many of these).

The second question to answer (please use a yellow note) is "What made this topic or project a success?" Again, attach the note with your answer to the appropriate newsprint sheet in your session, poster room, or hallway.

After a day or two, you and your colleagues will have written hundreds (thousands?!) of notes, all of which will be posted near the mega map in the poster room for everyone to consider. After each session, session leaders will summarize key points and post the synthesis on the mega map as a "living" or systemic document that grows and begins to function with a heartbeat and rhythm during the symposium. **During the symposium, drop by and see how topics relate, suggest relationships and feedback loops, note new insights or "Ahas!," and see what's happening.** By Wednesday evening, the organizing team and any volunteers who wish to help will group the notes for Thursday's Wrap-Up and Synthesis session.

The principles that we'll be working from in this process are to begin with a whole systems perspective; create a little tension or dissidence so that people are motivated to learn and can assess personal learning; and help learners visualize an improvement in their system, so they can base their actions on an inquiry system

that integrates process and IPM content. Activities will lead to renewal, resilience, and life-long systems over time.

For a picture of Whole Systems Thinking being applied to this symposium, turn to the diagram in this booklet.

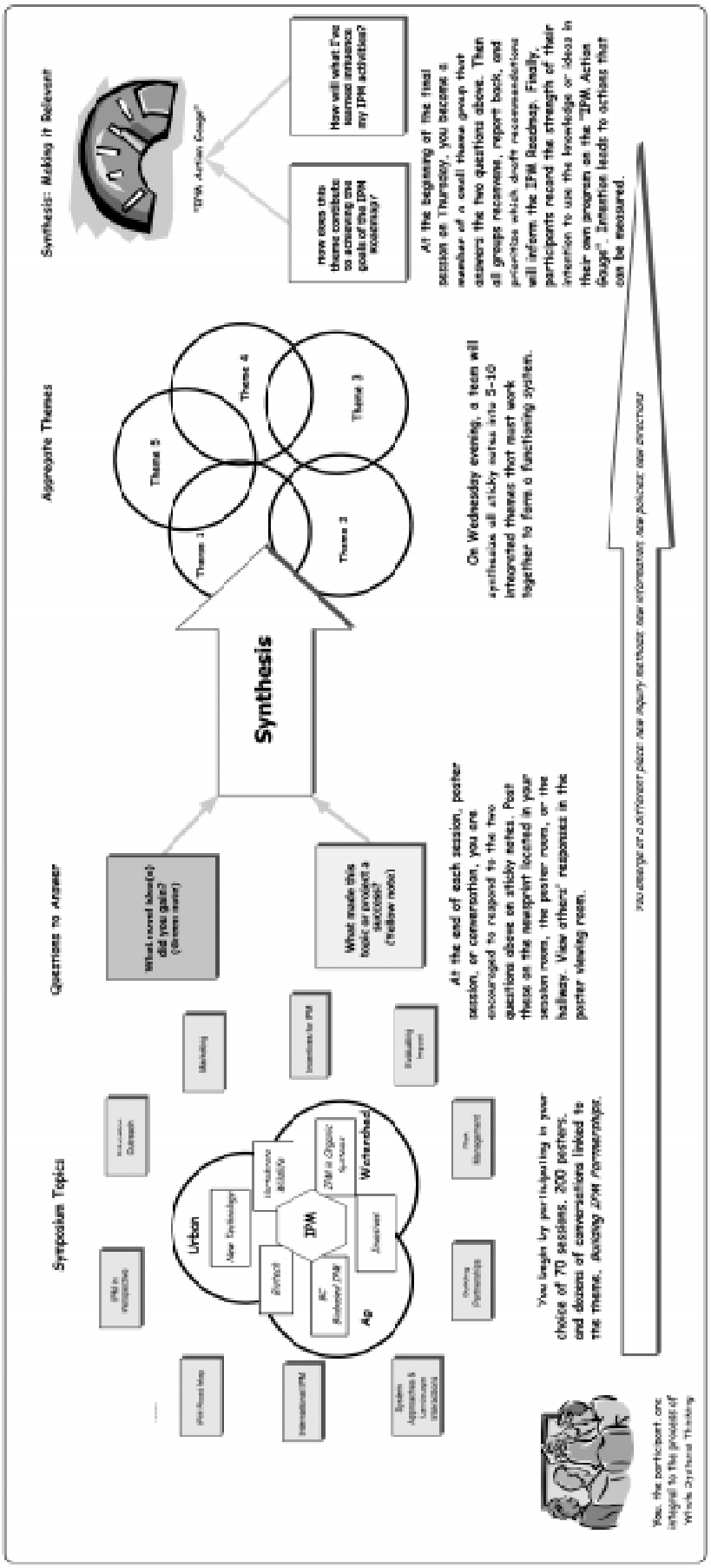
Thursday, April 10 • Final Plenary Session

As an active participant in "Applying Whole Systems Thinking to IPM," you were asked to identify novel ideas you learned and to post them. You also identified what made certain topics or projects a success, and again, you posted these. A team synthesized these and made suggestions for 5–10 subgroups, each of which will focus on an aspect of IPM.

In the first part of the Wrap-Up session, you are invited to: 1) participate in a theme group; 2) within that group, determine how your theme contributes to achieving the goals of the IPM Roadmap; and 3) articulate how the theme and what you have learned at the symposium will influence your IPM activities. Another way to express this last task is to ask yourself: "When I go home and someone asks me about this symposium, what will I say? What will I do Monday morning that reflects what happened here?" Focus on personal actions with measurable implications. Examples of themes might be new alliances, new actions, new thinking, or new integrations within disciplines. Each theme group will have a facilitator who will lead the process and report to the entire group during the second hour.

In the second hour, collective responses from theme groups will serve as both a baseline for comparison in future years, and the beginnings of recommendations to the USDA in regard to the IPM Roadmap. We'll record the responses and as a group, clarify priorities. In parting, each participant can take the opportunity to mark a dot on the "IPM Action Gauge" that gets at individual *intention*, which leads to *actions* that can be measured. We may also include an Action Gauge for your perception of how effectively the IPM Roadmap might reflect national priorities and plans to achieve success.

Organized by Ray D. William,
Carrie Koplinka-Loehr,
Peter B. Goodell, and Molly Engel



sessions

Fourth National IPM Symposium

Sessions have been organized around the following topics:

A. IPM Recognition and Incentive

The power of the marketplace is a long-recognized and under-utilized potential to drive IPM adoption in agriculture and communities. Market-based incentives for IPM include customer loyalty, price premiums, access to markets, reduced susceptibility to pesticide and other agri-scares, and cost-sharing for IPM practices. Our first session will focus on leading certification and labeling options for IPM growers, pest management professionals, and others. The second will address processor, retailer, food service, and consumer organization participation. The third session will address opportunities in the new farm bill for advancing IPM implementation including the Environmental Quality Incentives Program (EQIP), a federal cost-share program.

Coordinators: Tom Green, Curt Petzoldt

A1. Building Alliances between IPM Practitioners and Consumers

[Tuesday 1:45–5 PM]

IPM is currently used as a requirement in more than 15 certification and labeling programs in North America. A set of IPM practices is included in participant requirements, an audit process is used to verify compliance, and participants who pass the audit can use the label and supporting materials and programs to market their product or services. Leaders from these programs in the agricultural and community arenas will explain how their program operates, the ways in which participants benefit, methods used to document progress along the IPM continuum, and how IPM professionals can help support them in their work.

1:45 PM	Introduction to Session and IPM Institute, Thomas A. Green, IPM Institute of North America, Inc.
2:15 PM	A Comprehensive Eco-label Program: Food Alliance Certified, Ray Kirsch, Midwest Food Alliance
2:45 PM	The Protected Harvest Eco-label, Jeff Dlott, RealToolbox Inc.
3:30 PM	Development of National Integrated Fruit Production for the Canadian Apple Industry, Berndt Solymar, EarthTramper Consulting Inc.
4 PM	New England IPM Registry for the Structural Pest Management Industry, Craig Hollingsworth, University of Massachusetts
4:30 PM	IPM and Tropical Agriculture: Costs, Benefits and Challenges, Aimee Russillo, Rainforest Alliance

A2. The Role of Distributors, Wholesale and Institutional Buyers, Consumer Groups, and Retailers in IPM and Eco-labeling

[Wednesday 9 AM–12:15 PM]

Although several organizations are identifying IPM products, the number of supermarkets carrying IPM products and consumers who recognize the meaning of IPM remains small. We will explore the needs and experiences of wholesalers, brokers, retailers, and institutional buyers as they relate to IPM labeled products. Speakers will address questions such as: What would an organization or institution need to know to be interested in IPM labeled products? How would IPM products benefit a supermarket or institutional buyer's customers? Why might such an organization purchase IPM products preferentially? How might someone successfully sell IPM products to a supermarket or institutional buyer?

9 AM	Introduction to Session, Curt Petzoldt, New York IPM Program
9:10 AM	Consumer Education: Rating Eco-labels at Consumers Union, Urvashi Rangan, Consumers Union
9:35 AM	Food Processor IPM and Eco-label Opportunities and Experiences, Tom Facer, Agrilink Foods
10 AM	Food Service Company Interest in IPM and Eco-labels, Craig Watson, SYSCO
10:45 AM	Meeting the Needs of a University Dining Service for IPM and Eco-labeling, TBA
11:15 AM	Supermarket Perspectives on IPM and Eco-labels, Michael Maley, River Market Community Coop
11:45 AM	Panel Discussion Session with all speakers present

A3. Opportunities for IPM Implementation in the New Farm Bill

[Wednesday 1:45–5 PM]

Funding for conservation increased dramatically in the 2002 'Farm Bill'. Programs such as 'EQIP' and 'CSP' present significant

opportunities for incentivizing producer implementation of IPM. The NRCS—charged with implementing the conservation programs—is responsible for diverse environmental, natural resource, and farm management issues. Given the competing interests, IPM practitioners must become more engaged if IPM is to receive equitable attention. We must learn about the programs, advise NRCS in their design, and collaborate in their promotion and implementation. This session is designed to introduce the programs, clarify the opportunities, barriers, and issues involved, and provide a forum for discussion.

1:45 PM Opportunities for IPM Implementation in the New Farm Bill, Joe Bagdon, National Water and Climate Center, USDA-NRCS; Tony Bailey, Indiana State Office, Natural Resource Conservation Service, USDA; Michael Fitzner, IPM Program, USDA-CSREES; Lori Berger, California Minor Crops Council; Tom Fuchs, Texas Cooperative Extension, Texas A&M University; Curtis Petzoldt, New York State Agricultural Experiment Station, Cornell University; Robin Spitko, National Association of Independent Crop Consultants and New England Fruit Consultants; John Vickery, Independent Consultant; Melvin Womack, Conservation Operations Division, Natural Resource Conservation Service, USDA

B. Marketing IPM

IPM has done a great job of developing scientifically sound pest management programs for agriculture, forestry, and urban settings. Yet while we do good science, we don't always do a good job of "packaging" IPM programs, of communicating the *value* of IPM to wide-ranging audiences. In this session, we'll learn how all of us involved with IPM can improve our strategies and methods for marketing—and thus implementing—IPM. The workshop concludes with a 30-min. panel discussion; all speakers will be present: Topic: "Specific Steps to Improve Marketability of IPM."

Coordinators: Bill Hutchison, Mary Woodsen

B1. Marketing IPM

[Tuesday 1:45–5 PM]

1:45 PM Introduction to the Workshop: Who's the Audience? Presenting IPM to Unique Clientele Groups: Transition from Theory to Practice, Bill Hutchison, University of Minnesota

1:50 PM Connecting Growers and Customers: Eco and IPM Labels as a New Link in the Production-Grocer-Customer Chain, Rochelle Kelvin, Protected Harvest

2:20 PM Connecting with Growers and Crop Consultants: Communicating Economic Risks and Value of IPM, Jeff Gunsolus, University of Minnesota

2:50 PM Connecting with the Media/Press, Tammy Webber, Indianapolis Star

3:30 PM Connecting with Policy Makers, Carolyn Brickey, Protected Harvest

4 PM Improving your Marketing Skills: Snappy Prose for Dynamic Newsletters and Brochures, Mary Woodsen, Cornell University

4:30 PM Specific Steps to Improve Marketability of IPM, Bill Hutchison, Rochelle Kelvin, Jeff Gunsolus, Tammy Webber, Carolyn Brickey, Mary Woodsen, Lois Levitan, Cornell University

C. New Management Technologies

New technologies and novel approaches are needed to improve the cost-effectiveness, reduce the environmental impact, and increase the adoption by growers of IPM programs. Several such innovations will be discussed in sessions on the use of biorational pesticides and precision agriculture in IPM. The need for innovation in IPM has also resulted in the promotion by some entrepreneurs of unproven or fraudulent technologies and approaches. A third session entitled "Dubious Products for Integrated Pest Management" will explore a number of these failed, misguided, or fraudulent innovations.

Coordinators: Gary Felton, Michael Stout

C1. Precision Ag and GPS/GIS

[Wednesday 9–10:30 AM]

Information management and final use of that information is the center of future agricultural production and successful IPM programs. Precision agriculture is a broad concept involving comprehensive information management, rather than just variably applying inputs or making yield maps. As precision agriculture becomes more prevalent in today's agricultural production, it is necessary to determine what components are the most practical for and profitable to the grower.

9 AM Precision Agriculture, GIS/GPS, G. Kelly Robertson, McNeil Consulting; Brian Bangert, Funk Farms; B. Rogers Leonard, Louisiana State University; Charles Mellinger, Glades Crop Care; John Wagner, Precision Partners, Inc.

C2. Dubious Products For Integrated Pest Management

[Wednesday 10:45 AM–12:15 PM]

The occurrence of entomological fakes, frauds, and mistakes indicates a dynamic scientific field. Our rapidly advancing science almost guarantees that entrepreneurs will attempt to exploit unproven technologies or new scientific results which sound attractive to the layman. Large numbers of active scientists increase the probability that occasional mistakes will be made. Entomologists can benefit from examining the lack of science behind these fascinating, expensive, and sometimes humorous failures.

10:45 AM Introduction, John T. Trumble, University of California

10:50 AM Medical-Veterinary Entomology: Fads, Phonies, Fakes, and Frauds in Vector Suppression, Nancy C. Hinkle, University of Georgia

11:10 AM Vain Hopes and Last Resorts in Field and Forest Pest Suppression, Timothy D. Paine, University of California

11:30 AM Good Ideas Gone Bad in Structural Pest Control, Michael K. Rust, University of California

11:50 AM Curious, Cautionary, and Inexplicable Natural Products Used in Pest Control, John T. Trumble, University of California

C3. Biorational Insecticides—Selectivity and Importance in IPM Programs

[Wednesday 1:45–5 PM]

Biorational insecticides, which act on biochemical sites present in insects but not in mammals, have been developed and introduced for selective control of insect pests. Botanical insecticides, Bt and IGRs such as juvenile hormone mimics, ecdysone agonists, chitin synthesis inhibitors, and others, can serve as a base for IPM programs in various agricultural systems. Special attention will focus on their selectivity and suitability to be used as part of pest management programs in various agricultural systems, such as, field crops, ornamentals, orchards, and forestry.

1:45 PM *Bacillus thuringiensis*, an Important Agent in IPM Programs, Mark E. Whalon, Michigan State University

2:05 PM Novaluron (Rimon), a novel IGR, Selectivity and Importance in IPM Programs, Isaac Ishaaya, ARO, The Volcani Center, Israel

2:25 PM Botanical Insecticides, Important Agents in IPM Programs, Murray B. Isman, University of British Columbia

2:45 PM IPM in Forestry Using Rational Insecticides and Biological Control, Arthur Retnakaran, Canadian Forest Service

3:30 PM The Use of Biorational Insecticides in Vegetable Crops, Phyllis W. Weintraub, ARO, Gilat Research Center, Israel

3:50 PM Ecdysteroids, Selectivity and Importance in IPM Programs, Guy Smagghe, University of Ghent

4:10 PM Natural Enemy Interactions with Biorational Insecticides in Citrus, Beth Grafton-Cardwell, University of California

4:30 PM The Use of Non-conventional Insecticides in Ornamentals in Canada, Graeme Murphy, Ontario Ministry of Agriculture

D. Evaluation and Impact Assessment

Measuring impacts; evaluation techniques

Coordinator: Esther Day, Thomas Greitens

D1. IPM Evaluation and Impact Assessment

[Wednesday 9 AM–5 PM] and [Thursday 1 PM–5 PM]

The August 2001 GAO report (GAO-01-815) recommended certain changes to the IPM initiative. One of these changes included establishing objectives for IPM programs and developing a methodology for measuring those objectives. Since that time, there has been consensus in the IPM community and within federal agencies to measure three objectives of federally funded IPM programs. These include: 1) improving the economic viability of IPM programs; 2) using IPM as a way to reduce the risk to public health from farming practices; and 3) utilizing IPM as a way to reduce negative environmental impacts of farming practices. Through the development of a matrix we will establish a methodology to measure these new objectives. Four sessions and a half-day roundtable discussion deal with ways to develop this methodology. These four sessions are: Economic Assessment, Adoption and Pesticide Use, Environmental Assessment, and Health Risks.

Wednesday, April 9

9 AM Welcome and Introduction, Ann Sorensen, American Farmland Trust

9:10 AM IPM Assessment and Risk: Framing the Issues and Vocabulary, Scott Swinton, Michigan State University

9:25 AM Defining and Measuring Reduction in Adoption Risk, Tom Green, IPM Institute of North America, Inc.

9:40 AM Opening Remarks, Harold Coble, USDA

10 AM Economic Assessment, Scott Swinton, Michigan State University; Deana Sexson, University of Wisconsin

11:10 AM Adoption and Pesticide Use, Bill Coli, University of Massachusetts; Dennis Keeney, Institute for Agriculture and Trade Policy; Larry Wilhoit, California Department of Pesticide Regulation

1:45 PM Adoption and Pesticide Use Panel Discussion

2:20 PM Environmental Assessment, Charles Benbrook, Benbrook Consulting; Joseph Kovach, Ohio State University; Joe Bagdon, USDA - Natural Resources Conservation Service; Thomas Greitens, American Farmland Trust

4:45 PM Concluding Remarks, George Norton, Virginia Polytechnic Institute and State University

Thursday, April 10

1 PM Health Risks, David Pimentel, Cornell University; Bob Krieger, University of California, Riverside; Paul Ruther, Center for Health, Environment and Justice

2:45 PM Roundtable Discussion, Harold Coble, USDA, and Eldon Ortman, USDA, facilitators

4:45 PM Conclusions and Wrap Up: Where We Were and Where We Need to Go, Harold Coble, USDA

D2. Countering IPM Adoption Risk in Agriculture

[Thursday 8–9:30 AM]

When growers adopt IPM, they face the real risk that the system may fail and cost them money in any one year. This risk has been consistently identified as a barrier to IPM adoption in numerous studies over the past thirty years. How can risk be effectively countered as a disincentive? We'll hear from a processor how they address these risks to contract growers, an agchem retailer about an innovative program to reduce pesticide use and customer risk, and a new federal crop insurance program to reduce risks to farmers who adopt state extension-recommended nutrient Best Management Practices (BMPs).

8 AM Introductory Comments from Panel Members, William Bing, USDA Risk Management Agency; Brian Brandt, American Farmland Trust–Agricultural Conservation Innovation Center; Todd DeKryger, Gerber Products Company; Ray Young, Young and Young Consultants

8:40 AM AM Audience-led Panel Discussion

E. Building Partnerships; Examples and the Necessary Skills

What is the sound of one hand clapping? You may not need to puzzle over this if you learn to forge partnerships. For this conference topic, we won't just share what we know; we'll involve you from the moment you step up to the registration desk. Join us for sessions that draw upon the expertise of people from California to North Carolina, from Virginia to Oregon. In the 12 sessions that we've planned, you can gain the skills that are integral to forming successful partnerships, find out why some partnerships soar and others flop, glean specifics from dozens of public and private partnerships, then begin your own successful partnerships . . . and listen to the applause.

Coordinator: Carrie Koplinka-Loehr

E1. Building Partnerships through Regional Pest Management Centers

[Wednesday 3:30–5 PM]

This session will consist of five speakers (panel session) who will discuss their experiences in partnership building and the challenges, successes, and outcomes of these collaborations. There will be ample time for audience participation. This will be an interactive session. One of the major roles of the Regional Pest Management Centers is to encourage collaboration of pest management programs, growers, commodity groups, extension, researchers, state regulators, and others involved in pest management. This session will highlight several examples of partnership building.

3:30 PM Building Partnerships through Regional Pest Management Centers, John Ayers, Northeastern Pest Management Center, moderator; Joe Browde, California Association of Winegrape Growers; Keith Esplin, Potato Growers of Idaho; Todd DeKryger, Gerber Products Company; Kathy Murray, Maine Department of Agriculture; Russ Mizell, Southern Region Pest Management Center

E2. Cancelled

E3. Face to Face: the Fundamentals of Collaboration

[Wednesday 9 AM–10:30 AM]

How do you build collaborations? In this participatory session, you'll delve into the fundamentals of building a collaborative effort. Explore what a collaborative effort is and why it is important in our work. Then we'll learn how to go about involving key individuals and organizations, establish a common purpose and attainable goals, and make the best use of our collective assets to get the work done. We'll learn the keys to successful collaborative leadership by understanding leadership, communication, and group dynamics.

9 AM Face to Face: the Fundamentals of Collaboration, Janet Ayres, Purdue University, and Carrie Koplinka-Loehr, New York State IPM Program

E4. You Can Do It Too: Necessary Skills for Building Collaborations

[Wednesday 10:45 AM–12:15 PM]

Gain practical skills so you can answer: How do you identify stakeholders for a collaborative effort? How can you listen to understand rather than to argue? How do you build a common purpose and attainable goals? How do you take action? You'll leave this session with a better understanding of the skills needed to build and implement a collaborative effort.

10:45 AM You Can Do It Too: Necessary Skills for Building Collaboration, Janet Ayres, Purdue University, and Ray William, Oregon State University

E5. Beyond Partnerships: How Growers Really Adopt New IPM Technologies

[Wednesday 1:45–3:15 PM]

After decades of research, the adoption of new IPM technologies by growers has continued to be problematic and field results have often been elusive. At the same time, providing growers the ability and opportunity to adopt new IPM technologies is becoming increasingly important, as economic, international, regulatory, and environmental pressures have intensified. Even the most genial partnership is only a first step in getting new technologies implemented. Just as there are methods that guide a research experiment, there are also methods that can guide efforts to make the adoption of new technologies possible on a wide scale. Applying those methods starts with understanding how growers adopt new technologies and then taking the steps that make successful implementation more likely.

Using the work from wide-scale implementation projects in three different states and crops, we'll illustrate the principles necessary for increasing and maintaining the commercial use of new practices. Presenters will show how to overcome such common barriers as, "That may be true, but it won't work on my farm"; "If I had the time to farm by the book I wouldn't need to farm"; and, "All ethics start after breakfast."

Through the presentations and, the ensuing discussion, participants will have a better sense of what affects the pace of adoption, the concrete examples of how adoption was increased, and awareness of basic steps that can be used to improve the effectiveness of partnership efforts.

1:45 PM Beyond Partnerships: How Growers Really Adopt New IPM Technologies, Larry Elworth, Center for Agricultural Partnerships, moderator; Pat Weddle, Weddle, Hansen, & Associates; Nana Simone, Simone IPM Consulting; Larry Gut, Michigan State University

E6. From Grower to Lab and Back: Advancing Orchard IPM through a Coordinated Program that Builds Partnerships

[Tuesday 1:45–3:15 PM]

In this day of short-term funding and private-sector pest management alliances, what is the role of the land-grant university? We explore how an established statewide university infrastructure linking researchers/extension personnel/growers and consultants fostered and accelerated development and adoption of new IPM tools in orchard crops. Stakeholders will each present a case history relating how the partnership was important in achieving their goals. Discussion questions include:

- Does forming partnerships help implementation?
- What are the roles and limitations of partners and stakeholders?
- How can partnerships be maintained after short-term funding runs out?

1:45 PM From Grower to Lab and Back: Advancing Orchard IPM through a Coordinated Program that Buildings Partnerships

- Local County Cooperative Extension View, Bill Olson, UC Cooperative Extension, Butte County
- Campus-based Faculty/Researcher View, Nick Mills, University of California, Berkeley
- Regional IPM Advisor View, Carolyn Pickel, UC Statewide IPM Program, Sacramento Valley
- Statewide Resources for IPM Information, Mary Louise Flint, University of California Statewide IPM Program, Davis
- Grower View, Bill Chandler, Chandler Farms, Selma, CA
- How These Efforts Help a State Regulatory Agency Promote Least Risk Pest Management Practices, Bob Elliot, California Department of Pesticide Regulation

E7. Barns, Bays, and Beans: Dynamic and Successful Partnerships

[Tuesday 3:30–5 PM]

Speakers will discuss their experiences in partnership building and the challenges, successes, and outcomes of these collaborations. There will be ample time for audience participation. This will be an interactive session. Speakers from the American Farmland Trust, Bay Area Contra Costa Project, Chesapeake Bay Alliance, and Protected Harvest will present some of the most difficult hurdles, rewards, and benefits of their collaborative efforts. To illustrate, for several years in the San Francisco Bay area, agencies have formed IPM partnerships with more than 150 hardware stores and nurseries to encourage consumers to use less toxic products when they have pest problems. You will learn how to get retailers interested in IPM, what kind of store employee IPM training program works, and how to get more IPM products on the store shelves.

3:30 PM Barns, Bays, and Beans: Dynamic and Successful Partnerships, Sherry Glick, Environmental Protection Agency, moderator; Bart Brandenburg, Bay Area Contra Costa Project; Rebecca Wertime, Alliance for Chesapeake Bay; Ann Sorensen, American Farmland Trust; Carolyn Brickey, Protected Harvest

E8. Local Field Trip to a Certified Audubon Cooperative Sanctuary

[Thursday 7:30–9:30 AM]
Meet at 7:30 AM in The Westin hotel lobby to board the bus. Space is limited; sign up at symposium registration desk.

Audubon International's premiere education program, The Audubon Cooperative Sanctuary System (ACSS), educates people about environmental stewardship and motivates them to take action in their daily lives that will enhance and protect wildlife and their habitats and conserve natural resources. Programs for homeowners, businesses, schools, and golf courses tailor information to the unique setting and needs of each member.
The golf course program has been shown to increase wildlife habitat; decrease the use of pesticides, fertilizer, and water; while improving playing quality, boosting patron interest and loyalty; and enhancing job satisfaction. This two-hour field trip will provide an opportunity to learn more about this successful program while visiting Smock Golf Course, a municipal golf course which was designated as a Certified Audubon Cooperative Sanctuary in February 2002.

7:30 AM Tour of a Certified Audubon Cooperative Sanctuary, Joellen Zeh, Audubon International; Jan Tellstrom, Smock Golf Course

E9. "That Looks Great!" Building Rapport among IPM Communicators

[Tuesday 7–9 PM]

Got an urge to show off that brochure you produced last year? Or let someone see how clever your Web site has become? Maybe even share a public service announcement that you wrote? Bring your publications, your computer, your colleague, or just yourself to this session where you can learn from IPM communicators about their educational and promotional feats. Designers, Webmasters, writers, editors, teachers, and learners all welcome. Informal, inclusive format.

7 PM "That Looks Great!", Carrie Koplinka-Loehr, NYS IPM Program

E10. Coordinator to Coordinator: Sharing Expertise about State IPM Programs

[Wednesday 7–9 PM]

State IPM coordinators share many challenges, most having very limited experience and resources. Moreover, they operate in different organizational structures and have a wide range of areas of emphasis. Some IPM coordinators are new while others have well established, highly successful programs. It will be very beneficial for expertise to be shared among IPM coordinators to determine how best to perform their duties, such as establishing a responsive IPM contact point, providing information, identifying expertise, documenting successes, assisting with funding, conducting small-scale demonstration projects, and supporting and encouraging implementation of IPM in county extension programs and ultimately by clientele.

7 PM Coordinator to Coordinator: Sharing Expertise about State IPM Programs, Norman C. Leppla, University of Florida IPM Program; Michael Fitzner, USDA-CSREES

E11. Keys to Successful Partnerships - Develop Integrated Pest and Crop Management: Some Lessons from California

[Wednesday 10:45 AM–12:15 PM]

Speakers will provide first-hand insights into public-private partnership initiatives in California, with a focus on efforts to implement biologically integrated farming systems (BIFS). BIFS projects demonstrate whole farming systems that are less reliant on pesticides and synthetic nitrogen, with similar yields and quality. The projects recognize the importance of grower and consultant participants as demonstrators of alternative farming systems. Speakers will highlight outcomes and keys to progress in the partnerships, stressing elements that enabled people to work together successfully to achieve changes in grower practices and attitudes. We'll address bridging environmental and agricultural interests, plus measuring impact and success, including commodity-specific surveys and the use of California's unique pesticide use report (PUR) database to track changes in agricultural chemical use.

10:45 AM Keys to Successful Partnerships, Jenny Broome, University of California-Davis, moderator and speaker; Jeff Dlott, RealToolbox, Inc.; Joe Grant, University of California Cooperative Extension (Walnut BIOS Project)

E12. Building a National Plant Pest and Disease Diagnostics Network in Response to Potential Biological Attacks on U.S. Agriculture

[Wednesday 9–10:30 AM]

USDA CSREES in partnership with APHIS and six land grant universities are creating a rapid response plant diagnostics system to help counter bioterrorist threats to U.S. agriculture. This session will describe how the network is developing and how it will fit into our overall response to the terrorist threat. The session will provide an excellent opportunity to explore how existing IPM infrastructure and systems can link with and strengthen this diagnostics and early warning system.

9 AM Building a National Plant Pest and Disease Diagnostics Network in Response to Potential Biological Attacks on U.S. Agriculture, Robert S. Zeigler, Kansas State University

F. Community (Urban) IPM

"Community IPM" is pest management for the non-agricultural sector, including structures, schools, homes, landscapes, golf courses, parks, rights-of-ways, and more. These environments span urban, suburban, and rural settings. Community IPM sessions will run throughout the conference, focusing on the latest, up-to-the minute techniques, solutions, and challenges facing integrated pest management. IPM implementation, fruitful partnering, success stories, and challenges will be discussed in depth using panel presentations, audience participation, and case studies. Unique programs for delivering IPM information to community residents will be presented for both outdoor and structural pests. The impact of legislation and policies that mandate or prescribe IPM, illustrated by examples from several municipalities, also will be discussed.

Coordinators: Jennifer Grant, Tim Gibb

F1. School IPM: What Should Be the Role of the Federal Government?

[Wednesday 1:45–3:15 PM]

This session will focus on legislation, the role of the Federal Government, and voluntary implementation of IPM in Schools vs. legislative mandate. This session will include panel presentations and continue on with discussion. The following organizations will be represented on the panel: U.S. Environmental Protection Agency, National Pest Management Association, National Coalition against the Misuse of Pesticides—Beyond Pesticides, and Responsible Industry for a Sound Environment.

1:45 PM What Should Be the Role of the Federal Government for IPM in Schools?, Mike Merchant, Texas A&M University; Sherry L. Glick, U.S. Environmental Protection Agency; Carl Martin, Arizona Structural Pest Control Commission; Bob Rosenberg, National Pest Management Association; Kagen Owens, Beyond Pesticides; Allen James, Responsible Industry for Sound Environment (RISE)

F2. Progress in State and Local School IPM Programs

[Wednesday 3:30–5 PM]

This session will address effective approaches to encourage implementation of school IPM on local and state levels. Speakers will make brief presentations on different approaches to implementing IPM in school districts, the role of EPA-funded regional centers, Internet resources, and economic impacts. Session participants will discuss in small groups (by geographical region, if possible) status of school IPM, successful techniques to encourage IPM adoption, and needs assessment (research, outreach, and/or regulatory).

3:30 PM Progress on State and Local IPM Programs, Lynn Braband, Cornell University; Marc Lame, Indiana University; Bobbie Corrigan, RMC Pest Management Consulting; Carl Martin, State of Arizona; Kagen Owens, Beyond Pesticides; Dan Dickerson, New York City Schools; Lynn Hawkins, KnowPesticides; John Carter, Monroe County School Corporation; Gene Harrington, National Pest Management Association

F3. Partnerships in School IPM

[Thursday 8–9:30 AM]

To have a well working School IPM Program, it takes committed partners. This session will feature local and national organizations that can help you as you build your School IPM Program. This session will include panel members from The IPM Institute, National Pest Management Association, Local School Board Official, Federal Government, Extension, Parent Teacher Association, and Environmental Group: Improving Kids Environment.

8 AM Building Partnerships to Implement School IPM, Sherry Glick, U.S. Environmental Protection Agency; Tom Green, IPM Institute; Al Greene, U.S. General Services Administration; Bob Rosenberg, National Pest Management Association; Dawn Gouge, Extension Arizona IPM; Tim Gibb, Indiana School Board Trustee; Tom Neltner, Improving Kids Environment (IKE)

F4. IPM Issues in Urban Communities

[Tuesday 1:45–3:15 PM]

The session offers a broad perspective on Community IPM issues, particularly in urban environments. "Community IPM" is everything beyond production agriculture, including, homes, schools, buildings, landscapes, parks, and golf courses—the places where we live, work, and play. Whether you are currently working in this area, or just considering it—the session should be of interest to everyone. After all, we all live in communities! Presenters include an environmental advocate, a university researcher, and a private pest management practitioner.

1:45 PM A National Perspective on Community IPM, Kagan Owens, Beyond Pesticides

2:05 PM Pests at the Agriculture-Urban Interface, Joe Kovach, Ohio State University

2:25 PM Challenges and Successes in Implementing Structural IPM in the Private Sector, David L. Shangle, Dalsh Consulting, Inc.

F5. Delivering IPM to Community Residents

[Wednesday 10:45 AM–12:15 PM]

Unique methods for delivering IPM information directly to residents of urban, suburban, and rural communities will be presented. Three successful programs will be showcased, followed by audience discussion of other noteworthy examples from around the country.

10:45 AM The Minnesota Urban Pesticide Initiative Program, Collie Graddick, Minnesota Department of Agriculture

11:05 AM Delivering IPM Information to the California Public Through Master Gardeners, Retail Nursery Personnel and the Web, Mary Louise Flint, University of California

11:25 AM The Grow Green Program, Robert (Skip) Richter, Texas A&M University

F6. IPM in Outdoor Environments

[Wednesday 9–10:30 AM]

Outdoor environments in communities include parks, yards, landscaped public grounds, golf courses, and many, many miles of rights-of-ways for roads, railroads, and utilities. Learn the latest about what IPM practices are being researched and implemented in these diverse settings.

9 AM Challenges and Opportunities for IPM in Fine Turf Management, Frank Rossi, Cornell University

9:20 AM IPM for Landscapes: Striving for Sustainability, Paula Shrewsbury, University of Maryland

9:40 AM Integrated Vegetation Management, Art Gover, The Pennsylvania State University

F7. Good IPM in Wake of Legislation and Policies

[Tuesday 3:30–5 PM]

This session will focus on the challenges and innovations of communities adopting regulations that reduce the use of pesticides. From phase-outs to complete bans on aesthetic uses, speakers from California, Canada and New York will discuss how legislation to reduce or eliminate municipal pesticide use has encouraged the adoption of IPM. Approaches, hurdles, unusual

pest management situations, and success stories will be highlighted from a variety of communities. Also learn about evaluating pesticides for use in a reduced risk pest management program.

3:30 PM	The Story of New York's Municipal Pesticide Phase-Outs, Jody L. Gangloff-Kaufmann, Cornell Community IPM Program
3:55 PM	Getting Past Pesticides: San Francisco's IPM Program, Debbie Raphael, City/County of San Francisco
4:20 PM	Voluntary Turf Integrated Pest Management Accreditation, An Alternative to Municipal Pesticide Bans in Canada, Pamela Charbonneau, Ontario Ministry of Food and Agriculture

G. IPM Education and Outreach

People who can benefit from understanding and using IPM are as diverse as the environments in which they live, work, and play. As a result, education and outreach programs must be designed to be effective for a broad range of audiences, both professional and general public. Speakers in a series of sessions will focus on innovative and successful education and outreach efforts for multiple audiences including:

1. Production agriculture (New Tools for Agricultural Professionals)
2. K-16 students and faculty (IPM Curriculum and Instructional Approaches)
3. General publics (many): (Public Community IPM Outreach: Beyond the Fact Sheet)
4. Federal agency employees and administrators (Federal Agency IPM Training)

Coordinator: Lyn Garling

G1. Federal Agency IPM Training and Certification

[Tuesday 3:30–5 PM]

IPM provides a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks (US Code Sec. 136r-1.). A number of federal agencies either have a strong policy mandate (e.g., DOI: NPS, FWS, BLM), or are required by law (e.g., USDA agencies; see US Code Sec. 136r-1.) to increase the adoption and implementation of IPM. Currently, the opportunities for IPM training among federal agencies are inadequate, making it difficult for such agencies to comply with IPM policy mandates or legal obligations. Hence, it is imperative that increased opportunities be provided for IPM education and training of employees among federal agencies, particularly those connected to agricultural, land management, and/or natural resource missions. Increasing the quality and consistency of IPM training and implementation among federal agencies will help ensure that the most economically feasible and sustainable programs are developed for the management of pests on federal lands in the future. This workshop will explore the justification, benefits, and feasibility of developing a program for Federal Inter-Agency IPM Training and Certification. In addition, the pros and cons of developing a harmonized system for pesticide applicator certification will be discussed.

3:30 PM	Introduction, Expectations for Workshop, and Conceptual Model for Federal Agency IPM Training and Certification, Robert M. Nowierski, USDA-CSREES
3:40 PM	Example of Short Course Module for Federal Agency-Specific IPM Training, Rob Wiedenmann, Illinois Natural History Survey
3:50 PM	Current Federal Agency IPM Training and Certification—Department of Interior, Gina Ramos, Bureau of Land Management; Department of Agriculture, Rita Beard, U.S. Forest Service; Department of Defense, Lieutenant Colonel David West, Department of Defense
4:10 PM	Current State, Private, and Non-Profit IPM Training and Certification, University of California Statewide IPM Program, Mary Louise Flint, University of California-Davis; NAICC's CCAs, Robin Spitko, New England Fruit Consultants
4:30 PM	Merits of Federal Agency IPM Certification, Pete Egan, Department of Defense; Rita Beard; Carol DiSalvo, National Park Service
4:45 PM	Merits of Harmonized Pesticide Applicator Certification, Rob Hedberg, Weed Science Society of America; Gina Ramos; Major Lisa O'Brien, Department of Defense

G2. Aggregating IPM News: Navigating the Information Tsunami Efficiently with RSS

[Thursday 8–9:30 AM]

Find out how this new Internet technology improves your ability to keep up with many sources of information in less time. Hear real-world experiences from a novice user, from someone who has successfully used RSS in a private company, and from a Webmaster.

8 AM	What is RSS and Why is it Such a Breakthrough?, John K. VanDyk, Iowa State University
8:20 AM	RSS: A User's Perspective, Jim VanKirk, NYSAES
8:40 AM	How RSS Saves Time: an RSS Success Story, David Detlefsen, Novatia LLC
9 AM	Implementing RSS, Matt Westgate, Iowa State University

G3. Delivering IPM Messages through Service and Sales

[Thursday 8 AM–9:30 PM]

Studies have shown that consumers seek pest management information at point-of-purchase (goods or services) more often than from any other source. How can quality IPM information be dispensed via these outlets? Speakers in this session will relate experiences from three innovative programs to educate PCOs, retail personnel and consumers.

8 AM Potential for IPM Education through Certification for PCOs**,** Bart Brandenburg, Consultant

8:20 AM Successes in Consumer IPM Education through Point-of-Purchase, Steve Bogash, Penn State University CES

8:40 AM "Our Water, Our World" Public Outreach Program: A Partnership among Pollution Prevention Agencies, Retail Stores and Master Gardeners, Tanya Drlik, BIRC

G4. WeedSOFT: A New Approach in Integrated Weed Management

[Wednesday 10:45 AM–12:15 PM]

WeedSOFT® is a decision support system designed to assist growers, consultants, and extension educators in making weed management decisions. This interactive software is currently being used in seven North Central states. This session will explain how WeedSOFT® works as a decision aid and as an educational tool in explaining biological principles associated with weed management decisions. There will be a panel of weed scientists from the participating North Central states that will be there to discuss and answer questions on how this software is being used in each of these states. Audience participation is encouraged in this session.

10:45 AM WeedSOFT: A New Approach in Integrated Weed Management, Christy L. Sprague, University of Illinois; Alex R. Martin, University of Nebraska; Chris Boerboom, University of Wisconsin; Anita Dille, Kansas State University; James Kells, Michigan State University; Bill Johnson, Purdue University; Brent Sellers, University of Missouri

G5. University of Florida's Plant Medicine Program

[Thursday 8–9:30 AM]

In response to the increasing need for plant health practitioners, in 1999 the University of Florida established a unique interdisciplinary graduate program that confers a Doctor of Plant Medicine (D.P.M.). Students master all aspects of plant medicine through completion of 120 graduate credits in the plant sciences, entomology, plant pathology, nematology, and pest management. During multiple internships, students exchange ideas with academic and industry professionals, and apply their skills to practical situations. Information will be presented on the nature of the program including required courses and internships, supervisory committees, and the interests and career plans of current students.

8 AM Overview of the University of Florida's Plant Medicine Program, Robert J. McGovern, and Norman C. Leppla, University of Florida

8:10 AM Giving Urban Homeowners an "IPM Toolbox": An Internship in Extension, Esther Dunn, University of Florida

8:30 AM Golf Course Internship: Integrated Turf Management, Stephanie M. Dickerson, University of Florida

8:50 AM A Summer Internship In Sonoma County, Ca: Managing Vineyard Pests, Monica L. Cooper, University of Florida

G6. Tools and Training Innovations

[Tuesday 1:45–3:15 PM]

IPM professionals working with growers face multiple challenges. How do we navigate the flood of information and put it in useable form? Or keep up with changes relevant to both pest forecasting, IPM tactics, and producers' needs? To be effective, advisors and producers need to have real-time information in a user-friendly format. Hands-on, up-to-date training for advisors and models for effective interaction with farmers is also key to effective IPM implementation. Experienced IPM practitioners in this session will share their innovative tools and approaches in each of these areas.

1:45 PM Treasure Valley Pest Alert Project, Ben Simko, Oregon State University CES

2:05 PM Electronic Information Transfer: Better than a Farm Call, Tim Weigle, New York State IPM

2:25 PM NE IPM Training Modules & T.A.G. Teams, Keith Waldron, New York State IPM

2:45 PM A New Path for Continuing Education: The Crop Advisor Institute, Brent Brueland, Iowa State University

G7. Instructional Approaches K-16

[Tuesday 3:30–5 PM]

IPM problem-solving is by nature interdisciplinary. This creates challenges and opportunities at the instructional level. Increasingly, K-12 curricula are utilizing real-world scenarios to teach concepts impacting science and society. Where and how does IPM fit? Two speakers present their programs' approaches to integrated curricula. Additionally, university level IPM focus provides the link connecting theory and practice for tomorrow's IPM professionals.

3:30 PM Challenges and Opportunities for IPM K-12, Ed Rajotte, Penn State University

3:50 PM Statewide Purple Loosestrife Project and Curriculum, Michael Klepinger, Michigan State University

4:10 PM Teaching Concepts in Integrated Pest Management, Robert Norris, University of California-Davis

G8. Developing IPM Education for Younger Audiences (K-6)

[Wednesday 9–10:30 AM]

Why wait to change the mind of adults? Start with the kids! Young children can learn elementary steps involved in an IPM approach through creative activities and curricula. Speakers in this session will describe materials they developed for youngsters and why and how they are working.

9 AM Urban IPM Curriculum for Elementary School, Erica Jenkins, Michigan State University

9:20 AM Join Our Pest Patrol: IPM Adventure for Kids, Jean Ciborowski, Minnesota Department of Agriculture

9:40 AM Who Wants to Be an IPM Super-Sleuth?, Tom Green, IPM Institute

G9. New Messages; New Messengers

[Wednesday 3:30–5 PM]

Studies have shown that the public does not generally seek out information from our university extension sources as a first option—many do not even know these resources exist. How can we bring IPM education out to the public in innovative ways by reaching them where they DO go? Speakers in this session will describe new approaches and provide tools for hitting the airwaves effectively.

3:30 PM The BugMobile! A Talking Car: The Outer Limits of Outreach? Michelle Niedermeier, Penn State, Pennsylvania IPM Program

4 PM Hit the Spot: How to Produce Radio PSAs (hands-on workshop), Jill Shultz, NYS IPM Program

G10. IPM Education: Takin' it to the Street

[Wednesday 1:45–3:15 PM]

The non-farm general public is "the other 98%" who makes pest management decisions or are impacted by decisions made by others. An educated, empowered citizen is the key to widespread demand and therefore implementation of IPM. Reaching general public audiences of all ages, cultures, classes, professions, and environments demands accurate knowledge about the audience, development of new materials and above all, creativity and flexibility in approach. The speakers in this series will describe a wide array of such innovations targeting apartment building residents, neighborhood homeowners and renters, and city workers.

1:45 PM Educational Tools for Participatory IPM in an Urban Housing Development, John Knight, Safer Pest Control, Chicago, IL

2:05 PM Key Elements for IPM Outreach and Education in a Low-Income Community, Pat Bobo, Al Bakey Jr., Parents Together, Ypsilanti, MI

2:25 PM Implementing City-Wide IPM: Educational Strategies for Educating and Re-training City Employees, Debbie Raphael, City of San Francisco

G11. Innovations in School and Community IPM Education

[Wednesday 10:45 AM–12:15 PM]

IPM is real-world problem solving. Students actively involved in IPM implementation creates a model and highly effective way of teaching applied science concepts AND reaching out to the students' home communities with the IPM message. Speakers in this session will describe three highly innovative approaches that have been undertaken in Michigan.

10:45 AM The Roach Patrol: Real World Science in Action, Michael Jones and students, Cass Tech High School, Detroit, MI

11:05 AM Infusing IPM Education at the School District Level, Don Scott, Assistant Superintendent of Schools (ret), Saginaw Area School District/G.A.P. Program

11:25 AM Strategies for Linking School and Community IPM Education**,** Larry Swain, Michigan Department of Agriculture

H. Biological Control and Bio-based IPM

This topic will focus on biological control and bio-based strategies for the management of arthropods, weeds, and diseases. Specific sessions will address: 1) barriers to the adoption of biocontrol agents and bio-pesticides; 2) biocontrol of plant pathogens; 3) assessing the impact of inundatively-released biocontrol fungi; 4) management of non-target impacts of biocontrol; and 5) IPM and the regulatory world from APHIS-PPQ.

Coordinator: Bob Nowierski

H1. Barriers to the Adoption of Biocontrol Agents and Biological Pesticides

[Wednesday 9 AM–12:15 PM]

The adoption of biologically-based pest control products, such as microbial pesticides, pheromones, and plant derived biochemicals in IPM systems has lagged chemical solutions. Biological pesticides provide safe, environmentally friendly, and effective solutions that can shine if given the chance to be incorporated into IPM systems. This workshop will review the barriers to adoption of new biological alternatives for pest management. It will include perspectives from growers, pest control advisors, distributors, university researchers, IR-4, and the Biopesticide Industry Alliance. The outcome of the workshop is to develop concrete solutions to overcoming the barriers to increase their adoption in IPM systems.

9 AM Barriers to the Adoption of Biocontrol Agents and Biological Pesticides, Barry Wilk, Scientific Methods; Pam Marrone, AgraQuest, Inc.; Fred Betz, Eden Bioscience Corporation; Gary Libman, Emerald BioAgriculture; Robert Holm, IR-4; John Trumble, University of California-Riverside; R. Charudattan, University of Florida; Richard Bonanno, University of Massachusetts; Steve Balling, Del Monte

H2. Biological Control of Plant Pathogens

[Tuesday 1:45–3:15 PM]

This session will focus on the incorporation of biologically-based tactics in disease management as well as impediments to expanded adoption of biopesticides. Three speakers with expertise in soil biological diversity and the practical use of biocontrol strategies for disease management will be invited to discuss their perspectives on development and use of biologicals and composts to suppress plant diseases. The session format will allow each speaker 20 minutes followed by a panel discussion with questions from the audience and from the organizers that will focus on how

disease management programs can benefit from increased adoption of bio-based tactics.

1:45 PM Green Manures and Soil Community Management to Suppress Plant Diseases, Linda L. Kinkel, University of Minnesota

2:05 PM Integrating Biological Controls for Management of Field and Storage Diseases of Potato, Barry J. Jacobsen, Montana State University

2:25 PM Successes as a Distributor of Biocontrol Products, Jan C. Meneley, AgBio Development, Inc.

2:45 PM Discussion on the Status of Biologically Based IPM Strategies for Disease Management, Walter R. Stevenson, University of Wisconsin; Jana S. Lamboy, New York State IPM Program

H3. Assessing the Impact of Inundatively-Released Biocontrol Fungi

[Wednesday 1:45–3:15 PM]

Fungi used for pest control in IPM settings, in most cases, have been released inundatively. There are (usually) well-documented impacts on the target organism but often unknown impacts on non-target organisms. These may be closely related to the fungus or the target and they may be clearly beneficial. In this session we will review research findings, address regulatory hurdles, and identify future needs for evaluating the impact of inundatively applied fungi for control of pests—insects, plant pathogens, and weeds. There will be ample time for questions and discussion of challenges facing the use of fungi for pest management.

1:50 PM Mycoherbicides, Raghavan Charudattan, University of Florida

2:08 PM Fungi for Plant Pathogen Control, Robert P. Larkin, USDA ARS

2:26 PM Mycoinsecticides, John D. Vandenberg, USDA ARS

2:44 PM Mycoinsecticides - Regulations and Risks, Stefan T. Jaronski, USDA ARS

H4. IPM and APHIS PPQ Regulatory Safeguarding Effort

[Tuesday 3:30–5 PM]

Federal stewardship for safeguarding U.S. agriculture and its natural ecosystems from threats posed by invasive insect pests, diseases, and weeds is the responsibility of USDA APHIS PPQ. Agency efforts are directed toward a significant list of both exotic pests (not yet established in the U.S.) and those pests once considered exotic or limited in range that have become invasive. Regulatory priorities are established on the basis of risk analysis. APHIS PPQ utilizes many principles common to the discipline of IPM to design programs to detect, identify, treat, and monitor pests, diseases, and weeds on the regulatory radar screen. State-of-the-art science is continuously monitored for advances that can improve the agency's ability to deliver effective, economic, and environmentally rational programs. The presentations in this session will highlight the infrastructure and provide details on select model programs that illustrate the strategies, technologies, and processes and partnership opportunities with university and industry that are employed by APHIS PPQ to protect U.S. agriculture.

3:30 PM Creating a Science-Based Platform for Federal Regulatory IPM and Eradication Programs, David T. Kaplan, USDA, APHIS, PPQ, CPHST

3:50 PM Plant Pest Surveys and the U.S. Safeguarding Continuum, Daniel Fieselmann, USDA, APHIS, PPQ, CPHST

4:10 PM Biological Control of Pink Hibiscus and Papaya Mealybugs, Dale Meyerdirk, National Biological Control Institute

4:30 PM Biological Control of Rangeland Weeds, Richard Hansen, National Weed Laboratory, USDA, APHIS, PPQ, CPHST

I. Vertebrate and Wildlife IPM

Problems involving wildlife as pests have increased over the last three decades. An important and growing component includes nuisance wildlife in communities. A private wildlife control industry has developed to address these concerns. Two sessions at the Fourth National IPM Symposium will address urban wildlife pests and the wildlife control industry. The first session will track the development of the wildlife control industry and assess its needs. The second session will discuss the development of associated training materials. Both sessions will engage all participants in small group interactions and result in recommendations for action.

Coordinator: Mike Hoffman

I1. IPM and Urban Wildlife Pest Situations

[Tuesday 1:45–3:15 PM]

In recent years, wildlife as pests in urbanized situations has developed into a major issue. The scale of this development was largely unanticipated, even by those involved. This session will summarize the history of the wildlife control industry and provide perspectives from both a state wildlife agency and a state pest management regulatory agency. The relevance of IPM concepts to urban wildlife control will be discussed. Session participants will interact with each other on the nature of urban wildlife control, the role of pesticides, and educational/outreach needs.

1:45 PM History and Growth of the Wildlife Control Industry, Mike Faler, Critter Control, Inc.

1:55 PM Development of the Wildlife Control Industry as a Trade/Profession, Tim Julien, National Wildlife Control Operators Association

2:05 PM A State Wildlife Agency Perspective, TBA

2:15 PM A State Pest Management Regulatory Agency Perspective, Larry Swain, Michigan Department of Agriculture

2:25 PM IPM Paradigms and Urban Wildlife Control, Lynn Braband, NYS IPM Program

2:35 PM Assessment/Needs Discussion, Lynn Braband, Larry Swain

I2. Developing Training Materials for Nuisance Wildlife Control Operators

[Tuesday 3:30–5 PM]

With the growth of the private sector's involvement in nuisance wildlife control, the need exists for the development of appropriate training materials. In this session, we will introduce a "best practices" curriculum being developed by New York State. There also will be opportunities for other states and organizations to share their training materials. Session participants will then discuss the next steps for improving the training of nuisance wildlife control operators: identification of needs; means to support/encourage current efforts; and the value of partnerships in the development of training materials.

3:30 PM IPM and Urban Wildlife Pest Situations, Jill Shultz, NYS IPM; Lynn Braband, NYS IPM; Paul Curtis, Cornell University

J. IPM in Perspective

IPM can be viewed from many vantage points. This session will provide a venue for sharing various points of view about the implementation of IPM in the field. Invited participants come from a wide range of backgrounds including cooperative pest management district, crop protection industry, private consultants, and policy consultants. Those attending this session will have information to consider for their own situations including the opportunities and possibilities presented by dynamic speakers. Speakers will be requested to provide resource material including a list of relevant and useful Web sites as well as their PowerPoint presentation in note format.

Coordinators: Allison Jones, Kim Crum

J1. IPM Perspectives

[Wednesday 1:45–5 PM]

1:45 PM Introduction, Pete Goodell, University of California Statewide IPM Program

1:50 PM Implementing IPM with Other Production Systems, Cliff Omart, Lodi-Woodbridge Winegrape Commission

2:20 PM How the Crop Protection Industry Can Promote and Succeed with IPM, John L. Perry Jr., Bayer CropScience

2:45 PM IPM Partnerships, Burleson Smith, USDA-OPMP

3:30 PM Reality Check, Leonard Gianessi, National Center for Food and Agricultural Policy

4 PM Take Home Message, Al Averitt, Protech Advisory Services Inc.

4:20 PM Open Discussion, Pete Goodell

4:45 PM Closing Remarks, Pete Goodell

K. Strategic Planning and Visioning for IPM: The Roadmap and Beyond

What does the future hold for IPM beyond the roadmap?; needs and constraints.

Coordinator: Ed Rajotte

K1. Building Alliances—Opening Session

[Tuesday 8:30 AM–12:30 PM]

8:30 AM Welcome and Introductions, Eldon Ortman, USDA

8:40 AM IPM: Perceptions, Pitfalls, and Promises, Harold Coble, USDA

9:10 AM How Hippos Learn to Dance: Building Public-Private Partnerships, Paul Helliker, California State Department of Pesticide Regulation

9:30 AM Balancing the Landscape, Jack Erisman, Past Chair of Illinois Council on Food and Agricultural Research (C-FAR)

9:50 AM Global Agriculture and the Environment—Lessons Learned about Reducing the Environmental Impacts of Agriculture at the Farm and Landscape Levels, Jason Clay, Center for Conservation Innovation, World Wildlife Fund

10:10 AM Break

10:40 AM Building IPM Alliances with Industry, Frederick A. Hegele, Director of Quality Control and Regulatory Affairs, General Mills

11 AM Technology and Service Innovation as a Unifying Focus for the Future of IPM, Scott H. Hutchins, Dow AgroSciences

11:20 AM The Next Level: Return on Investment for IPM, Madeline Mellinger, Glades Crop Care Inc.

11:40 AM Discussion

11:50 AM The National IPM Roadmap, Eldon Ortman, USDA

12:05 PM Whole Systems Thinking Applied to IPM

12:20 PM Announcements

K2. Funding IPM

[Thursday 8–9:30 AM]

The scope of Integrated Pest Management has broadened beyond production agriculture to include natural resource and recreational environments as well as residential and institutional facilities. As this transition continues, the dynamic activities associated with this discipline will encounter changing funding realities and opportunities. This moderated session will consist of three panelists to give a federal, state, and private sector perspective of future IPM funding challenges and prospects.

8 AM Introduction, Bill Hoffman, CSREES/PAS

8:15 AM Federal Funding Perspective, Michael Fitzner, IPM Program, USDA-CSREES

8:30 AM Private Funding Perspective, Ann Sorensen, American Farmland Trust

8:45 AM State Funding Perspectives, Bill Coli, University of Massachusetts

L. Invasive Species

The movement of people, livestock, and equipment into natural areas to support recreation, forestry, livestock production, mining, firefighting and other efforts has increased the rate of range expansion of invasive species in wildlands and waterways. In many cases, invasive species cause a combination of economic, environmental, and health threats. The impacts of invasive species and the need to protect natural resources has increased demand for IPM approaches on a wide range of habitat types. Invasive species have become a high priority for natural resource managers; coordinated efforts are needed to address this growing problem.

Coordinator: Janet Clark, Chris Dionigi

L1. Application and Prioritization of IPM Projects in Natural Areas

[Tuesday 1:45–5 PM]

Effective invasive species IPM in natural areas presents managers with unique challenges: a spectrum of pest species, a paucity of management tools and information, vast and remote (and often multi-jurisdictional) resource areas, and possibly threatened and endangered species, and other sensitive resources. Limited management resources, land that has a low direct economic value, and other conditions require managers to strategically prioritize projects, identify and apply efficient practices, and partner with others. Case studies of terrestrial and aquatic IPM programs will be examined. Discussions will identify effective approaches to project prioritization and develop recommendations for high-priority research needs.

1:45 PM The Need for IPM Project Prioritization in Natural Areas, Chris Dionigi, National Invasive Species Council

2:30 PM Using NEPA as an Assessment Tool, Rita Beard, U.S. Forest Service

3 PM Discussion

3:30 PM Responses to Plant Invasion, Bill Gregg, U.S. Geological Service

3:50 PM Case Study: TEAM Leafy Spurge, Gerry Anderson, USDA Agricultural Research Service

4:10 PM Lygodium Task Force, Amy Ferriter, South Florida Water Management District

4:30 PM Discussion

M. Risk Assessment and Management

Defining economic, environmental, and health risks: measuring risks; crop consultants perspective; insurance

Coordinator: Tom Green

Merged with Evaluation and Impact Assessment; see Session D.

N. Biotechnology

Biotechnology has changed the face of American agriculture over the past decade, with broad adoption of insect-protected corn and cotton and herbicide-tolerant corn, cotton, and soybeans. Yet never in the history of agriculture have technologies been scrutinized as much as transgenic plants. Many scientists believe that transgenic crop plants will be important tools for integrated pest management and sustainable agriculture. Other scientists question these benefits. These sessions will consider positive and negative aspects of biotechnology in terms of pest management and sustainable agriculture. A new type of transgenic crop plant, corn that is resistant to corn rootworms, also will be considered.

Coordinators: Rick Hellmich, Graham Head

N1. Images of Sustainable Agriculture: Landscapes, Pest Management and Biotechnology

[Wednesday 9 AM–12:15 PM]

This session will examine the role of current commercial biotech crops in Integrated Pest Management systems and the potential of future products to further change agricultural practices. Presentations and discussions will assess advantages and disadvantages of biotech crops relative to land use, sustainable agriculture, ecological impact, biodiversity, and control of non-target pests. Attention also will be given to how information technologies can be used to evaluate new agricultural technologies.

9 AM Scope of Land use Issues Related to Agriculture—the Really Big Picture, Fred Kirschenmann, Leopold Center for Sustainable Agriculture

9:30 AM Role of Biotechnology for Sustainable Agriculture, Richard L. Hellmich, USDA-ARS

9:50 AM Ecological/Biodiversity Impacts of Sgricultural Practices, and Role of New Technologies in Minimizing or Mitigating these Impacts, Graham Head, Monsanto LLC

10:10 AM Information Technology Tools for Sustainable Agriculture, Joe Russo, ZedX, Inc.

10:50 AM Impacts of Ag Biotech Crops on Secondary Non-target Pest Control, Galen Dively, University of Maryland

11:10 AM Panel discussion; debate format, including all previous speakers

N2. Role of CRW Transgenics in Corn IPM

[Wednesday 1:45–3:15 PM]

With the commercialization of corn rootworm (CRW) transgenics, it is important to consider the role of this new technology in relation to existing corn production systems that utilize integrated pest management. This session will identify issues related to the use of CRW transgenics in IPM production systems including prophylactic vs. prescriptive use of the technology. Following introductory remarks, an eight member panel will

discuss with the audience integration of transgenic hybrids into integrated pest management production systems and the potential impact on alternative pest management options. This session will be highly interactive and audience members will be encouraged to ask questions and participate in the discussion.

1:45 PM The Role of Corn Rootworm Transgenics in Corn IPM, Susan T. Ratcliffe, University of Illinois at Urbana-Champaign; Michael E. Gray, University of Illinois at Urbana-Champaign; Lance J. Meinke, University of Nebraska; Jon J. Tollefson, Iowa State University; Paula Davis, Pioneer Hi-Bred International, Inc.; Ty T. Vaughn, Monsanto Company; Frederick L. Kirschenmann, Leopold Center for Sustainable Agriculture; Eldon Gould, Illinois Corn Grower; Joe Russo, ZedX, Inc.; Tom Slunecka, National Corn Growers' Association

O. International IPM

Success stories around world, roles of NGOs; USDA, IPM CRSP; FAO, USDA

Coordinator: Doug Pfeiffer

O1. IPM CRSP

[Wednesday 1:45–3:30 PM]

The Integrated Pest Management Collaborative Research Support Program is an international program supported by USAID. Although the mangement entity is Virginia Tech, researchers from 13 universities as well as USDA comprise the American side of the project. The project includes a wide range of other countries in widely separated regions: Africa (Mali, Uganda, Egypt, Eritrea and Ethiopia), Central America (Guatemala), South America (Ecuador), South Asia (Bangladesh), Southeast Asia (Philippines), Caribbean Islands, and Eastern Europe (Albania). There is a participatory emphasis in all sites, with host scientists, in-country stake holders, and American cooperators arriving at the central pest management problems and constraints to their solution, before designing IPM research programs. This symposium presents talks representative of our CRSP. For those interested in more detail on work in each of our sites, the CRSP meeting following this symposium will include progress in each country.

1:45 PM Introduction, Douglas G. Pfeiffer, Virginia Tech University

1:50 PM The Participatory Spproach to IPM Research, George Norton, Virginia Tech University

2:10 PM Grafting Eggplants: Transplanting a Technology Across Regions, Sally Miller, Ohio State University

2:30 PM Whiteflies: Pests across Regions, Bob Gilbertson, University of California-Davis

2:50 PM Gender Issues in International IPM, Sally Hamilton, University of Denver

3:10 PM Overview of IPM CRSP Sites, E. A. Heinrichs, Virginia Tech University

O2. Panel—The Future of Global IPM

[Wednesday 3:45–5 PM]

Adoption of IPM internationally has multiple obstacles, each of which may be most visible from the perspective of selected interest groups. Yet international IPM workers must often interact to further adoption of IPM, while each working within the confines of their own group. This panel will allow representatives of several types of international programs to present their own experience and viewpoints.

3:45 PM University Perspective, S. K. DeDatta, Virginia Tech University; Federal Perspective, Bob Hedlund, U.S. Agency for International Development; Global, FAO Perspective, TBA; International Centers Perspective, Abdelaziz Lagnaoui, World Bank; NGO Perspective, Monica Moore, Pesticide Action Network; Keith Jones, CropLife

O3. Regulatory/Export Issues in International IPM

[Thursday 8–9:30 AM]

Crop production, including pest management aspects, is an activity that occurs in an increasingly global marketplace. Consequently, importing countries are more interested in exotic pests and pesticide residues entering the country, and growers in exporting countries must sometimes deal with regulatory restrictions of multiple potential market countries. Producers of plant protection products must deal with regulations in multiple countries as well. New approaches such as genetically modified organisms (GMOs) pose problems with adoption with their associated controversy in various countries. Speakers in this symposium will be discussing their experience with a range of issues that affect international IPM.

8 AM Introduction, Douglas G. Pfeiffer, Virginia Tech University

8:05 AM Registering Soft Chemicals, Iain Wetherston, Technology Sciences Group Inc.

8:25 AM The Prospects for GMOs in International IPM, John Foster, University of Nebraska

8:45 AM Organic Certification in International Agriculture, Jim Simon, Rutgers University

9:05 AM Soybean: International Ramifications of IPM, Antonio Panizzi, Embrapa-Labex IPM USDA/ARS

P. Systems Approach and Landscape Interactions

Design, execution, analyses; ecosystem approach to pest and crop management; building multidisciplinary teams; concept and tools in ecosystem analysis

Coordinator: Jerry DeWitt

P1. A Cropping Systems Centric View of the Landscape: IPM Centers without Borders

[Wednesday 9–10:30 AM]

Cropping systems performance and pest interactions are largely influenced by the soil/climate space and management. IPM Centers are actively defining research and outreach priorities and fostering collaboration on projects within and between regions, regions that are often politically defined. This panel discussion will outline techniques for developing a spatially explicit framework for defining agroecoregions, explore pest management examples, and consider ways of facilitating a more spatially explicit approach to pest management research and priority setting. Approximately half of the allotted time will be dedicated to presentations, the other half to facilitated discussion.

9 AM	An Agroecoregional Approach to Pest Management, Dave Mortensen, Penn State University
9:20 AM	A Spatially Explicit Approach to Pest Management Problems: An International View, Jeffrey W. White, U.S. Water Conservation Laboratory, USDA-ARS
9:40 AM	Thinking outside the Regional Box, Mike Fitzner, CSREES-USDA

P2. Global Climate Change and Its Implication for IPM

[Wednesday 1:45–3:15 PM]

The session will introduce studies on implications of climate change to agriculture and expected scenarios for integrated pest management.

1:45 PM	Global Climate Change and Its Implication to Crop Production: Examples from the SoyFace Project, Stephen Long, University of Illinois at Urbana-Champaign
2 PM	Potential Impacts of Projected Climatic Change on European Corn Borer Biology, Ecology, and Management in the Northeastern U.S., Dennis Calvin, Penn State University
2:15 PM	Impact of Climate Change on Disease and Pest Pictures, Implication to IPM development, X.B. Yang, Iowa State University
2:30 PM	Crop-weed Competition as Influenced by Elevated CO2, Anil Shrestha, University of California
2:45 PM	The Effects of Projected Climate Change on Pest Treatment Costs, Bruce McCarl, Texas A&M University

P3. Putting Whole System Pest Management into Practice

[Wednesday 3:30–5 PM] and [Thursday 8–9:30 AM]

The background behind a whole system approach to pest management will be discussed. Speakers will then explore practical ways to put the concepts of whole system pest management into practice. The focus will be on the multiple tactics that can be used to strengthen plant defense mechanisms, enhance beneficial organisms, and stress pests. Speakers will concentrate on practices that decrease crop damage from weeds, diseases, nematodes, and insects.

3:30 PM	An Overview of Whole System Pest Management, Joe Lewis, USDA-Agricultural Research Service
4 PM	Creating and Maintaining Healthy Soils, Fred Magdoff, University of Vermont
4:30 PM	Decreasing Insect Pests by Ecosystem Management, Jason Harmon, University of California-Davis
8 AM	Soil and Crop Management Practices for Minimizing Damage by Nematodes and Diseases, George Abawi, Cornell University
8:30 AM	Ecological Approaches to Weed Management, Matt Liebman, Iowa State University
9 AM	A Farmer's View of Whole System Pest Management, Fred Kirschenmann, Leopold Center for Sustainable Agriculture

Q. IPM in Organic Systems

IPM principles, strategies, and tactics are highly applicable and adaptable to organic agricultural systems. Conventional farmers and ranchers nation-wide are increasingly interested in approaches to integrated pest management for organic systems since the release of USDA organic certification standards in 2002. Current applied research and extension programs are providing successful field-based working models of pest management for organic growers. Field crop, fruit, and vegetable organic production systems will be discussed and research and educational needs will be identified to support the growing organic agriculture field for small and conventional-sized producers.

Coordinators: Jerry DeWitt, Geoff Zehnder

Q1. Integrated Pest Management in Organic Systems

[Tuesday 1:45–3:15 PM]

1:45 PM	IPM Principles in California Organic Crops, Sean Swezey, University of California-Santa Cruz
2:15 PM	Organic Pest Management Approaches in Midwest Cropping Systems, Kathleen Delate, Iowa State University

R. Successes in Agricultural and Urban IPM

Traditional research reports, accomplishments in extension/outreach, results of surveys

Coordinator: Mike Hoffman

No formal sessions; see poster presentations.

S. Commodity Related Topics

Commodity related sessions present information on a specific commodity and are ideal for interacting with colleagues with similar commodity interests. The sessions will provide a venue for making new contacts for future collaborations and interactions.

Coordinator: Tom Fuchs

S1. Nursery and Floriculture IPM: New Bridges to Tomorrow

[Tuesday 1:45–3:15 PM]

Successful development and implementation of IPM strategies under the current funding trends will increasingly depend on effective integration at the geographical, institutional, and disciplinary levels. Our session will showcase on-going efforts to achieve such integration within the nursery and floriculture industry. Participants will provide insight on how truly integrated programs may be developed and implemented across international borders, between industry and academic partners, between growers and scientists, researchers and extension specialists, and among scientific disciplines.

1:45 PM Science, Success and Viability of Floriculture IPM, Kevin M. Heinz, Texas A&M University

2 PM Plant Health and Its Role in Sustainable IPM Systems, P. Allen Hammer, Purdue University

2:15 PM Optimizing IPM Efforts: The Role of Industry-Academia Interactions, Richard K. Lindquist, Olympic Horticultural Products™

2:30 PM Grower Perspectives on IPM Adoption and Implementation, Lin Schmale, Society of American Florists

2:45 PM The Role of Economics in Facilitating and Assessing Horticultural IPM Programs, George Norton, Virginia Tech University

3 PM Multi-disciplinary Approaches to IPM Delivery in Ornamental Crops, Carlos E. Bogran, Texas Cooperative Extension

S2. IPM in Commercial Greenhouses: How Can Biological Control Play a More Prominent Role?

[Tuesday 3:30–5 PM]

Historically, biological control has played a minor role in pest management programs for greenhouse floricultural crops in the United States. Economic factors represent one key impediment to greater adoption. This symposium will discuss how biological control can gain greater acceptance among commercial growers and, ultimately, play a more prominent role in greenhouse IPM programs. Presentations will address use of integrated crop management to increase production efficiency and natural enemy efficacy, compatibility between chemical control and biological control, case studies that evaluate economic feasibility of biological control for two different greenhouse pest-crop systems, and a grower's perspective on scouting for pests.

3:30 PM Introduction and Overview, Raymond A. Cloyd, University of Illinois at Urbana-Champaign

3:40 PM Developing an Integrated Crop Management Program for Ivy Geraniums, George P. Opit, Yan Chen, James R. Nechols, Kimberly A. Williams, David C. Margolies, Kansas State University

3:55 PM Economic Feasibility of Biological Control for Twospotted Mite on Ivy Geraniums, Thomas L. Marsh, Sara Schumacher, Terry Kastens, Kansas State University

4:10 PM Economic Feasibility of Biological Control for Whiteflies on Poinsettias, Roy Van Driesche, University of Massachusetts; John P. Sanderson, Cornell University

4:25 PM Integrated Pest Management in Greenhouses: Are Pest Control Materials and Natural Enemies Compatible?, Raymond A. Cloyd, University of Illinois at Urbana-Champaign

4:40 PM Scouting for Pests from a Commercial Grower's Perspective, Joe Boarini, Grande Greenhouse, Inc.

4:55 PM Concluding Remarks, James R. Nechols, Kansas State University

S3. Disease, Dispersal, Disaster—Animal Agriculture IPM at the Crossroads

[Wednesday 9–10:30 AM]

Animal agriculture IPM is a significant component of a whole farm approach to pest management. Developing sound IPM programs and managing arthropod pests in these production systems is challenging but made even more so by potential concerns over off site movement of livestock pests at the rural urban interface, the loss of some management options through development of insecticide resistance, the impacts of FQPA, and other factors. This session will provide a brief overview of veterinary entomology, examples of IPM activities in today's animal production systems, and some insights into the challenges and role livestock IPM may face in the future.

9 AM Animal Agriculture IPM: Setting the Stage, J. Keith Waldron, NYS Integrated Pest Management Program, Cornell University

9:15 AM Why Can't We All Just Get Along?, An Overview of Livestock IPM in a Changing World, Bradley A. Mullens, University of California, Riverside

9:30 AM Animal Agriculture IPM in Action–Implementation in the Real World, Nancy C. Hinkle, University of Georgia

9:45 AM Ag-Urban Interface: Legal Aspects of Animal Agriculture in Today's Urban Sprawl, Ralph H. Williams, Purdue University

10 AM Vectors, West Nile Virus and Veterinary Entomology, Phillip E. Kaufman, Cornell University

10:15 AM Food Borne Pathogens, New Horizons for IPM Threshold Development, D. Wes Watson, North Carolina State University

poster abstracts

Three poster sessions will be held: Tuesday 5–7 PM, Wednesday 7–9 AM, and Wednesday 5–7 PM. Poster sessions will be divided by topic. While all posters will be displayed throughout the symposium, authors are asked to be by their posters according to this schedule:

Tuesday 5–7 PM	D–Evaluation and Impact Assessment, F–Community (Urban) IPM, G–IPM Education and Outreach, and Q–IPM in Organic Systems
Wednesday 7–9 AM	A–IPM Recognition and Incentive, B–Marketing IPM, H–Biological Control and Bio-based IPM, I–Vertebrate and Wildlife IPM, J–IPM in Perspective, K–Strategic Planning and Visioning for IPM, L–Invasive Species, M–Risk Assessment and Management, N–Biotechnology, R–Successes in Agricultural and Urban IPM
Wednesday 5–7 PM	C–New Management Technologies, E–Building Partnerships, O–International IPM, P–Systems Approach and Landscape Interactions, S–Commodity Related Topics

A1-P IPM Institute of North America: Resource for IPM Certification in Agriculture and Communities

*Thomas A. Green[1], Gina K. Walejko[1], Danielle S. Cassidy[1] and Curtis H. Petzoldt[2]

[1]IPM Institute of North America, Inc., 1914 Rowley Ave., Madison, WI 53726, USA

[2]Cornell University, IPM Program, 630 W. North St., NYSAES, Geneva, NY 14456, USA

The IPM Institute is an independent non-profit organization formed in 1998 to foster recognition and rewards in the marketplace for goods and service providers who practice IPM. The Institute educates consumers about IPM and assists companies and organizations to assess IPM performance. Current projects include online resources for school IPM, a collaboration with the University of Florida and industry to increase adoption of IPM practices in the woody ornamentals industry, a cooperative project with American Farmland Trust to protect IPM practitioners from financial risk, development and maintenance of IPM assessments for the Food Alliance (www.thefoodalliance.org), certification and training for IPM program auditors, and IPM STAR® certification for organizations, professionals, and pest management products and services. The Institute is funded by grants from government and foundations and support from members, and directed by a seven-member board including representatives from land-grant universities, non-governmental organizations and industry. Visit www.ipminstitute.org for links to more than 18 certification and ecolabel programs that use IPM as a requirement for participation.

**indicates Senior Author*

B1-P Talking about West Nile Virus Prevention and Control—Opportunity for a Public Conversation About IPM

* Lois Levitan

Environmental Risk Analysis Program, Center for the Environment, Cornell University, Rice Hall, Ithaca, New York, 14853 USA

In 1999 West Nile Virus emerged as a mosquito-borne threat to public health in the Northeast United States. Since then—and as its range has expanded throughout the U.S, into five provinces of Canada, and likely into Central and South America, affecting wildlife, farm animals, and people—West Nile Virus has garnered four seasons of intense media coverage and the focused attention of several high-level government agencies.* While the terms of the debate have rarely been in the traditional parlance of Integrated Pest Management, the issues of environmental, health, and financial risk reduction are familiar. Because of sustained public interest, the costly experience of an emergency response, and increased attention to public health in the context of biosecurity, the development and implementation of West Nile Virus prevention and control plans afford an excellent opportunity for introducing and reiterating the principles and practices of IPM, both in the media and with policy-makers across a spectrum of government agencies and disciplinary foci.

*At the Federal level, these agencies include the Centers for Disease Control, the Food and Drug Administration, and the National Institute of Health, all in the Department of Health and Human Services; the Animal and Plant Health Inspection Services in the Department of Agriculture; Geological Services and National Wildlife Health Center in the Department of the Interior; and the Environmental Protection Agency.

B2-P The Development of the Healthy Grown Brand: The WWF/WPVGA/UW Collaboration Story

*Deana Sexson[1], Jeff Wyman[1], Randy Duckworth[2], Mike Carter[2], Clif Curtis[2], Jeb Barzen[2], Andy Wallendal[2], Nick Somers[2], Chuck Benbrook, Jeff Dlott[3] and Kit Schmidt[1]

[1]Dept. of Horticulture, NPM Program, University of Wisconsin, Madison, WI 53706 USA

[2]WWF/WPVGA/UW Collaboration Executive Committee members

[3]WWF/WPVGA/UW Collaboration Consultants and Advisory Committee members

The World Wildlife Fund (WWF), the Wisconsin Potato and Vegetable Growers Association (WPVGA), and the University of Wisconsin (UW) have worked since 1996 to identify and accelerate adoption of pest, crop, and farm management practices that would reduce the ecological footprint of potato production in Wisconsin. The project designated targets and timetables for the elimination of specific high-risk pesticides while increasing the adoption of biologically based Integrated Pest Management (bioIPM) systems for the industry. Through this effort, the Wisconsin potato industry achieved a 21 percent overall reduction of toxicity in the system from 1995 to 1999 (toxicity values for each pesticide are determined by the relative environmental and human risk they pose), and a 37% reduction of 11 specifically targeted high-risk pesticides. Other collaboration goals include ecosystem restoration, biodiversity, and soil and water quality efforts.

Recognizing that bioIPM systems and other best management practices (BMPs) have to be ecologically and economically sustainable, collaboration partners committed to identify market based incentives to reward grower's progress in reducing the environmental impacts from potato farming. Therefore, in August of 2000, the Collaboration started work on a fresh market potato eco-standard. Collaboration measurement methods provided a solid foundation for its development. In 2001 a new ecolabel, Protected Harvest, owned by an independent non-profit organization was introduced. Wisconsin potatoes are the first product certified under the Protected Harvest label and are marketed under the brand "Healthy Grown." The WWF panda logo on Protected Harvest certified bags draws consumers attention to the stringent production standards required for certification. This year (2002) marks the second growing season for "Healthy Grown"/Protected Harvest potatoes.

For more information about the project, visit the Collaboration Web site at http://ipcm.wisc.edu/bioIPM.

B3-P IPM Label Development for Vegetables Produced by Small-Scale Farmers Using IPM Nicaragua and El Salvador

*Alfredo Rueda, Julio López Montes, and Orlando Cáceres

Integrated Pest Management Program in Central America (PROMIPAC). Zamorano University, P.O.BOX 93, Tegucigalpa, Honduras, Central America

The Integrated Pest Management Program for Farmers in Central America (PROMIPAC) is a SDC project executed by Zamorano University with the collaboration of more than 80 partner institutions. Since 2000, PROMIPAC has implemented the Farmers Field Schools (FFS) methodology in El Salvador and Nicaragua to teach IPM to small-scale farmers. Earlier results of the program demonstrated that farmers using FFS IPM could produce basic grains and vegetables reducing the number of pesticide applications without sacrificing the quantity and quality of their products. Participating farmers have been interested in marketing their products with an IPM label. PROMIPAC and collaborators are exploring the differential markets for IPM products in the region. Initially a marketing study was conducted on housewives and supermarket managers in El Salvador and Nicaragua. The results suggested that consumers are willing to pay 20% more for vegetables that are produced with less toxic substances if the quality is good. Supermarkets are interested in adding store space for these types of products if the farmers can keep vegetables in their shells all year around. Two pilot studies were conducted to accompany and teach farmers how to market their IPM products in the market. The results suggest that farmers can increase their revenue up to 50% by adding a certified IPM label and by direct product marketing in regional farmers markets and supermarket chains.

B4-P System Dynamics Methods Applied to Eco-labeling for Apples

*Michelle Miller[1] and Sheri Butterfield[2]

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[2]Institute for Environmental Studies, University of Wisconsin, 550 N. Park Street, Madison, WI 53706, USA

The Wisconsin Apple Growers Association, in partnership with the University of Wisconsin, is exploring various eco-labeling approaches and adapting a model to fit their needs. The systems feedback modeling approach applied to eco-labeling suggests potential action scenarios to address industry concerns. The first phase of the project has been to clarify industry interest and needs, work with growers and others to compare various ecolabeling models, develop a dynamic hypothesis that addresses the situation faced by WI apple growers in particular, and then craft a model that can be used to identify the quality of relationships between system components. Gathering baseline data on pesticides and IPM practices used by growers is critical in this first phase. The second phase of the project will explore ways to strengthen desirable feedback in the eco-labeling system and then test various scenarios to insure a desired result.

C1-P Evaluation of Low-risk Pesticides for Late Season Control of Bagworm, *Thyridopteryx ephemeraeformis,* as Part of an IPM Approach for Nursery, Landscape and Arborist Managers

*Stanton Gill[1], Rondalyn Reeser[1], Michael Raupp[2]

[1] Central MD Research and Education Center, University of Maryland Cooperative Extension, 11975 Homewood Road, Ellicott City, Maryland 21042 USA

[2] Department of Entomology, University of Maryland, 4112A Plant Science Building, College Park, MD 20742 USA

The larvae of moth and butterfly consume huge quantities of landscape and nursery plant material each season. Caterpillars being relatively slow moving foragers have many predators and parasites that attack and feed on them. Unfortunately many of the parasites allow the caterpillars to continue to live long enough for the insect to cause major injury to ornamental plants. In many cases a control strategy must be employed to control the caterpillar or suffer major aesthetic or health threatening injury to the landscape ornamental plant.

For young lepidopterous caterpillars we have the bacteria *Bacillus thuringiensis*. Many of the new formulations applied when caterpillars are small give very effective control. The problem has been that Bt is not effective on latter instar stages of lepidopterous caterpillars.

The objective of this trial was to evaluate the efficacy of two rates of tebufenozide (Confirm—Dow AgroSciences), Spinosyn A and Spinosyn D (Conserve—Dow AgroSciences), and Carbaryl (Sevin—Union Carbide) for control of late instar larvae of bagworm, *Thyridopteryx ephemeraeformis*. The trial was performed at the Central Maryland Research and Education Center in Ellicott City, Maryland. All materials provided significant and excellent reductions in the number of living larvae found on each plant. Sevin gave 70–80 % control. Confirm at the low rate gave 95–100% control. Confirm at the high rate gave 98–100% control. Conserve gave 98–100% control.

C2-P Comparing the Presence-Absence Sampling Technique to a Five Minute Search for Webspinning Spider Mites

*Carolyn Pickel[1] and Bill Olson[2]

[1]UC IPM Area Advisor, Yuba City, CA USA

[2]UCCE, Butte County, Oroville, CA USA

The presence-absence sampling technique for webspinning mites is a useful method of determining need for treatment and reduces likelihood of treating without justification. However, very few Pest Control Advisors (PCAs) use this technique because it is too time consuming. A "Five-minute search" monitoring technique, similar to what Pest Control Advisors (PCAs) currently use with a rating system added, was evaluated in 2001 and 2002. Results were then compared with the presence-absence technique to determine if any correlation between the two could be made. The "Five-minute search" monitoring technique for webspinning mites was performed in the same area of the orchard as the presence-absence technique, but the "Five-minute search" was conducted first so that scouts would not be influenced by the results of the presence–absence technique. The new monitoring technique involved looking for symptoms of webspinning mites, as well as, looking at individual leaves with a hand lens to evaluate mite predator and web spinning mite populations. The rating system included six categories that were assigned a numerical value for webspinning mites (none, low, low/moderate, moderate, moderate/high, high) and three categories for mite predators (low, moderate, high). There was a high correlation $R2 = 0.63$, $p > 0.01$ in 2001 and $R2 = 0.84$, $p > 0.01$ in 2002. The development of a technique similar to what is already used that is reliable, quantifiable, and enables quick assessment of population levels to make treatment decisions will be easier to implement.

C3-P Effective Formulations for Detection and Management of Three Ceratitis Fruit Flies

*Gerhard Booysen[1], John R. McLaughlin[2], Christopher V. Sack[3], Darek Czokajlo[2], Philipp Kirsch[2], and Stephan Venter[1]

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[2]IPM Tech, Inc, 4134 N. Vancouver Ave. Suite 105, Portland, OR USA

[3]SUNY, ESF, Dept. Chemistry, 1 Forestry Dr, Jahn Hall, Syracuse, NY USA

Fruit flies seriously limit both production and trade of vegetables throughout the world. Strict phytosanitary regulations restrict international commodity trade and necessitate blanket applications of insecticides leading to toxic residues on fruit, and human and environmental health effects.

Effective, selective, and residue-free control of Mediterranean, marula and natal fruit flies has been demonstrated in commercial citrus, mango, grape, and other sub-tropical fruit orchards. Formulations have also been developed for trapping these species in detection and monitoring programs.

C4-P Reproductive Development of Laboratory-reared and Field Collected Plum Curculio (Coleoptera: Curculionidae)

*Eric J. Hoffmann, Andrea B. Coombs and Mark E. Whalon

Department of Entomology, Michigan State University, B-11 CIPS, East Lansing, MI 48824, USA

Laboratory-reared southern and field-collected northern strain plum curculio, *Conotrachelus nenuphar* (Herbst), were sampled to examine the relationship between growing degree days and female reproductive development. Adult beetles were dissected to measure mating status, maximum oocyte size, and number of oocytes. Southern strain beetles initiated mating 10 days after eclosion at 25°C and did not require mating to induce oocyte development. Northern strain females mated after overwintering; an estimated 95% of the population mated after 142 degree days (base 10°C). Southern and northern strain beetles had a stable

maximum oocyte length of 62 and 72 mm, respectively. Oocyte size is a less biased measure of reproductive development than either the proportion of mated females or the number of retained oocytes. Rapid assessment of field-caught female reproductive status could assist in determining the damage potential of the plum curculio population and inform management decisions relating to their control.

C5-P Plastic Pyramids: An Effective New Design for Monitoring Plum Curculio

*Philipp Kirsch[1], Andrea Biasi Coombs[2], Mark E. Whalon[2], Larry J. Gut[2] and William Meade[1]

[1]IPM Tech, Inc. 4134 N. Vancouver Ave., #105, Portland OR 97217 USA

[2]Michigan State University, Department of Entomology, Center for Integrated Plant Systems, East Lansing, MI USA

Plum curculio is a major pest of all tree fruit crops in the Eastern U.S. IPM scientists, in the public and private sector, have refined trap designs and are working to develop an odor-baited system. Trap types were evaluated for monitoring plum curculio in apple research plots during the 2002 growing season. Trap types included plastic pyramid, screen, wood pyramid, panel, and kill types. All traps were baited with three lures: aggregation pheromone, plum essence, and an enhanced volatile blend.

Season-long plum curculio captures were significantly greater in the borders than in the woods or orchard interior. Plastic pyramids captured significantly more weevils when averaged across habitats. Plastic pyramid traps captured the first weevils in the season. The orchard border, adjacent to plum curculio overwintering habitats, is the best location and the plastic pyramid trap is the best trap for capturing high numbers of plum curculio.

C6-P Response of Male Leafroller Moths to an Attracticide Formulation Containing Different Concentrations of Pheromone

*Philipp Kirsch[1], Tomislav Curkovic[2], Jay F. Brunner[3], Peter J. Landolt[4], and Darek Czokajlo[1]

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[3]Washington State University, Tree Fruit Research & Extension Center, Department of Entomology, 1100 N. Western Avenue, Wenatchee, WA

[4]USDA-ARS, 5230 Konnowac Pass Rd, Wapato, WA USA

Response of *C. rosaceana* (Obliquebanded leafroller) and *P. pyrusana* (Pandemis leafroller) males to an attracticide formulation (specific pheromone blend + technical permethrin 6%) was evaluated using wind tunnel studies and field trials. The attracticide formulation for each species was loaded with increasing pheromone concentrations, 0.00064% to 16%. A 50 ul droplet of the attracticide was used as an attractant source (lure) and compared to standard lures (rubber septa) in field trials and calling females in wind tunnel bioassays. Field trials compared capture of wild males in delta traps baited with different concentrations of the attracticide and a lure. The possible repellency of the attracticide formulation containing 6% permethrin was evaluated for a range of pheromone concentrations, 0.16%, 1.6%, and 16%, using captures in traps as described above. An attracticide formulation with a blend of pheromone components for both species (in approximately the optimum ratio) was also evaluated for at concentrations of 0.16%, 1.6%, and 16%. Results showed increasing male capture to increasing pheromone concentrations in both species. No repellency was observed in males to attracticide formulation containing permethrin. Response of males to the attracticide formulation with both species pheromone was evaluated.

C7-P Last Call CM: Effective Codling Moth Control in Canadian Maritime Apple Orchards

*Robert Smith[1], Michelle Larsen[1] and Philipp Kirsch[2]

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Last Call CM was evaluated in 30 different apple orchards in 2001 in the Canadian Maritime provinces (Nova Scotia, New Brunswick, and Prince Edward Island). Codling moth control with this attract and kill technology was superior or equal to that obtained with conventional organophosphate insecticide programs. Last Call Attract and Kill is a proven alternative that eliminates pesticide residues on fruit and does not disrupt native predators or parasites. One late May application provided control of both the first generation and a partial second in this region.

C8-P Serenade, *Bacillus subtilis* (Strain Qst 713), Biofungicide for Management of Major Diseases of California Wine Grapes

*Paul J. Walgenbach and Don Edgecomb

Agraquest, Inc., 1530 Drew Avenue, Davis, CA 95616 USA

Powdery mildew is a serious, recurrent disease of wine grapes in California. Bunch rot is also a serious disease, but is more geographically limited. In any given year these two diseases can attack a single crop, resulting in serious loss. For powdery mildew, a typical control program includes early-season applications of sulfur prior to bloom followed by a regime of synthetic fungicides up until verasion. Bunch rot is typically controlled by synthetic fungicides with bloom, preclosure, verasion, and occasionally, preharvest applications. Serenade is the only biofungicide with significant activity on both diseases. Serenade works via multiple modes of action with virtually no nontarget effects. It is ideally suited for both organic and IPM programs that employ an array of tools to control diseases. It provides growers attractive options with respect to both re-entry intervals (REI) and pre-harvest intervals (PHI). Serenade is an effective tool that can be used to reduce reliance on synthetic chemistry.

C9-P Serenade, *Bacillus subtilis* (Strain Qst 713) Biofungicide for Management of Sclerotinia Diseases in Leafy Vegetables

*Paul J. Walgenbach and Don Edgecomb

Agraquest, Inc., 1530 Drew Avenue, Davis, CA 95616, USA

Lettuce leaf drop (*Sclerotinia minor* and *S. sclerotium*) and celery pink rot (*S. sclerotium*) are serious, widespread diseases of these crops in California and Arizona. *S. minor* is limited to coastal California, the major production area for these crops. Both organisms attack stems and lower leaves of plants, but *S. sclerotium* has an aerial spore that attacks upper leaves as well. Control is typically accomplished with fungicide applications to the base of plants and surrounding soil after thinning. Further fungicide applications at appropriate intervals are required until conditions for disease development have subsided. Serenade works via multiple modes of action, on both causal agents, with virtually no non-target effects. Serenade is ideally suited for IPM programs that employ an array of tools for disease management. Thus, it has been widely adopted in both conventional and organic systems. Beyond disease control, it provides growers attractive options with respect to both re-entry intervals (REI) and pre-harvest intervals (PHI). Serenade is an effective tool that can be used to reduce reliance on synthetic chemistry.

C10-P Serenade Biofungicide Controls a Wide Range of Fresh Market Plant Diseases

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Serenade (*Bacillus subtilis*) biofungicide (QRD 137, QRD 131, QRD 132) is a new biologically based fungicide/bactericide registered for use against a wide range of vegetable diseases in the U.S. Serenade delivers consistent disease control with a novel mode of action by preventing pathogen spore germination, disrupting germ tube and mycelial growth, and producing a zone of inhibition where applied. This biofungicide is OMRI approved for organic production, is compatible with IPM programs, has a 0 day preharvest interval, and a 4 hour re-entry interval. It has no restriction on the number of applications per crop and may be alternated with other registered products to aid in resistance management.

Serenade has been shown in numerous vegetable field trials in the U.S. to be effective in controlling a wide range of plant pathogens in fresh market vegetables. Some examples include bean rust and white mold of snap beans (*Uromyces appendiculatus* and *Sclerotinia sclerotiorum*), powdery mildew of cucurbits (*Erysiphe* and *Sphaerotheca* spp.), head and leaf drop of leafy vegetables (*Sclerotinia* spp.), bacterial spot of pepper (*Xanthomonas* spp.), and tomato early blight and bacterial spot (*Alternaria solani* and *Xanthomonas* spp.). Uses continue to be discovered for this versatile plant disease control product.

C11-P Using Mustard Green Manures for Soil-borne Pest Management

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Mustard green manures (*Sinapis alba* and *Brassica juncea*) are being used on 20,000 acres of irrigated ground in Central Washington to suppress soil-born pests and improve soil quality. The mustard green manures are being used mainly before potatoes to suppress *Verticillium dahliae*, improve water infiltration, and to control wind erosion. A program of on-farm research and extension has provided growers with information on the ability of these green manures to replace expensive fumigants and to improve soil aggregation and water infiltration. Trials have also been conducted over several years to evaluate biomass production and glucosinolate concentrations of mustard varieties, effects of planting date and N rate, and potential of non-mustard green manures.

C12-P Cancelled

C13-P Perimeter Trap Crop as an Integrated Pest Management Tactic in Ohio Pumpkins

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Integrated Pest Management of pumpkins has been a focus for researchers over the past decade in Ohio. Some of the most recent studies have been aimed at using trap crops to reduce striped and spotted cucumber beetle feeding on seedlings, preventing disease transmission (bacterial wilt or squash mosaic virus), or protecting seedlings from being completely devoured. To investigate whether it is possible to alleviate early season cucumber beetle pressure by means other than broadcast insecticides, three separate but related research projects on trap crops were conducted. In 2000, the first experiment evaluated cucumber beetle feeding preferences for various squash (*Cucurbita maxima*) trap crops. Of the 10 different squash and pumpkin varieties tested, cucumber beetles preferred Turks Turban over other squash types during the seedling stage. In 2001, the second experiment tested the use of a perimeter trap crop of Turks Turban and the systemic insecticide, Imidacloprid (Admire), to control cucumber beetles, with the trap crop planted the same day as the pumpkins. Yield among the three treatments were significantly different, with the Admire treated plot with no trap crop posting higher yields than the plot treated with low rates of Admire surrounded by a trap crop treated with a high rate of Admire. The lowest yielding treatment was an untreated field surrounded by an Admire treated trap crop. In 2002, the third experiment also used perimeter trap crops of Turks Turban

squash treated with Admire planted several weeks prior to the main pumpkin crop, but also added kairomone traps to further reduce cucumber beetle populations. There were no significant differences in yield between the trap crop and non-trap crop treated plots. The kairomone traps did not significantly reduce the amount of damage sustained by the pumpkin foliage or fruit in the treatment. To date, the use of perimeter trap crops in pumpkins instead of broadcast insecticides to effectively reduce cucumber beetle pressure or increase yields has not benefited growers who are willing to use insecticides, but could be a technique used by organic growers who have few pest management alternatives. The kairomone traps are worthy of further research in cucurbits.

C14-P Synthetic Host Volatile Augmentation of Trap Crops for Alternative Management of Colorado Potato Beetle, *Leptinotarsa decemlineata* (SAY)

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The attractiveness of synthetic host attractant-baited pitfall traps and trap crops to colonizing adult Colorado potato beetle, *Leptinotarsa decemlineata* (Say), and this application to a comprehensive potato trap crop pest management strategy were evaluated in a field setting. There were significantly more adult *L. decemlineata* in baited than un-baited pitfall traps and significantly more colonizing adults, egg masses, and small larvae in attractant-treated trap crops than in untreated trap crops. In a field evaluation of conventionally-managed plots compared with plots bordered by attractant-treated and untreated trap crops, significantly more egg masses, small larvae, large larvae, and adults were found in plots bordered by untreated trap crops than those bordered by attractant-treated trap crops or conventionally-managed plots. There were no significant differences in egg mass and small larvae densities between plots bordered by attractant-treated trap crops and conventionally-managed plots, but there were significantly fewer large larvae and adult beetles in conventionally managed plots than in plots bordered by untreated and attractant-treated trap crops. Insecticide application based on established management thresholds required that the conventional plots be sprayed twice, while plots bordered by trap crops were sprayed once. Significantly less insecticide was applied to plots bordered by attractant-treated and untreated trap crops than conventionally-managed plots, while levels in plots bordered by untreated and attractant-treated trap crops were identical. Total insecticide input volume for plots bordered by trap crops was 44% less than conventionally-managed plots. Leaf area index (LAI) of conventionally-treated plots, plots bordered by attractant-treated trap crops, and plots bordered by untreated trap crops were all statistically different from one another. Mean yield (kg) in plots bordered by untreated trap crops was significantly lower than in plots bordered by attractant-treated trap crops and conventionally-managed plots. There was no significant difference between plots bordered by attractant-treated trap crops and conventionally-managed plots. Synthetic host attractant treatment of trap crops improved the efficacy of trap crop pest management in this system such that plots bordered by attractant-treated trap crop produced yields that were statistically-equivalent to conventionally-managed plots while requiring just under half the insecticide input.

C15-P Management of Sweetpotato Leaf Beetle in Jamaica

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The sweetpotato leaf beetle, *Typophorus nigritus viridicyaneus* (Crotch) (Coleoptera: Chrysomelidae, Eumolpinae), has recently emerged as an important economic pest on sweetpotatoes in several parishes of Jamaica. The biology of this pest in Jamaica was studied. Through the IPM CRSP project, we have been developing new IPM techniques for managing this pest in sweetpotatoes. New resistant varieties from the USDA, ARS Laboratory in Charleston, SC were evaluated in Jamaica, and several showed high levels of resistance to the sweetpotato leaf beetle. Several chemical and biological insecticides were also evaluated in conjunction with the pest resistant cultivars. A combination of fipronyl and the resistant cultivars 'White Regal' or PI 531116 provided excellent control of this pest. Other materials, including a garlic extract, also showed promising levels of control of sweetpotato leaf beetle larvae.

C16-P Effect of Chemical Resistance Activators on Purple Blotch Disease, Yield and Quality of Three Onion Cultivars

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Disease resistance can be activated in plants by exposure to certain microorganisms or by treatments with chemicals that trigger specific genes associated with Systemic Acquired Resistance (SAR). The objective of this work was to determine the effect of chemical resistance activators on purple blotch disease (*Alternaria porri*), and on onion yield and quality. The experiment

was conducted at the MSU Muck Soil Research Station, Laingsburg, Michigan, on Houghton Muck soil. The experimental design was a split plot design, with four replications. Main plots were the inducing treatments, and subplots were cultivars. One row of each cultivar (Spartan Supreme, Altisimo, and T-439) was planted in each bed. Main plot treatments consisted of the following chemical treatments, sprayed three times: 1) acibenzolar-S-methyl (ASM) at 20 ppm; 2) beta-amino butyric acid (BABA) at 10 mM; 3) methyl jasmonate at 10 mM, all first three treatments added to crop oil concentrate (Herbimax 1%); 4) fungicide Bravo Weather Stick 28% (1L a.i./ha) alternated with Kocide 4.5 LF (0.69 L a.i./ha) and Manzate 200 DF (1.65 kg a.i./ha); only Herbimax 1% ; 5) control (non-treated plants). An *A. porri* spore suspension (8500 spores/mL) was sprayed on the plants 82 days after planting. The inoculation occurred seven days after all the chemical treatments were applied. At 25 days after inoculation (DAI), fungicide and methyl jasmonate treated plants showed 10 and 11 lesions/plant, while untreated plants had 20 lesions/plant. At this same time, plants sprayed with ASM had 24 lesions /plant, and plants treated with BABA showed 15 lesions/plant, which was not statistically different from the untreated plants. Although plants treated with fungicide or methyl jasmonate showed less disease symptoms, this difference was not observed in total and marketable yield, which were 23.5 and 23 t/ha, respectively. After 167 days of storage, there was no difference in the percentage of good (marketable) bulbs between treatments, with an average of 88% good bulbs. In a greenhouse experiment, methyl jasmonate and BABA (both at 10 mM) were sprayed on onions cultivars Hoopla, T-439 and Altisimo, and plants were challenged with *A. porri*. Again, the number of lesions was lower in treated plants at 5 and 10 DAI, when compared to untreated plants or plants sprayed only with surfactant (Herbimax 1%). Histological analysis of the leaf tissue of these plants is in progress, to better elucidate the mechanisms involved in induced resistance expression in onions.

C17-P Monitoring Adult Populations with Sex Pheromone Traps for Timing of Interventions Against Defoliators in Onions

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The lack of effective surveillance and monitoring tools to time interventions results in unnecessarily high frequency of spraying to control insect defoliators in onion grown after rice. Field studies were conducted in Bongabon, Nueva Ecija during the 2001 and 2002 dry seasons to evaluate the effectiveness of sex-pheromone baited traps as indicator for timing of insecticide applications against onion defoliators, *Spodoptera litura* (F.) and *S. exigua* (Hubner) (Lepidoptera: Noctuidae). In both years, peaks in adult trap catches were recorded between 25-59 days after transplanting. One to three insecticide applications at 3, 5, and 7 days after peaks in sex pheromone trap catches resulted in crop yield and leaf damage similar to those of weekly sprayed plots. Plants in all treatments yielded significantly higher than plants in the untreated plots. Use of sex pheromone-baited traps can reduce insecticide applications substantially, from weekly spraying, to only 1- 3 applications in a cropping season without reducing yields. It also reduces farmers' exposure to pesticides and minimizes adverse effects on natural enemies of pests. The use of sex pheromone-baited traps can be a key tool in developing cost-reducing technologies to manage pests in rice-onion vegetable cropping system.

C18-P Population Dynamics of the Leafminer, *Liriomyza trifolii* (Burgess), in Onion, *Alium cepa* L.

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The population dynamics of *Liriomyza trifolii* (Burgess) was studied for two years in weekly-sprayed and unsprayed onion fields in Bongabon, Nueva Ecija Philippines. Nueva Ecija province is known for large area cultivation of onion during the summer months from December–May. Changes in population density of *L. trifolii* larvae, adult mines, damaged leaves, natural enemies and adult fly density was recorded over a crop period. There were little differences noted on the above parameters studied between sprayed and unsprayed plots except for a significant reduction in larval parasitism and number of predators recorded from the weekly-sprayed plot. Peak population density of larvae and damage were recorded when the crop neared maturity, so it is doubtful if losses could still be incurred at this time when bulbs neared maturity. Results showed that spraying the farmers' most commonly used insecticide (chlorpyrifos+BPMC) was not effective against *L. trifolii* but detrimental to its naturally occurring parasitoids and predators. Since farmers had been applying the above insecticide for quite sometime, it is possible that the insect had developed resistance. Our results indicated that spraying against *L. trifolii* in onion does harm to farmers and non-target species and therefore may be unnecessary and wasted.

C19-P Potential Reduction of Adverse Environmental and Health Impacts of Methyl Bromide and Other Nematicides

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Two environmental regulations have major implications for vegetable production in Florida. The first is the Montreal Protocol Agreement, which resulted in the phase out of methyl bromide (MBr) by 2005. The second regulation is with the use of Telone (1,3 Dichloropropene), the main replacement chemical for MBr, which includes major worker safety issues and ground water

contamination in Dade Co. To reduce Florida vegetable growers' potential adverse environmental/health impacts because of these two major environmental issues, Glades Crop Care, Inc. (GCC) has developed a nematode sampling program that potentially will result in reduced levels of nematicides. Through a Risk Avoidance and Mitigation Program (RAMP) Grant, Glades Crop Care (GCC) is developing field data that indicates the locations, movement and populations of root knot nematode (RKN, *Meloidogyne* spp.) and other plant parasitic nematodes. In order to generate field-level data for the new sampling protocol, GCC has tested a geo-referenced nematode sampling system consisting of 1) crop bioassays, 2) soil nematode assays, and 3) selective plant bioassays. Our program will show growers the location and distribution of their nematode infestation(s), what affect various control measures and no nematicide applications have on RKN and other plant parasitic nematodes, and how nematode population trends are impacted by various combinations of management practices.

C20-P Farmers' Participatory Integrated Management of Peanut Bud Necrosis Disease of Mungbean (*Vigna radiata* L. Wilczek)

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Peanut bud necrosis virus (PBNV) is one of the important virus diseases of mungbean in Andhra Pradesh State, India. PBNV occurs during early stages of crop growth and results in substantial yield losses. In severe cases of disease occurrence, total yield losses are not uncommon. Mungbean being short duration (70–75 days) crop with marginal profits, many farmers do not adopt chemical methods. On-station experiments on integrated virus disease management (IVDM) at Hyderabad, India clearly demonstrated the effectiveness of an IPM module. The module consisted of a border crop with sorghum around the mungbean crop raised after an insecticide seed treatment and one insecticide spraying resulted in higher economic returns. Five farmers from Warangal district of Andhra Pradesh State conducted the trials under supervision during Monsoon 2002 with local agronomic package of practices. The trials were undertaken under both high disease pressure, i.e., farmers' traditional practice of non-integrated virus disease management (non-IVDM) and low disease pressure integrated virus disease management (IVDM). The IVDM consisted of a 11-row border crop of sorghum around the mungbean raised after imidacloprid seed treatment @ 3g/Kg seed and one imidacloprid spray (0.008%) at 30 days after sowing. The occurrence of PBNV in IVDM was significantly lower (7.36–21.26%) than the non-IVDM (44.78–93.08%). The increase in yield over the non-IVDM varied from 64.72 to 367.67%.

The trials undertaken in the farmers, participatory demonstrations convinced many other local farmers about the effectiveness of IVDM in managing the PBNV disease resulting in higher economic returns. The farmers showed keen interest to adopt the technology during the forthcoming crop seasons.

C21-P Regional Web-mapping of Sweet Corn Lepidopteran Pests in the Northeastern US

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Pest monitoring is hard to develop in northeastern agro-landscapes due to farm and crop diversity, spatial segregation in urbanizing landscapes, and small size of many farms. We are establishing a regional human and information technology infrastructure for agricultural pest monitoring information in this landscape through linked GIS and Web technology ("web-mapping"), using sweet corn as a model system. In 2002, data came from VA (T. Kuhar & A. Herbert, VA Tech), MD (R. Bean, MD Dept. Ag), DE (J. Whalon & M. Spellman, U. DE), PA (~15 Extn. agents), NJ (K. Hollstrom, NJ IPM program), NY (A. Seaman NY IPM), MA (R. Hazzard, U. MA), CT, and ME (D. Handley, U. of Maine). An ASP® application enabled Web-based data entry from field locations throughout the region directly into MS Access® relational databases. Delphi® and MapObjects® applications created maps and time-series graphics for each site. An automated Web editor converted these to image (*.gif) and text (*.html) files, and hyperlinked all (~2,000 files per update in 2001) into "clickable maps" Web pages. These showed regional views, with hot-links to times series graphics at each site. To improve spatio-temporal views at local and regional scales, and enable increased data resolution, we are now migrating to more real-time methods. Web-tracking software shows annual increases in user sessions accessing mapped views of insect pest pressure. Farmers can use this information for pest management planning and decision making.

C22-P Effects of Insecticide Deposit Patterns on Biological Efficacy and Feeding Behavior of Fall Armyworm, *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae)

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Pesticide delivery systems can effect deposition on canopies and resultant biological effects of a toxicant at any given point throughout the canopy. The present study assessed the effects of two insecticides (cypermethrin and spinosad) provided by different nozzles on biological efficacy and feeding behavior, applied to three different canopies (tomato, corn, and soybean), using different nozzles and the Capstan pulsing system. Biological efficacy was estimated using second larvae instar of fall armyworm on corn and soybean. Six replicates were used for each combination of insecticide, application rates, nozzles, canopies, and plant sections. Results showed that the total deposit from each nozzle and resulting mortality was higher on the top, followed by middle, and bottom sections for both canopies. The

larvae showed avoidance behavior on cypermethrin treated leaf disks. The implications of the development of resistance in each presentation scenario are reported elsewhere. The effects of nozzles flow rates, canopy, sections, insecticides, and hours post treatment on mortality and consumption rates showed that all main factors had a significant effect on mortality. The effect of hours post treatment accounted for the greatest portion of the variability. The results suggest that using different application equipment on various canopy architectures can present significant differences in deposit patterns and resulting biological efficacy.

C23-P Identifying Field Specific Characteristics that Lead to Successful Postemergence Weed Management in Corn

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Across the United States, the most frequent herbicides used for weed control in corn are soil-applied, preemergence products. Although preemergence herbicides are often considered an important tool in weed management, there are number of concerns associated with them. One possible alternative is to integrate postemergence weed control into weed management systems. In order to evaluate the potential success of single postemergence applications, three different experiments were conducted between 2000 and 2002 across multiple northeastern states. The objectives of these studies were to develop prediction models for weed emergence across geographic locations, examine the impact of postemergence herbicide application timing and program across multiple locations, and to evaluate the impact of both weed density and time of weed removal on corn grain yield. The ability to predict weed emergence across geographic location using a soil degree-day scale varied with weed species with the coefficients of determination for the predictive emergence model ranging from 0.67 to 0.88, depending on species. Most weed species had two distinct peaks of emergence. In terms of periodicity, common ragweed had one of the shortest emergence periods, while redroot and smooth pigweed had one of the longest periods of emergence. In the weed density experiment, at low weed densities, application timings ranging from V2 to V8 corn provided corn yields similar to the weed-free plots. At higher weed densities, however, the V4 application timing provided the most consistent and highest yielding results. In the application timing experiment at multiple locations, the V3/4 timing was more effective than the V2 timing when averaged over treatment. Glyphosate alone was impacted the most by timing, with the V2 treatment having less effect on weed biomass, compared to the other treatments. The glyphosate mixtures and the nicosulfuron-based treatment were equal at the V3/4 timing when averaged across location. Problem weeds with some total post treatment locations included quackgrass and yellow nutsedge in Maine, common cocklebur and horsenettle in Delaware, large crabgrass and yellow foxtail in Massachusetts, and common ragweed and giant foxtail at several locations. Regardless of treatment, the untreated check had at least 5 times more weed biomass than any herbicide treatment regardless of timing. Excluding the weedy check, corn grain yield ranged from less than 56 kg/ha to more than 224 kg/ha depending on location. Yield in the glyphosate alone V2 treatment was less than the other V2 treatments that included residual herbicides. These experiments demonstrate that single postemergence applications can be successful, but are dependent on weed species and density as well as herbicide program.

C24-P Comperitiveness of Palmer Amaranth and Velvetleaf in Response to Preemergence Herbicide

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Growth and competitiveness of weeds that escape a preemergence herbicide might be reduced due to herbicide injury. As a result, expected crop yield loss from escaped weeds should be less than that of uncontrolled weeds. Field experiments were conducted at Ashland Bottoms, KS (2001 and 2002) and Rossville, KS (2002) to quantify corn yield loss in response to Palmer amaranth or velvetleaf with and without isoxaflutole and/or flumetsulam, and to determine seed production from these two weed species. Palmer amaranth and velvetleaf were established at a density range of 0 to 6 and 0 to 32 plants m^{-1} of corn row, respectively. In the absence of either isoxaflutole or flumetsulam, corn yield loss increased with increasing density of both Palmer amaranth and velvetleaf. At Rossville 2002, Palmer amaranth that escaped through either isoxaflutole or flumetsulam caused 25% corn yield loss at a density of 6 plants m^{-1}. In contrast, yield loss from untreated Palmer amaranth at the same density was 38%. At Ashland Bottoms 2002, velvetleaf (6 plants m^{-1}) that escaped through flumetsulam reduced corn yield by 6% compared to 54% yield reduction with untreated velvetleaf at the same density. When treated with herbicide, seed production by Palmer amaranth and velvetleaf were reduced by 27% and 95%, respectively, compared to untreated weeds. The study showed that corn yield reduction from both Palmer amaranth and velvetleaf that escape through a preemergence herbicide is less than from untreated weeds. Moreover, seed production from escaped weeds was also reduced.

C25-P Implementing Integrated Site-specific Weed Management

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Recent technological advancements make it possible to manage weed populations within fields according to spatial variability in weed populations, soil properties, and crop yield potential. This ability could potentially reduce herbicide use, especially if decisions are part of an integrated site-specific weed management strategy. A study was conducted in western Kansas to determine the economic feasibility of reducing preemergent herbicide rate in field corn. A uniform rate of atrazine (1.2 kg/ha) was applied on an entire 15.4 ha field with varying soil characteristics and weed population and three rates (1/3, 2/3, and 1X = 0.41 kg/ha) of premixed flufenacet and isoxaflutole were applied in repeated parallel strips across the field. Untreated areas were interspersed within the strips. Individual weed species in 1 m2 quadrats were counted and mapped at 2,176 grid points, then uniformly sprayed with a postemergent tank mixture of prosulfuron, primisulfuron, and diflufenzopyr at 0.001 + 0.001 + 0.32 kg/ha. Six weeks later weeds were remapped at the original grid points and the populations used to calculate competitive load values according to species and competitive index. Because drought forced harvesting the corn for silage, corn grain yield was predicted based on a model in the WeedSOFT computer program that estimates yield loss from weed species competition. Quadratic production functions were created from the silage data and estimated grain yield data to calculate optimal herbicide rate and to capture the negative relationship of applying too much herbicide. The preemergent herbicide rate of flufenacet and isoxaflutole premixture providing maximum economic return was the 2/3 rate.

C26-P Cotman and Large Farm Production Records: A Foundation for Community Insect Management Programs in Arkansas

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Arkansas has a history of community-based insect management programs. Pioneering work of J. R. Phillips and colleagues in the 1970's and 1980's introduced the concept of community management systems for population control of heliothines. Recent advances in measuring cotton crop stress with the COTMAN management system, practical applications of spatial information management, and improved data organization and synthesis capacities have created unique opportunities to reintroduce the concepts of community-based insect management in Arkansas. With initial assistance from Cotton Incorporated, the Arkansas Agricultural Experiment Station, the USDA Southern Field Crops Laboratory at Stoneville, Mississippi, and the Soybean Promotion Board of Arkansas, we have established foundations for community-management programs at three separate locations in the state. We hope to expand this effort to five or more sites as our research matures and resources are allocated to the effort. The most elaborate effort underway is a detailed study of seven years of COTMAN and crop production records on Wildy Farms in northeastern Arkansas. This is a unique, detailed data set from one of the most intensely managed cotton farms in the country. We will use the example of this farm as a prototype for other locations in the state. The community concept will be established on a diversity of different farms including a variety of different crops. Coordination of this effort across the state will provide spatial and temporal management information for macro-level decisions and information at the state-level.

C27-P Management of Thrips (Thysanoptera: Thripidae) on Early-season Cotton

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Imidacloprid and thiamethoxam cotton seed treatments were compared to in-furrow treatments of aldicarb granules for suppression of thrips species as early-season pests of cotton. In one study planted no-till, larval thrips numbers did not differ among treatments until 35 days after planting (DAP) and all treatments differed from the untreated control. However, yields among treatments and the untreated control did not differ statistically. In another study planted conventionally, thrips larval numbers were suppressed by treatments up to 28 DAP, but were not different from the control at 35 DAP. Yields in this study did not differ among treatments, but all were significantly greater than from the control. In a third study where thrips larval numbers averaged 18.0 per plant in the untreated 29 DAP, but only 1.2 in the thiamethoxam treatment, yield was 169 lb/A in the control compared to 922 averaged across treatments. Seed treatments appear to be a highly effective management option for controlling thrips on seedling cotton.

C28-P Developing Prescription Insecticide (Svi) Applications with Cotton Yield Maps

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Tests were conducted in 2002 at Hardwick Planting Company near Newellton, LA. A yield grid map was created with yield data collected from wheat (2000) and grain sorghum (2001). A yield map was developed by defining low yielding (20% of a 216 acre field) or normal to high yielding (80% of field). The field was divided into eight equivalent blocks. Each block was assigned one of the two treatments, (SVI vs. broadcast whole plot). Treatments were assigned to plots in a RBD. SVI treatments were prescribed to zones within each plot according to the yield map. Field zones that were considered low yielding were not sprayed in the SVI. Entire blocks were sprayed in the broadcast treatment. Applications were made using a fixed wing aircraft equipped with an onboard computer, GPS guidance system, and liquid flow controller. Three insecticide treatments were applied to the test area using a single site-specific prescription. Pre- and post-treatment insect pest densities were recorded using handheld computers equipped with GPS receivers. Heliothines (bollworm and tobacco budworm) and other arthropod pests were sampled but only heliothine data was used in this evaluation. Heliothine infestation levels were determined by sampling 10 random plants per site. Densities were evaluated by examining fruiting forms (squares, white flowers, bloom tags, and bolls) for larvae and damage to fruiting forms. A GPS equipped cotton picker recorded harvest yield data. Pre-treatment arthropod surveys indicated significant variations in pest densities across the field. Insect pests were controlled in both the broadcast and SVI sprayed plots. Post-treatment scouting indicated insect presence in the non-sprayed SVI zones. Mean yield data comparing the two treatments was not significantly different. Insect control costs were lower in SVI treatments than in the broadcast. Insecticide use declined by 20% ($21.66 an acre) in the SVI treatment. Using SVI technology in prescription applications with sufficient science-based data to support recommendations can moderate production costs. The results of this study support the integration of precision agricultural technologies into current IPM strategies and further reduce foliar insecticide requirements.

C29-P Efficacy of Seed- and Foliar-treated Insecticides for Managing Bean Leaf Beetles and Bean Pod Mottle Virus

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Bean pod mottle virus causes qualitative and quantitative damage to soybeans and is transmitted most efficiently by the bean leaf beetle, *Ceratoma trifurcata* Forster. The current management strategy in Iowa suggests one early and one mid-season lambda-cyhalothrin application. With this study we attempted to increase our management strategies for this pest complex. During the summer of 2002, at three locations in Iowa, five potential strategies for managing bean leaf beetles and bean pod mottle virus were evaluated. This study was conducted to determine the efficacy of applying seed treatments, thiamethoxam or clothianidin, either alone or in combination with lambda-cyhalothrin. The effectiveness of these strategies was measured by comparisons of beetle populations, percent of virus incidence, plant height, seed weight, and yield between treatments.

C30-P Research on the Management of the Soybean Stem Borer in Kansas

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Review of the current research being conducted on the soybean stem borer (*Dectes texanus texanus*) in Kansas. Presentation will focus on recent field trials where insecticides were used in an attempt to control soybean stem borer infestations.

C31-P WeedSOFT: Using a Decision Support System for Regional IPM Implementation

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WeedSOFT ADVISOR is a Windows-based weed management decision support system developed in Nebraska and adapted to six other North Central states. WeedSOFT ADVISOR provides recommendations for preemergence, postemergence and pre + postemergence treatments in corn, soybeans, wheat, sorghum, sugarbeets, alfalfa, and dry beans. The ADVISOR model allows each state to customize parameters to fit their specific needs. Extension/research scientists from the partner states have created state-specific databases to account for state-to-state variations in such parameters as soil properties, prevalent weed species, crop/weed management strategies, and herbicide use restrictions. Each state collects feedback from WeedSOFT ADVISOR users to ensure the software meets their weed management needs. State-specific versions of WeedSOFT were distributed in five states in 2002. All seven states will have versions available for the 2003 growing season. Future enhancements to WeedSOFT will include a weed mapping component to spatially track weed problem areas within a field and enable more site-specific treatment of these areas. This regional project is supported by funding from CSREES RAMP # 2001-51101-11100.

C32-P Spinosad and Methoxyfenozide: IPM Tools for Insect Management

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Spinosad is derived from the fermentation of the actinomycete *Sacharoployspora spinosa* and is the active ingredient in Tracer*, SpinTor*, Success* and other products for insect control. It has a rapid mode of action and efficacy activity similar to synthetic products on Lepidoptera, Thynsanoptera and select Diptera and Coleoptera. It has no activity on many insects which results in a high degree of selectivity. Methoxyfenozide is a second-generation MAC (molt accelerating compound) insecticide that mimics ecdysone activity in Lepidoptera insects. It is marketed under the trade name Intrepid*. Lepidopteran insects become affected faster than with other insect growth regulators. Methoxyfenozide is even more selective than spinosad with activity limited to only Lepidoptera. The rapid activity of these compounds permits the crop advisor to wait until economic thresholds have been exceeded, which is not the case with many selective products. The preservation of the beneficial arthropods keeps secondary pests in check and extend retreatment intervals. The MACs and spinosad both won the EPA Presidential Green Chemistry Challenge for overall environmental favorable properties including these IPM attributes. An overview of new labeling initiatives including organic formulations will be provided.

*Trademarks of Dow AgroSciences LLC

C33-P Intercept Panel Trap (INT PT): Effective in Management of Forest Colepotera

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Trap efficacy in capturing economically important forest Coleoptera was measured in field trials comparing the Intercept Panel Trap (INT PT) with the Multi-Funnel Trap. The INT PT was designed to provide a better option for the monitoring of forest Coleoptera. The trap is made of corrugated plastic and is very robust under rigorous field conditions, but still lightweight, easy to carry, weather- and waterproof, and easy to install. The trap disassembles rapidly and stores flat, which uses less storage space than Funnel Traps. The INT PT also costs significantly less than the Funnel Trap.

C34-P A Novel Trap for Stored Product Moths Based on Electromagnetic Amplification of the Sex Pheromone

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A newly designed moth trap for stored product use has been developed by Dykstra Laboratories, Inc. in Gainesville, Florida, USA. The trap uses standard pheromone lures but amplifies the electromagnetic emissions emanating from the pheromone molecule by placing the lure inside a resonant cavity. This molecular amplification has been shown to be more attractive to the Indianmeal moth in laboratory tests by capturing approximately four times the number of moths over conventional sticky traps. Although the trap needs regular cleaning, it is reusable and will function efficiently for over a year without changing the pheromone lure. The major concepts behind the success of the trap assume the validity of the electromagnetic theory of olfaction in insects as put forward by Robert H. Wright and Philip S. Callahan.

D1-P Performance Planning and Reporting System Helping Integrated Pest Management Programs Report and Showcase Results!

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The Web-based Performance Planning and Reporting System (PPRS) provides access to information about integrated pest management (IPM) implementation at land-grant universities by providing descriptions of program plans and accomplishments online. This system provides information on a state's program as a whole, and it describes key areas of program activities in more detail.

Land-grant university IPM coordinators choose areas of emphasis for the state IPM program that reflect the needs of the local clientele and program activities. Areas of IPM program emphasis may be crop centered (such as corn, cotton, or blueberries), audience centered (such as schools or community IPM), or

activity centered (such as in-service training, plant disease diagnostics, or information dissemination). The program reports on targeted pests and specific indicators that point to progress toward national program objectives.

This planning and reporting process strengthens State IPM Programs in the following ways:

1. By recording program goals and reporting on the results, coordinators identify important areas for needed funding at the state level.
2. Information from these reports gives CSREES justification for providing funding and support for university-based IPM programs.
3. Objectives and indicators help programs define their goals and determine planned activities to achieve those goals.
4. Annual reports provide a consistent measurement tool for the effectiveness of the activities and a guide for change.

The PPRS system is viewable at: www.pprs.info.

D2-P Mitigating Environmental Risk with Integrated Pest Management

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USDA–Natural Resources Conservation Service (NRCS) policy now mandates site-specific environmental risk analysis and appropriate mitigation for all pest management activities that pose substantial risk to natural resources. Airsheds, surface water bodies, and groundwater that are in proximity to pesticide application often need special consideration for adequate resource protection. Institution of IPM in these agricultural fields can be an ideal tool towards protecting these areas. Conservation planners and other farm advisors can use the NRCS Windows Pesticide Screening Tool (WIN-PST) to evaluate site-specific pesticide environmental risk. WIN-PST qualitatively ranks the potential for pesticide transport via leaching below the root zone and runoff beyond the edge of the field. It then combines these exposure potentials with long-term pesticide toxicities to humans and aquatic life. The final results are hazard potentials to humans and fish from non-point source exposure. We are now working to add air quality risks to WIN-PST analysis. Working in partnership with other IPM practitioners, NRCS planners will use WIN-PST to guide producer selection of mitigating conservation practices and management techniques that help protect water and air quality. The overall goal of the new NRCS policy is to integrate environmentally sound pest management into all conservation plans.

D3-P Reducing Pesticide Use in Home Gardens Through Training and Participatory Research in Biological Control

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Over 550 Master Gardeners in Indiana, Illinois, Ohio, and Kentucky were taught about alternatives to pesticides in workshops that focused on the theory and practice biological control of pest in home gardens. In addition, gardeners learned how to conduct experiments in their backyards and were encouraged to participate in the summer research program that tested specific mechanical, cultural, and biological controls. Workshop participants were surveyed before the workshop, and in the two succeeding growing seasons after the training to measure change in their pest management practices. The McNemar's Analysis conducted on the pre- versus post- workshop responses indicated that the percentage of gardeners that used cultural and mechanical control remained the same (above 80%) and more than 30% of the gardeners reducing their use chemical pesticides with 20% eliminating their pesticide use entirely. Despite these gains, workshop participants and individuals who conducted research failed to increase the rate at which they adopted biological control. Individuals who conducted research on alternatives to pesticides did not reduce their rate of pesticide use any more than those who simply attended the workshop.

D4-P Agricultural Diversification and Integrated Pest Management in a Rice-vegetable Farming System in Bangladesh

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An economic optimization model calibrated with data from Bangladesh is used to study factors associated with a shift toward diversified, high-valued vegetable crops and the incentives associated with the use of IPM methods for low-income vegetable producers. We measure how IPM technologies affect the crop and technology choices of farmers. The model encompasses three seasons and examines crop and technology choice under price and yield uncertainty. The model incorporates data from experimental IPM trials conducted in Bangladesh. Simulation results show that access to IPM technology and IPM availability combined with access to credit increase household welfare and lead to higher rates of vegetable adoption. Off-farm employment opportunities work against vegetable cultivation and IPM use by risk-averse farmers. Implications for policy and extension efforts are highlighted.

D5-P Managing Western Flower Thrips Using a Combination of Impatiens with Resistance and Reduced-risk Insecticides

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In 2000-2001, two greenhouse experiments were conducted to determine if impatiens, *Impatiens wallerana* Hook. f., cultivars demonstrated resistance to western flower thrips, *Frankliniella occidentalis* (Pergande), feeding and if combining resistant cultivars of impatiens with the insecticides spinosad and methiocarb at different rates (label rate, ½ label rate, and ¼ label rate) negatively affected western flower thrips (WFT) feeding. Individual insect-free plants of eight impatiens cultivars were inoculated with laboratory-reared WFT. Thrips were allowed to feed on the impatiens plants for a specified time period (14 d in 2000 or 3 d in 2001) before exposure to spray treatments; non-inoculated unsprayed, deionized water, and spinosad or methiocarb at different rates. Visual evaluations of feeding damage, percent leaf area damaged, and thrips counts were the variables measured. Results from the two experiments indicated that 'Cajun Carmine' plants not treated with insecticides had injury levels comparable to plants treated with spinosad and methiocarb. In comparison with the other cultivars tested, 'Cajun Carmine' and 'Cajun Lilac' had lower numbers of WFT. Spinosad and methiocarb application rates as low as ¼ label rate reduced thrips feeding injury. The number of WFT on impatiens treated with spinosad and methiocarb were similar to the non-inoculated unsprayed control. The impatiens cultivar 'Cajun Carmine' in combination with treatments of either spinosad or methiocarb resulted in less WFT injury than a susceptible impatiens cultivar, 'Impulse Orange' given the same insecticide treatments.

D6-P Western Flower Thrips Differentially Attracted to Four Verbena Cultivars with Similar Genetic Background

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Western flower thrips, *Frankliniella occidentalis* (Pergande), significantly impact floricultural crops worldwide. Insecticides to control this pest are limited due to federal regulations and acquired resistance to many insecticides. Holistic integrated pest management (IPM) programs are emerging within the industry to manage western flower thrips (WFT) that minimize worker exposure and limit environmental impacts. However, the use of trap crops, which function by using a pest's preference for certain plants to localize the pest for insecticide applications or where they will have minimal impact on main crops, is not extensively utilized in commercial greenhouses due to perceived economic obstacles. Four verbena, *Verbena x hybrida* Voss., cultivars were monitored in ten greenhouses for six weeks to determine WFT preferences. Yellow sticky cards placed immediately above flowers were used to determine if endemic WFT were differentially attracted to verbena cultivars. Western flower thrips preferred the cultivar 'Tapien Lavender' to three other verbena cultivars from the same breeding series and the controls. 'Tapien Lavender' attracted up to 7.78 times more thrips than the control. Verbena cultivars could be a useful tool in IPM programs either as a trap crop for WFT or as a means of enhancing scouting efficiency by luring WFT into specific regions for easier detection.

D7-P Characterizing the Diversity of Domestic Populations of *Frankiniella occidentalis* (Pergande) and Their Potential Impact on Floricultural Crops

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Frankliniella occidentalis (Pergande), western flower thrips (WFT), obtained from native (N), laboratory (LC), or greenhouse (GH) environments in California (CA), Illinois (IL), Massachusetts (MA), Nevada (NV), or Texas (TX) were evaluated for feeding aggressiveness on *Impatiens wallerana* Hook.f. and for spinosad resistance on *Gerbera jamesonii* Bol. ex. Adlam. In one experiment, insects from seven populations, CA-N2, CA-N3, CA-LC1, IL-LC1, TX-LC1, CA-GH1, and IL-GH1, were used to assess feeding aggressiveness or to initiate a laboratory colony. Feeding aggressiveness was assessed 0, 7, 14, and 21 weeks after collection (WAC) using a digital image analysis system to determine the percent leaf area damaged by feeding. Damage varied the most at 0 WAC and variation decreased until 21 WAC. Declining damage was attributed to the standardization of fitness in the laboratory colonies or possibly to limited genetic diversity within the colonies reducing insect fitness over time. In a second experiment, nine populations, CA-N2, NV-N1, NV-N2, CA-GH1, IL-GH1, TX-GH1, IL-LC1, MA-LC1, and TX-LC1, reared for 4 months in the laboratory varied in percent survival when flowers inoculated with 25 WFT were sprayed with spinosad at label (0.81 mL • L^{-1}), half label (0.41 mL • L^{-1}), deionized water, or no spray. At the 0.41 mL • L-1rate, CA-GH1 and IL-GH1 populations had the highest survival at 8.8 and 5.0%, respectively. At the 0.81 mL • L^{-1} rate, 8.8% of recovered insects from IL-GH1 survived which was significantly more than any other colony. Feeding aggressiveness of WFT populations on impatiens leaves varies. Some resistance to spinosad exists in greenhouse populations of WFT.

D8-P Pest Status of Southwestern Corn Borer and Sugarcane Borer in Corn, Grain Sorghum and Rice in Louisiana

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The southwestern corn borer (SWCB), *Diatraea grandiosella* Dyar, and sugarcane borer (SCB), *Diatraea saccharalis* (F.), have become

increasingly important insect pests causing economic losses to the corn, grain sorghum, and more recently, to the rice industries in Louisiana. Both the SWCB and the SCB have been considered sporadic pests distributed throughout the State. However, recent mild winters aided by the rising adoption of reduced tillage practices have favored increased survival rates of overwintering larvae. SWCB and SCB populations build up to two generations in corn. When corn becomes less attractive for oviposition, adults move to late planted crops such as grain sorghum. As corn and sorghum are harvested, sugarcane borer eventually moves to infest available hosts such as late planted rice, especially in Central and Northeast Louisiana. A recent survey was conducted to assess the impact of both the SWCB and SCB in corn, grain sorghum, and rice during the 2002 growing season. Results presented reveal the importance of SWCB and SCB in the central and northeastern areas of the State and the need of an integrated approach to manage both borer populations in Louisiana.

D9-P Monitoring Susceptibility of Western Corn Rootworm Populations Associated with Areawide Management Programs

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Populations of adult rootworms from both within and outside management programs were collected and sent to the University of Nebraska for each of the six years of the pilot program. Susceptibility of western corn rootworm populations was determined using both traditional dose-response assays as well as a diagnostic concentration assay validated with populations known to be resistant to carbaryl for each of the areawide management sites. Biochemical assays were also conducted to determine potential changes in activity of specific detoxification enzymes known to participate in carbaryl resistance. Additionally, feeding behavior assays were conducted at the end of the program by measuring the propensity of beetles to feed on cucurbitacin treated cellulose discs. In three of the four areawide management sites (IN/IL, IA, and KS), the mortality of rootworm adults at a diagnostic carbaryl concentration declined significantly over the six years of the study. In contrast, no significant changes were observed in populations obtained from the companion areas outside of the management program. A significant shift in responsiveness to cucurbitacin baits was also observed among populations from the managed relative to the companion areas. Although there were no reports of reduced efficacy of insecticidal baits employed in the areawide programs, these results suggest strongly that rootworm populations were in the early stages of resistance development and continued selection may lead to control failures. These results suggest that if an areawide approach to rootworm management becomes widely practiced that alternative technologies (e.g., alternative active ingredients, crop rotation, transgenics) be incorporated into the program.

D10-P Impact Assessment of an IPM Program in Cotton

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State IPM coordinators and IPM program evaluators face an increasing demand for hard data on the payoffs resulting from the investment of public funds in IPM programs. With ever increasing competition for resources, research and extension programs will be evaluated according to the same criteria as other agricultural inputs (i.e., the value of the product must at least equal the cost of the resources expended). Thus, there is a critical need for evaluation programs to measure the level of grower adoption of IPM methods that have been developed and promulgated by state IPM programs, and to quantify the economic returns on dollars invested in IPM research and extension programs. The Clemson University Cotton IPM Program provides an excellent model for IPM program evaluation because of the many changes in pest management technology and practices that have occurred since its inception in the early 1970s. In this study we focus on two questions; 1) What are the benefits to cotton producers who have adopted IPM practices? and 2) To what degree has the level of IPM adoption and associated benefits been influenced by the state land grant university research and extension programs? The poster highlights results of a mail survey done to assess the levels and determinants of IPM adoption among cotton growers in South Carolina.

D11-P IPM in California Cotton: How Integrated Is It?

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A comprehensive mail survey of 266 California cotton growers examined trends in use of a large array of pest control practices, ranging from pest monitoring methods to use of organophosphate insecticides. Some preliminary results from data analysis by

the University of California Statewide Integrated Pest Management Program will be presented here. The current analysis focuses on the degree of integration of biological, cultural, and chemical pest control practices for a few of the most significant pests of cotton.

E1-P IPM Adoption Requires IPM Infrastructure

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One of the most important aspects of Integrated Pest Management adoption is the development of an IPM infrastructure. This infrastructure requires the coordination of many different stakeholders with each contributing their own expertise to produce the final product.

There are key building blocks that are required to build a solid IPM infrastructure. Identification of the stakeholders, grower commitment or "buy-in," an effective research program, and the availability of good quality IPM scouts and consultants are required to ensure the success of an IPM program.

E2-P Strengthening Partnerships Within the Maryland Integrated Pest Management Program.

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Through increased cooperation between the University of Maryland and the Maryland Department of Agriculture, the Maryland IPM program strives to promote, support, implement, and regulate IPM efforts to benefit all the citizens of Maryland. In a region undergoing rapid urbanization, these two Maryland institutions promote innovative programs to support "best management strategies" for pest control and therefore safeguard the environment for Maryland stakeholders. At the University level, Maryland Cooperative Extension and Maryland Agricultural Experiment Station provide programs in education, research and outreach to address the dynamics of pest management challenges. The Maryland Department of Agriculture functions as the regulatory and support arm of IPM efforts in Maryland, charged with enforcing and implementing laws and executive orders designed to promote agriculture and protect stakeholders.

E3-P Idaho Pest Management Center

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The objective of the Idaho Pest Management Center is to help focus research and extension efforts on the development and delivery of environmentally and economically sound pest management practices by identifying, delivering, and coordinating information through a single Web site. The Idaho Virtual Center contains information on all University, Regional, and Federal pest management programs, such as USEPA, IPM, IR-4, Sustainable Agriculture, Pesticide Safety Education, Crops at Risk, Food Safety, and Water Quality. Other data, such as crop profiles and pest management strategic plans, pest profiles, monthly pesticide updates, Idaho minor crop information, and publications are available through this Web page. The Center serves as a focal point for a communication network.

Impacts of program:

- Increased use of recommended pest management practices among Idahoans by enhancing access to information
- Greater UI programming efficiency and team building efforts by increasing successes in large grants programs, collaboration and use of regional resources, and identifying gaps and prioritizing pest management needs
- Engagement of diverse stakeholders
- Enhanced interdisciplinary and multi-organizational efforts

E4-P The Northeastern Pest Management Center

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The Northeastern Pest Management Center (NE PMC) is part of a nationwide system established in the United States and funded through USDA grants to respond quickly to integrated pest management (IPM) information needs in both the public and private sectors. The Center facilitates the use of environmentally and economically sound IPM techniques through a network that includes communication linkages among diverse stakeholders and reliable information for their use.

Our network connects farmers, nursery owners, park managers, homeowners, consumer and environmental groups, government regulatory agencies, researchers, and educators with online bulletin boards, newsletters, mail lists, and a committee structure designed to facilitate this collaboration. IPM working groups and state-based information network projects extend the network across all IPM settings and through all states in the region, respectively. NE PMC utilizes information generated by land-grant university programs and other sources to develop a comprehensive database of reliable, research-based integrated pest management information originating predominantly at land-grant universities. With this information, people are able to make sound pest management decisions in any context, from a backyard garden to national regulatory offices.

For more information, visit our website: http://nepmc.org.

E5-P IPM Florida—At Your Service!

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The University of Florida IPM program, IPM Florida, currently addresses four areas of emphasis: ornamental plant nursery production, vegetable production (emphasizing tomato), cotton production, and School IPM. The IPM Florida office is housed in the Department of Entomology and Nematology with a full-time IPM Coordinator, four part-time Doctor of Plant Medicine students, and a half-time Ph.D. level assistant to be added during 2003. A "Survey of Florida County Extension IPM/Biological Control Needs" was used to determine the kinds of extension support expected from IPM Florida. An IPM/BC Web site (http://biocontrol.ifas.ufl.edu) and associated listserv were also established. Extension faculty have communicated the following topics as their highest priorities for IPM Florida: pest management guides, networking and consultation, current pesticide information, current IPM information, collaboration on projects, measure adoption of IPM, IPM scouting and thresholds, and in-service training. A mini-grant program is being developed to address these priorities.

E6-P Center for Invasive Plant Management: Partnerships in Action

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The Center for Invasive Plant Management (www.weedcenter.org) was established to promote proactive, ecologically sound management of invasive plants in western North America by sponsoring research, conducting public education, and facilitating collaboration and communication among researchers, educators, and land managers. Based at Montana State University, the Center has a 10-member Board of Directors from throughout the West representing landowners, state and federal agencies, industry, conservation organizations, and academia. Since the Center was established in 2000, it has initiated and facilitated a number of multi-disciplinary programs to bring together diverse expertise to address invasive plant issues on rangelands, wildlands, and forests. Programs include an online educational course for land managers, a workshop and follow-up projects in land restoration, and a granting program for cooperative weed management areas. In every case, partnerships are the key to successful program development and implementation.

E7-P EPA'S Strategic Agricultural Initiative: Promoting Risk Reduction on Minor-use Crops Through Outreach and Partnerships

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In response to the Food Quality Protection Act (FQPA) of 1996, EPA created the Regional Strategic Agricultural Initiative to support implementation and transition efforts by growers. FQPA mandated the reregistration of older pesticides and reassessment of pesticide tolerances in food, setting guidelines to protect vulnerable consumer groups such as children. The greatest impacts of FQPA are likely to be on minor-use crops, such as the fruits and vegetables that serve as mainstays in the diets of children. These impacts are driving forces in the adoption of new pest management strategies. Through cooperative efforts with growers, groups, university researchers, extension personnel and others, the impacts of FQPA on minor-use growers can be reduced. The Strategic Agricultural Initiative has been implemented in each of EPA's 10 Regional offices. Regional specialists work to:

- Build partnerships with producers, commodity groups, Universities, and other agricultural stakeholders.
- Cooperate with USDA in the formation and use of the Regional Pest Management Centers.
- Through outreach, capture and share lessons learned about Integrated Pest Management.
- Provide routine feedback to EPA's Office of Pesticide Programs (OPP) and USDA on producers, pest management issues and concerns.

Forming and strengthening innovative strategic partnerships with stakeholder groups is key to facilitating the adoption of reduced-risk tactics such as IPM. The EPA Regional Specialists serve to communicate regulatory decisions and their potential impacts to the agricultural community, and seek to facilitate the transition to reduced-risk alternatives in response to those impacts.

E8-P Cancelled

E9-P Implementing a Weed Management Decision Support System Throughout the Southern Region

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During the past four years, regional and national IPM projects have focused on adapting the weed management decision support system, HADSS, for use in ten Southern states. Cooperating weed scientists in Alabama, Arkansas, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, and Texas have developed state-specific versions of HADSS and have tested these programs in research station and on-farm validation trials. In general, validation trials have shown that recommendations from HADSS are equal to or better than a grower standard practice or an expert's recommendation in terms of weed control, yield loss, and net return in the large majority of cases. Analysis has shown that state databases vary markedly in weed species included, weed competitive indices, herbicide treatments, and treatment efficacies. A Web-based version of HADSS is available to anyone with a Web browser who is connected to the Internet at www.cropsci.ncsu.edu/webhadss.

E10-P GO IPM!, a Dynamic Regional Effort for IPM of Greenhouse and Ornamentals

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GO IPM, the Greenhouse and Ornamentals Commodity Work Group, was established to identify and address the research and extension needs and priorities of growers in the greenhouse and nursery industries. The group comprises growers, representatives of grower and environmental associations, extension specialists, professional scouts, sellers/producers of biocontrol agents and researchers from throughout the northeastern states. Formed in association with the Northeastern Pest Management Center (http://nepmc.org), GO IPM is focused on one key question: What hinders greater adoption of IPM by growers of greenhouse and nursery crops, and what can be done to overcome these hindrances?? The group is currently conducting a survey among growers and other key stakeholders to gain insights into current pest management needs. They are also compiling a directory of existing information resources and research and extension activities underway in the region. The group hopes to serve as a catalyst for regional collaboration to address important IPM issues facing growers and ensure that available resources are efficiently utilized. The group is eager to receive input on how they can most effectively support the greenhouse and nursery industry in the future.

E11-P Expanding Biointensive IPM Through Partnerships: The Wisconsin/Florida Ramp Example

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The University of Wisconsin (Madison, WI), Glades Crop Care, Inc. (Jupiter, FL), and Benbrook Consulting (Sandpoint, ID) received a USDA Risk Avoidance and Mitigation Program (RAMP) grant in 2001 to expand and enhance bioIPM vegetable programs in Wisconsin potato and Florida tomato and pepper systems. Through this unique partnership, specific growers" advancements in bioIPM systems have been documented in both the Wisconsin potatoes and Florida vegetable systems. Funding provided for the development of credible, comprehensive measurement systems of IPM systems, pesticide toxicity measures, and resistance management risk indices. Targeted and focused grower outreach opportunities provided growers with one-on-one learning while hands-on grower tools were developed to provide growers with bioIPM educational materials. In all, this project provided the collaboration between two unique entities working on bioIPM programs. The enhanced agricultural research, synergy, efficiency, focus and productivity which occurred between the Florida and Wisconsin project has resulted in a cooperative venture which is truly exciting and is proof of a well executed public/private relationship which has effectively enhanced both programs.

F1-P Pesticide Phase-out Laws: Processing, Planning, and Promoting Successful Community Involvement

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In 1999, the Suffolk County Legislature passed County Code Chapter 380, effective January 1, 2000. This bill phases out the use of pesticides on county-owned properties and buildings. Effective July 1, 2003, no county agency, department, or contracted applicator will be permitted to apply any substance classified as a known, likely, or possible carcinogen, except in the issuance of a waiver or as provided for in section 380-3.

The Suffolk County Community Advisory Committee (CAC) has been created by Legislature to oversee the implementation of County Code Chapter 380 by the County Department of Health Services. The CAC has developed a comprehensive Integrated Pest Management Program focused on improving education, sanitation, maintenance, and repair efforts throughout County owned buildings and properties. Suffolk County Cornell Cooperative Extension, in collaboration with the CAC, offers education and training in pest management practices to all levels and departments of county staff.

Cornell Cooperative Extension's outreach efforts include the development of an educational package centered on the theme "Spotlight on Pests." In addition, Extension Educators offer a traveling "Live Bug Show" to children and adults that promotes respect for the environment and its creatures.

We will demonstrate the development of this novel pest program and the dynamics the various stakeholders play in the interpretation and impact of this law.

F2-P Pilot School Program in Iowa: Approach and Assessment

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A potential conflict arises in the methods a school uses to keep pests under control and protect the children and staff that are present in the facilities. All too often, pesticides are selected as the pest control method, with the primary focus on eliminating the pest in a quick and inexpensive manner. In an effort to reverse this trend and improve the safety for those using school facilities, a pilot program for integrated pest management in the school environment was conducted in Iowa from March 2001 through June 2002. The approach used included surveying school districts to determine pest control practices, convening an advisory group comprised of state agencies and pest control industry representatives, and in-depth training and technical assistance to the four selected public school districts. Assistance to the schools was comprised of an IPM overview workshop, pesticide safety and pest-specific workshops, resources for implementing IPM, development of a school IPM Web site, a landscape IPM overview workshop, facility audits with emphases on structural repairs needed and conditions conducive for pests, an inventory of disinfectants and other pesticide products in the schools, and technical assistance as requested. Initial assessment involved the comparison of responses to a test taken before and after IPM training, and responses of a survey instrument taken after completion of training. Although exam scores were higher following training (mean pre-training score 54% vs. post-training score 72%), the distinction was not significant due to a small sample size. Exit evaluations displayed an overall satisfaction with the training efforts and knowledge gained, and indicated willingness to change behavior based on training. Eliminating clutter, reading disinfectant and pesticide labels before use, storing food in pest-proof containers, identifying pests before controlling them, and reducing pesticide use at work and home were IPM practices that respondents were willing to do following training. Final assessments determining what IPM practices had been implemented in the schools will be done May 2003.

F3-P Working with Pest Management Professsionals for Effective Implementation of IPM in Schools

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A recent survey of pest management practices in Ohio schools found that pest management professionals (PMPs) play an important role in many school districts pest management programs. 81% of the survey respondents reported that they relied on a PMP to apply pesticides in their district. When making the decision about when and which pesticides to apply 68% and 91% respectively, relied upon a PMP. Therefore the role of the PMP needs to be considered in any program promoting the effective implementation of IPM in Ohio schools. In order to better understand and incorporate this role, a survey of PMPs was conducted during the annual series of pesticide applicator re-certification schools held throughout Ohio. The survey was designed to gather information about current IPM practices and programs employed by Ohio PMPs and to learn what they perceive to be the barriers to implementing IPM in a school setting.

F4-P Efficacy and Cost Effectiveness of Least Toxic Approaches in a School IPM Program in Maryland

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Concerns over pesticide use and the health and safety of students and staff have resulted in a plethora of legislative actions affecting schools. These actions are intended to decrease children's pesticide exposure and are being considered in more than thirty states. Nationwide, more than thirteen states have either mandatory or voluntary "IPM in Schools" laws. With the exception of a limited number of reports for indoor pests there are very few comparative studies that examine the feasibility of implementing IPM tactics, strategies, or programs for turf, landscape, and hardscape pests in public schools. The objective of our study was to determine the efficacy and cost effectiveness of "least toxic" control tactics and strategies for managing weed, insect, and disease pests in public school demonstration sites in Maryland and New York and compare these with conventional practices. "Least toxic" pest management strategies use tactics such as cultural, biological, physical, and low risk products. After the first year of the demonstration several tactics and strategies have been evaluated including the removal of weeds from playing fields, parking lots, fence-lines, sidewalks, and planting beds mechanically and with "low risk" post-emergent herbicides derived from organic acids. In general the "least toxic" strategies have proven less effective and far more expensive than conventional ones. Least toxic approaches resulted in weed densities far above threshold levels established by the school system and required frequent re-treatment. These results raise important concerns regarding the feasibility of conducting mandated IPM programs in public schools in Maryland.

F5-P Adopting IPM in Tennessee Child-serving Facilities

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Pest management programs in schools, childcare and other child-serving facilities need to balance and reduce risk associated with pests and pesticides. To meet this objective, an IPM in Schools Program was initiated in the spring of 1996 as a joint venture between The University of Tennessee and The Tennessee Department of Agriculture, Division of Regulatory Services. Our IPM program was and still is promoted throughout the state. In 1997, results from a school system survey indicated 11.7% were using IPM and in 1999, our latest estimate raised the percentage of school children in schools using IPM to 38%. The IPM in Schools Program was expanded in 2001 to include all child-serving facilities and a new research team was formed, The University of Tennessee Youth, Environment and Health team (UT YEAH) to include members from The University of Tennessee's Family and Consumer Science, College of Social Work and Department of Health and Safety Sciences. Six workshops for 140 stakeholders in Knoxville, Nashville, Jackson, Chattanooga, Jonesborough and Memphis were conducted to discuss improving the well-being of Tennessee,s children by reducing risks associated with pests and pesticides in child-serving facilities. A summary of the workshops can be found at http://utyeah.utk.edu/. Results of a school system survey conducted in the winter of 2002/2003 to reassess these risks will be presented.

F6-P Chemical-Free Method for the Detection and Elimination of Head Lice

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Head lice have become a significant issue for children and their families. Millions of cases are reported each year in the United States, and lice infestations are a problem worldwide. Insecticidal shampoo and cream rinse products used to treat head lice represent one of the last vestiges of applying pesticides directly to human skin. Because of the demographics of these cases, it is mostly young children who receive such treatments. Parents are increasingly reluctant to treat their children with pesticides, and are especially frustrated because many strains of lice are resistant to one or more of the chemicals used in these applications. This is also a difficult problem for schools, camps, daycares, and other institutions eager to recommend pesticide free alternatives.

This paper presents results using a special hexagonal comb that provides a simple, effective, non-chemical option for the detection and control of human head lice. The objective of this combing approach is to diagnose and curtail head lice infestations without direct scalp exposure of children (and adults) to pesticides. The technique first detangles hair, then enables easy removal of lice at all stages of development after hatching. The comb targets the lice themselves, not their eggs ("nits"). By removing the lice, one removes egg-layers, and catches newly hatched lice before they mature. With attentive combing over time an infestation can be eliminated. The method can also be used to inspect for head lice, with the capability of detecting lice at an earlier stage in an infestation than possible with the current, traditional inspection method (visual searching for nits). The inspection procedure can be followed to screen individuals for lice (such as students in a school nurse's office), or it can be used to periodically monitor previously infested people to confirm that the lice treated with this or any other method were indeed eliminated.

F7-P Developing Educational Programs for Retail Stores that Sell Pesticides

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Employees of retail stores that sell pesticides are often a primary source of pest management information to homeowners. However, a survey of 650 retail stores indicated that the level of employee training in pest management was somewhat limited. Only 34% of the retail stores provided any employee training related to pesticide use. The use of integrated pest management (IPM) was seldom included as a topic and less than10% of the stores used university or USDA publications as references.

Using a grant from USEPA Region 5, educational programs were conducted in 2001 and 2002 at six different locations in Illinois. The three-hour program provided a general overview of pest identification, pesticide safety, and making pest control recommendations with an emphasis on IPM techniques. Each participating retail store received a package of University of Illinois Extension publications at no cost. Program evaluations were very favorable with pesticide safety topics and IPM references receiving the highest overall ratings.

F8-P Homeowner Solutions: An Interactive Tutorial

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Homeowner Solutions is an interactive CD tutorial designed to help the general public voluntarily learn and better understand important concepts about using pesticides in and around their home. The intended audience includes homeowners, landlords and tenants, school custodians and Master Gardeners.

The tutorial contains 21 chapters, 54 learning objectives, and over 290 screens, 125 audio clips, 300 graphics, 160 animations, and 130 user interactions. It provides information about each learning objective and then asks users to choose their response to a given

pesticide handling scenario. It then indicates whether their response is correct and the reason why or why not. Basically, the tutorial provides users review questions in an interactive format. It is user friendly, easy to navigate within the tutorial, and it does not install any software or files on a user's personal computer.

Included on the CD is our complete series of Home PEST brochures. The Home Pesticide Education Safety Training project is a voluntary educational effort in Wisconsin to provide the general public with the knowledge they need to make informed decisions about pesticide use in and around the home. Rather than repeat in the tutorial itself the detailed information contained in the brochures, we occasionally refer users to the appropriate Home PEST brochure for additional information. An integral feature of the tutorial is that a user may open up and read the referenced Home PEST brochure without having to exit the tutorial itself.

F9-P Proactive, Low Toxic Management of Stinging Insects in Sensitive Areas

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Stinging insects are among the most frequent and persistent pest problems at schools, parks, and similar locations. Responses for control are usually reactive and involve pesticides. For two years, IPM specialists from the NY State Community IPM Program, Cornell Department of Entomology, and Cornell Cooperative Extension have worked with proactive, non-toxic, and low toxic approaches to stinging insect management. These demonstrations were held at schools and other sensitive sites throughout New York State. Sites were inspected regularly for nests. Nests were removed with water sprays and other non-chemical tools. Commercially available, low toxic insecticides were also used. Additional techniques included sanitation, exclusion, vacuums, and traps. Effectiveness was evaluated by comparing the results of sites with weekly, semimonthly, and monthly inspections. "Managed" schools were also compared to nest counts at "unmanaged" schools.

Semimonthly inspections were sufficient for maintaining control of paper wasps and locating yellowjacket nests. Physical methods and low toxic sprays were effective in removing paper wasp nests. The removal of yellowjacket nests from voids was more difficult and labor intensive. Vacuums and low toxic insecticides (especially dusts) were among the most promising tools. Sanitation and exclusion were highly valuable for persistent stinging insect problems. Results of this work can be applied to many situations where risks from both pests and pesticides must be minimized, such as schools, day care, and other public facilities.

F10-P Community-wide Imported Fire Ant Management in Texas

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Managing the red imported fire ant, *Solenopsis invicta* Buren (Hymenoptera: Formicidae) has been demonstrated to dramatically reduce the cost of insecticide use, maintain control of fire ants and eliminate problems caused by the ant. This demonstration, conducted in the Lago Santa Fe community in Galveston County, Texas, demonstrated several recent advances in conducting community-wide programs, including: 1) the effectiveness of the "hopper blend" treatment (50:50 hydramethylnon plus s-methoprene ant bait); 2) application methods such as the truck-mountable industrial "bait blower"; and 3) scheduling treatments to reach a goal of maximum control for an athletic event, the 2002 National Ski Championships.

F11-P Evaluation of Golf Turf Management Systems with Reduced Chemical Pesticide Inputs

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We designed this project to provide information on the feasibility and performance of golf course turf managed with few or no chemical pesticides. The project is located at one of the five golf courses at the Bethpage State Park, Long Island, NY, and is funded by the USGA. Current golf course pest management practices ("unrestricted") are compared with IPM and non-chemical management. Further comparisons are made between standard cultural practices and "alternative" practices that we believe will reduce turfgrass stress and thereby minimize pest problems. Total management systems, as practiced by turf managers are imposed, rather than focusing on individual technologies and isolated practices. Two years of a three-year project have been completed.

Systems were evaluated for multiple quality, pest, aesthetic and functional performance measures. Reductions of pesticide applications on the IPM greens ranged from 27-46% as compared to unrestricted greens. Further reductions are expected in 2003 with the use of an injection sprayer that will facilitate spot and custom pesticide applications. Non-chemical greens have been maintained without chemical pesticides for two years, but quality was unacceptable for portions of both years. In 2002, alternative cultural management greens in all pest management treatments had higher quality and fewer pesticide applications than their counterparts. Three non-chemical greens were renovated to

velvet bentgrass after the first season, and maintained superior quality and fewer pest problems than their standard culture, creeping bentgrass/poa annua counterparts.

F12-P Area-wide Termite Suppression in Hawaii

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The Formosan subterranean termite, *Coptotermes formosanus*, was likely introduced to Hawaii in the mid 1800s, and is now the most economically important pest in the State. Costs to Hawaii residents to control and repair damages have been estimated to exceed $100 million annually, and repairs to public schools have been estimated at $241 million. Termites are a serious problem on all seven of the Hawaiian Islands. The environmental and climatic diversity found in the islands impact termite distribution, behavior and control methods.

This multi-leveled, area-wide termite suppression project addresses research, extension and instruction by bringing University of Hawaii and USDA-ARS scientist in contact with school children and the community. Public schools, located on every island under every environmental condition, serve as "windows" into the various communities. The entire state benefits through student and community education, and effective termite control in state buildings.

Termite baiting systems have been installed at pilot schools and are being monitored by students and researchers. Information is provided for students in the classroom, and researchers are working with school teachers to develop a comprehensive curriculum.

F13-P Management of Root-knot Disease of Onion (*Allium cepa* L.) Caused By *Meloidogyne graminicola*

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The rice root-knot nematode, *Meloidogyne graminicola*, causes root-knot disease of onion in rice-vegetable cropping system. Greenhouse and/or replicated on-farm trials of different management strategies to reduce the population of *M. graminicola* were conducted. Host suitability studies showed that all types and cultivars of onion tested were susceptible to the nematode. Wheat, soybean, garden pea, mustard, winged bean, pechay, Chinese cabbage, lettuce, and snap bean were also good hosts. Pepper, cucumber, mungbean, corn, peanut, sitao, cowpea, and members of Cucurbitaceae and Solanaceae (except tomato) were poor hosts and potential rotation crops in rice-onion system. Soil amendment with organic fertilizer or compost had no effect on nematode population and onion yield. Farmer's practice of land preparation reduced initial soil population densities (Pi) but did not affect onion yield. Surface firing by rice hull burning (RHB) reduced Pi and increased onion yield. Increasing the thickness of rice hulls from 15 cm deep to 30 cm deep increased yield by 44% over no RHB and 12% over 15-cm deep rice hulls. It also produced 38% more large bulbs for export over 15-cm deep burned rice hulls and 152% over no RHB. Soil organic matter, phosphorus, and exchangeable potassium increased in plots with burned rice hulls. Integration of crop rotation with nonhost crops, good land preparation, and rice hull burning is an important approach to manage root-knot disease in rice-onion system in areas where there is an abundant supply of rice hulls.

G1-P USDA, Cooperative State Research, Education, and Extension Service Competitive Grants Programs

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The Cooperative State Research, Education, and Extension Service has a number of pest management competitive grants programs in its portfolio. They include local, regional, and national focused programs, which span from discovery to implementation. These include National Research Initiative (NRI) grants in Entomology and Nematology, Biologically Based Pest Management, Biology of Plant-Microbe Associations, and Biology of Weedy Invasive Plants. In addition, there are research grants available with the Minor Crop Pest Management (IR-4), the Pest Management Alternatives Program (PMAP), and the Small Business Innovation Research (SBIR) grants programs. Research and extension grants are available with the Regional IPM Grants Programs (RIPM), and research and education grants are available through the Sustainable Agriculture Research and Education (SARE) program. Integrated research, education, and extension grants are available through the Integrated Pest Management Centers, Crops at Risk (CAR), Risk Avoidance and Mitigation (RAMP), Organic Transitions (ORG), and Methyl Bromide Transitions (MBT) programs.

G2-P Regional Integrated Pest Management Centers—Promoting IPM Programs that Help Agriculture, Consumers & the Envirionment

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Regional IPM Centers help the Cooperative State Research, Education and Extension Service (CSREES) and its partner institutions identify, prioritize, and coordinate national pest management research, extension, and education programs. While IPM Centers are regionally based, inter-regional collaboration that crosses parochial boundaries is an important component of the program's success.

Regional IPM Centers have many benefits, including:

1. Increasing effectiveness of public investments by enhancing the coordination of research and outreach efforts
2. Bolstering interdisciplinary and multi-organizational IPM research and outreach efforts
3. Providing timely and high quality information on IPM practices and use patterns to government agencies and agricultural stakeholders
4. Organizing responses to emerging regional and national issues
5. Fostering a high level of stakeholder involvement and support for public research and outreach IPM programs

Four Regional IPM Centers are spread geographically across the United States. They lead collaboration, needs assessment and communication among stakeholders, regulators and the university community.

G3-P The Southern Region Pest Management Center

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In September 2000, USDA-CSREES created the Regional Pest Management Centers (PMCs) as part of a nationwide pest management information network. CSREES established the regional PMCs to respond quickly to information needs in both the public and private sectors and to help USDA and its partner institutions identify, prioritize, and coordinate national pest management research and education programs. Through a competitive process, four regional PMCs were funded in FY 2000 with funding that previously supported the CSREES Pesticide Impact Assessment Program (PIAP). The poster describes the Center in the Southern Region and provides details about its management and function.

G4-P National Foundation for IPM Education: Ten Years of IPM Leadership

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The National Foundation for IPM is a not-for-profit public foundation that promotes education, provides information, and encourages research to increase the adoption of IPM. The Foundation's mission is to design and conduct educational programs for interdisciplinary training on IPM; increase visibility and acceptance of IPM by disseminating information; facilitate the transfer of IPM technologies to professionals and the general public; and support demonstration research. Directors include representatives from government, academia and the private sector. The Foundation supports IPM demonstration research primarily through a cooperative agreement with the U.S. Environmental Protection Agency to foster mutual interests in pesticide risk reduction and IPM adoption. Through this agreement, the Foundation manages a national competitive grants program that has invested over three million dollars in more than 70 IPM-related projects since 1995. For more information, visit the Foundation Web site www.ipm-education.org. Contributions to the Foundation are tax deductible.

G5-P Collaborating with Public Libraries to Introduce the Public to Integrated Pest Management

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Integrated pest management (IPM) is often the best compromise between concerns about uncontrolled pests and pesticide risks. However, many people are not familiar with the basic principles of IPM. With education, most households could apply IPM techniques to manage pests around the home and reduce pesticide risks. Additionally, the public could encourage adoption of IPM by demanding IPM products in the marketplace.

We contacted public libraries throughout Georgia and asked them to collaborate with us to conduct a public education campaign concerning the benefits and application of IPM. In many areas, the local extension office was also involved in educational activities. Through a series of displays, handouts, and other information, we were able to significantly increase public awareness of IPM.

G6-P Educational Resources for Integrated Pest Management from California

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Since 1981, the IPM Education and Publications group of the UC Statewide IPM Program has published 14 crop-specific manuals covering 20 crops, floriculture, and nurseries. With the completion of the floriculture book (and the grape pest management book developed by other authors), the IPM Project now provides growers with a comprehensive guide for carrying out an IPM program in every major California crop. IPM information needs of urban audiences are being addressed by the titles *Pests of the Garden and Small Farm* and *Pests of Landscape Trees and Shrubs*. These immensely popular books have extended the UC IPM Project's reach far beyond the traditional agricultural clientele. *Pests of Landscape Trees and Shrubs*, for instance, is an official study guide for people being professionally certified by the International Society of Arboriculture. A CD-ROM resource, *The UC Guide to Solving Garden* and *Landscape Problems,* is used in every Master Gardener office to diagnose and make management suggestions for garden and landscape pests. *A Natural Enemies Handbook*, published in 1998, provides comprehensive coverage of biological control for all types of pests. A new textbook, *IPM in Practice: Principles and Methods of Integrated Pest Management,*

provides a complete curriculum for preparing students for practical careers in IPM.

In 1987, UC IPM initiated a project to develop brief but comprehensive pest management guides (PMG) that could be electronically accessed and rapidly updated. Written by UC AES or CE faculty or CE Advisors but edited and maintained in a strict format by IPM E&P staff, these PMGs are UC's official pest management suggestions. The guidelines are updated regularly and maintained on the UC IPM Web site (www.ipm.ucdavis.edu) with thousands of color photographs linked to assist in identification. The Pest Note series for home and landscape pests, also available on the Web and as attractive printed copy, covers over a hundred common pests, emphasizing less toxic solutions.

G7-P Teaching IPM to a Global Audience: Using Distance Education to Teach International Plant Protection

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By using various distance education technologies, students around the world have the opportunity to learn about IPM. The Department of Entomology at the University of Nebraska-Lincoln currently offers 12 distance courses. Our newest distance course, International Plant Protection, was offered for the first time in the Fall Semester 2002.

Information about the global use of IPM was delivered via the Internet by using Blackboard courseware. In addition to reading the assigned course materials, students were required to asynchronously discuss various topics and assignments with each other and the instructors of the course on a discussion board. This type of asynchronous interaction provided students with the opportunity to work together throughout the duration of the course regardless of their personal and professional responsibilities.

Eighteen graduate students from three different countries participated in the International Plant Protection course. Eighty-nine percent were employed full-time, and 61 percent of the students were 41 years of age or older. One hundred percent of the students had computer access in their homes. Eighty-three percent of the respondents completed the majority of their course work at home, and seventeen percent of the students worked on their assignments while at their respective places of employment.

Our data supports the concept of using the Internet as an educational tool for teaching IPM to new and diverse audiences. The potential to teach people about IPM through the use of various distance education technologies is endless. Furthermore, learners living across the nation and around the world can work together and discuss the many aspects of IPM.

G8-P Nine Years of Global IPM Information Dissemination

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In 1993, the Consortium for International Crop Protection (CICP) conceived and pioneered the concept of providing global IPM information electronically. The result was IPMnet, a unique, free information service composed of a Web site and a monthly electronic free newsletter, IPMnet NEWS. Nine years later, IPMnet NEWS has grown to nearly 3,000 e-mail recipients in a documented 128 countries, and a total monthly readership estimated at 5,000 through e-mail, the Web, numerous small sub networks, and pass-along copies. Each month the NEWS provides a user-oriented mix of current IPM news, publication and CD reviews and alerts, equipment information, available position notices, selected journal articles, and the latest additions to the IPMnet CALENDAR. The NEWS strives to provide useful material as free of editorial bias as possible, along with contact names, addresses, e-addresses, and Web sites so recipients can easily seek further information for specific items of interest. Both the NEWS and CALENDAR are unique information resources, unduplicated anywhere else that CICP is aware of. IPMnet is sponsored by the Consortium (ten U.S. land-grant universities) plus the U.S. Dept. of Agriculture, with funding through the Cooperative State Research, Education, and Extension Service and close collaboration with the Integrated Plant Protection Center at Oregon State University. A recent development involves working with USDA to help disseminate information relating to the USDA Regional Pest Management Centers. The result provides regular updates about the centers to audiences within and beyond the U.S. as an effort to foster this growing network and establish global contacts.

G9-P Minnesota Pesticide Resource Center (www.mnpesticide.org): A Cyber Resource for Pesticide Reduction and Alternatives

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The Minnesota Pesticide Resource Center (MPRC) is the product of an innovative collaboration between local, state, and federal agencies and institutions who joined together to educate Minnesotans about pesticides and their alternatives. The Center provides visitors with an online resource to help find and interpret pesticide related information. Launched in June 2002, the MPRC Web site (www.mnpesticide.org) has both state-specific information and information of relevance to the state. Some of the topics included are monitoring and use data, toxicological information, at risk audiences, integrated pest management, pesticide alternatives, and Minnesota statutes and rules. MPRC is intended for wide array of audiences including farmers, health professionals, environmental groups, public sector staff, and the interested public.

Relevant state agencies (e.g. Minnesota Department of Health, U.S. Fish and Wildlife Service, etc.), have their own "gateway" Web pages that organize their respective pesticide and pest management information. The MPRC site serves as a common entrance to these various gateways. Users can search for information via these sources, or alternatively by topic (e.g., health, environment, regulation, monitoring data, use data, etc.). The MPRC Web site was developed with funding from the Minnesota Office of Environmental Assistance (OEA). The site is managed by the Institute for Agriculture and Trade Policy (IATP), a 501(c)3 nonprofit institution. MPRC steering committee members meet regularly to guide site content and policy. Budget shortages, finding consensus among participating agencies, and striving to meet the needs of the site's diverse audience are a few of the challenges that face further MRPC growth and outreach.

G10-P Online IPM Decision Tools in the Northwest

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We provide an overview of online IPM decision tools for the NW as developed by members of the Oregon Statewide IPM Program, the Integrated Plant Protection Center (IPPC), and collaborators (http://ippc.orst.edu). Our long term goal is to develop and support truly integrated, interactive pest management decision support system (DSS) tools online. Projects include: 1) a comprehensive DSS for all crops, based upon the PNW (OR, WA, ID) plant disease, insect and weed management handbooks; 2) the "IPM Weather Data and Degree-Days" Web site, with more than 700 weather stations in six NW states linked to parameters for 44 models, daily downscaled degree-day maps, and a degree-day GIS/mapping calculator for site-specific predictions; 3) Web and email-based pest alert system for tree fruit and vegetable production in Oregon; 4) the Western Region Cutworm Monitoring Program, a developing 6-state network led by Montana State University (http://cutworm.org), with online GIS mapping of adult and larval cutworm densities, degree-day predictions, and moisture effects combined as an expert system to produce risk maps for pale western and army cutworms; 5) a fully integrated DSS for peppermint (IPMP version 3.0), with tools for managing insect, nematode, disease, and weed pests in Oregon and Washington; and 6) a web portal to support the Pest Management Centers–Pacific NW Coalition (OR, WA, ID, UT, AK). Users may register to configure a "my IPM portal" page, with multiple "channels" of news and customized IPM information, for their own needs and interests.

G11-P A Multi-region Internet-based Extension Pest Alert System

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An online pest alert system was created to serve extension IPM needs for multiple regions in the Pacific Northwest. It is a versatile, extendable, reproducible communication network for local and regional scale reporting and warnings of pest incidence and outbreaks. The system is a database-driven, e-mail and Web-based application server based on Coldfusion (R) that offers (1) Near-Real Time Pest Alerts, (2) Phenology Forecasting, and (3) Preparedness Management Strategies to growers. The information is dually endorsed by extension agents and/or research specialists. Currently it has been adopted and is supported for Tree Fruit IPM in Hood River and Medford Oregon, and for Vegetable IPM in the Willamette Valley, Oregon. In these instances, it is providing an electronic means for sharing immediate pest outbreak alerts, forecasts, and other timely information between growers, field personnel, extensionists, and researchers. The system offers the advantage of immediacy and information sharing between various stakeholders. It encourages precise and judicious action and is expected to improve pest management decision-making by stakeholders. Users need to register (free) and can then customize their choices according to crops or situations of interest. Registered users can enter their location-specific pest monitoring data over the Web; however, the moderator's approval is required to post information through the system. The regional and multi-regional scale deployment of this interactive, integrated system encourages development of areawide integrated pest management programs, and promotes a landscape-scale perspective for all stakeholders.

G12-P Teaching IPM Concepts in the K-12 Curriculum

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Integrated Pest Management (IPM) is a robust framework for integrating multiple disciplines, teaching hands-on science and real-world decision-making. The Pennsylvania IPM (PA IPM) Program works with local, state, and regional cooperators to develop IPM curriculum for K-12. In Pennsylvania, IPM is also part of the new Academic Standards in Environment and Ecology, which spells out specific learning objectives in IPM.

G13-P "The Bugmobile!" A Vehicle for Public Engagement

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Reaching the public with messages of insect diversity, IPM and reducing risks of pesticide use is challenging. Traditional extension methods of distributing fact sheets or targeted talks to pesticide user groups reach only a limited audience. The PA IPM Program created an interactive exhibit via an old VW beetle painted like a

ladybug for use at large public venues such as county fairs, teacher conventions, etc. Response? Overwhelming.

G14-P IPM/Pesticide Safety Youth Education Utilizing Diverse Media

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This poster session will highlight educational materials developed by Pesticide Education Program. These materials include D.B. Pest, a computer tutorial, an activity book, high school curricula and other educational materials. These educational materials have been pilot tested in high school science and agricultural science classes, at safety day camps, and in school enrichment programs. The materials have been requested and used for educational programs in several states. This poster presentation will provide the opportunity for others to view and receive these educational materials.

Including an IPM educational unit that is balanced in its perceptions into the already existing curricula can serve several purposes. Although many schools nationwide have not adopted IPM as part of their academic requirements, as Pennsylvania has, they are adopting IPM policies for their school environment. Mastery of IPM concepts will help prepare students to be more informed consumers regarding pesticide residues on foods, more environmentally sound alternatives for pest control, and safer applicators if and when the need to use pesticide arises. These same educational materials can, and have been, adopted for adult consumer outreach education.

G15-P NSF Graduate Teaching Fellows in Grades K-12 at the University of Maine: Integrated Pest Management Activities

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The primary objective of the University of Maine's National Science Foundation Graduate Teaching Fellows in K-12 Education program (NSF GK-12) is to provide role models to future science, mathematics, and engineering professionals. The program provides active learning for students in grades K-12 and professional development for teachers in science and mathematics. University graduate students work directly with 22 teachers and 1000 students in 4 school districts. The program is designed to enrich K-12 student education by incorporating the academic specialties of current fellows into the teaching of state-sanctioned curricula. Furthermore, fellows get an opportunity to improve their communication skills with K-12 learners of varied abilities and to develop age-appropriate scientific explorations. Entomology and plant science provide a basis for teaching Integrated Pest Management (IPM) concepts in the classroom, as well as indoor and outdoor activities that demonstrate real-world pest management decision-making skills. Focus areas include basic insect identification and biology, field data collection and analysis, current issues in IPM, the use of multimedia resources (e.g., Web sites, publications, videos, related curricula), and the creation of new lesson plans.

G16-P Developing the IPM Professional Masters Degree At Michigan State University

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The Department of Entomology is coordinating a Professional Masters of Science in Integrated Pest Management program for students to gain knowledge and experience for employment in private agricultural and pest management industries, government agencies and university research and education positions. The objectives for the program are to provide: 1) a broad education experience by having a required curriculum of advanced course work for all students, flexible elective classes to meet the students interests, and seminar classes in statistical methods, IPM Decision Making and IPM Capstone problem solving which are unique to the program but which allow other graduate students to take; 2) an internship with an industrial, university, or government partner to give real world experiences and a professional paper explaining those experiences providing additional writing skills; and 3) a Certificate of Business Management and Communication to prepare the students for the workplace.

The outcomes are gainfully employed students in meaningful positions in the pest management and agricultural industries, or advancement in their own company. There have been four classes with a total of 14 students with six graduates and two students going on for their PhD degrees.

G17-P The University of Florida's Doctor of Plant Medicine Program: Training the IPM Practitioners of Tomorrow

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The University of Florida has taken a bold step in teaching the intricacies of crop management with the creation of the Plant Medicine Program. Although other universities offer degree programs in IPM and plant protection, no other is as comprehensive as U. F.'s, leading to a Doctor of Plant Medicine (D.P.M.) degree. The innovative Plant Medicine Program offers students a multidisciplinary approach to developing solutions to the challenges of crop production. Extensive coursework in the plant sciences, entomology, plant pathology, nematology, and pest management prepares students to be successful problem solvers and decision makers. During multiple internships, students exchange ideas with academic and industry professionals, and apply their skills to practical situations. Interns have worked with private corporations, public institutions, and government

agencies, in research, regulatory, and extension capacities. Florida's agricultural diversity is complemented by internships in other states and abroad. Students pursue a variety of interests, ranging from traditional agronomic crops to ornamentals, turfgrass, vegetables, and temperate and tropical fruit crops. Each student may tailor the program to reflect specific interests, while maintaining a strong foundation in the core courses. Since its inception in 1999, enrollment in the D.P.M. program has grown to over 40 students. Beginning in 2004, graduates will become valued members of the global agricultural community.

G18-P Texas IPM Internship Program

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The Texas IPM Internship Program, a partnership between Texas Cooperative Extension, Texas Pest Management Association and the Texas Department of Agriculture, was initiated in 1998 to assist in developing future IPM professionals by providing practical, hands-on, field experience in IPM. College sophomores, juniors and seniors majoring in crop production or crop protection disciplines are eligible to participate in the program which lasts from 10-16 weeks during summer semesters. Interns are supervised by Extension Agents-IPM headquartered at various locations across the state who work directly with growers in evaluating new IPM technology and implementing IPM programs. Interns are eligible to receive college credits, receive an hourly wage, and are paid a training stipend upon successful completion of the internship. Evaluations of the program by interns have been very positive.

G19-P IPM Farmers Field School (FFS) in Central America

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The Farmers Field School (FFS) methodology had been introduced to El Salvador and Nicaragua with some modifications from the FAO model and adapted to the living style of farmers from this region by the Integrated Pest Management Program for Farmers in Central America (PROMIPAC). PROMIPAC is a SDC project executed by Zamorano University with the collaboration of more of 80 partner institutions. Five Training of Trainers (TOT) courses have been held since 2000, to 90 facilitators in both countries. The trained facilitators from government and non-government institutions carried out 42 FFS with 960 farmers, in fields of maize, beans, cucumber, cabbage, green pepper and tomatoes. FFS curricula included, besides IPM, topics such as marketing, community organization and soil and water conservation. FFS were successful in decreasing pesticides application without reducing production in the demonstration fields. Some farmers accustomed to apply weekly in vegetable fields, realized they could produce green pepper with only five sprays of less-dangerous pesticides. FFS incremented farmer's knowledge of IPM up to 40%. Facilitators reported that farmers using FFS methodology were empowered and changed attitude. Now they believe in the role of natural enemies. Some of the partner institutions are adopting the FFS methodology as their main methodological extension model for IPM and other topics. A difficulty we encountered was that some facilitators focused more on the methodology than on the farmer's field production. A study to evaluate impact as an overall process will be conducted in 2003.

G20-P Universities Are Adopting the Farmers Field School (FFS) Methodology to Teach IPM in Nicaragua and El Salvador

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Integrated Pest Management Program in Central America (PROMIPAC). Zamorano University, P.O.BOX 93, Tegucigalpa, Honduras, Central America

The Farmers Field School (FFS) methodology had been introduced to the Central American countries with some modifications from the FAO model and adapted to the living style of farmers from this region by the Integrated Pest Management Program for Farmers in Central America (PROMIPAC). PROMIPAC is a SDC project executed by Zamorano University. The FFS methodology apply techniques, knowledge and tools from Integrated Pest Management (IPM) using concepts like learning by doing, adult education and good decision making into the agricultural system perspective. The FFS had been applied in Nicaragua and El Salvador since 2000 with agronomy students from eight universities and eight agricultural colleges. PROMIPAC and the educative institutions in both countries had developed an IPM curriculum for classes easily adapted to each particular situation. The curriculum is basically focused on crop protection and ecological themes incorporated into normal classes and field practices following the FFS methodology. Until now PROMIPAC and partners had developed 11 FFS with the participation of 444 students and 42 teachers. The students showed an increase of their knowledge by 25% compared to students not involved in FFS. The score was measured by differences between an initial test and a final test. According to data presented by the universities, the students also had improved the field abilities and right decision making just by practicing the learning by doing philosophy.

G21-P IPM in Washington State—A Coordinated Approach

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Washington State University develops and provides research-based information on integrated pest management strategies to growers, landscapers, structural pest control operators, schools, homeowners, and others through a coordinated outreach program. Research and educational needs are assessed through related programs in the WSU Department of Entomology: the Agricultural IPM Program (http://ipm.wsu.edu), the Washington State Pest Management Resource Service (WSPRS, http://wsprs.wsu.edu), and the WSU IPM and Pesticide Education Program (http://pep.wsu.edu). Agricultural research is conducted by faculty and staff throughout Washington state at research centers such as the one in Prosser to develop biological, cultural, and reduced-risk chemical methodologies for pest control. Agricultural producers receive assistance with IPM plan development and implementation. Urban IPM education programs are coordinated at WSU Puyallup. IPM curriculum and workshops are presented to landscape and turf managers within an IPM Certification Program. The Hortsense Website provides IPM options for homeowner plant problems. A cooperative effort directed at IPM in Schools involving EPA and state agencies is also coordinated through Puyallup. WSPRS, housed in Tri-Cities and Puyallup, created and maintains a searchable Website that offers a wide spectrum of IPM information to citizens of Washington State. Through the WSPRS site, users have 24/7 access to publications, relational databases, and lists of workshops and seminars to assist them in making informed pest management decisions.

G22-P University of Idaho IPM Minigrants: A Decade of Extension Programming in Pest Management

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The Extension IPM program at the University of Idaho competitively awards small grants-in-aid (maximum $3,750) from our USDA-CSREES Smith-Lever 3(d) monies to Extension faculty for local IPM programming. Preference is given to projects that

1. Have high potential for improving pesticide use and increasing grower profitability;
2. Take a train-the-trainer approach by especially targeting consultants, industry fieldstaff, agrichemical dealers and sales staff, agency personnel and others who advise farmers and homeowners about pest control;
3. Will increase use of IPM in major field and row crops, commercial fruits and vegetables, urban commercial horticulture, and rangeland/public weed management.

Despite the relatively small financial investment, impact has been significant. Between 1993 (when the Minigrants program began) through 2002, we awarded $136,000 to 79 local projects that were lead by 28 County Extension Educators and 12 State Specialists who worked as teams at 31 of Idaho's 44 counties. Projects routinely leverage Minigrant awards with additional support from state commodity commissions, industry sponsors, and public granting agencies. Together these faculty conducted field days, demonstrations, workshops and other clinics that provided IPM training to 16,000 Idaho farmers, industry field staff, and homeowners.

G23-P The North Dakota IPM Crop Survey: Expanding with Technology

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A statewide pest survey was expanded with the aid of new technology in 2002 to six major crops in North Dakota. Crop stage, insect and disease situations were reported during critical times of the growing season based on a crop and pest scouting calendar. As compared to previous surveys, the 2002 survey broadened the use of GPS for location of survey fields, GIS for graphic interface of pest occurrence and severity in the state, and internet postings of pest occurrence. Timely survey summaries were presented through weekly newsletters, daily updates on the internet, an area wide listserve, and linked to Internet-based forecasting models where available.

G24-P Delivering IPM in Kentucky: Integrating Concept and Method

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From its very inception Integrated Pest Management in Kentucky has been taught and demonstrated in its very broadest sense. In the very early days, the IPM program was aimed almost exclusively at field and forage crops. The program sought to educate producers, not only with the control of crop pests, but to further integrate pest management into the closely linked crop production skills leading to de facto Integrated Crop Management. These efforts continue, but today we work with a much broader definition of "commodity," including areas not traditionally associated with production agriculture. Included in these efforts are attempts to educate non-agriculture clients about how important it is for producers to utilize IPM. Our efforts are integrated in topic, expertise, source of ideas, methods of delivery, participation, and operation. Working groups form, change, and dissolve as needs arise, change and problems are solved.

G25-P School IPM in Iowa: Developing Grade Specific Lesson Plans

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According to an Iowa survey of those best acquainted with their school's pest control practices, 80% of the respondents were not familiar with integrated pest management (IPM). However, more than 50% of the respondents were interested in learning about IPM. In an effort to provide IPM information to school districts in Iowa, a pilot program was initiated in October 2000. One component of this program was the development of grade-level specific lesson plans to address integrated pest management principles. Four lesson plans were developed specifically for high school classes (grades 9-12). These plans included:

- Pesticide Use: Environmental Awareness and Impact of Conservation Organizations
- Pesticides as Chemical Tools in IPM
- IPM Pesticides and Regulations
- IPM Case Study

Each lesson plan focuses on a specific topic (social studies, chemistry, etc.), provides an overview and purpose, outlines specific activities, and provides additional background or technical information. Lesson plans have been posted on the Web site (http://school.ipm.iastate.edu/). School districts have been notified about the availability of the lesson plans, and have been given the option of obtaining the plans from the Web site or from hard copies mailed by the investigators.

G26-P Model Certification Training Manual for Right-of-way Pesticide Applicators

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The EPA, through the National Foundation for IPM Education, funded the development of a national training manual for the right-of-way category since expertise in this subject is often limited for the states. The editorial committee represents all sections of the U.S., right-of-way types, and both users and trainers. This document is available on the Web and is intended to enhance or supplement the applicator training material. The array of control options is presented with particular emphasis on proper use of herbicides.

G27-P Exploring the IPM House: A Program for Youth Education in Residential IPM

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Homeowners may use up to ten times more pesticide per acre than farmers when managing pest problems. With the current rate of urban development, residential pesticide usage poses a significant threat to both the environment and human health. An integrated pest management (IPM) approach can be used to reduce the need for household pesticides; however, most adults are not familiar with IPM concepts. Children taught about IPM are more likely to adopt IPM as adults and less likely to rely exclusively on pesticides when trying to manage pest problems. This project involved the construction of a detailed model house to visually demonstrate lifestyle, home construction, and landscape practices that may be implemented to help control pests and reduce pesticide use around the home. A relay game was also incorporated into the lesson plan to teach children the basic concepts of IPM for common household pests. This discovery-based curriculum is presented to children through the "Teaching Kids About The Environment" (Teaching KATE) program.

G28-P Home and Garden Information Center, Answering Questions Via the Web

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The Home and Garden Information Center (HGIC) is committed to assisting Northeast residents in solving their pest plant and landscape problems. The Center's approach to this mission has been the development of self-help diagnostic tools that are included in Web sites, fact sheets and a Master Gardener handbook. HGIC has a solid 12-year track record for meeting the public's demand for accurate, up-to-date information and formulating specific answers to horticulture and pest management questions. The World Wide Web has created new opportunities to reach vast new audiences with IPM information. HGIC has taken advantage of this new technology by enabling the public to submit gardening and pest questions via the Center's Web site.

Responses to questions are sent via e-mail. Data on subject, question, answer, and location is saved into an Access database via cold fusion. Various reports can be easily generated on specific pests, diseases, plants, zip codes, etc.

G29-P BCERF Teaching Tools for Change: Talking About Pesticides At Home and in the Neighborhood

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Talking About Pesticides at Home and in the Neighborhood is a slideshow-based teaching curriculum that is part of an educational "Tool Kit" produced by the Cornell Program on Breast Cancer and Environmental Risk Factors (BCERF). BCERF worked closely with NYS IPM educators in designing and field-testing this curriculum. While researchers are continuing to explore links between breast cancer and pesticide exposure, there are many reasons to avoid exposure to pesticides. Recently, attention is being paid to exposures in homes, gardens, schools and other community settings. Concerned citizens have expressed to BCERF and NYS IPM the need for improved education and communication about these issues. Participants in Talking About Pesticides at Home and in the Neighborhood will be better able to: understand IPM as a pest management strategy in a variety of settings; interview and select a commercial landscaper/pest control professional who is responsive to concerns about pesticide use and exposure; communicate with neighbors about issues of pesticide use in the neighborhood, and participate in decisions regarding pesticide use in community settings, such as schools.

G30-P Development of IPM Plans for Small Federal Parks: Needs and Challenges

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Small federal parks are faced with several needs and challenges relative to integrated pest management programs aimed at their buildings, resources, and grounds. Personnel must meet these needs and: 1) protect their natural resources, cultural displays, and museum collections from a multitude of pest species, 2) control these pests, in most cases, without chemical pesticides (especially those deemed as harmful to the environment), and 3) determine the most appropriate management strategy. The challenges arise when these needs must be addressed by a small staff which is well versed in history and culture of the time period represented by their park, but usually possess little biological background or training to fully address pest management. The overall goals of a small federal park parallel those of IPM, which integrates ecological approaches to preventing or reducing unacceptable pest presence or damage, focusing on managing pest populations in an economically feasible, environmentally friendly, and sociologically acceptable manner. Because small federal parks are usually limited in manpower and resources, they are generally unable to quickly and effectively deal with pest outbreaks. Thus, adequate IPM plans are necessary to ensure appropriate and timely management of pests, especially problematic exotic species. Development of IPM plans for small federal parks at various sites throughout the southeastern U.S. will provide personnel with a concise overview of pest biology and effective management tools for pest suppression. These IPM plans also address pesticide safety and documentation. Development and implementation of these IPM plans in small federal parks will enable personnel to better manage pest problems while more efficiently utilizing their limited resources and time. A more important benefit is the protection and preservation of park resources for the enjoyment and education of current and future generations.

G31-P IPM in Alaska: Urban Forestry

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Anchorage, Alaska has a population near 300,000 and the largest per capita trees for a city that size. There are no forester or arborist positions to manage the health of these trees. For over 20 years the Cooperative Extension Service (CES) in partnership with the U.S. Forest Service have been the point of contact for all the public's questions and concerns related to urban forestry including one of the largest outbreaks of Spruce Bark Beetle on record. From phone inquiries, site visits, public meetings, and workshops, CES was integrally involved in educating the public about the beetle over a ten year period from the first infestation to the gradual decline in new outbreaks. The IPM program tracked the progress of the beetle with adaptive programming in response to the public's need for information.

G32-P Cancelled

G33-P The Need for Diagnostic Keys in Production Guides

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The success of any Integrated Pest Management program (IPM) hinges on the proper identification of troublesome pests, which in turn rests on the ability of individuals to trouble shoot problems. It is for these reasons that sections on trouble shooting problems have been included in Guam's most recent crop production guides: Guam Cucurbit Guide and Eggplant, Pepper, and Tomato Production Guide for Guam. The trouble shooting section consists of a short introduction, diagnostic key, and an index. The introduction introduces the reader to the many causes of poor plant health and the difference between symptoms, injury, and signs. The key is divided into various plant stages or plant parts: seedling, stem, fruits / flowers, shoots / leaves, and roots. Within each plant stage various common symptoms encountered on Guam are described: wilt, spots, yellowing, bitter taste, mis-shapen, holes, etc. Keyed to the symptoms are possible causes.

The likeliest cause is listed first. Causes are broken down into animal pests, plant pathogens and unfavorable factors. In order that a reader can quickly locate information contained within the body of the guide, an index is included. Most guides treat the various causes of poor plant health separately, and it is up to the reader to sort through the various chapters to try to determine the cause of a particular symptom or injury. Not only does a diagnostics section save the reader time in diagnosing problems, it also directs the reader towards a holistic approach to plant diagnostics. With a gained appreciation of the interaction of pests, diseases and the environment, the producer in turn has a greater awareness of the need for an integrated approach to solving plant health problems.

G34-P Horticultural Entomology Resources

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Insects and mites on fruit and vegetables continue to plague growers. Extension agents and field professionals must be able to recognize insect stages and damage to better assist growers and homeowners. They must also transfer information and technology so clientele can better understand insect life histories and implement control tactics and management strategies. This poster presents a multimedia approach to better understand insects their identification and life histories. In turn, clientele are better positioned to implement IPM practices. Several venues are available to aid in IPM adoption.

G35-P Measuring Success of an Fruit Fly IPM Program

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Fruit fly pests limit the productivity of Hawaiian agriculture. The melon, Mediterranean, Oriental, and solanaceous fruit flies are targeted in this areawide implementation program on three Hawaiian Islands. The multi-agency collaboration changed team as well as client notions about what was possible. Program implementation used a logic-model based plan that was established at the onset. Sustainable fruit fly management using environmentally acceptable technologies was the intended long-term outcome. Temporal and spatial reductions in pest populations were tracked by a geographic information system. Changes in farmer knowledge, attitudes, skills, and aspirations were measured at benchmark periods against a baseline values that were established at project onset. The successful implementation of base-tactics resulted in unbelievable decreases in pest populations and damage. Farmer adoption of the program was variable, but high. Impacts were significant, but it remains to be seen whether farmers can operate and sustain the IPM program when program support ends.

G36-P Using a Self-assessment Tool to Promote and Educate Integrated Pest Management to Farmers.

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The National Integrated Pest Management (IPM) Initiative was announced in 1994 with the intent to "achieve the national goal of IPM implementation on 75% of crop acres by the year 2000." For the most part this goal has been met on high value crops such as apples, grapes and potatoes. However this goal has not been met on commodity crops such as corn and soybeans. A variety of reasons for the lack of IPM adoption exist, including physical constraints of the farm, government programs, knowledge base, time and labor requirements and the appearance of increased risk. Further, many farmers are confused by what an IPM practice "is."

Creating awareness and interest in IPM practices and relating them directly to the farm can help to increase adoption. The "Pest Management Assessment for Field Corn," a farmer self-assessment, was developed to help farmers take credit for IPM practices that they currently use and to provide an awareness of other IPM practices they may wish to consider. The assessment consists of questions in four categories; general, weed, insect and disease management. The assessment is administered either as part of crop production meeting or via a Web site (http://ipcm.wisc.edu/surveys/corn/). Farmers are assured complete confidentially, as the assessment is not collected, or in the case of the Internet, not linked to them. Point values are collected to calculate averages and ranges, which are then reported back at the end of the meeting or posted on the Web site.

To date, 100 farmers and 28 Farm Short Course students have taken the assessment via meetings or the classroom. The Web site is a recent addition (November, 2002) and has yet to be fully utilized. Resulting averages indicate farmers have a long way to go before reaching a high level of IPM adoption. On average, farmers received 67%, 51%, 47% and 55% of the possible points in the general (57 points), weed (115), insect (83) and disease (40) categories, respectively. Further, resulting ranges indicated a wide degree of IPM adoption. Point ranges were 15-57, 26-99, 7-80 and 2-38 for general, weed, insect and disease, respectively.

Further refinements to the assessment will include the addition of soybean and alfalfa to both the printed copy and the Internet version. The ultimate goal is to develop a farm wide assessment that will relate IPM practices directly to the farmer in a confidential manner.

G37-P Determining the Impact of Field Crop Integrated Pest Management Extension Efforts in New York State

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In 1993 the USDA set a goal of realizing Integrated Pest Management (IPM) adoption on 75 percent of the acres managed nationally by the year 2000. In New York, field crops are grown on approximately 2.8 million acres, nearly 95 percent of the state's crop acreage. It is estimated that most of New York's farmers are using at least some of the IPM techniques recommended for managing pests.

Cornell Cooperative Extension (CCE) personnel have championed numerous outreach efforts aimed at educating field crop producers about integrated crop and pest management (ICM / IPM), their applications, their economic and environmental protection benefits, and their integration into crop production efforts. Ultimately, CCE programs foster adoption of ICM / IPM methods and practices. What percent of our producers currently utilize IPM and to what extent is not well known.

In March 1998 3,001 New York field crop producers were surveyed to evaluate the impact of CCE IPM educational efforts and to identify grower pest management needs. Over one thousand producers provided feedback. Respondents included those identifying themselves as regular CCE information "customers," participants in an intensive CCE IPM Educational Crop Monitoring program, a CCE sponsored Tactical Agricultural (TAg) Program or as those not obtaining their information from CCE.

Using some key field crop IPM and ICM practices as indicators, analysis of the survey indicates growers with a closer affinity to CCE programs, and particularly those who participated in the intensive IPM education TAg program, were more likely to exhibit higher amounts of IPM adoption than those individuals who were not closely involved with CCE. These results indicate the benefits of CCE outreach efforts employing an integrated, intensive, experiential learning approach.

G38-P New York State Tactical Agriculture Program (TAg)

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The Tactical Agriculture (TAg) program is an experiential, hands-on training program providing integrated pest (IPM) and crop management (ICM) education to field crop producers and other agribusiness personnel. The TAg program has been active in New York for over a decade effectively teaching field crop producers to better manage their field crops, protect the environment and reduce health risks associated with pest control.

Participants are actively engaged in a growing-season-long program, which addresses critical pest and crop management issues that arise during the growing season and brings the message home through the collection and analysis of data from their own farms fields.

Teamwork is the key to a successful TAg program. Cornell University's NYS IPM Program coordinates TAg implementation efforts and provides technical assistance. The Field Crop IPM Area Extension Educator works very closely with county and regionally based Extension Educators to design a TAg program that best fits needs of their field crop clientele.

County Extension Educators identify and organize groups of 3-6 producers from a local "neighborhood" to form a TAg team. Each participant enrolls a corn and alfalfa field that is used as their on-site "classroom." TAg teams meet about every two weeks rotating the meeting location to a different participant farm each time. This schedule takes advantage not only of the educational opportunities afforded by changes in season, but also allows comparisons of IPM and ICM applications to different crops, different soils, field conditions, operation management constraints and opportunities, etc. Participants discuss timely pest and crop management topics, learn appropriate techniques to acquire information and apply this knowledge to actual field conditions optimizing management decisions. Teaching responsibilities are shared by County Extension Educators and the IPM Area Educator.

During 2000-2002, 15 teams, 84 farming operations, and 168 fields (about 2,500 acres) were enrolled in TAg. Pre and post-evaluations indicate the TAg participants dramatically increased their knowledge in IPM and ICM and plan to apply this knowledge on the 40,000 acres of field crops they manage.

G39-P Using Theoretical Net Returns Calculated By HADSS to Compare Scouting Methods for Weeds in Peanut

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A perceived limitation to incorporating HADSS (Herbicide Application Decision Support System) into routine peanut weed management decisions is economical and timely scouting of fields. A total of 52 peanut fields were scouted from 1997 through 2001 in North Carolina to determine the weed density in a 9.3 m^2 section for each 0.4 ha grid of the field. These weed populations and their spatial distributions were used to compare theoretical net return over herbicide investment for various scouting methods and weed management approaches. HADSS was used to determine the expected net return for each treatment in each 0.4 ha section of every field under differing assumptions of weed size, soil moisture conditions, and pricing structures. The treatment with the highest net return averaged across all 0.4 ha grids was considered to be the optimal whole-field treatment. For all 52 fields, theoretical net return for the best whole-field treatment, and for site-specific weed management (applying the most economical recommendation on each 0.4-ha grid) averaged $414 and $435/ha, respectively. Estimated return from the commercial

postemergence herbicide program of acifluorfen plus bentazon plus 2,4-DB followed by clethodim (where grass was present) averaged $316/ha across all 52 fields. For fields of 5 ha or more (17 fields) in which 12 or more samples were taken, theoretical net return was $500, $510, and $516/ha for three-sample (one pass through the middle of the field with samples taken on both ends and in the center of the field), six-sample (two passes through the field with three stops per pass), and full-sample (one stop for each 0.4 ha) approaches, respectively. The percentage of times the optimum whole-field treatment was selected by HADSS using these respective scouting approaches was 52, 74, and 91%.

G40-P Complexity of Recommending Reduced Tillage as a Component of IPM in Virginia Type Peanut Production

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Popularity of reduced-tillage production has increased considerably in the southeastern United States. However, acceptance in peanut has been limited due to perceived difficulties in digging in this system and inconsistent yield response. While yield in reduced-tillage and conventional-tillage systems can be the same, seldom do yields in reduced-tillage systems exceed those in conventional-tillage systems. However, many advantages to reduced tillage have been suggested. From a pest management perspective, lower incidence of tomato spotted wilt has been reported when peanut is grown in reduced-tillage systems rather than conventional-tillage systems. Tillage has become a component of the Risk Index for Tomato Spotted Wilt Virus in Georgia, and more recently in a similar advisory developed in North Carolina. Although it would appear that recommending reduced tillage systems would be relatively straightforward, especially due to the long-term benefits to soil, savings in time and energy, and reduced tomato spotted wilt virus, making such a recommendation is more complex. Response of Virginia market type peanut to tillage has been inconsistent in North Carolina. For this reason, care must be implemented when deciding whether or not reduced tillage systems should be incorporated as a component of peanut IPM. Changes in Federal farm legislation, however, most likely will shift peanut production to sandier soils that respond more favorably to reduced-tillage peanut production. This change may result in greater acceptance of reduced-tillage systems and may increase potential of this cultural practice as a component of peanut IPM.

G41-P Monitoring Western Corn Rootworm in Soybean

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Over a decade ago, Purdue University Extension Specialists and County Extension Educators identified western corn rootworm larvae, "*Diabrotica virgifera virgifera*" (WCR) in northwestern Indiana cornfields planted into soybean stubble (first-year corn). Corn damage from this pest can include root pruning, plant lodging, goose-necking, and yield loss. The application of a rootworm soil insecticide at planting is the primary control treatment for this pest. However, not every first-year corn field in the affected area contains economically damaging western corn rootworm populations. Purdue University Extension Entomologists have developed a method for effectively scouting soybean fields for adult WCR populations, the year prior to corn planting, in order to help growers identify fields with a high probability for WCR damage. This scouting procedure utilizes Pherocon AM yellow sticky traps placed within the soybean field over an approximately six-week period in midsummer.

With funding from the Center of Integrated Pest Management (CIPM), County Extension Educators, Purdue Ag Center Superintendents, and Extension Entomology Specialists, cooperated with over 40 Indiana farmers who were interested in utilizing this IPM technology on their farms. This project also allows Extension personnel to continue to evaluate the migration of the pest in Indiana, examine economic thresholds over a larger pool of treatments, and promote the use of this IPM practice as a sound alternative to indiscriminate use of soil insecticides. Educational resources that have been developed include a project Web site and a Power Point program for utilization by County Extension Educators.

G42-P Aphid Alert: Regional Surveillance of Virus Vector Aphid Species of Potato in the Northern Plains

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Aphid Alert is a regional potato virus vector surveillance program utilizing suction and green pan traps in 21 sites in Minnesota, North Dakota, Wisconsin, Montana, Nebraska, and South Dakota since 1998. The objectives are two-fold: to provide seed potato industry with real-time information on the seasonal flight activity of key aphid vectors of potato viruses, and to characterize the annual species composition and relative abundance of known aphid vectors. Traps are serviced weekly and results are reported to approximately 900 professionals and producers by direct mail and e-mail of the weekly Aphid Alert newsletter. More detailed information is made available on the World Wide Web http://ipmworld.umn.edu/alert.htm. A subscriber survey in 1999 showed that 78% of seed potato growers used information provided in the Aphid Alert Newsletter as an aid in making management decisions. Vector abundance has differed greatly from one year to the next with cumulative mean capture of potato virus Y (PVY) vector species per trap of 601.5, 173.8, 230.7, 102.4, and 417.0 in 1998-2002, respectively. Among vectors of PVY, birdcherry-oat aphid, *Rhopalosiphum padi* (L.) has been identified as key component of the regional PVY

pathosystem along with the green peach aphid, *Myzus persicae* (Sulzer). Flight activity of green peach aphids, the most important vector of potato leafroll virus, also showed considerable variation among years with a cumulative mean capture per trap of 11.7, 16.8, 3.8, 0.7 and 3.51 in 1998-2002, respectively. Development of a predictive model shows that trap captures of these two key species are useful in predicting severity of PVY and PLRV outbreaks in the current crop as measured by winter test results of all seed lots entered into the Minnesota seed certification program. Work to describe the weather events associated with outbreaks along with the proximity of a seed field to crops which harbor these key vectors is currently being pursued.

G43-P Development of a County-based IPM Program in Arkansas, 1997-2003

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There have been numerous IPM projects and programs in Arkansas over the years, many achieving great successes in reduction of pesticide usage within particular crops and increased economic benefits to growers. In response to the National Initiative and in an effort to increase and better coordinate actual farm implementation, a county-based IPM program was initiated in 1997. This program offers financial and specialized support to participating counties. Counties submit project proposals, which are screened and approved (or not) by an IPM Program Committee. Documentation of program efforts and results is required. Arkansas farmers have traditionally used many IPM methods but largely in an unfocused way. Similarly, researchers and extension personnel have developed pest management recommendations using many biological, cultural, and chemical techniques but more often than not, have failed to integrate them into a single, cohesive system for growers to use. The need for IPM education is obvious today, with increasing challenges to crop production for Arkansas growers. In Arkansas, the success of implementing any IPM program will rest logically and predominately on the County Extension Agents. This is as it should be, since local education efforts are generally the most successful in the short and long term. The county agent system has obvious close contact with the farmer, but also works closely with consultants and industry representatives at the local level. The results of this program have shown great success in the implementation of IPM in Arkansas agriculture.

G44-P IRAC: The Insecticide Resistance Action Committee

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The Insecticide Resistance Action Committee was formed in 1984 to provide a coordinated crop protection industry response to the development of resistance in insect and mite pests. The mission of IRAC is to develop resistance management strategies to enable growers to use crop protection products in a way that maintains their efficacy. Our aim is to keep all classes of insecticides and acaricides as viable control options and to protect the long-term viability of agricultural systems. In addition, the need for resistance management in public health situations has also been well recognized by IRAC. The application of good IPM practices is an integral part of IRM and will become more so in the future. The poster reviews current activities which include developing educational materials and of a real time database to identify problem areas. For more information visit the poster and the IRAC web site (www.plantprotection.org/irac).

H1-P Independent Biological Control Producers and the Association Supporting Them: Establishing a Meaningful Voice

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Biological control forms the basis of Integrated Pest Management and independent biological control producers support IPM by supplying beneficial insects, mites and nematodes commercially. The Association of Natural Bio-Control Producers (ANBP) was formed in 1990 by commercial insectaries to provide a united voice in regulatory issues facing the industry. Since then the organization's mission has grown to include the development of quality standards, support biological control education, and biological control research.

In 1998, ANBP members participated in the formation of ASTM subcommittee E35.30 on Natural Multi-Cellular Biological Control Organisms with a scope of: "the development of standard definitions, classifications, appropriate test methods, and recommended practices for quality, handling, distribution and use of natural multi-cellular biological control organisms. The activities will be coordinated with related committees in ASTM and with other professional and government organizations."

In support of biological control education, the ANBP has developed an annual conference, a quarterly newsletter, and its Web site www.anbp.org. In support of research, the ANBP has created a research fund and compiles a list of high priority research needs shared by the industry.

H2-P Biologically-based IPM in Oregon

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On behalf of multiple agencies and authors, this poster outlines the status, trends, and prospects for biologically-based integrated pest management (BBIPM) in Oregon. It reflects a concerted effort by these agencies to maximize adoption of biologically-based strategies through enhancements to collaborative research, education, and extension programs. The poster will review historical trends in research and adoption of BBIPM approaches, and summarize the extent of current research at Oregon State University, the USDA ARS Horticultural Research Laboratory,

and the Oregon Department of Agriculture. It will quantify, as far as is possible, trends in the rate of success of programs, and it will summarize the economic, environmental, and social benefits of successful programs. These programs span conventional agricultural arthropod, disease and weed targets, and invasive plant species, and they are beginning to focus upon non-traditional targets in freshwater, estuarine, and marine systems. They encompass the full spectrum of the discipline, from theoretical investigations, to education and outreach that enhances the local adoption of BBIPM tactics. The poster will summarize what are considered to be current constraints to the implementation of BBIPM within Oregon, and it will outline a process that is being developed to build a nationally leading program in this arena. Summaries of individual projects, principle investigators, and the agencies that they represent, will be provided as additional materials, with the poster.

H3-P Evaluating Pesticides for Their Impact on Beneficial Organisms

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A piece of information critical to pest managers that is not readily available is the impact of pesticides on beneficial organisms. Companies registering new pesticides are not required to develop extensive information on the impact of the pesticide on organisms that may assist in IPM. Two standardized laboratory techniques to screen pesticides against key beneficial organisms were developed. One technique was used to test the survival of a range of seven commonly occurring or purchased beneficial insects in the presence of 120 pesticides. A second technique was used to screen three beneficial microorganisms for survival in the presence of 120 pesticides. Results were summarized and indexed and made available electronically. In addition results of this study can be used to modify pesticide impact evaluation models such as the Environmental Impact Quotient (EIQ).

H4-P Behavioral Responses of Female *Hippodamia convergens* (Convergent Lady Beetle) to Insectary Plants

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Much popular literature suggests that so-called insectary plants attract coccinellids, yet little research data are available to determine if these claims are true. We tested behavioral responses of two populations (California and Idaho) of adult female *Hippodamia convergens* in Y-olfactometers to seven home-garden and field-crop plants: buckwheat (*Fagopyrum esculentum*), yarrow (*Achillea* 'moonshine'), fennel (*Foniculum vulgare*), brown mustard (*Brassica nigra*), red clover (*Trifolium pratense*), marigold (*Tagetes* 'Janie Flame'), and winter wheat (Madson and Stevens); we additionally examined beetle response to a commercially available semiochemical (Ladybug Lure). The only treatment that generated a statistically significant beetle response was winter wheat in the presence of English grain aphids. There was no response to any treatment in the absence of aphids.

H5-P Evaluating Lethal and Sub-lethal Effects of Greenhouse Pesticides on the Soil-dwelling Predatory Mite, *Hypoaspis miles*

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Hypoaspis miles, a soil-dwelling predatory mite, is commercially available for biological control of fungus gnats, *Bradysia* sp., in greenhouses. Including H. miles in greenhouse IPM programs requires its compatibility with pesticides used for other greenhouse pests and diseases, but surveyed greenhouse managers found compatibility information lacking. A laboratory method was developed to evaluate lethal and sub-lethal effects of pesticides on *H. miles*. Three widely used insecticides and three fungicides were selected for evaluation, based on suggestions from Illinois greenhouse growers and biological control producers. Experimental units consisted of two 22 x 22 mm glass fiber filter paper supported by two 22 x 22 mm cover glasses, separated by a 3-mm high ring cut from 15mm diameter polycarbonate tubing. To identify the most susceptible life stage of *H. miles*, and a dose of Kelthane 50W giving intermediate mortality appropriate for a positive control in subsequent evaluations, individual mites in experimental units were exposed to one of five concentrations of Kelthane 50W or water. Larvae were the most susceptible life stage of *H. miles*, with 66.7% killed by Kelthane 50W at 28 mg m-2. Studies to assess the lethal and sub-lethal effects of selected insecticides and fungicides are currently underway.

H6-P Pear Germplasm Resistance to Some Arthropod Pests

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Pear arthropod pests are showing increased resistance to the most common organophosphate insecticides in use. Biological and cultural controls have encouraging, but still limited application in pear IPM. Host plant resistance may be a valuable and yet untapped control tactic in pear production systems. Despite the considerable genetic diversity in pear, no attempt has been made to develop new cultivars resistant to arthropods. Fear that resistance factors may affect pear quality and lack of reliable information may be an explanation. The use of arthropod resistance can be effectively integrated into pear IPM systems. Even partial resistance to arthropods can be advantageous by synergizing the effect of cultural, biological control, and chemical

controls. In addition, arthropod-resistant varieties would be valuable in area-wide IPM programs by potentially reducing overall target pest populations at a landscape or regional scale. Mating disruption works best at moderate to low codling moth population levels. The goal of this study was to 1) evaluate arthropod pest-pear interactions, and 2) identify pear resistance sources for use in the development of new and improved pest-resistant varieties. Twelve pear varieties in three groups: 1) commercial U.S. varieties, 2) European varieties, and 3) Asian varieties were screened for resistance against codling moth, leafrollers, and pest mites. Surveys conducted during the 2000 and 2001 growing seasons assessed pest population trends on each of the varieties. Pest incidence and abundance on the genotype provided a measure of the genotype's susceptibility. Asian varieties (Kosui, Nijisseiki, Tse Li, Sion Szu) were most susceptible to two-spotted and McDaniel spider mites,and the commercial varieties Bartlett, Anjou, Bosc, and Comice were susceptible to Eriophyids. All groups showed similar susceptibility to leafrollers. Both Asian and the European varieties Ubileen Gift, Spina Carpi, Helmershus Roda, and wild type *Pyrus communis* showed some level of resistance to codling moth. Among the commercially grown varieties in Oregon, Bartlett was the most and Anjou the least susceptible to codling moth infestation.

H7-P Biological Management of Fire Blight (*Erwinia amylovora*) in Apples with Serenade® *Bacillus subtilis* (QST 713)

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Fire blight is a very important apple bacterial disease, and causes serious economic losses in the majority of world apple crops. It is of increasing concern because many new apple varieties are highly susceptible to fire blight. Also, repeat use of antibiotics to control fire blight has resulted in *E. amylovora* strains which are resistant to Streptomycin. Dr. Herb Aldwinckle at Cornell University has evaluated Serenade and other alternative materials for controlling the blossom and shoot blight phases of fire blight. Private consultants and researchers have also evaluated Serenade's performance in fire blight control programs. Serenade works through complex modes of action that entail biological action of the *B. subtilis* bacteria and also lipopoeptide compounds produced by the bacteria. Because of Serenade's novel, complex modes of action and environmental friendliness, it is ideally suited for use in IPM programs that utilize many tools such as cultural practices, classical biological control and other fungicides. Serenade's contribution to fire blight control, programs which reduce dependency on antibiotics is presented.

H8-P Cancelled

H9-P Augmentative Releases of Hymenopterous Parasitoids—A Component Strategy in the IPM of Tephritid Fruit Flies in Hawaii

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Federal and state agencies in Hawaii have embarked on an area-wide IPM program that aims to suppress tephritid fruit flies, economically important pests of fruits and vegetables. In a joint effort with the University of Hawaii and State Department of Agriculture, USDA-ARS implemented a package of fruit fly control technology in the county of Kamuela, island of Hawaii, one of several demonstration sites in the Hawaiian island chain. Considering that our laboratory has the mass-rearing technology and capability to produce fruit fly parasitoids in large scale, the IPM program has presented an opportunity to evaluate the efficacy of insectary-raised parasitoids as a component strategy. Targeting the melon fly (*Bactrocera cucurbitae*) first, approximately 2.7 million *Psyttalia fletcheri*, a strict solitary larval parasitoid of melon fly, have been propagated, shipped, and released in the target sites since April 2002. Initial parasitoid recovery data indicated that gravid parasitoids were able to locate and attack melon fly larvae infesting a wide variety of vegetables. In conjunction with the on-going parasitoid releases, a laboratory assay was likewise undertaken to determine possible outcome that may result in the event that *Fopius arisanus*, an egg parasitoid, is liberated in the field in concurrence with *P. fletcheri*. An update of current undertaking and implications of laboratory findings on potential consequences of multiparasitoid releases are presented.

H10-P Area-wide IPM Methods and Strategies for Suppression of Tephritid Fruit Flies in Hawaii

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Tephritid fruit flies consisting of the Mediterranean fruit fly, the Melon fly, the oriental fruit fly, and the Solanaceous fruit fly are perennial pests of vegetable and fruit crops in Hawaii. The complex ecosystem in Hawaii is an ideal environment where these fruit flies persist causing serious damage to vegetable and fruit crops and increasing the cost of trade from mandatory quarantine treatment of export commodities. An area-wide pest management program was initiated in 1995 by ARS to integrate and evaluate technologies for sustained area-wide suppression of pest insects. The Hawaii program was funded in 1999 for five years. USDA's Agriculture Research Service, the University of Hawaii, and the Hawaii State Department of Agriculture are

cooperatively targeting the economically important fruit flies in Hawaii. The goals of the program are: 1) develop and implement environmentally acceptable, biologically based, sustainable pest management strategies; 2) Reduce use of organophosphate and carbamate insecticides; 3) Suppress fruit flies to economically manageable levels for the benefit of Hawaii growers. The tools being used for fruit fly suppression include protein bait sprays, male annihilation, release of sterile insects, release of parasitoids, and sanitation of crop remnants. The complexity of the program involving the suppression of 1, 2, or 3 fruit fly species in three different demonstration sites will be discussed. The contribution of the three cooperators in supporting and implementing the program will be explained. Current results from suppression of fruit flies in the demonstration sites will be reported, including the effectiveness of the suppression technologies used. In conclusion, the fulfillment of research needs, growers acceptance, and support of the program will be discussed.

H11-P A Research-intensive Approach to Development and Implementation of IPM for Blueberry Insect Pests

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Michigan is the largest producer of highbush blueberries in the U.S., but faces potential production challenges from a suite of native and invasive insect pests. In general, broad-spectrum insecticides have been the foundation of insect control, and there is a critical need to identify and evaluate pest management alternatives before regulatory changes remove these effective tools. In response to the challenges that lay ahead from FQPA-related restrictions, a strategic IPM development and implementation program is underway to meet the needs for insect control in future production of this minor crop. In recent years, this program has attracted competitive research and extension funding from regional and national sources, as well as maintaining an active IR-4 program to provide the data for new tools to be registered in blueberry. Recent research indicates that reduced-risk insecticides and cultural controls show great promise for future integration into pest management programs, and on-farm trials are underway to evaluate new approaches under commercial agriculture conditions. The success of this developing program is based on active participation by key stakeholders, including commodity group representatives, growers, consultants, chemical company representatives, and researchers. This poster will highlight recent accomplishments in the regulatory, research, and extension arenas that combine to provide Michigan's blueberry growers with answers to their short- and long-term insect pest management challenges.

H12-P Control of the Vine Mealybug, *Planococcus ficus*, on Grape in the Coachella Valley Using Parasitoids and Ant Control

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Field releases of the parasitoid, *Anagyrus pseudococci* (Girault), in conjunction with control the field ant, *Formica perpilosa* (Wheeler) significantly reduced the total number of vine mealybugs infesting grapevines. Experiments were conducted on three vineyards (two Superior Seedless Grape vineyards and a Thompson Seedless Grape vineyard) during the 2000–2001 and 2001–2002 growing seasons. Each ranch had a single experimental block divided into five plots of ca. 0.63 ha each. All plots except the control plots were treated with Lorsban (chlorpyrifos) to control *F. perpilosa* and two field-rate applications of Admire (imidacloprid). Lorsban applications were restricted to a 0.5 m wide strip of soil directly beneath the grapevines in order to avoid the vine trunk and concentrate the insecticide at the base of the vines where *F. perpilosa* nests. Parasitoids were released at 15,000 per week beginning either 12 weeks prior to harvest (high release rate), for 9 weeks beginning in March to mid May (medium release rate), or for four weeks beginning in late April (low release rate). Chlorpyrifos provided control of *F. perpilosa* for between 3 & 4 weeks. Populations of *F. perpilosa* rebounded at a critical period just prior to harvest; additional applications of Lorsban could not be applied due to a 76-day pre-harvest interval. This trial also focused on developing ant low-toxic baits to replace chlorpyrifos. Bait preference trials were conducted and indicate that anchovy bait with the active ingredient imidacloprid is highly preferred by *F. perpilosa*.

H13-P *Muscodor albus*, a Volatile Antibiotic Producing Fungus for Control of Soil-borne and Postharvest Diseases

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Agriculture is in need of safer products to replace methyl bromide and other synthetic fungicides. Soil-borne diseases caused by pathogens such as Pythium, Rhizoctonia, Verticillium, and Phytophthora are a major problem in horticulture, field crop production, and greenhouses; causing root rots, wilts, and loss of vigor and yield. Methyl bromide, a potent ozone-depleting agent being phased out by 2005, is frequently used as a soil fumigant before planting strawberries, tomatoes, peppers, and other crops to control soil-borne diseases and pests. Harvested commodities such as fresh fruits are also highly susceptible to fungal decay and often require pre- or postharvest fungicide treatment to reduce losses. Many fungicides for postharvest use are being phased out due to toxicological concerns, and fungicide resistance has become widespread. The endophytic fungus *Muscodor albus*, isolated from a cinnamon tree in Honduras, produces a mixture of volatile compounds that are toxic to other microorganisms. The potential for this promising natural biofumigant in greenhouse soil, preplant and postharvest treatments is presented.

H14-P Biological Control of European Corn Borer with *Trichogramma ostriniae*

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The European corn borer, *Ostriniae nubilalis* (Noctuidae: Crambidae) is a serious pest of field and sweet corn, peppers, and other crops. Over the past several years we have been investigating the efficacy of inoculative releases of *Trichogramma ostriniae*, an egg parasitoid originally from China, for suppression of European corn borer in sweet and field corn. Releases of 30,000 *T. ostriniae* from a single release packet per acre when corn is approximately 18 inches tall results in establishment and persistence through harvest. Parasitism of egg masses often exceeds 80% resulting in significant reductions in damage at harvest. *Trichogramma ostriniae* does not overwinter; thus releases are required each season. Several attributes of *T. ostriniae* appear to enable it to be successful, including rapid dispersal and excellent search capabilities, tolerance of insecticide applications, lack of density dependence, and ability to parasitize almost all eggs per egg mass. Recent trials of inundative releases in peppers suggest that it also holds promise in this crop against European corn borer.

H15-P Floral Volatile Attractants: Development of Novel Lures for Management of Moth and Beetle Pests

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Floral volatile blends were tested in vegetable production districts in the United States and South Africa. This poster reports trap captures by species. Several new candidate blends have been identified for monitoring and control of key economic pests, including European Corn Borer (*Ostrinia nubilalis*), Corn Earworm (*Helicoverpa zea*), American Bollworm (*Helicoverpa armigera*), and Potato Tuber Moth (*Phthorimaea operculella*).

Mass trapping experiments using floral lure baits were successful in reducing egg and larval counts of American Bollworm and Tomato Semi-looper (*Chrysodeixis acuta*) in small plot trials in South African fresh market tomato production. These experiments demonstrate the potential for using semiochemicals to target key pests within IPM programs for high value vegetable crops.

H16-P Magnet: Insights Into the Management of Cabbage Maggots (*Delia radicum*) to Reduce Dependence of Chlorpyrifos Use

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Brassicacae growers are highly dependent on chlorpyrifos (organophosphate; Lorsban) for control of an important pest, the cabbage root fly (CRF; cabbage maggot; *Delia radicum* (L.)). The threat of its loss and environmental scrutiny has increased grower willingness to test and adopt new management strategies. As a result of evaluating the cabbage maggot pest situation in root crops in Oregon, a program was developed called "MagNet": a network of people working together to develop a best management strategy targeting cabbage maggot management. A strategic plan is being developed to reduce overall chlorpyrifos use, including: practical monitoring techniques (egg scrapes, seasonal flight, mid season damage assessment (M60) spring emergence, and harvest assessments); degree-day modeling; spatial management (GIS field mapping), fall field cultivation methods; enhancement of beneficial organism habitat (e.g. straw mulches); and testing of alternative chemistries and application. The 2002 data indicates that there are four concerted egg-laying periods verified by adult catches in yellow water traps, placement of spring pupae emergent traps, and degree-day modeling. Program staff has selected three pilot brassica growers. We have monitored for egg-laying in over 75 fields of these growers' fields in 2001 and 2002. This information is proving to better time treatments to high risk periods. Higher proportions of plants with eggs were seen within one quarter mile of a known CRF-source. An excel-based geographic information system (GIS) is being developed to conduct routine analytical procedures for the growers' management purposes. Lorsban applied in furrows, Fipronil, Mustang (pyrethrin) and Spinosad (bacterial by-product) and film-treated seeds are showing promising results. Emergence of CRF adults has shown to be reduced after fall and spring disking of pupae-infested fields. An IPM continuum rating system (P4Plan) and field risk assessment are being designed to inspire grower interest and adoption of these IPM practices.

H17-P Hoverfly Habitat Management for Aphid Pests of Broccoli

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Conserving or enhancing floral, alternative host, or shelter resources has been shown to increase the effectiveness of predatory hoverflies in some agroecosystems. However, for most systems it is still difficult to predict just how limited certain hoverfly species are for these resources, what direct and/or indirect effects increasing these resources may have on herbivorous pests or other natural enemies, and how cost effective these manipulations may or may not be for an IPM program. To help determine the usefulness of this tactic for enhancing the potential of hoverflies to limit cabbage aphid (*Brevicoryne brassicae*) infestations in commercial broccoli, a series of field, cage, and laboratory trials were conducted to assess: 1) the ability of hoverflies to find and limit cabbage aphid infestations, 2) the field-scale effect that added flowering plants have on the attraction and oviposition activities of these hoverfly species, and 3) the relative preference that hoverflies and other key arthropods in the broccoli system have for select types of floral resources. A few hoverfly species demonstrated the ability to greatly reduce cabbage aphid colonies, but they arrived at these colonies only after an economically unacceptable level of aphid infestation had occurred. Oviposition was greater on infested broccoli closer to blocks of floral resources in the field, but aphid number and time of season appeared to exert a stronger influence. Certain hoverfly species and key pest herbivores expressed preferences for certain flower types. These findings suggest that a landscape perspective may be required to make inferences about factors that limit hoverfly activity.

H18-P Refining IPM of Western Flower Thrips Research and Extension Activities At Cornell University

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Over the last four years several laboratory and field research projects have been conducted in a coordinated attempt to improve the efficacy, reliability, economics and grower adoption of Western Flower Thrips (*Frankliniella occidentalis*) IPM. Primarily focusing on biocontrol of WFT with the predaceous mites (*Neoceiulus cucumeris* and *Hypoaspis miles*), protocols are being formulated and tested in the field. Collaboration of faculty, extension agents, and growers has lead to successful adoption. Summaries and results of these activities are illustrated.

H19-P Integrated Pest Management of Late Blight of Tomato and Potato

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Late blight of tomato and potato, caused by *Phytophthora infestans*, is one of the most devastating plant diseases and requires more fungicide for disease suppression than any other plant disease. Over the past several years, our program has examined host resistance and several biological control products in an attempt to develop an integrated management system for control of late blight. Late blight resistance trials with conventional and heirloom tomato lines revealed significant differences in their susceptibility to *P. infestans*. For example, Gold Nugget and Sunrise were very susceptible and would require an intensive fungicide program, while Brandywine, Big Beef, and Aunt Ginny's Purple, were moderately resistant and could produce marketable fruit with less chemical inputs. More than a dozen biocontrol products have been tested for efficacy against late blight development, however, there has been little success with these products. One compound, Actigard, a product that induces plant defense, did reduce disease progress on two tomato cultivars but not on a susceptible potato cultivar. Advanced technology in the development of new biorational and biofungicides along with new sources of resistance incorporated into an IPM program could lead to more success in the control of late blight along with a reduction of pesticides released into the environment.

H20-P A Potential Alternative to Chemical Control in the Potato Crop in Idaho

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The effectiveness, and the relatively low cost and ease of use of insecticides make them the primary means of managing potato pests. Idaho produces 35% of the potatoes grown in the US, but accounts for 41% (1,066,000 pounds) of the insecticide use on potatoes. The Environmental Protection Agency (EPA) is in the process of re-registering pesticides under the requirements of the Food Quality Protection Act, and EPA could eventually cancel some or all organophosphate, and carbamate pesticides on potatoes. With the new regulations in place, growers will have to find alternatives to these insecticides. This research is focused on finding and incorporating alternatives to chemical control and establishing a successful integrated pest management program. Different commercial potato fields were surveyed and potential natural enemies of Colorado potato beetle in southeastern Idaho were identified and investigated. Coleopterans dominated the complex of ground arthropods in potato fields in southeastern Idaho and *Pterostichus melanarius* (Illiger), an introduced European carabid species, represented 88% of all individuals caught in 2001. *Pterostichus melanarius* adults have been reported to feed on a wide range of insects. Laboratory tests were conducted with the

objective of characterizing the attributes and effectiveness of *P. melanarius* and identifying species found to be acceptable as food to adults of this carabid species in no-choice feeding trials. Three species of aphids, green peach aphid, potato aphid, and bird cherry oat aphid (all vectors of potato viruses), and all instars of Colorado potato beetle were offered as preys. *Pterostichus melanarius* can kill as many as 12 third and fourth instar CPB larvae and 24 first and second instar larvae in 24 hours. This beetle can also eat more than 50 aphids in one day. *P. melanarius* responded to different prey densities in a functional manner (the number of prey consumed per predator increases as prey density goes up). These tests showed that *P. melanarius* could be a potential biological control agent of potato pest, and since it is already present and abundant in southeast Idaho, it can be used in conjunction with more selective chemistries for the control of potato pests. Future experiments will assess the effect of these more selective chemistries on *P. melanarius* in the field.

H21-P Combining Biological Products and Green Sprouting for Control of Soilborne Diseases of Potato

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Commercially-available biocontrol products were evaluated, alone and in combination with green sprouting to promote early emergence, for efficacy in controlling Rhizoctonia disease and other soilborne potato diseases in field tests in Newport, Maine. Two bacterial formulations, Deny (*Burkholderia cepacia* J82) and Kodiak (*Bacillus subtilis* GB03), and two fungal preparations, RootShield (*Trichoderma harzianum* T-22) and SoilGard (*Trichoderma virens* GI-21), were tested along with a chemical control, Evolve (Topsin, mancozeb, & cymoxanil), and a combination chemical/biological treatment (Evolve/Deny). All treatments significantly reduced the incidence and severity of stem canker lesions compared to the pathogen-treated control (25-89% reduction). No treatments consistently reduced the incidence of black scurf on tubers, although Evolve, Kodiak, Deny, and SoilGard reduced scurf severity in some years. The bacterial treatments generally resulted in greater yield and greater percentage of larger size potatoes than the pathogen control. Green sprouted seed (GS) reached 95% emergence 7-9 days earlier than non-sprouted seed (NS) and showed fewer emergence problems. Overall, GS reduced the incidence and severity of stem and stolon canker, black scurf, and common scab, as well as the total incidence and severity of all diseases combined compared to NS plants. Despite effects on diseases, yields were not different for GS and NS treatments. Interactions between the sprouting and biocontrol factors were not significant for any parameter, indicating there were no synergistic effects of the combination of green sprouting with biocontrol treatments.

H22-P Incorporating Predators and Selective Insecticides Into a Decision-making Guide for Sweet Corn

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A new sweet corn pest management decision making guide that includes the impact of predators and selective insecticides assists in understanding the economic and ecological costs and benefits of integrated biological and chemical control. This guide helps evaluate the options for control of European corn borer (*Ostrinia nubilalis* (Hübner)) when the primary predators are *Coleomegilla maculata* (DeGeer), *Harmonia axyridis* (Pallas), and *Orius insidiosus* (Say). The control products evaluated are lambda cyhalothrin, indoxacarb, spinosad, and Bt corn. The results of this guide, based on a combination of field and laboratory data, highlight the importance of coccinellid larvae and *O. insidiosus* adults in *O. nubilalis* control. Results also demonstrate how higher predator populations do not necessarily result in higher *O. nubilalis* predation due to changes in temperature, pollen availability, and aphid density. Bt corn and lambda cyhalothrin typically provide the highest levels of control, but there are situations where other tactics are as good or better than these options. Further refinement and validation are required before growers can use this guide. However, this model can serve as a framework around which further integrated pest management research can be focused.

H23-P Cancelled

H24-P Management of Root-knot Nematodes Infesting Chickpea Through Intercropping

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Chickpea (*Cicer arietinum* L.) occupies an important position in India's agriculture and ranks first in the world under chickpea cultivation. The root-knot nematodes *Meloidogyne* spp are widely distributed in most of the chickpea growing countries and are considered one of the important biotic constraints in the cultivation of chickpea in India, southeast Asia, middle east, and Africa. On a global basis plant parasitic nematodes are estimated to cause losses in yield of 13.7% in chickpea. In India M. incognita can reduce yield from 17% to 60% depending upon nematode inoculum density and soil types. Being a susceptible crop to root-knot nematode its management is expensive. Hence, the present study has been made to bring down root-knot population through intercropping of non-leguminous crops with chickpea a leguminous crop with high protein contents.

A field trial was conducted to study the effect of intercropping of three non-leguminous crops, mustard, linseed, and coriander with leguminous crop chickpea at Indian Institute of Pulses Research, Kanpur, India during 1997-98 and 1998-99 during post rainy season in sandy loam soils. The trial has two major treatments, sole cropping and intercropping, where chickpea intercropped with mustard, linseed in the ratio of 6:2, coriander in the ratio of

4:2, while chickpea were sown as sole crop in 27 m^2 plot size and these treatments were replicated 4 times.

First year, the highest population of root-knot nematode was recorded from chickpea + coriander intercropping, while least population was recovered from chickpea + mustard intercropped. Rhizobium nodule population was found low (15.4) at 45 days in chickpea + coriander intercropped followed by chickpea sole (19.2). After 60 days, nodule population was again low in both the treatments, while it becomes lower in chickpea sole, chickpea + linseed after 75 days as compared with 60 days nodule population. The highest yield was obtained from sole crop of chickpea (1922 kg/ha) while in intercropping with mustard, coriander and linseed the highest chickpea equivalent yield was 1551 kg/ha in chickpea + linseed.

The root-knot nematode population pattern was changed during second year in the same field and the highest population of root-knot nematode was recorded in sole chickpea while minimum was found in mustard sole cropping. Intercropping chickpea with linseed had highest population of root-knot nematode. The highest chickpea equivalent yield was obtained from intercropping of chickpea with coriander (us$ 651 gross return/ha) followed chickpea + linseed (us$ 631/ha). In sole cropping the highest yield was from chickpea (us$ 612/ha) followed by linseed (us$ 518/ha). Intercropping chickpea with mustard was found effective considerably in managing root-knot nematode population in chickpea cultivation without any additional monetary input with good returns in yield.

H25-P Compatibility of Herbicides and Adjuvants with the Candidate Bioherbicide *Microsphaeropsis amaranthi* in Tank Mixture

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Microspaheropsis amaranthi is a pathogen of waterhemp (*Amaranthus tuberculatus* Sauer.), a serious weed of Midwestern cropping systems. Waterhemp exhibits resistance to a wide range of herbicide chemistries, and is a frequent escape from existing weed management systems. We are investigating the potential of *M. amaranthi* to be integrated into production systems to provide supplemental control of waterhemp. Conidia of *M. amaranthi* were mixed with herbicide solutions and incubated for 2 h in order to simulate mixture in a spray tank during field application. Some herbicides had little effect upon conidial germination (e.g.FirstRate®, Pursuit®), whereas other herbicides caused a marked reduction in the germinability of conidia, even at concentrations significantly lower than recommended (e.g. Roundup UltraMAX®, Aatrex 4L®). In the case of glyphosate products, further investigation revealed that glyphosate salts had only a limited impact upon germinability, but the surfactant blends associated with these products rapidly killed conidia. Finally, we report that adjuvant blends can be tailored to support activity of glyphosate without inhibiting the activity of *M. amaranthi*.

H26-P Development of a Biologically-based Pest and Disease Management System in Sugar Beets

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Sugar beets (*Beta vulgaris* L.) are beset by one important insect pest, the sugarbeet root maggot (*Tetanops myopaeformis),* several lesser pests such as wireworms (Coleoptera: Elateridae), and a trio of significant diseases: (1) seedling diseases caused by Aphanomyces and Pythium, (2) Rhizoctonia Crown and Root Rot, and (3) Cercospora Leaf Spot. Although sugar beets are grown on 550,600 hectares in the U.S. (2002) they are considered a minor use crop and farmers have only a narrow choice of chemical control tools. Many of these chemicals are in jeopardy from resistance or regulatory action, creating an ideal stage for the development of a biologically based, integrated system. Our collaborative group is studying the deployment of insect pathogenic fungi (*Beauveria bassiana* and/or *Metarhizium anisopliae*) along with *Bacillus* sp. LS201, *Bacillus subtilis* MSU127 and *Bacillus mycoides* BAC J for management of the sugar beet pathogens. These microbial tools are being developed with a view to integrate them with chemically or biologically Induced Systemic Resistance, resistant/tolerant beet hybrids, microbial control agents of sugarbeet cyst nematode, cultural practices, use of disease and pest predictive models, as well as judicious, moderate use of traditional chemical pesticides. During the past two years we have identified several excellent candidate fungi for root maggot and wireworm control to add to the arsenal of the Montana State University bacterial agents. Field evaluations have demonstrated the promise of this approach.

H27-P Mitigating the Mexican Rice Borer Threat to Rice and Sugarcane Crops in Louisiana and Texas

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A multi-discipline, multi-agency effort involving research, extension, and regulatory personnel cooperating with private crop consultants is leading to the identification, assessment, and solution of a major insect stem borer pest threat. Utilizing twice weekly monitoring of pheromone traps in 12 Texas counties and 7 Louisiana parishes, newly discovered *Eoreuma loftini* (Dyar) (Lepidoptera: Pyralidae), Mexican Rice Borer (MRB), populations in 2000 were found in Brazoria, Colorado, Fort Bend, Waller, and Wharton counties. MRB were discovered in two additional Texas counties (Austin and Harris) in 2001, and a third (Galveston) in 2002. The insect is not known to occur in Louisiana, but is at relatively high populations now within 50-60 miles of the new sugarcane production area near Beaumont, TX. In addition to pheromone trap assessment, larval infestations have been

discovered in newly invaded areas. Management studies on varietal resistance and insecticide approaches involved cooperators in the USDA, LSU AgCenter, and Texas A&M Systems, chemical industry colleagues, the Rio Grande Valley Sugar Growers Association, Texas Rice Producer organizations, and the American Sugar Cane League. Replicated variety assessment to determine relative MRB resistance has shown at least 4.5-fold differences in susceptibility at relatively low to moderate population densities among selected cultivars of sugarcane and rice. Initial insecticide studies in rice seem to show substantially more potential as a management tool than in sugarcane. Agricultural Extension agents together with Texas and Louisiana Departments of Agriculture personnel have participated extensively in these studies and technology transfers. This work was supported by USDA (CSREES) research/extension grants from Critical Issues and Southern IPM programs.

H28-P Evolution of an IPM Program for Insects in Cotton

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In the early 1970's, Clemson University Extension Entomologists and Agents began to organize cotton scouting programs in an effort to get more management into the insect control equation. In other words; scout, record what you find, and only treat with insecticides when insect-pest numbers match or exceed the economic thresholds. These days virtually every grower has someone to scout their cotton for insect pests. Scouting is the foundation of IPM in cotton. The registration and introduction of the pyrethroid insecticides marked a new era in cotton insect control. Never before had cotton growers had an insecticide that was so effective at such low rates, and with good residual activity to boot. In 1983, cotton farmers in South Carolina approved a referendum to start an eradication program to eliminate the boll weevil as an economic pest of cotton. The program was very successful, and by the end of 1985 the boll weevil was no longer capable of economically damaging cotton in South Carolina. With the boll weevil eliminated from the cotton agroecosystem, the early applications of organophosphates such as azinphos-methyl and methyl parathion were eliminated as well. This conserved the beneficial arthropods which began to provide more assistance in the management of early infestations of bollworms and tobacco budworms. Transgenic cottons have fit into this IPM system quite well. The Bt toxin is 100% effective against budworms and about 80 to 90% against bollworm. It also does a good job on European corn borer, and provides some suppression of armyworms and loopers. The Bt toxin is not effective on aphids, stink bugs, mites, thrips, and plant bugs. Insecticides are still used on a limited basis to control bollworms and other lepidopterous pests, and the sucking insect pests. Cultivars containing two Bt proteins, such as Bollgard II®, are targeted for release beginning in 2003. These products will be even more effective against lepidopterous pests.

H29-P Development of Pest Management Strategies for Forage Alfalfa Persistence

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Now in its third year, the overall goal of the NC-226 Multi-state Research Project is to address a critical concern of producers: the significant reduction in alfalfa stand life caused by pests. Although alfalfa can persist in stands for many years, ecological and physiological factors act in concert with the pest community to shorten the life of stands. The resulting lack of persistence significantly reduces profit for producers. The mission of the project is to improve persistence of forage alfalfa stands through the implementation of ecologically-based pest management. The project conceptualizes alfalfa persistence by focusing on yield component analysis. Herbage yield per unit area is equal to the product of the density of plants per unit area, the number of shoots per plant, and the mass per shoot. Using this approach, we identify key characteristics to maximize yield and persistence of a stand. Pest complexes vary in their impacts on yield components, and thus have different effects on the persistence problem. For example, our research has found that potato leafhopper injury to shoot tissue reduces translocation of photoassimilates toward crown and root storage tissues, thus potentially limiting the maximum numbers of shoots produced by plants during the next growth cycle. Pathogens and insects that injure crowns and roots may impact plant survivorship in severe cases, or impact shoot production or shoot mass in other cases. Weeds likely reduce light or water interception by alfalfa, thus reducing shoot mass, or subsequently, shoot density. By measuring the impact of individual and combined stresses on alfalfa yield components through time, we intend to determine key management points to improve persistence. In addition, host plant resistance is especially important for pest management in alfalfa, and thus cultivar evaluation is a focal part of our research. The poster will highlight accomplishments in the project to date.

H30-P Area-wide IPM for Controlling Pest Mole Crickets in Florida Pastures and Turfgrasses

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To determine the efficacy and optimum application rate of beneficial-nematode releases on mole cricket control and the resultant pasture grass recovery, nematodes were applied in strips to 1-acre pasture plots at 0, 1/8, 1/4, and 1/2 billion nematodes/A in September 2000. There were three replicates per treatment. Trapped mole crickets were counted weekly; samples were analyzed for nematode infection monthly; and grass canopy groundcover was estimated yearly. Additional nematodes were applied at the 1/4 or 1/8 billion/A rate in 2001 to 20 other sites in eight Florida counties. Infected mole crickets spread the nematodes throughout the 24-acre pasture within six months of the first trial. Percentage nematode-infected mole crickets in April 2002 at that first site ranged from 30 to 50%. Mole cricket numbers declined 65-80%, and grass canopy increased by 50 to 200%. For sites treated in spring 2001, or fall 2001, infected mole crickets in spring 2002 ranged from 20 to 75%, or from 0 to 80%, respectively. Mole crickets infected with nematodes usually die within 24 to 48 hours. The data show that nematodes from Nematac S product bred successfully within mole crickets. Nematode offspring persisted in the soil through flood and winter months and continued to attack other adult mole crickets in 19 of the 20 test sites. There were dramatic pasture recoveries validating the efficacy of this biocontrol program and a potential for economic relief to livestock producers and turfgrass managers in Florida.

H31-P Integrated Management of the Honey Bee Pest *Varroa destructor*

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The parasitic mite *Varroa destructor* is the most damaging pest to honey bees in North America and much of the world. Development of resistance to chemical acaricides and concern about contamination of hive products with these chemicals prompted our evaluation of non-chemical management tactics: mite-resistant stock, and mechanical (open hive bottom boards to exclude fallen mites) and cultural (apiary isolation) controls. In spring 2002, management tactics were randomly assigned to 40 new colonies so that there were five replications of each combination of tactics: 1) resistant or non-resistant queen, 2) open bottom board or solid bottom board, and 3) isolated or non-isolated apiary. Mite abundance was estimated once every three weeks using collections of fallen mites on bottom board sticky traps; colony strength (adult bee and brood abundance, and food stores) was determined every six weeks. By mid-September, there were greater than 40 times as many *Varroa* in non-isolated colonies with non-resistant queens and closed bottom boards than in isolated colonies with resistant queens and open bottom boards. Data analysis indicated that the differences in mite abundance among treatment combinations were affected, in magnitude, by genetic stock > apiary location > bottom board type. Effects of treatment combinations on colony strength were not detected. Results indicate that using a combination of non-chemical tactics may reduce, or eliminate the need for, chemical acaricide treatments for *Varroa.*

H32-P Genetic Resistance in Maple and Elm Against the Potato Leafhopper

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Feeding injury, abundance, and performance of the potato leafhopper were measured on different red maple clones, Freeman maple cultivars, two elm cultivars, and an American elm clonal selection. While none of the elms showed any evidence of feeding injury, the maple trees varied from tolerant (i.e., Freeman maples) to susceptible (i.e., red maple 56026). More eggs were laid and more nymphs became adults on American and Patriot elms, than on red maple clones and Freeman maple cultivars. Red maples were more suitable for oviposition and nymphal survival and development than the Freeman maples. Abundance of leafhoppers among trees varied from many insects caught from elms to very few from the Freeman maples. Our data show that resistance against feeding injury by the potato leafhopper among maples and elms is influenced, in part, by the degree of leaf flushing early in the season. Resistance against the insect's performance is related to the nutritional content of the leaves during the season.

H33-P IPM Options in Poultry Pest Management

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House flies are the primary pest in poultry production. In-house composting is being investigated as a means to suppress fly development, while simultaneously reducing clean-out frequency and yielding a value-added end product. This study was undertaken to determine effects of mechanical turning of hen manure or mechanical turning of manure mixed with a carbon source (wood chips) on fly populations. Turning aerates the manure pile, stimulates internal heat production, and promotes drying. Partially composted manure should be less attractive for oviposition than freshly deposited feces. Core temperatures should exceed thermal death thresholds for eggs and pupae. Stresses from mechanical agitation should physically damage eggs, larvae, and pupae, increasing mortality. Fly larvae were observed moving from the core to the pile surface immediately following turning. Composting creates a thermal range from the core to the

surface, ensuring that larvae can seek optimal temperatures. While turning buries the top layer of manure, fresh feces are continually deposited, renewing prime oviposition material. Late instars abandon the manure pile to pupate in dry areas; therefore pupae are not incorporated in the pile nor exposed to elevated temperatures. Turning disrupts establishment of beneficial organisms (parasites, predators, competitors). Turning discontinuance may yield fly rebound due to absence of beneficials.

I1-P The Gashouse: Novel CO_2 Generation Technology for Trapping Ticks and Biting Flies

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Novel methods have been developed for generation of carbon dioxide through combination of two or more chemicals within a custom designed device that is placed on traps in the field. Carbon dioxide release rates, metered by the rate of reaction (and choice of chemicals), are quantified. Trap captures will be presented for preliminary field tests targeting mosquitoes. This technology is a promising alternative to deployment of dry ice, or compressed gas cylinders.

This system can be interfaced with existing mosquito traps, such as CDC minitraps, or Faye Prince traps, or placed on the ground over a sticky surface to trap terrestrial arthropods such as ticks. The chemicals employed to achieve this reaction are inexpensive and commonly found in U.S. food and pharmaceutical production. The clear aqueous reaction product can be safely disposed of on site with no hazard to the environment or to the operator. This CO_2 release technology is an alternative delivery system for vector control specialists working in IPM programs that target species of medical and veterinary importance.

J1-P Implementation of the MELCAST Melon Disease Forecaster in South Carolina

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Production of watermelon and muskmelon in South Carolina requires use of fungicides to prevent and manage the diseases gummy stem blight, Alternaria leaf blight, and anthracnose. MELCAST, a weather-based spray advisory program, was implemented in 2000. Daily MELCAST spray advisories were made available via a toll-free number (1-877-SCMELON) and on the Internet (www.clemson.edu/scmelon). Twenty-two growers and five Extension agents accessed the MELCAST system in 2000. Eight, five, and four growers used MELCAST the entire season in 2000, 2001, and 2002, respectively. On average, growers made two fewer sprays with MELCAST than with their usual spray schedules, a 36% reduction in the number of sprays. A typical MELCAST program reduced the Environmental Impact Quotient for fungicides by 29%. Under the dry spring conditions in South Carolina between 1998 and 2002, pressure from foliar diseases was low and most growers reduced fungicide sprays, which limited participation in the program. Challenges to increasing the use of MELCAST include additional record keeping, irregular spray intervals, and threats from diseases not covered by MELCAST.

J2-P Influence of Different Doses of Pesticides on Chickpea (*Cicer arietinum* L.)-*Rhizobium* Symbiosis

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A set of experiments under sterilised and unsterilised conditions was conducted in Soil Microbiology Laboratory, Department of Soil Science, Indira Gandhi Agricultural University, Raipur (C.G.) during 2001-2002 to detect the suitable doses of different pesticides for effective chickpea–*Rhizobium* symbiosis. In this connection, experiments were conducted with chickpea cv. JG-11 by using unsterilised and sterilized Vertisol. Under both sterilised and unsterilized conditions, high concentrations of pesticides adversely affected the parameters of chickpea–*Rhizobium* symbiosis, like nodulation, nitrogen and biomass accumulation, including *Rhizobium* population density. On the other hand, *Rhizobium* inoculation without pesticides was found to be most beneficial. Under the experimental conditions medium doses of pesticides (Metasystox @ 2 ltr a.i. ha^{-1}, Chloropyrifos @ 2 ltr ha^{-1}, Pendimethalin @ 1.5 ltr a.i. ha^{-1}, Alachor @ 2 ltr a.i. ha^{-1}) were found to be almost at par statistically with the safer and lower doses i e (Metasystox @ 1 ltr ha^{-1}, Chloropyrifos @ 1 ltr ha^{-1}, Pendimethalin @ 0.75 ltr a.i. ha^{-1} and Alachlor @ 1ltr a.i. ha^{-1}) in respect of chickpea -*Rhizobium* symbiosis. Herbicides (Pendimethalin and Alachlor) were found to be more harmful than insecticides (Metasystox and Chloropyrifos). Higher concentration of Pendimethalin (@ 2.25 ltr a.i. ha^{-1}) was observed to be more toxic than other pesticides under study.

J3-P Sampling Hemipteran Pests in Cotton: A Challenge to Cotton IPM

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Cotton insect pest management (IPM) strategies are constantly evolving with changes in crop production practices, emergence of new pests, and development of novel pest control technologies. During the previous decade, events such as producer participation in area-wide boll weevil eradication programs, development of target-specific insecticides, and introduction of Bollgard cotton have caused entomologists to refine cotton IPM. These changes have addressed the management of insecticide-resistant pests, a general reduction in broad-spectrum insecticides, and an increase in the abundance of hemipteran pests. Agricultural consultants in

cotton IPM typically view the emerging problems with hemipteran pests as simply an exchange for control issues with boll weevil and heliothine pests. The cotton industry generally recognizes sampling and initiating treatments against hemipteran pests (tarnished plant bugs and a complex of stink bugs) is difficult due to their mobility, in-field distribution, and host range. For cotton, the problem is more complex because dense, tall canopies make using sweep nets and shake sheets a cumbersome task for estimating bug densities. Sampling is the foundation of IPM programs and the issues with sampling bug pests present challenges at the core of an overall IPM program. The lack of a reliable sampling method has reduced the ability of agricultural consultants to make well-informed control decisions. Using stink bugs as a model bug pest, a sampling plan for initiating insecticide treatments in cotton is being reviewed and adapted by LSU AgCenter researchers and crop managers.

K1-P Enhancements to the Statewide IPM Program in Oregon

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On behalf of multiple authors and agencies, this poster will outline a current process which seeks to greatly enhance adoption of IPM throughout Oregon. It reflects a new engagement of university, state, and federal agencies with stakeholders within the state, and outlines the approach that will be used to quantify the economic, social, and environmental benefits of IPM adoption. Four specific themes encompass the programs that are under development. These are 1) enhanced adoption of biologically-based IPM; 2) development of improved diagnostic and forecasting systems; 3) rational pesticide use; and 4) enhanced education and outreach programs. The poster will provide a survey of this developing program by mapping specific projects across the State and by providing details of the status and trends of IPM in various commodities. The program acknowledges a number of essential features of Oregon agriculture, including its diversity, the wide bioclimatic variation across the state, and the distinct ecological and physical properties of the EPA-designated ecoregions within which agriculture resides. It also acknowledges the advanced status of watershed health and environmental protection programs in Oregon, summarized within the recent State of the Environment Report, and reflected in the establishment of a Natural Resources Institute, based at Oregon State University. Finally, it reflects the recent development of Regional Pest Management Centers, Regional Diagnostic Networks, and the adoption of an IPM standard by the USDA NRCS. The poster will attempt to provide a visually-compelling focus for discussion of the developing program and the constraints to IPM adoption.

L1-P Invasive Species: What About the Seemingly Innocuous?

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The avocado thrips is just one of several recent invasive species that have challenged University scientists, PCAs, and growers. Existing IPM programs have had to be adjusted quickly to accommodate these new invaders of California agriculture. In the case of the avocado thrips there was no scientific record of this new world species. It only received its scientific name in 1997, shortly after its arrival in southern California (Ventura County). Its origin was suspected to be Mexico or Central America. Subsequent foreign exploration by this author and Dr. Mark Hoddle at UCR confirmed it native range to be Mexico and Guatemala.

But why was it never recorded as a significant pest of avocado in its native home? A sabbatical leave this year by this author confirmed that this species is not a pest of commercial Hass orchards in either Mexico or Guatemala. Research conducted over four months in these countries confirmed the presence of breeding populations of avocado thrips within commercial orchards. However, these populations never reached the astronomical levels experienced over the last five years in southern California and the Mexican and Guatemala populations were confined to the new growth, never moving to the tender new fruit to cause feeding scars.

This case of a none pest species in its native home becoming a significant pest as an invasive species in a new region or climatic zone begs the question "Why aren't we doing more, rather than less, to stem the tide of immigrant "innocuous" or unknown species along with known significant pest species?"

L2-P Semiochemical-based Management of the Larger Pine Shoot Beetle, *Tomicus piniperda*

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An optimized, patented lure for the larger pine shoot beetle, *Tomicus piniperda* has been developed and tested in the United States, Poland, and Croatia. Seven different beetle attractants were tested: á-pinene, á-pinene oxide, ethanol, nonanal, myrtenal, myrtenol, and trans-verbenol. á-pinene was tested alone or in combination with two or more of the remaining compounds. Attraction of all candidate lures was compared to attraction of Tomodor, a Polish commercial lure for *T. piniperda*, using the Intercept® Panel Trap (PT). A lure containing á-pinene, á-pinene oxide, nonanal, myrtenal, myrtenol, and trans-verbenol was used to compare trap captures in Intercept PT with 12-unit multi-funnel traps in U.S., Theyson trap in Croatia, and IBL-3 trap in

Poland. This study demonstrated that at least a quaternary semiochemical combination, including á-pinene, nonanal, trans-verbenol, and myrtenol is required to assure maximum trap captures. The best IPM Tech lure was significantly more attractive than Tomodor when tested in Poland and Croatia. Catches of *T. piniperda* in the Intercept PT were significantly higher than in the IBL-3 trap or Theyson trap.

L3-P Potential for Attract and Kill to Control Gypsy Moth

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Field observational trials were conducted with LastCall®-based formulations of the gypsy moth pheromone. Male moths were readily attracted to and made vigorous contact with droplets of the formulation containing 6% permethrin. Males exhibited intoxication following contact. Attracticidal formulations have proven a robust method for control of codling moth in areas where mating disruption is ineffective and are a promising means for suppression of gypsy moth.

M1-P Occupational Exposure to Permethrin (Pounce) and Propiconazole (Tilt) in Michigan Seed Corn Production

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The Environmental Protection Agency (EPA) is currently reevaluating the risk of occupational exposure to pesticides during its reregistration process. To gather actual field data to refine the risk assessments, Michigan State University (MSU) and the Michigan Department of Agriculture (MDA) completed a study in seed corn to determine: 1) hand labor activities during production; 2) time needed to perform each activity; 3) time after pesticide application before reentering fields to perform those activities; 4) exposure durations while performing each activity; 5) levels of dislodgeable foliar residues during work times; and 6) actual dermal exposure from exposure from dislodgeable foliar residues.

Activities documented where exposure can occur were planting, scouting, irrigation, rogueing, detassseling, isolation, certification, and phytosanitary inspections. The time of year and growth stage when these activities were conducted were determined, the duration of time it took to perform them per day, week, and season was averaged, and the time after application before workers reentered fields to perform them were calculated. This data resulted in greatly reducing the theoretical risk because actual times were much lower than the assumptions used by EPA in risk assessments. To provide this documentation, time log records were obtained from over 40 individuals working in over 250 fields. Pesticide application records were obtained from every field to determine re-entry times.

To determine their actual exposure to pesticides during field inspections, dislodgeable foliar residues were taken from leaf punches of 400 cm^2 per sample, 15 individuals wore inner and outer whole body dosimeters which were analyzed for residues, and additional measurements were taken from hand washes and face and neck wipes. Dermal exposure was much less than expected to cis- or trans- permethrin and propiconazole. Face and neck wipes found no detection of permethrin on any of 15 samples, and 2/15 samples had low levels of propiconazole. Hand washes had 3 of 15 detects of permethrin and 4/15 detects of propiconazole. The whole body outer dosimeter samples only had detectable levels of cis-or trans- permethrin on the lower leg, and propiconazole as detected on only one set of outer dosimeter. Foliar dislodgeable residues were present in 9 of 30 fields for cis- and trans-permethrin and 4 of 12 fields for propiconazole (3 fields not treated) indicating there were small levels of residue present at the time of work.

EPA, seed corn companies, pesticide manufacturers, and the Agricultural Reentry Task Force have stated that it is very valuable to have this data to provide a realistic risk assessment.

M2-P Variation in the Response of *Helicoverpa zea* and *Heliothis Virescens* to CryI and CryII Insecticial Proteins

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A monitoring effort has been initiated at the University of Arkansas to measure current and future variability in the response of key noctuids to insecticidal proteins expressed in agronomic crops. Initial research in 2002 focused on the establishment of baseline data for cryII proteins contained in Bollgard II cotton and cryI proteins contained in commercial cotton and corn. All assays were conducted by diet incorporation methods with mortality assessments at seven days post-exposure of neonates to the treated diets. More than 20 colonies of *Helicoverpa zea* and *Heliothis virescens* were established from field collection in Arkansas during 2002. Variation in response, as measured by range in LC-50 values, was as high as 40-fold with *H. zea* exposed to crylac. Variation among populations in response to cryII proteins and among *H. virescens* populations was similarly measured but at a lower level. Colonies with higher LC-50s tended to be those collected as larvae from Bollgard cotton. The amount of variation observed was no greater than that reported in the literature, but the association of the higher LC-50s with field survival of insects has encouraged additional investigations in 2003. We are especially interested in variable expression of insecticidal protein by the transgenic crops and the potential impact of this variability on the variation in insect response as measured in the standardized diet incorporation assays. We intend to explore the genetic differences among the colonies as the research matures and greater variability is observed.

N1-P Use of Transgenic Bt Resistance in IPM of Corn in the Southeastern United States

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Transgenic corn hybrids expressing the insecticidal protein Cry1Ab from *Bacillus thuringiensis* (Bt) var. *kurstaki* offer the potential for reducing losses by fall armyworm, *Spodoptera frugiperda* (J. E. Smith), and corn earworm, *Helicoverpa zea* Boddie in the southeastern U.S. where corn borer species are not economically important. The only commercially deployed Bt resistance in corn in this area is the Cry1Ab gene as events MON810 and Bt11. Endotoxin in these events is expressed in vegetative and reproductive structures throughout the season. Field trials were conducted at seven locations in Georgia to compare Bt corn with genetically similar non-Bt hybrids when planted at the recommend planting time and one and two months later. Bt corn reduced whorl damage by fall armyworm by more than 90% and ear damage by corn earworm by 50 to 70%. Bt corn did not consistently enhance grain yield when planted at the recommended planting time. Bt corn usually improved yield and provided a positive economic return in late plantings. In 28 plot years, Bt corn had no significant effect on aflatoxin contamination of grain. However, Bt corn permitted later plantings of corn which generally have less aflatoxin contamination than corn planted at the recommended planting time. Bt corn permits later corn planting providing farmers with more planting options and potential for double-cropping corn in the coastal plain region of the southeastern U.S.

N2-P Effects of Herbicide Resistant Rice (Var. 'Liberty Link') on Rice Water Weevil

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Liberty Link rice is a variety that has been transformed to confer resistance to the herbicide glufosinate. Although herbicide resistant varieties are resistant to their respective herbicides, injury to plants can occur following application. Depending on the severity of injury, suitability of plant tissue for insect pests may be altered. Greenhouse experiments were designed to determine if Liberty Link rice differed from its parent line, "Bengal" in its resistance to the rice water weevil. Moreover, experiments were conducted to examine if glufosinate application on Liberty Link rice impacted rice water weevil ovipositional preference and/or larval populations. Additionally, contact bioassays were conducted to determine if commercially formulated glufosinate (Liberty) was toxic to rice water weevil adults. Greenhouse studies showed recommended rates of commercially formulated glufosinate applied to Liberty Link rice resulted in a 30% reduction in rice water weevil oviposition and a 20% reduction in larval densities. Non-Liberty treated Liberty Link rice had significantly higher numbers of late instar rice water weevils than those found on "Bengal." Bioassays on adult weevils showed that the LD50 was nearly four times that used in the greenhouse experiments.

N3-P Genetic Recombination Between Introduced and Indigenous Strains of *Beauveria bassiana*

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Genetic recombination in asexual fungi, including the entomopathogen *Beauveria bassiana,* can occur through the parasexual cycle, during which vegetatively compatible hyphae fuse to form heterokaryons and exchange genetic material. This recombination could alter virulence and host range, and should be considered when assessing the risks of wide-scale applications of a given mycoinsecticide. Using nitrate non-utilizing (nit) mutants, we assessed vegetative compatibility groups (VCG) among strains of *B.* bassiana representing naturally occurring strains collected throughout the US and strains, like GHA, which have been mass released as biological control agents against insect pests. Genetic similarity among these strains was analyzed using RAPD DNA markers. Our data revealed a group of genetically similar strains isolated from Colorado potato beetles (CPB) from northeastern North America belonging to the same VCG. Following in vitro studies, we co-inoculated CPB larvae utilizing pairs of complementary nit mutants of genetically distinguishable strains from the same VCG and from different VCGs. These assays revealed heterokaryon formation only between strains of the same VCG, suggesting that this self/non-self recognition system is an effective barrier preventing genetic exchange between dissimilar strains in the field. We are doing further studies to assess heterokaryon stability and frequency.

O1-P IPMNET—The Global Network of Electronic IPM Information

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IPMnet is an international, collaborative, electronic Integrated Pest Management (IPM) information source specifically focused on contemporary, economic, environmentally-attuned approaches to managing/controlling insects, plant diseases, weeds, nematodes, and vertebrate pests. Launched as an electronic bulletin board in late 1993, IPMnet has expanded to provide current international IPM information to researchers, extensionists, technical specialists, producers, administrators, educators, consultants, retailers—in short, all who may be interested. This purpose-designed network is sponsored by the Consortium for International Crop Protection (CICP) and the Integrated Plant Protection Center (IPPC) of Oregon State University. IPMnet is structured to create and facilitate both a worldwide information channel and a resource for strengthening and fostering IPM. The intent of IPMnet is to assemble and disseminate useful information that will

support not only IPM extension, research, and teaching, but technology implementation and policy development as well. IPMnet offers two ways to connect to its information resources: through World Wide Web at http://IPMnet.org and by mailing list subscription at IPMnetNUZ@bcc.orst.edu.

O2-P The Cornell International Integrated Pest Management Initiative

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In the last three years Cornell University has developed a program in International IPM that is seeking to bring together the 60 or more faculty working in IPM related areas to support international efforts. The initiative has priority areas of activities, in addition to promoting the wide variety of international contacts and activities of individual Cornell faculty. Priority areas exist for distance learning, soil health, biological control, pesticide resistance, and vegetable and fruit IPM. Geographically the initiative has been active in Armenia, China, Colombia, Honduras, Indonesia, the Middle East, and Zimbabwe. In the poster we present the various international IPM activities at Cornell in more detail.

O3-P Contribution of Training and Ecological Factors on IPM Adoption Rates in Honduran Small-scale Agriculture

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Obtaining an environmentally-sound and sustainable increase in agricultural production still remains a major challenge throughout the developing world. During the past 20 years, a diverse array of national and international institutions have conducted IPM extension projects in Honduras, specifically aimed at modifying small farmers' pest management practices. Despite those efforts, a formal project impact assessment has not been conducted and obstacles that potentially hinder IPM adoption await identification.

One of the main problems in Honduran maize production is the fall armyworm, *Spodoptera frugiperda* (FAW). In small-scale agricultural production, reducing pesticide use for FAW control mainly consists of the manipulation of natural enemies. Since natural enemies have proven ecological requirements beyond the field-edge, successful pest suppression depends on nature and management of the agricultural landscape.

We evaluated IPM adoption by smallholders who received varying degrees of training. The impact of training on farmers' appreciation of key biological and ecological concepts and their resulting pest management behavior were assessed through personal interviews and monitoring their practices. Research was broadened to quantify opportunities for efficient FAW management that exist within a broader environment. An appreciation of pest abundance and its associated natural enemy response was gained through monitoring insect population dynamics within fields. In-field dynamics were expanded to an agro-ecosystem level of consideration and linked both with the availability of selected habitat components and farmers, pest management practices.

O4-P IPM for the Date Palm Weevil in the Middle East

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The Red Palm Weevil (*Rhynchophorus ferrugineus*) is a severe palm pest from Asia, which has invaded the Mediterranean basin. Females oviposit ca. 80 eggs on the trunk. The emerging larvae bore into the trunk, potentially breaking the tree and causing total loss. Damage to date palm-based agro-economies can be severe due to the destruction of thousands of trees. With the support of Novartis (Switzerland), The Peres Center for Peace initiated a regional IPM program based on education, prevention, and treatment, incorporating Egypt, Israel, The Hashemite Kingdom of Jordan, and the Palestinian Authority. Activities are conducted in all four areas, with the major laboratory being in Egypt, infestations are most severe. Information and methodologies developed in the project are also communicated to other date growing countries in the region for their benefit.

Our prevention-based IPM utilizes pheromone-containing traps for weevil monitoring and control. Scouts and growers were trained through oral explanations, field demonstrations, and a dedicated movie, to detect infestations and understand the significance of their findings (both weevil adults and infested material). Detection of infested trees was enhanced through the use of sniffer dogs, trained by Kibbutz Afikim Kennels, and a specialized "sounding device," developed by the NIR Company in Germany. Heavily infested trees were cut and their remnants burned to prevent further spread of the weevils. Less infested trees were saved through injection of insecticides into their trunks. Prophylactic insecticide use was heavy in the early stages of outbreaks, but later replaced by detection-based control. Emphasis is now upon trapping adults, tree curing, quarantine measures, and specific attention to possible "hot spots" where infestation danger is greatest.

Realizing that transfer of infested offshoots is a principal route of communicating infested material to new areas, we initiated the acoustic detection of incipient infestations in offshoots prior to sale and shipment.

O5-P Organic Methods of Vegetation Management and Olive Insect Control in Albania

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The effect of two types of vegetation management in olive groves (organic production system and conventional system) were tested in an experimental grove at the Fruit Tree Research Institute in Vlora, during 2001-2002.

The experiments demonstrated that the use of several more environmentally sound management methods can be integrated into IPM programs for olive organic production. The use of straw mulch resulted in effective suppression of weed competition and conservation of soil moisture for extended durations. In the mulching treatment the productivity of olive trees compared with other treatments was observed. Mulching treatment can replace the use of herbicides (Diuron and Glyphosate), which were also effective controlling weeds in the conventional production system.

Alternatives for control of the key pest of olive crops which will provide minor risk to the farmers and the environment were developed. In an organic production system, the efficacy of the bio pesticide *Bacillus thuringiensis* (BT) to control olive moth (*Prays oleae*) was demonstrated. In an olive orchard where BT was used, the number of natural enemies was higher compared with those in conventional system where the broad-spectrum insecticide BI 58 (dimethoate) was applied.

During the years with a normal population pressure of olive fruit fly, promising results were achieved to control olive fruit fly with natural products combined with cultural practices (early harvest of olive fruits). Bait treatments with protein hydrolysate + natural pyrethrum in organic production system and protein hydrolysate + BI 58 in conventional system have been shown to maintain olive fruit fly infestation below the economic threshold levels compared with an untreated control.

In the years with high level of infestation of olive fruit fly the same methods have not been able to maintain olive fruit fly infestation below the economic threshold levels. Preventative treatment could be recommended in such situations.

O6-P Effect of Harvest Timing on Olive Fly Infestation and Olive Oil Yield and Quality

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Our purpose was to study the relationship among the time of olive ripening, dipteran ethology, and oil quality in order to use harvest timing as a control tactic in the management of olive fruit fly, *Bactrocera oleae* (Gmelin). From the results obtained, the optimal harvest time for the cv Frantoi (early ripening cultivar) may be the first and second decades of October. During this period the olive oil content in the fruits is not significantly different from the later harvesting dates. The percentage of olive fruit fly infestation during this period is low compared with the treatments harvested in November. For the cv Kalinjot (late ripening cultivar), the optimal harvest time for good olive oil yield and at the same time escaping from the highest olive fruit fly infestation could be the end of October and early November.

The olive oil analysis of cv Kalinjoti (the main cultivar grown in Albania) performed at OLITECN S.R.L. laboratory (an accredited lab by IOOC in Greece) indicated that it is possible to produce extra virgin oil from olives harvested early enough to escape olive fruit fly infestation. The olive oil produced on October 15 and November 1 has lower free acidity compared with the olive oil produced on November 15, which falls in the virgin category.

In general we determined that early harvesting of olives provided a useful aid for integrated control of olive fruit fly.

O7-P "Attract and Kill" Method Using Eco-traps for Controlling Olive Fruit Fly in Albania

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The efficacy of an improved form of mass trapping method (Attract and Kill method) for control of olive fruit fly, *Bactrocera oleae* (Gmelin) was tested during 2000-2002 at an experimental grove at the Fruit Tree Research Institute in Vlora. The method was compared to bait sprays applied from the ground, and with chemical treatments, which constituted the standard control methods currently used. During the years with a normal population pressure from olive fruit fly, the level of fruit infestation, the main parameter used for the evaluation of olive fruit fly control, was considerably lower during the growing season in the orchard protected by mass trapping and chemical treatments compared to the untreated control. The results indicated that using one killing device/tree baited with ammonium bicarbonate and pheromone has the potential to keep the level of fruit infestation to levels equivalent to the conventional control field, treated at least five times by ground sprays of protein hydrolyzate plus dimethoate. In the years when olive fruit fly developed to higher population density, the application of Eco-traps gave good results only in isolated olive groves. In general, the results showed that the attract and kill method could progressively replace the use of insecticide for the control of the olive fruit fly. The reduction of the amount of pesticides for crop protection, the augmentation of beneficial fauna in the olive ecosystem, and the possibility of using "Attract and Kill" method in organic olive cultivation are the main benefits.

O8-P Last Call Attract and Kill: Effective Control for Cryptophlebia in Citrus and Macadamia in South Africa

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False codling moth is the key lepidopteran pest of citrus, other subtropical fruits in Southern Africa. Macadamia nut borer is a key pest in macadamia production in Southern Africa, Hawaii and Australia. Novel synthetic pathways were developed to obtain economically viable high purity pheromone components for these species. Results of Last Call Attract and Kill field trials are presented, proving multi-year efficacy of this technology in managing these pest species in commercial farming operations in South Africa.

Last Call is an effective, selective and residue-free technology for the control of false codling moth and macadamia nut borer in citrus and macadamia in Southern Africa. Two products, LastCall MNB and LastCall FCM are now registered, and being implemented for Cryptophlebia control on over 2000 acres of subtropical fruits and nuts. Similar formulations are in development for macadamia nut borer in Australia and Hawaii.

O9-P A Contribution to the Study of Eriophyd Mites of Olive Trees in Albania

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In Albania, olive trees are attacked by various pests among which mites represent an important group. Among the Eriophyids living on the olive trees, *Aceria oleae* (Nal.), *Ditrymacus athiasella* Keifer and *Tegolophus hassani* Keifer are the most common species in Vlora region and *A. oleae* is almost always predominant. The three species have the preference for cv Kalinjoti and caused the same type of injury on leaves, flowers and fruits. The higher population density occurs during the first days of April on leaves and later the mites have the tendency to migrate to the flower organs. The setting of the fruits is influenced by their attack. Due to the fact that more than one species is normally present on the same branch injuries are depended from the density of their mixed populations. In our country, heavy infestations from eriphyd mites are observed only in heavy pruned trees.

O10-P Effective New Lure Maximizes Anastrepha Fruit Fly Captures in North and South America

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A synthetic lure developer jointly by IPM Tech, Inc. and USDA, ARS was very effective both for attraction of *Anastrepha* and longevity in the field. IPM Tech lures outperformed Biolure (Suterra, Inc.) 2-component lures advertised effective for Mexican fruit flies five-fold. The new lure was very effective in attracting South American fruitfly, *A. fraterculus*, in Peru, and is now being used operationally to suppress fruit fly damage in organic fruit and vegetable production in Peru.

O11-P Management of Fruit Fly, *Bactrocera cucurbitae* in Cucumber and Pumpkin Using Pheromone and Indigenous Bait Trap

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Different management packages against cucurbit fruit fly, *Bactrocera cucurbitae* Coquillett in cucumber during summer 2000 and 2001 and in pumpkin during winter 2001 were studied using bait traps of cuelure pheromone and mashed sweet gourd (MSG) in the farmers' fields in Bangladesh. Only male fruit flies were attracted to culure bait traps, whereas MSG bait trapped both male and female flies; females outnumbered males. Cuelure bait traps captured 5-18 times more fruit flies than the MSG trap. In both the crops, the higher the fruit fly capture, the lesser was the fruit infestation and higher yield. Around 60 to 70% lower fruit infestation and 50 to 80% more yields were obtained in the pheromone and MSG bait trap treated fields than the untreated control in cucumber, whereas fruit infestation decreased by 70 to 85% in pumpkin and the yield increased one- to three- folds in the treated plots than that of the untreated ones. Combined treatment of cuelure + MSG has a greater promise as a technique for fruit fly control both in cucumber and pumpkin.

O12-P Sweet Potato Weevil Management in the Commonwealth of the Northern Mariana Islands

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Infestation of sweetpotato (*Ipomoea batatas*) farms by sweetpotato weevils (*Cylas formicarius* and *Euscepes postfasciatus*) can reach 100% in the Commonwealth of the Northern Mariana Islands (CNMI) and throughout the U.S.-affiliated islands of the western Pacific. Most of these farms are a few acres in size and are operated on a subsistence level. Fresh water sources in the CNMI are limited and highly susceptible to contamination from pesticide leaching due to the porous nature of the islands' coralline limestone soils. There is a strong need to implement an integrated management program for sweetpotato weevils that reduces pesticide use in the CNMI and similar islands. In 2001, the Cooperative Research, Extension, and Education Service at Northern Marianas College established an integrated management program for sweetpotato weevil based on strategies developed locally and at international research centers. The components of the sweetpotato weevil management program in the CNMI emphasize: 1) crop rotation; 2) destruction of sweet potato residues in old fields to eliminate breeding sites for weevils; 3) clearing fields and field margins of morning glory, an alternate host for weevils; 4) using pheromone traps to monitor for and trap weevils; 5) treating planting materials with an approved pesticide such as (experimentally) *Beauvaria bassiana*; and 6) unified, complete crop harvest of sweet potato tubers to prevent weevils from ovipositing in tubers left in the ground.

O-13P Abundance and Parasitism Efficiency of Parasitoid, *Trathala flavoorbitalis* on *Leucinodes orbonalis* Guenée in Bangladesh

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Trathala flavoorbitalis, a larval-pupal parasitoid of eggplant shoot and fruit borer (ESFB), *Leucinodes orbonalis* Guenée is widely available in eggplant fields of Bangladesh. Parasitism rates of the parasitoid varied from 15.9% to 48.9% in the field. Parasitism rates depended on the host density, highest in August-September (hot-wet season) and lowest in January-February (cool-dry season). Its population can increase about ten-fold and parasitism rate about three-fold in a year if insecticide use in eggplant fields is avoided. Greenhouse and micro-plot studies have shown that *T. flavoorbitalis* is highly efficient in controlling ESFB infestation, amounting 90% in greenhouse and 70% in micro-plot tests. The development period from egg laying to adult emergence is about 16 days and it is a uniparental type of parasitoid, producing about 98% females.

O-14P Resistance of Eggplant Lines to Fruit and Shoot Borer, *Leucinodes orbonalis* Guenée

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A series of studies were conducted with local and exotic eggplant lines against eggplant shoot and fruit borer (ESFB), *Leucinodes orbonalis* Guenée in the greenhouse, micro-plots, and field at Gazipur, Bangladesh during 2001-2002. In the field screening under natural pest pressure eggplant lines, viz. BL107, EG195, TS060B, BL072, BL095(2), BL009 showed high resistant (HR) reaction (less than 1% infestation) and BL095, BL114 as resistant (R) (less than 5% infestation) against ESFB. In the micro-plot test with artificial infestation of ESFB populations of two locations, Gazipur—low insecticides use area and Jessore—high insecticide use area, four lines showed HR reaction against Gazipur ESFB population. However, eggplant lines BL107, BL009, BL114, BL072 and EG203 showed HR or R reaction against both the populations in the micro-plot study. The resistance showed by these lines is antibiotic in nature. The percent larval survivals of the tested lines ranged from 6.67 to 21.75 compared to 92.50% in the susceptible check, EG075. Larval survival rate was lowest in BL009 (6.67%) followed by BL114 (6.75%). Larval weight was also lowest on BL114 (0.017 g) followed by BL009 (0.019 g), while it was 0.94 g in the susceptible line EG075. In the antixenosis test, lowest percent plant infestation was observed in BL114 (5.75%) and BL009 (9.75%), on the contrary the susceptible check EG075 suffered 100% damage.

O-15P Integrated Management of Root-knot and Purple Blotch Diseases in Green Onion

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Green onion (*Allium fistulosum* L.) is a high value crop cultivated throughout the year in peri-urban farming communities surrounding Dhaka, Bangladesh. Due to intensive cultivation of green onion in rotation with rice, root-knot disease caused by *Meloidogyne graminicola*, and purple blotch caused by *Alternaria porri*, are common and devastating. An on-farm experiment was conducted at Kashimpur, a commercial green onion production area to evaluate the effects of soil organic amendments, nematicide, and fungicides in managing these diseases. The experiment

was carried out during the summer 1999 and 2000 in naturally infested fields. Plots amended with poultry litter (3t/ha) plus standard fertilization (composted cow manure 10 t, nitrogen 69 kg, phosphate 90 kg, potash 96.6 kg, sulfur 19.8 kg, zinc 4.29 kg, and boron 0.45 kg per hectare) alone, and in combination with Iprodione at a rate of 1000 ppm produced taller, heavier and healthier green onion plants with minimum diseases, compared with those of the traditional farmer practice (composted cow manure 20 t, nitrogen 92 kg, phosphate 299.7 kg, and potash 199.8 kg per hectare) and control treatment (only standard fertilizers). Both the treatments also resulted in about twice the yield of the plots managed using traditional farmer practice. Plant growth and yield were negatively correlated with purple blotch and root-knot diseases, while purple blotch disease incidence and root-knot nematode gall indexing values were positively correlated. Root gall production was also positively correlated with egg, adult, and total nematode population in the roots.

O16-P VAM Applied Singly and in Combination with Organic Materials in the Management of Root-knot Nematode (*Meloidogyne graminicola*) in Bulb Onion

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The study was conducted to (1) evaluate the activity of vesicular-arbuscular mycorrhiza (VAM) against rice root-knot nematode of onion; (2) determine the effects of VAM in combination with organic materials on the root-knot nematode; and (3) compare the nematicidal effectiveness of VAM applied alone with those combined with organic materials.

VAM-treated plants and those combined with organic materials have higher fresh weights compared to nematode alone treatment. The highest fresh weight was observed in VAM-cow manure combination (68.08 g/plant). Reduction in gall counts in roots due to VAM-organic material combination ranged from 42.28 to 69.43 per cent over that of control (nematode alone) treatment. VAM spore counts in soil and VAM infection in roots was high in VAM-treated plants. In most cases the addition of organic material improved spore production compared to the nematode + VAM treatment.

O17-P Antagonistic Plants for the Management of the Rice Root-knot Nematode (*Meloidogyne graminicola*) in Rice-Onion System

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Pot and microplot experiments were conducted to determine the effects of *Tagetes* sp. and two species of *Crotalaria* (*C. incana* and *C. mucronata*) on the population and development of the rice root-knot nematode, *Meloidogyne graminicola*. In the pot experiment, no galls were observed on these plants while the roots of rice were heavily galled (85.8 galls). The nematode density in the soil was reduced by 73-96%. When onion (var. Yellow Granex) was planted to pots grown with *Tagetes* sp. and *Crotalaria* spp., the number of galls was reduced by 87-96% and the nematode density by 67-96% compared with the treatment planted to rice. Incorporating the plants in the soil improved fertility as shown by the significant increase in fresh weight of onion. In the microplot experiment, percent reduction of nematode density in the soil was 98. No galls in the roots of these plants were also observed confirming their efficacy as antagonist against the rice root-knot nematode. Planting *Tagetes* sp. or *Crotalaria* in nematode infested soil is therefore feasible and can be used in the overall management of *M. graminicola*.

O18-P Effects of Cropping Systems and Insecticides on Natural Enemies on Cowpea in Uganda

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Field trials were conducted in a semi-arid area of eastern Uganda during the first rains of 2002 to monitor the abundance and diversity of arthropod natural enemies in various combinations of monocultures and intercropping systems. Cowpea was grown solely and in association with sorghum or greengram, and treatments incorporated two levels of insecticide application or no insecticides. Treatments were replicated four times in a randomized complete block design. Parasitism of aphids by *Aphidius* sp. (Hymenoptera: Aphidiidae) and Tachinidae, and the abundance, diversity, and distribution of predators such as Coccinellidae, Staphylinidae, Syrphidae, Mantodea, spiders, and *Orius* sp. (Hemiptera: Anthocoridae) were considerably affected by the cropping system, rate of insecticide spray, abundance of prey, and sampling periods. Numbers of natural enemies varied at different crop growing stages.

O19-P Grain Quality Dependence on Different Rates of Herbicides

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The rates of Granstar herbicide, 15 g/ha and 20 g/ha, Hussar herbicide, 75 g/ha and 100 g/ha, have given good results when used on winter wheat fields. We have gathered the following data,

which show that the average height of main straw of wheat was 92.9 cm where herbicide was not used in a control plot and the average yield for three years was taken at 41.3 c/ha. In the plots where herbicides were used, 98.0% of weeds were destroyed. Herbicides positively influenced wheat growth and development.

O20-P Bringing IPM Control Stratigies to Beekeepers in Other Countries as a Volunteer for Winrock International

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In second and third world countries Winrock International volunteers have opportunities to help beekeepers with problems affecting their ability to manage bees. Some new Integrated Pest Management (IPM) strategies that are being developed in the United States for American beekeepers can be adapted to foreign beekeeping. These strategies can be less costly and as effective for them than methods that are currently being used. One concern of beekeepers in Turkmenistan is Bee birds. These birds are protected by the Turkmenistan Department of the Environment as being agriculturally beneficial but because they consume large quantities of bees, beekeepers are limited in bird control methods. An IPM technique of bird control used in the United States for fruit and vegetable crops was introduced there and has reduced the pressure of Bee birds without injury during their last fall migration. Turkmenistan beekeepers also contend with Varroa mites, a parasite of honeybees. Chemical control methods are expensive and hard to obtain. The introduction of IPM strategies, 4.9mm cell size wax foundation and SMR queens, can help reduce populations of Varroa mites to below economic injury levels without depending solely on chemical treatments.

P1-P New Publications Increase Interest in IPM within an Ecologically Based Approach to Farming

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IPM is a key concept within an ecologically based approach to farming. The Michigan State University IPM Program joined a group of MSU Extension specialists, growers, consultants, and processors to develop the new Fruit Crop Ecology and Management. The new publication complements a series of pocket scouting guides. The ecology publication's goal is to foster a deeper understanding of the whole farm system and stimulate growers to think about the underlying interactions that affect IPM and other management decisions. The book includes discussion of the affects of humans who live and work within the ecosystem and purchase the fruit. Readers leave the book with new ideas for managing a sustainable system that is rooted with ease in the larger community.

While the new ecology book presents why IPM and other sustainable management practices are necessary, pocket guides developed by IPM staff and MSU faculty explain how to perform specifics of IPM identification, scouting, and decision making. The success of the first guide for scouting apples has led to three more guides: stone fruits, grapes, and woody landscape plants. Our challenge is to encourage joint use of the guides (how to perform IPM) and the ecology publications (why things work).

P2-P Visionary IPM: Systems Research Across Landscapes, Farms, Crops, and Pests

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Pest specialists and members of the Western Regional Coordinating Committee (WCC-69) are exploring IPM research and Extension methods across landscapes, whole farms, crops/fields, and multiple pests. During a pilot workshop, a farmer framed our discussion at a whole farm level for 16 pest scientists. Systems diagrams and summaries were constructed while scientists described their research methods and results within bio-regions, whole-farm rotations, and individual or multiple pests. Workshop outcomes included new collaborations, new insights, and new directions. We propose a similar workshop that focuses on whole-farm IPM with agency and professional agricultural sales people in fall, 2003 followed by regional workshops. Future IPM strategies will integrate information and management of pest dynamics across watersheds, farms, and pests to achieve this visionary IPM during the 21st century. This poster will present results and a proposal for your consideration.

P3-P Online Site-specific Degree-day Predictions Using GIS and Climate Map Technologies

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As part of a Web-hosted application server for phenology and pest outbreak risk models (http://osu.orst.edu/dept/ippc/wea), we have incorporated open source GRASS GIS mapping and online interactivity for site-specific degree-day estimates at locations without weather stations. Degree-day (DD) maps are created with GIS either daily or interactively via a Web-based form by several steps. First, actual DDs are calculated from among the 600+ sites in the five state NW USA (available for OR, WA, ID, MT, and WY). Second, historical climate map-based DD maps are computed from PRISM monthly temperature maps. Third, differences between actual and PRISM-based DDs are interpolated and then added to PRISM-based maps as a correction layer. These corrected DD maps are further "downscaled" from ca. 2 KM to 360 m resolution or better using elevation-based

local weighted linear regression and smoothing. Final corrected and downscaled DD maps are displayed via the open source GRASSLinks Web GIS interface for zooming, panning, and querying of site-specific degree-days, and to a DD calculator interface to nearest weather station, and other accessory data. DD map validation data are presented, plus discussion of possibilities for other online GIS applications for IPM.

P4-P Effect of Elevated CO_2 on C_3 Crop Endurance to a C_4 Weed: Some Preliminary Findings

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Enrichment of CO_2 has been found to enhance crop growth. However, the effect of CO_2 elevation on crop-weed competition has not been adequately explored. This aspect is of further interest in C_3 crops which are often poor competitors with C_4 weeds. Any increase in the competitive ability of C_3 crops by CO_2 enrichment may result in an increase in weed thresholds and a decrease in the need for postemergence weed control. A study was conducted to test the effect of the density of a C_4 weed, purple nutsedge (*Cyperus rotundus*), on the growth and yield of a C_3 crop, tomato (*Lycopersicon esculentum*). The plants were grown in pots in the field under ambient CO_2 conditions and at elevated CO_2 levels ranging from 1.5 to 2 times ambient concentrations, with weed densities of 0, 1, 2, 3 and 4 nutsedge tubers/pot. Nutsedge densities up to 3 tubers/pot had no effect on tomato yield under elevated CO_2 conditions whereas, densities greater than 2 tubers/pot lowered tomato yield under ambient CO_2 conditions. The tomato plants maintained their biomass under all levels of nutsedge densities in the elevated CO_2 treatment. In the ambient treatment, tomato biomass was lower when nutsedge density exceeded 3 tubers/pot. Elevated CO_2 had no effect on nutsedge biomass and number of tubers produced. Further studies are required to assess the impact of elevated CO_2 on crop-weed competition and their implications to integrated pest management.

P5-P How Do Management Practices Influence Pest Populations in Two Vegetable Crops on Organic and Conventional Farms?

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Organic farmers report a reduction in pest pressure after a number of years of organic production. Our goal in this project was to identify and quantify relationships between farm management practices, soil quality, and pest populations on mixed vegetable farms. We sampled extensively over a three year period in potatoes and winter squash on four organic and four conventional farms to characterize crop management practices, pest and beneficial complexes, a variety of soil characteristics, weed diversity and density, and field border flora and fauna. The data will be used to explore relationships between management practices, farm ecosystem factors, and pest and beneficial levels.

P6-P Looking Large; Thinking Wide: Understanding the Landscape to Manage Western Tarnished Plant Bugs

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Western tarnished plant bug (WTPB) is a pest on many agronomic and horticultural crops in California's San Joaquin Valley. In most crops, this pest moves into the field from external sources such as neighboring crops or plants. Understanding and characterizing the landscape in which WTPB develops will be key in improving IPM approaches to its management. We have developed tools and approaches to examine township scale areas for crop mix, spatial arrangement, temporal changes, and source/sink relationships. Many of these tools are based in ArcView GIS programs and routines. Timely land use maps have been obtained for Kern County through the Agricultural Commissioner's office. These were used to compare and contrast 50 townships for cropping composition and adjacency of cotton and alfalfa forage. In one 5,000 acre cropping community, WTPB was monitored through the year and its population densities represented spatially.

P7-P Regionalization of Cutworm Forecasts and Risk Warnings

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Two major cutworm species, the pale western and the army cutworm, are serious but sporadic pests of alfalfa, sugarbeets, corn, and small grains for Great Plains producers. Injurious larval infestations occur when sufficient populations are present and when weather conditions are favorable for larval survival. However, relying solely on spring larval monitoring results in poorly timed interventions and economic damage because larval monitoring is difficult, time consuming, and costly. Fall adult monitoring using pheromone traps provides information about

adult activity and relative abundance that can be used to forecast spring larval populations.

An areawide adult monitoring program began in Montana in 1992 and with funding obtained from USDA-CSREES-WRIPM, has since developed into a regional program including Montana, Wyoming, Utah, Idaho, Western Nebraska, Colorado, and South Dakota. An internet-based cutworm survey report was developed for Web entry of cutworm moth flight data and updated summaries may be viewed or printed <Cutworm.org>. However, detecting populations of pale western or army cutworm moths does not always provide accurate forecasts of damaging larval populations. Funding from WRIPM has enabled us to improve our ability to forecast damaging larval populations by incorporating known environmental factors that influence cutworm populations. A larval monitoring component has been added which will be used to validate forecasts. More accurately forecasting potential damaging cutworm larval outbreaks allows producers, consultants and Extension personnel to adjust costly and time consuming monitoring practices for the damaging larval stage.

P8-P Areawide Pest Management for Wheat

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Areawide Pest Management for Wheat is a five-year project to demonstrate pest management practices for the Russian wheat aphid and greenbug. Through visits to demonstration farms, we will demonstrate the effectiveness of Integrated Pest Management in wheat. Our project team includes specialists from the ARS laboratory in Stillwater, Oklahoma, and research and extension specialists from these five land-grant universities. Currently in the second year, we are inviting 180 wheat producers to participate in focus group sessions and crop production interviews. Our purpose is to learn how wheat producers make pest management decisions and to initiate their involvement in the project. Our research goal in the focus groups is to assess how pest management decisions relate to other production decisions made by producers. The research design will allow us to compare producers in different types of crop production systems and different wheat growing regions of the Great Plains.

Q1-P Areawide Organic Pest Management in Pear

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Areawide management programs for insect pests of apple and pear in the Western U.S. have been successful since their inception a decade ago. Most projects have been targeted at codling moth, primarily through the use of mating disruption to replace organophosphate insecticides. Pear psylla, another important pest of pear, is amenable to areawide management, in that it is highly dispersive and has a number of potential natural enemies in surrounding native woodland. Establishing organic orchards or orchards using soft management practices among conventional orchards has often been difficult in that pests readily migrate in from the conventional orchards, yet natural enemy immigration is limited by the pesticide use in those same conventional programs.

Organic pest management on an areawide basis could provide more opportunities for immigration of biocontrol agents. In 2002, an Areawide Organic Management Program was established on 310 ac of contiguous pear, surrounded by native vegetation. Organic pest management practices were implemented for insect and mite control throughout the project, however other organic practices were not required (e.g., nutrient, rodent, and weed management were often by conventional practices). Overall, there was a reduction in pesticide use, and an associated reduction in insecticide costs. This program will be expanded in 2003. See http://entomology.tfrec.wsu.edu/pearent/pcg.htm for more information.

Q2-P IPM Alternatives: Investigating Potential Non-target Impacts of an Organic Biopesticide in Apple Production

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Although integrated pest management (IPM) has reduced the use of pesticides, apple production is still dependent on pesticide use. A new organic alternative, kaolin, is now commercially available as a potential replacement for certain insecticides that manage key apple insect pests. Kaolin is a clay that has been previously used as an inert additive in the food industry. When sprayed onto the tree, kaolin forms a white, physical barrier on the surface of the leaves and fruit (i.e., the tree turns white) which repels insect pests or makes the feeding, egg-laying, or colonization site unrecognizable and/or unsuitable. However, it appears that kaolin may have other effects on the tree; the white barrier may reflect infrared radiation in the canopy causing a reduction in canopy temperature. This could be beneficial in warmer climates and reduce heat stress but may impact maturation of apples grown in cooler parts of the country. Since thorough coverage of the tree with kaolin is critical to obtain the desired effects on insect pests, does the white film on the tree impact tree vigor, fruit quality, and yield when used over multiple seasons in cooler orchard environments? Does the film impact disease management? Also, will the white film make the fruit unrecognizable or unsuitable for bird feeding which can be a serious problem in orchards? These are some of the questions the research aims to answer.

Q3-P Cowpea Varietal Resistance to Weeds

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Field experiments in 2000 and 2001 examined the competitive abilities of three cowpea (*Vigna unguiculata* (L.) Walp.) varieties with similar maturity and vegetative vigor but different growth habits. Iron-Clay (IC) grows erect, while IT89KD-288 (288) is semi-erect. UCR 779 (779) grows prostrate. Purslane (*Portulaca oleracea* L.) and sunflower (*Helianthus annuus* L.) were planted within the cowpea row as weeds. Canopy height and canopy width of cowpea varieties, light intensity above and below the sunflower and cowpea the canopies, and leaf area index (LAI) of each species were measured weekly. One meter of row was sampled at the same day to measure leaf area and dry weight. Growth parameters RGR (Relative Growth Rate), NAR (Net Assimilation Rate), SLA (Specific Leaf Area), LAR (Leaf Area Ratio), and LWR (Leaf Weight Ratio) were analyzed to determine characteristics that contribute to cowpea competitiveness. Sunflower reduced the amount of light that cowpea received and reduced cowpea biomass and grain yield in both years. Cowpea reduced the light received by purslane but purslane had little effect on cowpea. Leaf area of cowpea was reduced when sunflower was present. Leaf area of sunflower and purslane was reduced significantly by cowpea varieties. Cowpea varieties differed in their ability to compete with purslane and sunflower. IC was the most tolerant and UCR 779 the most susceptible to weed competition. Growth analysis indicated that IC reduced sunflower RGR significantly and 779 reduced purslane RGR significantly. The SLA of IC was increased by sunflower at an earlier stage of growth and by a higher percentage than for the 779 and 288 varieties. This could partially explain why IC was more competitive with sunflower. LARs and SLAs of three cowpea varieties were increased by sunflower, but decreased by purslane. The results also indicated that the erect growth habit might be more effective in suppressing weeds than prostrate growth habit

R1-P Vermont IPM: Collaborative, Multi-disciplinary and Diverse

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The Vermont IPM program focuses on the IPM priorities and needs identified through participatory assessments conducted in the state and region. There are four areas of emphasis within Vermont's IPM program: apples, vegetable & berry, field corn, and greenhouse ornamentals. In addition, a new school IPM program is being developed. All include collaborative regional efforts and involve diverse participants (e.g., commercial producers, state agency representatives, ag-industry personnel, researchers, private consultants, consumer advocacy groups, etc.). Vermont's IPM program is multi-disciplinary and closely integrated with research. Methods of information delivery include: one-to-one communication, field validation trials, workshops, training sessions and presentations, dissemination of educational materials through newsletters and Web sites, etc. In addition, the program offers undergraduate and graduate educational opportunities and 'hands-on' experiences.

R2-P Calibrating a Biological Calendar for Timing IPM Decisions for Ornamental Plants across Ohio

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Implementation of IPM strategies and tactics is often hindered by lack of and ready access to the data necessary to accurately time pest management decisions. Monitoring is a key component of IPM programs, but is complicated in ornamental landscapes by the tremendous diversity of pests. Because the development of both plants and insects are temperature-dependent, the blooming sequence of ornamental plants accurately tracks degree-day accumulation, and thus can be used to predict pest activity. From 1997-2001, Dan Herms monitored the phenology of 92 plant and 43 arthropod taxa in Secrest Arboretum, Wooster, Ohio. Despite substantial year-to-year variation in weather the order in which phenological events occurred remained highly consistent. The blooming sequence of plants is easier for green industry professionals and homeowners to monitor than is the phenology of often difficult to detect pests. The purpose of this study was to quantify the phenological development of key insects and indicator plants across Ohio in order to calibrate the more intensive phenological calendar developed at Wooster, Ohio on a statewide basis.

R3-P Survey of Pesticide Use on Turfgrass Grown in Ohio

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Pesticide use data and adoption of IPM practices continue to be important indicators of how IPM programs are implemented. The objective of this project was to collect pesticide use information on turfgrass from three metropolitan areas of Ohio and to begin the development of a turfgrass IPM definition. Surveys were mailed to 1,290 pesticide applicators. The final percentage of returned surveys was 20.1% (259 surveys). Cumulatively, the respondents to the survey managed 30,762 acres of different types of turfgrass, mostly residential and commercial. Total quantities of active ingredients (a.i.'s) in pounds for each type of pesticide applied in 2001 were 112,848 lbs of herbicides, 10,598 lbs of insecticides, 4,796 lbs of fungicides and 263 lbs of soil fumigants and plant growth regulators. The percentages of the total pounds of a.i. applied were 87.8%, 8.3%, 3.7% and 0.2% respectively. An average quantity of pesticide a.i. applied per acre calculated to be 4.2 lbs of a.i. per acre of turfgrass. The herbicide, insecticide and fungicide a.i.,s applied in the largest quantities were 2,4-D, imidacloprid and mancozeb, respectively. In addition to applying pesticides and/or pesticides with fertilizer to turfgrass, 92.2% of the respondents performed one to several other turfgrass maintenance activities. The majority of the respondents (65.9%) stated they always used pesticides at the labeled rate. Approximately 85% of the respondents set their wind velocity to stop spraying around 10 mph. Of the different types of pesticide application equipment used, truck or trailer tank sprayers and dry spreaders were calibrated with the greatest frequency. The top rated source of information about pesticide application was reading the pesticide label with an average score of 4.6 on a rating scale of 1 to 5.

R4-P Areawide IPM for Tree Fruits: The Southern Oregon Experience

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Following a pilot project in 1994, southern Oregon participated in a five year multi-state areawide IPM project, the Codling Moth Areawide Management Program (CAMP) 1995-99. The CAMP project featured large areas (300+ acres) of contiguous orchard where mating disruption for control of codling moth was used. During the course of the project, synthetic pesticide use was reduced by an average of 75% and organophosphate use by 66% for a per acre savings of over $200 per year. In 2000, an estimated 60% of the pome fruit acreage in southern Oregon was using codling moth mating disruption. In 2001, a new multi-state project funded by IFAFS and RAMP, dubbed Areawide II, was initiated with the goal of stabilizing and extending the codling moth mating disruption system to 75% of pome fruit acreage. Blocks as small as 20 acres are being used to demonstrate the utility of codling moth mating disruption at that scale. Research on increasing the impact of biological control agents is one focus of this new project. However, in 2002, the use of mating disruption has dropped to about 40% of the pome fruit acreage in southern Oregon. Economic distress in the tree fruit industry has resulted in abandonment of IPM in some instances. An American Farmland Trust grant was received in 2002 to specifically deal with issues concerning this downturn and with the goal of bringing acreage back to an IPM approach. This experience indicates that even a successful IPM program is vulnerable to many challenges and that continued research and extension effort may be needed simply to maintain past gains.

R5-P An Integrated Approach to Outbreaks of Internal Fruit Feeders in Pennsylvania: An IPM Case Study

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Since 1998, internally feeding insect pests of apples and peaches have emerged as a serious problem for commercial fruit growers, packers, and processors in Pennsylvania and the mid-Atlantic region. Internal feeders such as Oriental fruit moth (*Grapholita molesta*), and codling moth (*Cydia pomonella*) can render fresh fruit unmarketable, and cause processing fruit to be unusable. Since 1998, internal fruit feeders have caused the rejection of 1496 loads of fruit from processing plants in the mid-Atlantic region, creating a serious economic hardship for growers, and a significant challenge for IPM practitioners. Penn State University (PSU) researchers have assessed levels of insecticide resistance in PA internal fruit feeder populations and have tested novel insecticides that will replace the broad-spectrum arsenal of organophosphate, carbamate, and pyrethroid compounds. Studies are being conducted on novel insect control tactics such as pheromone mating disruption. Additionally, research is being conducted on the basic biology of OFM in order to develop accurate phenological models to aid in effective control. Extension programs such as 'internal fruit worm schools' and periodic extension updates serve to inform growers on the latest recommendations for control. The local fruit processing industry has also become involved in solving this emerging problem. Knouse Foods Cooperative, Inc. implemented an insect trapping program for member growers and has sponsored educational seminars on optimizing internal worm control. This multi-level cooperation has led to some significant improvements in fruit IPM in Pennsylvania. Successes and future challenges to the internal feeder problem are discussed.

R6-P Whiteflies in Arizona: An IPM Success Story

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Whiteflies (*Bemisia tabaci* [biotype B]) invaded Arizona in the early 1990's causing catastrophic losses to agriculture. Honeydew excretions contaminated cotton lint, giving rise to market penalties. Foliar insecticide intensity reached an historic 25-yr high in 1995 mainly because of this pest. However, in 1996 key

technologies and a major new IPM plan was introduced and disseminated to over 700 pest control advisors and growers through multilateral educational meetings. The AZ IPM plan depends on three central keys: "Sampling" & "Effective Chemical Use" built on a foundation of "Avoidance." Avoidance may be thought of as all practices that serve to prevent or maintain pests below economic levels. Effective Chemical Use optimizes all remedial inputs, and Sampling sits atop the pyramid and serves all other layers of management. With the adoption of the AZ IPM Plan, whitefly sprays have been reduced by 71% to around one spray per season, and growers have saved over $100 million in control costs and yield savings in the last five years. Foliar insecticide use reached a 25-yr low in 1999. Six years of success have led to historic lows in insecticide use in cotton and have been based on:

1. research-based guidelines for sampling & thresholds,
2. access to powerful and selective IGRs with proven guidelines for their use,
3. the extended suppressive interval, known as "bioresidual," which maximizes natural mortality factors of the whitefly and creates area-wide benefits, and
4. an organized, multi-lateral, multi-institutional and comprehensive educational campaign.

R7-P High Plains Integrated Pest Management: Regionalization and Integrating Pest Management Guidelines

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The High Plains Integrated Pest Management (HPIPM) Guide (Bulletin No. 564A) was conceived as a regional effort to provide current, effective pest management options for arthropods, and plant pathogens affecting all major field and horticultural crops grown in Colorado, Wyoming, Western Nebraska, and Montana. Individual insect and disease chapters include pest identification, appropriate sampling techniques, chemical and non-chemical control practices including cultural, biological control, and host plant resistance management options, as available. By including alternatives to pesticides, we hope to create a reference of management strategies growers will consider when faced with a pest problem. Experience has demonstrated that reliance on a single pest management tactic can be improved when multiple methods are used. The use of multiple strategies and tactics is a basic principle of integrated pest management programs.

Funding has been provided by the USDA-CSREES-WRIPM program and USEPA Region VIII has allowed us to convert this document to the Web (http://highplainsipm.org/) and offers considerable savings in updating, printing, and distribution. The Web version takes advantages of internet publishing by adding color images of arthropod and disease pests, providing a search engine, and offer viewable (html) and printable (pdf) versions of documents while keeping in mind that the predominately rural users in these states have limited or low quality internet access including slow modems, error-prone (static) phone lines, and costly service providers. Users have indicated the need for color pictures that aid in identification, damage symptoms, and easy-to-use search capability that would save time in locating material of interest. By providing Web access to this guide that emphasizes ease and speed of access and delivering needed pest information, users may use this site as a primary source of pest information, replacing the printed guide that is rapidly outdated and requires a great deal of time and energy to maintain. Individual chapters may be printed and mailed with the aid of County Extension Agents for those users who do not have Web service. An advisory committee comprised of constituents from the four states provides feedback for future HPIPM directions.

R8-P Developing a Reduced Risk Management Program to Control Foliar Blights on Carrots in Michigan

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Alternaria (*Alternaria dauci*) and Cercospora blights (*Cercospora carotae*), incite disease on carrot leaves and petioles. Tops weakened by disease break off during mechanical harvesting, leaving roots in the ground and reducing yields. A survey of Michigan carrot growers in 2002 gathered baseline information on current management practices of commercial carrot production and adoption of IPM. A field investigation was conducted in the 2001 and 2002 growing seasons to determine if the Tom-Cast disease-forecasting model could be used to time fungicide sprays. Tom-Cast was tested at spray thresholds of 10, 15, 20 disease severity values (DSVs). A copper hydroxide fungicide, a reduced risk azoxystrobin fungicide, and a standard chlorothalonil fungicide were used alone and in alternation, and significantly reduced foliar blight compared to the control in both years. In 2001, using Tom-Cast (DSV=15) to trigger sprays decreased the number of applications compared to a calendar-based schedule, while providing comparable disease control. In 2002, with an early occurrence of disease and an increase in disease pressure, application intervals of some fungicide programs had to be shortened (DSV=10). Results suggest that Tom-Cast can be used with different fungicides and can reduce the number of fungicide sprays needed to control foliar blight disease on carrots.

R9-P Using Tom-cast and Scouting to Manage Foliar Blights of Carrots

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Fungal foliar blights of carrots, caused by *Alternaria dauci* and *Cercospora carotae*, result in necrotic lesions on leaves and petioles that may cause defoliation, decreasing the efficiency of mechanical harvest. Traditionally, fungicides are applied every seven to ten days, regardless of weather conditions or disease pressure. The primary objectives of this study were to evaluate the Tom-Cast disease forecasting system for timing fungicide sprays to control foliar blights, and to determine when to apply the first spray based on field scouting and disease incidence. Chlorothalonil alternated with azoxystrobin was applied every ten days or according to Tom-Cast with a threshold of 15, 20, or 25 disease severity values (DSVs). Sprays for these programs were initiated prior to symptom development, or when foliage was infected at a trace (1-2%), 5%, or 10% level. Up to four sprays were omitted, saving $46.05 per acre. Comparable disease control was achieved by initiating applications when a trace amount of the foliage was blighted and applying subsequent sprays according to Tom-Cast 15 DSV, compared with calendar-based sprays initiated prior to blight symptom development. Field scouting and the Tom-Cast disease forecaster appear to be valuable tools for determining the appropriate timing of fungicide applications on carrots while making blight control more cost effective.

R10-P Evaluation of Disease Forecasters for Managing Foliar Blights of Carrots

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Alternaria dauci and *Cercospora carotae*, the fungi causing Alternaria and Cercospora blights, are destructive to leaves and petioles of carrots and reduce the harvestable yield in severely blighted fields. Traditionally, fungicides are applied every seven to ten days, regardless of weather conditions or disease pressure. The objective of this study was to evaluate available disease forecasting systems for timing sprays to limit foliar blights, including 1) a modified disease forecaster previously tested for timing sprays to control *Cercospora apii* on celery, 2) an Alternaria disease forecaster designed to time sprays for controlling *A. dauci* on carrot but not yet tested in Michigan, and 3) Tom-Cast, originally developed to predict the occurrence of diseases on tomatoes. Chlorothalonil was applied every seven days or according to the forecasting systems in 2001 and 2002. Sprays applied according to Tom-Cast 15 DSV resulted in a fungicide savings of $60.52 per acre compared with the seven-day schedule, while providing similar blight control. Number of sprays was reduced when fungicides were applied according to modified predictive systems for Alternaria and Cercospora compared with the seven-day schedule, but acceptable blight control was not always achieved. The Tom-Cast disease forecaster was easy to use and reliable for determining the appropriate timing of fungicide applications on carrots.

R11-P Relationship Between Fusarium Crown and Root Rot and *Ophiomyia simplex* in Asparagus Fields of Different Maturities

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Fusarium crown and root rot, (*Fusarium oxysporum* f. sp. *asparagi, F. proliferatum*) has been implicated in decline problems in production areas of asparagus. Pathogenic strains of both *Fusarium* spp. have been associated with *Ophiomyia simplex* (asparagus miner). Commercial fields were monitored in 2001 and 2002 for miner activity via weekly trapping for adults, monitoring of above ground stem damage, and end of season puparia counts. Puparia and mined stem tissue were plated for the presence of *Fusarium* spp. A two generation trend was seen across different-aged fields with the highest numbers trapped in early to mid-Aug. The highest number of adults trapped overall was in the 4-5 year old fields. There was no significant difference among the fields as to the number of puparia per stem (3-4). However, most of the pupae emerged during the season in the one year old fields, while in the older fields, which went into fern later in the season due to harvesting most of the pupae remained intact for overwintering. It is not known how significant sporulation of Fusarium on above ground mines is to the overall spread of pathogen inoculum. In 2001, 15% of pupae had *F. proliferatum* and 3% *F. oxysporum*, while stem tissue had 54% and 2%, respectively. In 2002, 14% of the pupae had *F. proliferatum* and 19% *F. oxysporum*, while stem tissue had 13% and 7% respectively.

R12-P Twenty Years of Sweet Corn IPM in Maine: A Work in Progress

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Sweet corn comprises roughly half of the commercial vegetable acreage in Maine. Historically, the crop has been intensively managed, using high levels of pesticides to control the major insect pests, European corn borer, corn earworm, and fall armyworm. In 1983, the University of Maine Cooperative Extension initiated a sweet corn IPM program to address the concerns of high pesticide use and relatively low profitability of this crop. The program initially introduced pest monitoring techniques and economic action thresholds being developed in the northeastern United States to a few selected volunteer farms. Since that time the program has expanded to serve over 100 farms statewide, and joined a network to provide information throughout the Northeast region. Over twenty sites within the

state are now regularly scouted and information is delivered to growers via weekly newsletters, e-mail, local and regional Web sites, and a telephone hotline. Annual pre-season grower meetings provide updates on monitoring techniques and management technologies. Applied research is an important part of this program, working with grower-cooperators to evaluate trap placement, specialized silk treatments, and parasite releases. Recent evaluations indicate that nearly all participating growers have modified their pest management programs as a result of the program. Most have seen an improvement in the crop quality, and more than half of the farmers found that the IPM program improved crop profitability. Future concerns for the program include funding and the apparent dependence of farmers on scouting data from outside resources.

R13-P Early Season Insect Control in Sweet Corn When Using Row Cover

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A common technique in cold climates to speed maturity in sweet corn is to start the corn under plastic or floating row cover. Once the corn is from one to two feet tall, the plastic or row cover is removed. Because it is so much farther advanced than sweet corn planted on bare ground the crop attracts early season European corn borer (ECB). Scouting for insect damage is difficult or impossible because the larvae are deep in the plant. Working with two large-scale growers of row cover sweet corn, a successful technique for insect control was identified. Pheromone traps next to the fields are used to monitor early season flight patterns. At flight peaks, the grower waits 3 to 4 days, then applies an insecticide spray. After another 3-4 days, a second insecticide application is made. No further applications are necessary. Three years of informal observation and one year of data collection have confirmed the results. Growers have developed confidence in using the technique and have achieved both high quality early sweet corn and minimal pesticide application.

R14-P Determining IPM Practices Used and Not Used in Virginia Through Grower Surveys

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Three IPM surveys (one for each commodity) were designed to determine what IPM practices corn, soybean, and small grains farmers in the coastal plains region of Virginia are and are not using, and why. This information could be useful for research and Extension personnel to determine what farmers need in terms of IPM programs, and would indicate areas where farmers need more education, service, or support. Survey questions were based on meetings with Extension Specialists, Virginia Cooperative Extension Agriculture and Natural Resource Agents, and farmer focus groups, where current IPM practices were discussed. Surveys were distributed to 249 individuals per commodity in October 2002. Major disease, insect, weed, and animal pests were identified for each crop. Based on farmer responses, specific IPM practices were categorized as "often used," "sometimes used," or "rarely used." Use of IPM Internet resources was 15% or less in three of four cases.

R15-P A Sclerotinia Risk Map for Canola

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A Sclerotinia risk map, adapted from one used in Canada, was initiated in 2001 for canola producers in North Dakota and northwestern Minnesota. Maximum and minimum air temperature and rainfall data from 57 North Dakota Agricultural Weather Network (NDAWN) stations were automatically e-mailed in 2002 to project consultants and a GIS map maker. Early season information provided for each NDAWN site included soil moisture in the upper four inches of soil, estimated soil moisture as a percent of field capacity in the upper four feet, GPS locations, elevation, soil type, and the 50% canola planting date for area fields. Environment Canada provided upper atmospheric data and calculated evapotranspiration and soil moisture in the surface soil and the sub soil. Appearance of apothecia was confirmed by crop consultants and extension personnel. Risk maps were produced twice weekly and posted on two Web sites. Risk map accuracy was estimated by disease survey and crop history of fields near NDAWN sites. The 2001 risk map appeared accurate except for one location where apothecia continued to appear longer than expected. The anomaly was addressed in 2002 by adding a second model for soil moisture under a small grain canopy to the existing model for soil moisture under a canola canopy.

R16-P Status of First Year Western Corn Rootworm Activity in Soybeans in Ohio

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In 1998, the Ohio State University Extension Integrated Pest Management program began monitoring for First Year Western Corn Rootworm (FYWCR), a biotype of the Western Corn Rootworm (*Diabrotica virgifera*). This biotype deposits eggs in soybean fields that can potentially damage corn planted in that field the next year. Soybean fields near cornfields were monitored using four Pherocon AM yellow sticky traps; two near one field edge and two near an adjacent field edge. Traps were set out in soybean fields in mid July and changed every two weeks for a six week period ending in late August. More than 1200 soybean fields

have been monitored for FYWCR beetles from 1998 through 2001 and only four fields have exceeded two beetles/trap/day. In 2002, sixty-four soybean fields were monitored in 20 counties. FYCRW beetles captured on sticky traps were higher in all counties in 2002 as compared with previous years. Based on a possible treatment level of two beetles/trap/day, only one field exceeded that level in 2002. As of 2002, economic levels of FYCRW have only been detected in a few isolated soybean fields in northwestern Ohio, but continued monitoring for this pest is warranted.

R17-P Seasonal Oviposition of the Western Corn Rootworm: Does Crop Phenology Play a Role?

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Since 1995, producers throughout east-central Illinois and northern Indiana have witnessed severe western corn rootworm, *Diabrotica virgifera virgifera* LeConte, larval injury to rotated corn, *Zea mays* L. In most instances, corn and soybean, *Glycine max*, have been rotated from field to field annually for decades in this major corn production area. The reason attributed to this failed cultural approach is a shift in the ovipositional behavior of western corn rootworms. The seasonal oviposition patterns of adult corn rootworms have been studied under both laboratory and continuous cornfield conditions. Entomologists predict that the new variant western corn rootworm would spread east of Illinois into northwestern Indiana, southern Michigan, and Ohio. To better understand the seasonal oviposition behavior of the new western corn rootworm variant that lays eggs in other crops, we conducted research (1999-2001) on the farms of three producers in Iroquois County, Illinois, near the epicenter of the crop rotation problem area. Weekly estimates of absolute western corn rootworm densities were determined by using emergence cages. Relative densities also were determined with vial and Pherocon AM sticky traps. Soil samples were taken throughout the growing season and eggs extracted to determine ovipositional patterns. During the summers of 2000 and 2001, we planted 32-hectares in Champaign, Illinois, eight treatment combinations of corn and soybean cultivars planted at two different dates. The corn and soybean cultivars also varied by maturity level. We created these differences in phenological development to see what potential impact they might have on the oviposition of the western corn rootworm variant. We will compare and contrast the seasonal oviposition behavior of western corn rootworm in continuous corn with the western corn rootworm variant that responds to crop phenology and lays eggs in many crops, including corn.

S1-P Level of Adoption of IPM Practices in New York Greenhouses

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Floriculture is an important industry that contributes to the local economy and enhances community quality of life. The floriculture industry in New York ranked sixth among the states with production sales in the year 2000 of $179.9 million. A survey of greenhouse IPM practices was conducted in 2000 by the New York Agricultural Statistics Service (NASS) to ascertain the level of IPM implementation. A secondary goal was to educate growers about IPM through taking the survey, especially about the importance of cultural practices and pest prevention. Out of 875 surveys mailed, 247 growers sent back the completed survey voluntarily. NASS conducted follow-ups by telephone (170) and personal interview (90), achieving balance in sampling the nine districts in the state and the different sized operations. By employing a survey point system, it was possible to evaluate implementation of greenhouse IPM, compare regional strengths and weaknesses, and compare IPM adoption by different sized operations. The results will be presented.

S2-P Field Biology of *Cenopalpus pulcher* (C. & F.) (Tenuipalpidae), an Invasive Mite New to Oregon Apple and Pear Orchards

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C. pulcher infests both apple and pear in most counties of the Willamette Valley of Oregon. Higher incidence was observed on abandoned or unmanaged orchards/trees. This suggests that the species is sensitive to apple and pear pesticides commonly used in the valley. In 2001, the populations of this species reached their peaks from late July/early August to early-September, and remained high until October at two locations in Corvallis area. We found *C. pulcher* feeding on leaves, soft twigs, and fruits and females depositing eggs on the striations and natural indentations of the leaves and fruits. Phytoseiids *Typhlodromus pyri* Scheuten, *Amblyseius andersoni* Chant, *Kampimodromus abberans* (Oudemans), and the stigmaeid *Zetzellia mali* (Ewing) were predators commonly associated with *C. pulcher* colonies in both apple and pear orchards. We found *C. pulcher* overwintering on apple and pear limbs under loose bark, but not on smooth-bark areas of limbs. In 2001-2002, the length of overwintering period was 6-7 months (November–April/May). About 90-94 % of hibernating adult females sequestered under old bud scales, on vegetative terminals. Examination of mounted hibernating females (December–May 2001) under high power showed no eggs or immature forms present. It seems that this species produce only

one or a few generations beginning late in the season in the Willamette Valley of Oregon.

S3-P From IPM to IFP: Current Status of Quebec Programs and Coordination with the Canadian Project

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Preventing apple trees from being severely attacked each year by multiple pests while maintaining ecological diversity and environmental sustainability requires growers to base their interventions on sound approaches such as IPM programs. Such programs have existed for some time in Canada, but apple producers from around the world now gradually adopt IFP (Integrated Fruit Production) programs that include not only pest-related practices but encompasses all farm operations in a program that integrates education, risk management, food safety, environmental protection, worker welfare, and fruit quality. Canadian IFP standards are currently being developed under the leadership of the Canadian Horticultural Council (a national association of growers) with funding from the government of Canada and the World Wildlife Fund. National standards will serve as a guide for provincial programs in each of Canada's apple-growing regions: British Columbia, Ontario, Quebec, and the Maritimes. Provincial IFP programs include practices for soil management, irrigation, integrated pest management, harvesting, grower education, etc. The IFP program for Quebec apples was the first of its kind to be published in Canada (in 2001), and its most recent version will be presented in more details as an example.

S4-P Refinement of IPM Program for Powdery Mildew of Cucurbits

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Recent research enables refining the IPM program presented at previous National IPM Workshops. Fungicides are still the main management tool for powdery mildew (PM), the most widespread cucurbit disease. PM is more severe on lower (under) leaf surfaces, thus systemic fungicides are important. Fungicide resistance continues to challenge management because systemics are usually at risk. Resistance to QoI fungicides was detected in 2002 in the U.S. Alternating among chemical classes is the main strategy for managing resistance; however, DMI fungicides are the only other class registered for PM in the U.S. and, while effective, PM strains with reduced DMI sensitivity are common. Another strategy is to mix systemics with protectant fungicides. Improving spray coverage on lower leaf surfaces would reduce dependence on systemics. Neither an air assist boom nor novel nozzles improved control achieved with conventional nozzles. Many organic and biocompatible protectant fungicides are available now. They vary in PM efficacy, price, and other labeled diseases. Only sulfur and oil were as effective as chlorothalonil. Host resistance has become more important. PM resistant (PMR) winter squash and pumpkin varieties are now marketed. PM was less severe when PMR was homozygous than heterozygous. A reduced-sprays IPM program (14-day interval started after threshold) and a program with biocompatible protectants improved PM control for some PMR varieties. Applying fungicides would reduce pressure to select new PM races. Merlin pumpkin was more susceptible to bacterial wilt than PM-susceptible pumpkins. PMR summer squash and melon varieties tested did not have this problem.

S5-P Site Specific Management of Seed Potato Virus Vectors

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Seed potatoes from the northern Midwest of the U.S. (Minnesota and North Dakota) have earned an international reputation for outstanding quality. Recently, aphid-transmitted viruses, potato virus Y (PVY) and potato leaf roll virus (PLRV) have unexpectedly devastated the seed potato industry in the northern Midwest. Both of these diseases are vectored by aphids. It has been noted that aphids first settle on field edges and then disperse into the field over time. This initial aggregation at may present an opportunity to control these insect vectors with site specific techniques.

The geographic information system (GIS) ArcMap was used to digitally map and analyze the spatial and temporal dynamics of green peach aphid, *Myzus persicae*, the most important vector of PLRV. Data was collected from three field seasons and indicates that *M. persicae* populations remain aggregated at field edges long enough to present a window of opportunity for targeted treatment. However, to be useful as a management tool, site specific management must be linked to a program monitoring the first arrival of aphids at field borders.

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