Western Integrated Pest Management Center

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The Western IPM Center promotes the development, adoption and evaluation of integrated pest management to benefit the people, environment and economy of the West.

IPM is a science-based approach to pest management using pest biology, environmental information and all available technology to reduce pest damage to acceptable levels by the most economical means.

We serve 13 Western states and the Pacific Island Territories and are supported by a grant from USDA's National Institute of Food and Agriculture.

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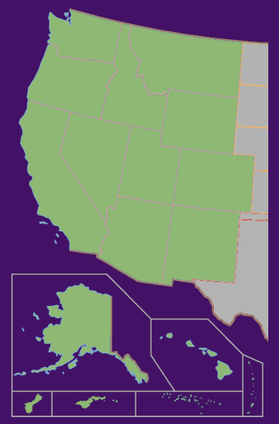

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Western IPM Center

USDA United States Department of Agriculture National Institute of Food and Agriculture

2014–15 CENTER REPORT

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Director's Message

The Western IPM Center made significant progress on documenting the benefits of IPM and improving collaborations in the last 18 months. In March 2015, we published a report documenting the adoption of IPM in agriculture in the Western United States and the impacts of that adoption in terms of human health and the environment. The report is a synthesis of all peer-reviewed publications, extension documents and reports from commodity groups and government agencies. IPM adoption is widespread throughout agriculture in the West, resulting in significant benefits to farmers, consumers and the environment. The report came to the attention of Sonny Ramaswamy, director of the National Institute of Food and Agriculture at USDA, who contacted me with questions. The end result is Director Ramaswamy now uses data from our report about Dr. Peter Ellsworth's cotton IPM program at the University of Arizona in his presentations around the country.

In July 2015, we published a report detailing the benefits of the Western Regional IPM grants program. The program was discontinued in 2014 and we wanted to look back at 10 years of regional IPM research and extension grants to see what was gained. The report documents benefits from new scientific knowledge, knowledge transfer to growers and industry, adoption of new IPM practices and the creation of new IPM tools and products. The program will continue to benefit the West as research and IPM tools are translated into practices.

On the collaborations front, the Western IPM Center made progress in two areas. The Western IPM Center and Western Region IR-4 published a set of criteria for describing the potential of a new pesticide to fit into an IPM program. The genesis of the project came from a document developed by EPA, then we expanded the criteria, developed a worksheet for use with any crop/pest/active ingredient and provided simple and complex examples of how to use the criteria. The ultimate goal is for IPM to play a more prominent role in the priority-setting process for IR-4 projects. Our second collaboration area was related to our signature programs. For the first time, Center-funded grant projects will be collaborating with our signature programs. The projects on soil solarization for disinfesting nursery soils and ergot in cool-season grass seed crops are collaborating with the Climate and Weather-Based Decision-Support Tools Signature Program, and projects on brown stink bugs in cotton and aphids in low desert alfalfa are collaborating with the Crop Pest-Loss and Impact Assessment Signature Program.

Now a personal note: I am leaving the Western IPM Center to become the Director of the Statewide IPM Program at University of California. I thoroughly enjoyed my time at the Center, traveling across the beautiful West and meeting many dedicated people implementing IPM in agriculture, communities and natural areas. Based on my experiences, I am convinced that adoption of IPM is benefiting the people, economy and environment across all 13 Western states and four Pacific Island Territories. I will continue to support the Western IPM Center however I can.

Introduction

Integrated pest management, or IPM, is an approach to controlling pests that is designed to be safer for people and the environment and economically beneficial for those who adopt IPM practices.

The Western Integrated Pest Management Center is one of four regional centers funded by the USDA's National Institute of Food and Agriculture to promote IPM practices.

To achieve those goals, the Western IPM Center offers grants to IPM researchers and extension specialists, sponsors signature programs and work groups to tackle region-wide issues, and serves as the hub of a multi-state partnership and communication network linking researchers, growers, extension educators, commodity organizations, environmental groups, pest control professionals, government agencies and others.

But in broad terms, what the Western IPM Center does is promote the development, adoption and evaluation of integrated pest management, and that's how this report is organized. In addition, it highlights the work our comment coordinators do to provide federal regulators valuable real-world information, lists the recipients of our 2015 grants and details the initial reported results and impacts of our 2013 and 2014 funded grant projects. To better align with our project periods, which begin in March and end with final reports due the following April, this report covers a year-and-a-half period from 2014 to mid-2015. Future reports will cover a one-year period and be published in the fall.

Advice and Input

The Western IPM Center actively seeks stakeholder input and feedback, and is advised by three project co-directors, a steering committee and a broad-based advisory committee. We meet with the committee members annually, and appreciate their energy and effort on behalf of the Western Region.

Co-Directors: **Dr. Kassim Al-Khatib**, University of California, Davis; **Dr. Peter Ellsworth**, University of Arizona; **Dr. Paul Jepson**, Oregon State University

Steering Committee: **Dr. Andy Jensen**, Manager, Northwest Potato Research Commission; **Dr. H. Michael Harrington**, Executive Director, Western Association of Agricultural Experiment Station Directors, Colorado State University; **Scott Ockey**, Field Development Manager, Western U.S., Certis USA; **Dr. Teryl R. Roper**, Professor and Regional Coordinator of the Western Sustainable Agriculture Research and Education Program, Utah State University; **Rebecca (Becky) Sisco**, Regional Field Coordinator, Western Region IR-4; **Dr. Daniel Sonke**, Manager, Agriculture Sustainability Programs, Campbell Soup Company

Advisory Committee: **Dr. Richard Bostock**, Director, Western Plant Diagnostic Network; **Ben Bowell**, Organic Education Specialist, Oregon Tilth; **Steve Ela**, Partner and Operations Manager, Ela Family Farms; **Ken Kamiya**, Owner, Kamiya Papaya, Hawaii; **Peg Perrault**, Environmental Specialist, EPA Region 8; **Dr. Anil Shrestha**, Professor of Weed Science, California State University, Fresno; **Greg Sprawls**, Branch Manager, Wilbur-Ellis, Ehrenberg Arizona; **Dr. Doug Walsh**, Professor and Entomologist, Washington State University; **Dr. Deborah Young**, Professor and Extension Specialist, Colorado State University; **Dr. Herb Bolton**, National Program Leader, USDA National Institute of Food and Agriculture (ex-officio); **Dr. David Epstein**, Entomologist, USDA Office of Pest Management Policy (ex-officio)

IPM Development

Developing an effective integrated pest management approach isn't a one-and-done proposition. IPM programs can be disrupted by an invasive species moving into an area or a native species reemerging. Add in changing regulations, weather patterns and crops, and the need for ongoing IPM development research is clear.

The Western IPM Center supports on-going IPM development. Through our grant and signature programs, work groups and pest management strategic plans, we help researchers continue to develop and adapt IPM techniques for our ever-changing world.

PROJECT INITIATION GRANTS

Since its founding, the Western IPM Center has supported research to develop new IPM tools and tactics. In 2014, we focused that part of our mission into project initiation grants – funding to help researchers launch new IPM ideas. These include proof-of-concept and preliminary experiments, needs assessments and priority-setting activities. These grants can help researchers develop the preliminary data needed to successfully compete for large research-specific grants, or show that what looked like a promising research avenue is in fact a blind alley.

The topics of the 2015 project initiation grants show the diversity of the West and creativity of its researchers, focusing on topics including brown stink bugs in cotton, aphids and biological insect control in alfalfa, soil solarization for disinfesting nurseries, molecular detection of ergot spores in cool-season grasses and wildland fruit as winter refugia for spotted wing drosophila.

INVASIVE SPECIES SIGNATURE PROGRAM

The Western IPM Center's Invasive Species Signature Program doesn't focus on sexy pests, the high-profile insects, weeds and diseases already getting a lot of attention and funding. Instead, through evolving subgroups focused on different insects, weeds and diseases, the Invasive Species Signature Program builds the capacity of researchers studying lesser-known pests to make large-scale impacts.

In 2014, the weeds group focused on Flowering Rush, an aquatic weed choking lakes in northern states across the West and Midwest, and the 2015 insects group organized around protecting Hawaii from the Coconut Rhinoceros Beetle, a threat to palm trees across the Pacific.

PEST MANAGEMENT STRATEGIC PLANS

Pest management strategic plans bring together growers, commodity groups, researchers, regulators and pest managers to document the pests and pest-management options for a particular crop or region. The plans that emerge don't necessarily make for scintillating reading, but they serve a powerful purpose: they identify and document priority research needs for those crops. And that helps attract research focus and funding – an average of $22 in new leveraged funding for every dollar the Center invests.

In 2014 and 2015 to date, Western researchers used Center funding to publish new or updated pest management strategic plans for hops, pears in Oregon and Washington, Washington wine grapes, High Plains wheat, and turfgrass and potted orchids in Hawaii.

WORK GROUPS

Most of the Western IPM Center's grants are very specific – a researcher wants to develop and evaluate a bio-economic model of IPM for weed control in chile pepper, for example.

Work groups are the opposite. Work groups take a big-picture approach, looking at information, resource and research needs on a region-wide or broad-category basis. A good example is the Western Weather Work Group, which set out to create decision-support tools for growers that combined weather data with degree-day or hourly pest-development models. That work group developed **www.uspest.org**, became a Center signature program, and in 2015 joined forces with a North Central Region weather work group to combine efforts and expand the available online resources. Two new work groups focus on gathering bed bug data across the region, and on soilborne diseases in potato.

IPM Adoption

Developing new integrated pest management tools and techniques is only the first step. To achieve the health, environmental and economic benefits IPM promises, it's vital that growers, pest managers and homeowners adopt the practices.

There are two ways to promote IPM adoption: shout it from the rooftops, and build tools that make it easy for people to become IPM practitioners. The Western IPM Center does both.

OUTREACH AND IMPLEMENTATION GRANTS

To promote adoption, in 2014 we created a new category in our annual grants program for projects focused on IPM outreach and implementation. Built around workshops, demonstrations, printed documents and online resources, these projects preach the gospel of IPM and show people how to practice it.

The projects funded in the first year of these grants are all outstanding examples of the concept. California's Vineyard Team used the funding to hold a series of hands-on demonstrations in several grape-growing regions, showing growers how to reduce off-target spray drift and reduce pesticide use. (Then they turned the workshops into an online curriculum.) At the University of Arizona, Shakunthala Nair used an outreach and implementation grant to create a nearly 300-page **Handbook on Pests in Community Environments in the Desert Southwest United States** which includes insect, vertebrate and weed pests, and provides IPM information for managing them. Also at the University of Arizona, Tim Vandervoet worked with pest managers in Arizona, California and Mexico to manage whiteflies in cotton using natural enemies. At workshops and extension meetings throughout the region, and through short extension publications, Vandervoet encouraged pest managers to sample natural enemies in their fields and begin using predator-prey ratios in their whitefly-control programs.

RAISING THE VISIBILITY OF IPM IN THE IR-4 PROCESS

The unfortunately named IR-4 program helps specialty crop growers get access to pesticides that otherwise wouldn't be available for their crops. IR-4 establishes pest-management priorities for specialty crops through an annual workshop, then helps get the top needs addressed and those products labeled and available.

Working with the Western Region IR-4 Program, the Western IPM Center helped raise the visibility of integrated pest management in that decision-making process. Together, the Western IPM Center and Western Region IR-4 Program created and published IPM Compatibility Guidance and "IPM-fit" criteria for use in the priority-setting process. Both documents are designed to help IPM-friendly products reach market and help growers successfully practice integrated pest management.

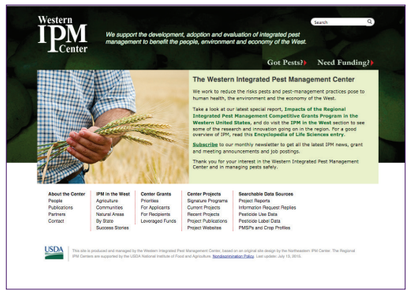
WEATHER-BASED DECISION-SUPPORT TOOLS

Another way the Western IPM Center promotes IPM adoption is through support of the Climate and Weather-Based Decision-Support Tools Signature Program, led by Paul Jepson at Oregon State University.

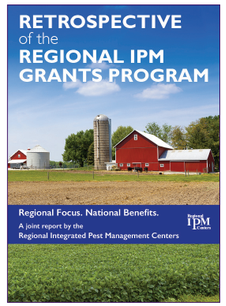
This project helped create and continues to improve and expand the **www.uspest.org** website, which provides growers across the country up-to-date weather and pest-development information. With more than 24,000 weather stations in the network, the ability to create virtual weather stations in other locations and more than 100 degree-day or hourly weather-driven pest-development models, growers can time their pest-management activities accurately and efficiently. Used thousands of times a day, **www.uspest.org** gives growers the data they need to practice integrated pest management.

CENTER COMMUNICATIONS

The Western IPM Center also directly encourages IPM awareness and adoption through our own communication efforts.



Beginning in January 2014, we began publishing The Western Front, the Center's newsletter, as a monthly electronic publication emailed to subscribers. The electronic newsletter replaced a three-times-a-year printed version, and improved the frequency of our communication, timeliness of the content and engagement with the IPM community in the West. Visit **www.westernipm.org** to subscribe.



Also in 2014, the Western IPM Center launched a completely new website at a new web address: **www.westernipm.org**. The site has all new content, and is much nicer to look at and easier to navigate.

In 2015, the Center spread the word about IPM through three special reports. The first, detailed on the next page, looked at **Adoption and Impacts of Integrated Pest Management in Agriculture in the Western United States**. Then came a look back at the **Impacts of the Regional Integrated Pest Management Competitive Grants Program in the Western United States**, followed by a nationally focused **Retrospective of the Regional IPM Grants Program**. A joint publication of all the Regional IPM Centers, the national retrospective was coordinated by the West. All are available on our website.

IPM Evaluation

Integrated pest management isn't a philosophy or a belief; it's a science. And because it's science, the IPM community can't just say IPM is superior or cheaper or safer than conventional pest management. We have to show it.

To document how IPM measures up, the Western IPM Center supports IPM evaluation efforts nationally and has been working to increase the ability of IPM researchers to measure and document the impacts of their work.

DOCUMENTING IPM ADOPTION AND IMPACTS

Farmers are some of the most practical, results-oriented humans on the planet, so if they're using IPM it's because they see a benefit. And a Western IPM Center special report published in March 2015 shows Western growers have adopted IPM in large numbers.

In fact, the report found that many IPM practices have become so widespread in the West they are now the conventional way to manage pests. To prepare **Adoption and Impacts of Integrated Pest Management in Agriculture in the Western United States**, Center staff reviewed all the available peer-reviewed studies and studies conducted by commodity groups or other agricultural interests about the use and impact of IPM in Western agriculture.

In addition to impressive levels of IPM adoption, the data in the report also document important impacts of expanded integrated pest management practices including reductions in pesticide use, especially among many of the most-toxic types.

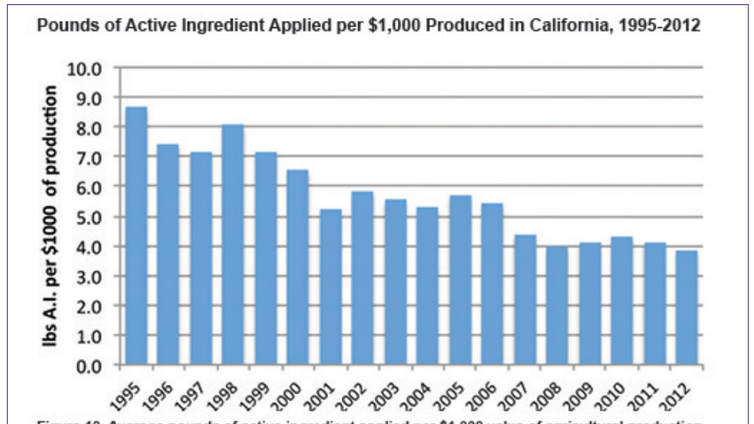


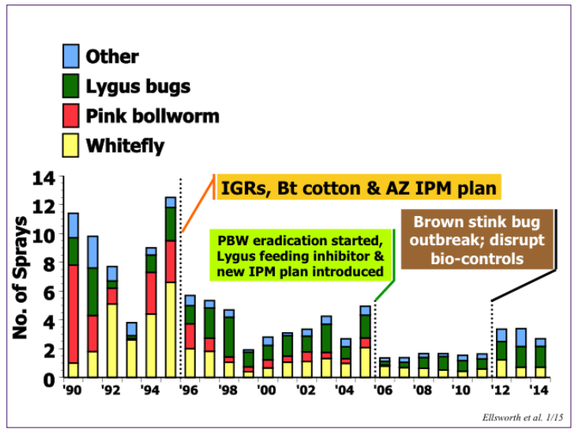
Figure 13. Average pounds of active ingredient applied per $1,000 value of agricultural production from 1995 to 2012. Data obtained from Pesticide Use Annual Summaries (California Department of Pesticide Regulation) and California Agricultural Statistics Review (California Department of Food and Agriculture).

One of the most interesting findings was data that show that the amount of pesticide used to produce $1,000 worth of food in California fell by more than half from 1995 to 2012, from over eight pounds of pesticide to under four pounds.

Download the report at **www.westernipm.org** under Publications.

CROP-PEST LOSSES AND IMPACT ASSESSMENTS

For showing IPM works, the Western IPM Center Crop-Pest Loss and Impact Assessment Signature Program is one of the strongest arguments out there. Led by Peter Ellsworth at the University of Arizona, the project has used a detailed annual survey of cotton pest managers to document significant reductions in pesticide use and growers' pest-management costs since the mid-1990s. Examples: the number of sprays growers made dropped from around 12 per year to about two; the amount of pesticide active ingredient used dropped from four pounds per acre to one. Today, an average of 20 percent of the cotton acreage in Arizona is never sprayed for insect pests because growers successfully manage pests through other means.



Through IPM adoption, from 1996 to 2014 Arizona cotton growers cumulatively saved $451 million and prevented more than 21 million pounds of insecticide active ingredient from reaching the environment. ***IPM works.***

EVALUATION WORK GROUP

Another way the Western IPM Center supports evaluation efforts in the region and nationally is by funding an IPM Adoption and Impacts Assessment Work Group that developed an online evaluation toolkit for researchers and extension specialists.

Available through both the Western IPM Center and the National IPM Centers' websites, the toolkit has eight modules covering different aspects of IPM evaluation and impact assessment, including surveys, economic analysis and case studies. The group also conducted an evaluation workshop at the International IPM Symposium in Salt Lake City in March 2015. Access the toolkit at **ipmimpact.ucanr.edu**

Comment Coordination

By gathering expert comments, the Western IPM Center speaks for growers and pest managers during the regulation and review of pesticides.

When the Environmental Protection Agency considers changes to pesticide registration or use requirements, having accurate information on how that pesticide is actually used in different crops can be critical to keeping a product in a pest manager's toolbox.

Gathering that information for the EPA, or other federal and state agencies, is exactly what the three Western IPM Center comment coordinators do. Our Center is the only of the Regional IPM Centers that devotes staff positions to comment coordination.

Our comment coordinators are:

- **Al Fournier,** University of Arizona, who covers the arid Southwest, including Arizona, Nevada, New Mexico and the desert regions of California.
- **Cathy Tarutani**, University of Hawaii, who covers Hawaii and the Pacific Island Territories.
- **Katie Murray**, Oregon State University, who covers Oregon, Washington, Idaho, Montana, Utah and Alaska.

California is covered by Center Director Jim Farrar.

Here's what they do: When a request for comments is received, the comment coordinators determine which crops or stakeholders may be affected. In Arizona and California, where there are pesticide-use records kept, they'll run a database query to determine the extent of use in those states and the crops affected. They then reach out to a network of contacts, including extension agents and specialists, to learn more about the importance of the request in their territories, then follow up as needed with growers or other appropriate stakeholders. They compile that information into a final report, and submit it to the agency that originated the request. Comments are also posted on the Western IPM Center website.

In 2014 and 2015, they provided information on a number of high-interest issues, including newly proposed Worker Protection Standards, and on a proposal to protect honeybees by restricting a number of pesticides toxic to bees when bees are present under managed pollinator contracts. Comment coordinators also submitted reports on quinoxyfen, acibenzolar, imazalil, fenamidone, thiophanate methyl, malathion, pyraclostrobin, etridiazole, dicrotophos and *Coniothyrium minitans*.

2015 Grants

The 2016 grant request for proposals will be released in early October, with about $270,000 available.

Project Initiation

Brown Stink Bug Management in an Established Cotton IPM Program: A Benefit-Cost Analysis
Project Director: Lydia Brown, University of Arizona
Objective: Evaluate whether brown stink bug treatments in desert cotton, which disrupt established IPM controls for whitefly and lygus bug, improve growers' economic outcomes.

Re-establishing IPM Recommendations for Aphids in Alfalfa Hay in the Low Desert
Project Director: Ayman Mostafa, University of Arizona
Objective: Re-establish an economic threshold and investigate the efficacy of selective insecticides for the management of the blue alfalpha aphid in the Desert Southwest, following a re-emergence of the pest as an economic problem in 2013.

A Model to Predict Duration of Soil Solarization for Disinfesting Nursery Soils Contaminated by Phytophthora Species
Project Director: Jennifer Parke, Oregon State University
Objective: Develop, implement and verify a web-based version of the model for predicting the duration of soil solarization required to kill soilborne Phytophthora species in container nurseries in California, Oregon and Washington.

Development of a Molecular Detection Protocol for Ergot Spores in Cool-Season Grasses Grown for Seed
Project Director: Jeremiah Dung, Oregon State University
Objective: Validate a newly developed detection procedure using samples collected from spore traps; provide an electronic Ergot Alert newsletter to inform growers and field personnel when primary inoculum of ergot is present; and assess the impact and value of the newsletter to growers.

Wildland Fruit as Winter Refugia for Spotted Wing Drosophila in the Intermountain West
Project Director: Lori Spears, Utah State University
Objective: Identify potentially important wild and feral fruit hosts of spotted wing drosophila in Idaho and Utah and validate and adapt current degree-day models to assist in the prediction of spotted wing drosophila activity in the Intermountain West.

Predicting Variation of Biological Insect Control in Alfalfa Hay and Seed Crops
Project Director: Randa Jabbour, University of Wyoming
Objective: Identify the key natural enemy groups in alfalfa hay and seed cropping fields; evaluate factors that effect pest abundance, natural-enemy abundance and parasitism rates; and quantify ambient floral resources within and adjacent to alfalfa production fields throughout the season.

Work Groups

Joining Forces: Midwest and Western Weather Work Groups for National Harmonization of Weather-Based Decision Tools
Project Director: Walter Mahaffee, USDA-ARS
Objective: Share and compare current online platforms for weather-based decision support; assess gaps and potential for harmonizing these systems to make them more interactive with each other and more widely available; collaboratively write a proposal to the SCRI program in 2016 to improve the systems.

Developing a Roadmap toward Sustainable Management of Potato Soilborne Diseases
Project Director: Brenda Schroeder, University of Idaho
Objective: Investigate how the replacements for methyl bromide in strawberry production could be applied to potato production, and identify new lines of research to control soilborne diseases of potatoes in order to reduce fumigant use.

Outreach and Implementation

Sharpening Tribal Skills in Forest Pest Detection and Response
Project Director: Nina Hapner, Kashia Bank of Pomo Indians of the Stewarts Point Rancheria
Objective: Increase knowledge of high-priority wildland pests and relevant IPM management practices through training programs; increase knowledge of the distribution of *Phytophthora ramorum* on tribal lands; and produce a field guide of pests.

Boulder County Emerald Ash Borer Outreach and Implementation Project
Project Director: Carrie Haverfield, Boulder County Commissioners Office
Objective: Increase awareness of emerald ash borer and motivate people to initiate proactive actions to detect, control and prevent the human-assisted spread of the pest.

Field Guide for Integrated Pest Management in Hops
Project Director: Ann George, Washington Hop Commission
Objective: Revise and update the **Field Guide for Integrated Pest Management in Hops**, originally published in 2009.

Special Issues Projects

Emerald Ash Borer Survey and Detection in Colorado
Project Director: Dan R. West, Colorado State University
Objective: Evaluate the extent of the emerald ash borer infestation in communities adjacent to the currently infested/presumed infested City of Boulder.

Below are summaries of 2014 grants and some of the impacts and potential impacts reported by the project directors. Complete reports can be found on our website on the Project Reports page under Searchable Data Sources.

IPM PLANNING DOCUMENTS

Revision and Updating of the Pacific Northwest Hop Pest Management Strategic Plan

Project Director: Ann George, U.S. Hop Industry Plant Protection Committee

This project developed a new pest management strategic plan for hops, taking into account the progress made on critical needs identified in the original 2008 PMSP, new pest management issues that have arisen since the publication of that document, and the increase in hop production in areas other than Pacific Northwest.

Impacts Reported:

The process of conducting the PMSP workshop provided immediate increases in knowledge on the part of the hop growers, researchers, and industry professionals in attendance via pooled knowledge and discussion. Subsequent publication of the document increased short- and medium-term knowledge of pest-management options among growers nationwide. Planning and completion of the PMSP provided up-to-date evidence of grower needs, helping hop researchers secure funds from the USDA Specialty Crops Research Initiative for further IPM research. One of the key needs elucidated in the PMSP process was a revision, update and reprinting of the 2009 **Field Guide for Integrated Pest Management in Hops**, which is already under way.

Potential Impacts:

Potential impacts of the PMSP include further adoption of integrated and sustainable pest management techniques in hops.

Revision and Updating of the Pest Management Strategic Plan for Washington State Wine Grape Production

Project Director: Vicky L. Scharlau, Washington Wine Industry Foundation

It had been 10 years since a pest management strategic plan was developed for Washington wine grapes. During this time, wine production increased more than 60% and new threats developed, including new viruses, diseases and increased insect activity that need to be documented in terms of prevention and reaction. Risk-management strategies and a viable method of assessing the economic turning point between managing and replacing virus-infected vineyards also need to be developed. As the pest complex changed and the American Viticultural Areas within Washington increased from five to 13, a new PMSP was needed.

Impacts Reported:

The new PMSP documents progress made on critical research, regulatory and education needs in the following areas:

- Virus management, including both prevention and reaction
- Monitoring and management of new and emerging arthropod pests
- Improved understanding and management of mealybugs and scale insects
- Improved understanding the direct impact of nematodes in Washington vineyards
- Refinement of powdery mildew management
- Monitoring and managing emerging trunk diseases
- Resistance management with respect to fungicides, herbicides and acaricides

Potential Impacts:

The **Pest Management Strategic Plan for Washington State Wine Grape Production** will aid in reducing environmental impacts, create greater knowledge of IPM practices, promote further increase in the wine grape industry and promote job growth.

PROJECT INITIATION

Disruption of Pear Psylla with a Sprayable Sex Attractant: New Technology for Pear IPM

Project Director: David Horton, USDA-ARS

Management of pear psylla, a key pest of pears in North America, requires control of the overwintered adult in late winter preceding bloom. The standard approach for controlling this generation has changed little since the mid-1900s: an oil-plus-insecticide mixture applied before bloom. This study examined whether saturation of orchards with the sex pheromone of pear psylla can be used to slow male success at locating females for mating.

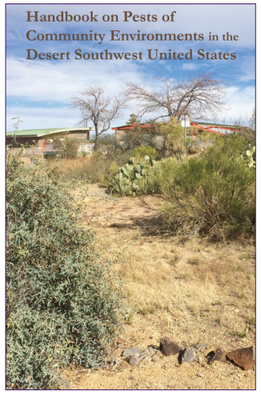
The results indicate the opposite is true: the pheromone in oil led to statistically higher mating rates for female psylla. One possibility is that presence of pheromone stimulated males to increase their search efforts on treated trees, leading to increased rates of contact with females. However, controlled behavioral trials will be needed to examine this hypothesis.

Impacts Reported:

Because the pheromone actually seems to stimulate mating, no immediate practical impacts for managing pear psylla are apparent. The results have been presented to the industry, so one short-term impact is an increase in grower understanding of psyllid biology.

OUTREACH & IMPLEMENTATION

Handbook on Pests in Community Environments in the Desert Southwest United States



Project Director: Shakunthala Nair, University of Arizona

The goal of this project was to develop a publication to help readers decide whether animals and plants they come across in communities in the desert Southwest are pests or not. Determining whether an organism is a pest or not is often the basis for pest-management efforts. The **Handbook on Pests of Community Environments in the Desert Southwest United States** covers all major arthropod, vertebrate and weed pests encountered in community environments in the desert Southwest, and will serve as a handy reference to support community IPM efforts in this region.

Impacts reported:

- Baseline data on stakeholder needs for pest-management-identification information. Before beginning the handbook, we assessed stakeholder needs in this area
- Up-to-date information with good quality photographs, available long after the end of the grant period
- An online version always available free of charge
- Improved stakeholder awareness regarding organisms in their environments
- Other organizations' use of the handbook. For example, the Arizona Department of Agriculture requested it as reference material for pesticide applicator licensing exams

Potential Impacts:

Potential impacts include new collaborative projects; people using the handbook may change pest management practices and potentially reduce unneeded sprays, reducing potential environmental impacts; and organizations using the handbook may lead to better-educated community IPM professionals and applicators.

Reducing Off-Target Spray Drift and Pesticide Use through Direct Education and Demonstration to Pesticide Applicators in California Vineyards

Project Director: Fritz Westover, Vineyard Team

The drift of spray from pesticide applications can expose people, wildlife and the environment to pesticide residues, but proper calibration of spray equipment can markedly reduce off-target spray drift. Multiple workshops in wine-growing regions were held to demonstrate practical calibration techniques and newer spray application technologies to improve spray practices by growers.

Impacts reported:

A total of 118 attendees completed the post-workshop survey and 99% of attendees rated the indoor portion of the workshop as good or excellent. Attendees were educated on eight specific practices to reduce spray drift and pesticide use, and improve coverage. On average, 74% of attendees plan to adopt new practices based on information in the workshop and 67% improved their understanding of practices that improve spray coverage and reduce drift.

Potential Impacts:

Potential impacts are that the adoption of the eight practices presented in these workshops will reduce pesticide use and drift in up to 131,582 acres of vineyard and orchard crops in California.

Improved Cotton Whitefly Management Using Biological Control-Based Thresholds

Project Director: Tim Vandervoet, University of Arizona

This project focused on the adoption and implementation of natural-enemy-based thresholds for the management of whiteflies in Arizona cotton. We worked with Arizona and California pest control advisors and pest managers in Mexico with the goal of encouraging them to incorporate natural enemies into whitefly management using predator-prey ratios.

Impacts reported:

Measured outcomes include improved awareness, knowledge and understanding of the role of natural enemies in cotton systems by pest managers and growers. Anecdotally, PCAs are reporting more attention to natural-enemy levels and consideration of these levels in cotton whitefly management. In other systems, PCAs are reporting more interest in selective approaches to control aphids in alfalfa and more attention to natural-enemy levels in citrus.

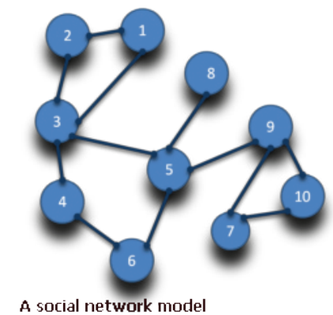
Potential Impacts:

The knowledge gains may to lead to an increased ability of growers and pest control advisors to use predator-prey ratios in conjunction with pre-existing whitefly thresholds. Other potential impacts may be a reduction in the use of broad-spectrum pesticides and optimized applications of selective insecticides based on incorporating natural enemy populations and their biocontrol potential.

WORK GROUPS

IPM Adoption and Impacts Assessment Work Group

Project Director: Neil McRoberts, University of California Davis



A social network model

The IPM Adoption and Impacts Assessment Work Group, a collection of natural and social scientists from across the country, created online resources showing IPM researchers how to conduct basic impact assessments. The online resources include an introduction to impact assessment, and modules on surveys, economic analysis, focus groups, secondary data, case studies, interviews and social network analysis. Chapters within each module include when a measurement or method is appropriate, what to collect, how to collect it, how to analyze it and how to report it.

Impacts reported:

There are eight assessment modules, and in addition to the content specifically written for the toolkit, a wide variety of other material is indexed and can be accessed through the toolkit pages.

Members of the work group held introductory webinars after the toolkit was launched in 2013 and more than 100 people registered to participate live. The toolkit was cited as a useful resource in RFAs released by the Northeastern IPM Center and the North Central IPM Center, and was specifically cited as an evaluation guide in the RFA released by the Western IPM Center.

At the International IPM Symposium in March 2015, members of the work group conducted a professional development workshop, and resources from that event are archived on the Western IPM Center website.

In its first two months, the toolkit had 580 visits (of which 339 were made by unique visitors) and a total of 3,097 page views. An important set of users (67 total) visited the toolkit between 10 and 50 times, and accounted for 344 page views (21% of the total). Visits to the toolkit were made predominantly from the United States, but visits were made from 26 different countries.

Western Region Tribal Work Group

Project Director: Nina Hapner, Kashia Band of Pomo Indians of the Stewarts Point Rancheria

The Western Region Tribal IPM Work Group mission was to protect tribal natural and cultural resources through mutual understanding, and expand the use of IPM to protect those resources.

Impacts Reported:

Group activities and publications enhanced communication on invasive pests between tribes, researchers, government entities and others and helped improve tribal forest-health management practices. Specific impacts include:

- A Tribal IPM Work Group electronic mailing list was created
- A Tribal Forest Health/Invasive Species Management Needs Assessment was conducted to guide future IPM priorities
- Several meetings brought together representatives from more than a dozen tribes, the California Department of Food and Agriculture, U.S. Forest Service, National Resources Conservation Service, USDA Animal & Plant Health Inspection Service and others. These connections created greater understanding of pest and forest-health issues
- Funds were leveraged from several sources to continue and expand the group's work

Potential Impacts:

The information from the needs assessment and work group meetings is informing our current work. We will publish the invasive species tribal IPM needs assessment and conduct "tribal citizen monitoring" and other workshops to train tribes to recognize and monitor forest insects and pathogens on their lands. We will expand our tribal IPM website, work to build the network for tribal forest health and IPM management of invasive species and look for opportunities to problem-solve and garner additional resources to assist tribes.

SPECIAL PROJECTS

Development of a Publicly Accessible, Query-Driven Database of Registered Products for Management of Ectoparasites of Animals

Project Director: Alec Gerry, University of California Riverside

This project developed a public database, **VetPestX**, of registered pesticides that can be accessed through the "Insect Pests of Animals" website at **www.veterinaryentomology.ucr.edu**.

Impacts Reported:

The database has generated interest by other veterinary entomologists and we have already expanded it to include Oklahoma and New Mexico. A main purpose of this database was to get users to the "Insect Pests of Animals" website where they can also find information on IPM strategies for management of these pests.

Potential Impacts:

One benefit of having this database maintained by professional entomologists is that we can remove products to which insects have become resistant, so the public is not using pesticides that contaminate the environment while having little effect on the target pests. Future additions to the database will include links to product labels so users can directly view labels without an additional Internet search.

Prevention Training and Emergency Response Planning for Coconut Rhinoceros Beetle in Pohnpei, Micronesia

Project Director: Eugene Joseph, Conservation Society of Pohnpei

The Coconut Rhinoceros Beetle is a serious threat to coconut and other palms throughout the Pacific Islands. The beetle is not yet present in the Federated States of Micronesia, but since its discovery in Guam in 2007 and Hawaii in 2013, it is now present in the region.

This project is focused on preventing the Coconut Rhinoceros Beetle from entering the island of Pohnpei by educating key players about the beetle, how it can be introduced and how they can prevent it from entering the island. About 35 participants attended a three-day workshop and developed an emergency response plan for Pohnpei.

Impacts reported:

The training reached all key players, including quarantine officers, Pohnpei Port Authority staff, United Airlines staff, agriculture, forestry, and others involved in invasive species. Later we conducted another invasive and Coconut Rhinoceros Beetle presentation for community conservation officers, forest rangers and state and municipal police that reached another 50 participants. All participants now better understand the impact the beetle would have on Pohnpei, and learned what they can do to prevent its arrival.

Potential Impacts:

The greatest potential impact of this project is that one of the participants at the trainings recognizes and prevents an introduction of the Coconut Rhinoceros Beetle onto the island of Pohnpei.

2013 GRANTS

Below are summaries of 2013 grants and some of the impacts and potential impacts reported by the project directors. Complete reports can be found on our website on the Project Reports page under Searchable Data Sources.

OUTREACH & PUBLICATION

Training Health Inspectors in School IPM

Project Directors: Josh Vincent and Tim Stock, Northwest Center for Alternatives to Pesticides

This project was designed to improve school compliance with the Oregon School IPM Law, which requires schools to adopt integrated pest management policies. The Northwest Center for Alternatives to Pesticides created an online training video titled **Integrated Pest Management and Health Inspections**. The video, targeting environmental health specialists, promotes sanitation and exclusion practices to reduce pests and therefore pesticides. The video showcases an on-site inspection to show how the principles of IPM overlap with key points of environmental health inspections. We also created a one-page summary, a database of regional environmental health specialist contacts and an online survey tool to provide feedback on content, tenets of IPM and training needs.

Impacts Reported:

The project equipped inspectors with adequate knowledge to enforce some sections of the Oregon School IPM Law. Additional and promising short- to medium-term impacts include reduced pesticide exposure for school children and school employees.

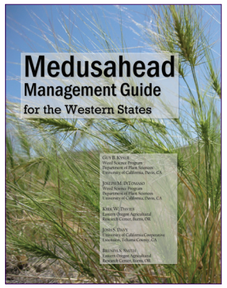
We surveyed 55 email contacts and 12 individuals responded for a 22% response rate. All found the video useful or very useful, and 50% indicated they had become more aware of local IPM laws and that they'd make control suggestions aimed at the root causes of pests. Of respondents who answered the question, 42 percent will confirm monitoring for early signs of pests, and 33 percent will recommend prevention prior to recommending pesticides.

Potential Impacts:

This project educated public health inspectors and enabled them to see schools through an IPM lens, and they are now more likely to recommend prevention and monitoring in place of a pesticide application. This creates the potential impact of decreasing pesticide use, increasing economic stability in school facilities management, improving indoor air quality and protecting students and school employees from harmful exposure to unnecessary pesticides.

Integrated Pest Management Guide for Medusahead in the Western United States

Project Director: Joe DiTomaso, University of California Davis



Medusahead is an annual grass weed that causes economic and environmental harm to rangeland and wildland throughout the West. Control strategies are very different in low-elevation grassland compared to high-elevation sagebrush rangeland. Although extensive research has been done on control of this weed, there was not a layman-oriented review of all control options. This project focused on creating that integrated guide.

Impacts Reported:

The **Medusahead Management Guide for the Western States** brings together all the known control strategies for medusahead in both grassland and sagebrush scrub environments and puts these strategies into an integrated management context. It serves as both a management guide for farm advisors, pest control advisors and growers, and as a review of the control literature to date.

Potential Impacts:

Because medusahead is found on more than 2.4 million acres in the West, increased control efforts should result in increased economic return from grazing lands and decreased habitat loss in sagebrush shrubland. Grower awareness of non-chemical control options and IPM strategies will help reduce reliance on herbicide applications.

Promoting IPM to Urban Audiences through YouTube

Project Director: Mary Louise Flint, University of California Statewide IPM Program

In this project, the UC IPM Program produced 12 short, educational YouTube videos for urban audiences to demonstrate various IPM practices. The videos cover topics such as how to inspect for bed bugs, protect yourself from mosquito bites, use nonchemical aphid management, understand pesticide labels and active ingredients, trap earwigs, and distinguish between yellowjackets and other wasps. The videos have been shared and promoted to a range of community audiences through newsletters, educational materials, outreach and extension programs and social media.

Impacts Reported:

We have incorporated the videos into our UC IPM web-based materials and in turn have made these resources more interactive and engaging. A growing number of people prefer to receive information through video rather than text, so delivering messages through videos will reach new audience who previously might not go to the UC IPM website for information. The videos are being translated into Spanish.

We can track the number of people who have viewed our videos, but don't have a way of finding out whether or not they changed their behaviors. We do have anecdotal reports from UC Master Gardeners telling us that they are using the videos in their trainings.

Potential Impacts:

Viewers will be more aware of less-toxic methods and UC IPM resources available to help them adopt environmentally friendly pest-control solutions. The methods suggested in the videos work, so viewers are more likely to have success with their pest-control efforts, potentially saving time and money.

IPM for Low-Income Residents: Stopping Harmful Self-Treatment for Bed Bugs

Project Director: Josh Vincent, Northwest Center for Alternatives to Pesticides

This project addressed the related problems of bed bug infestation and harmful pesticide exposure as a result of self-application among residents in public housing. Due to many factors, bed bugs are a common problem in this environment. When an infestation is discovered, the response of many residents is often to misapply or over-apply pesticides or other potentially harmful substances, endangering themselves, their families and their neighbors.

In this project, we developed resources to help educate low-literacy residents on bed bug prevention and control, while also training residents how to avoid risks associated with pesticide self-treatments. These included a handout for property managers, a low-literacy poster designed to encourage residents to avoid self-applying pesticides and a video that outlines prevention and control strategies for bed bugs in housing. The materials were distributed to a broad audience of more than 200 representatives from over 30 property-management and IPM providers serving low-income residents, as well as to our network of more than 14,000 individuals.

Impacts Reported:

The most visible direct impact of this project is the significant increase in awareness and dialogue on the topics of bed bugs, pesticides and pesticide risks among housing providers and their residents. Over 30 different property-management groups requested the handout, video and copies of the poster to display at various housing units throughout Oregon, Washington and California.

Based on the response and the positive feedback received, we believe that these materials are having their intended effect of

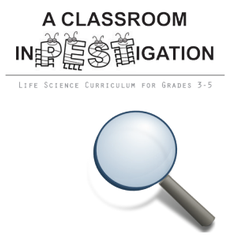
giving residents a better understanding on these topics. Through these materials, residents are better equipped to prevent bed bug problems and therefore less likely engage in potentially harmful self-application of pesticides. This impact represents success in reaching the fundamental goal of the project. Another direct impact is that property managers involved with this project are also now paying closer attention to bed bug prevention strategies as a part of their own efforts to minimize the use of pesticides.

Potential Impacts:

A large potential impact of this project is simply that fewer pesticides or other dangerous chemicals will be used in multifamily housing.

An IPM Curriculum for Elementary School Teachers in the West

Project Director: Deborah Young, Colorado State University



To get teachers interested in integrated pest management, this project turned IPM into a science curriculum they can use in their classrooms: **A Classroom InPESTigation: Life Science Curriculum for Grades 3 - 5**. The five one-hour lessons teach students what a pest is, what kind of pest it is, why it lives where it does, how pests can be managed, and how to conduct a classroom "inPESTigation" to see what pests might be in their classroom, and ways to prevent or control them. The curriculum was written to meet Colorado, Washington and the new federal Next Generation Science Standards.

Impacts Reported:

Because of this project, IPM curricula is available that meets state and national Next Generation Science Standards. Teachers, and the third- to fifth-grade students in their classes, have an increased awareness and understanding of place-based science curricula using IPM.

Potential Impacts:

Custodians and environmental risk managers have told us that the lack of acceptance by teachers hinders their effort to implement IPM. For full acceptance, facility managers and custodians need to work with teachers and administrators to implement the best methods to prevent and control pests with the least effect to people and the environment. We expect increased awareness of IPM by school staff, changes in behavior (such as storing food in classrooms in pest-proof containers), and the diffusion of IPM information to other teachers.

IPM ISSUES RESEARCH

Developing IPM Components to Address Emerging Virulent Strains of the Hop Powdery Mildew Fungus

Project Director: Ann George, Washington Hop Commission

Powdery mildew is the primary disease threat to hop production, with economic impacts estimated at 15% of total crop revenue. Cultivars of hop resistant to the disease have been developed and deployed to manage the disease, but recently a major source of resistance was overcome by the powdery mildew pathogen. This project sought to understand the distribution of virulent strains of the pathogen, the susceptibility of formerly resistant varieties, and develop basic information on disease management on previously resistant varieties to help develop effective management approaches.

We were able to identify differences in disease susceptibility among formerly resistant cultivars, which allowed growers to tailor disease-management efforts to be cultivar-specific. We also found that strains of the powdery mildew fungus able to infect formerly resistant cultivars became widespread in both Oregon and Washington, with the occurrence of these strains directly related to regional disease pressure.

In laboratory studies, we identified two resistance genes that appear to be effective against emerging strains of the pathogen. Seedlings from a public breeding program were selected in 2014 to combine two resistance genes to create a pyramided resistance that should be more durable than either gene individually. Beyond pyramided R genes, though, this project emphasized the need for breeding strategies to be evaluated critically since immunity to powdery mildew will be unstable in the long-term. Results have been widely communicated to translate research findings into practical management tools at the farm level.

Impacts Reported:

Differences in susceptibility to powdery mildew were found among cultivars that possess the resistance gene R6, leading to cultivar-specific disease management recommendations. For instance, the cultivar Nugget was found to possess useful levels of resistance in Washington State. Fungicide programs on this cultivar have been reduced considerably since 2012 in Washington, in some cases eliminating four applications per year.

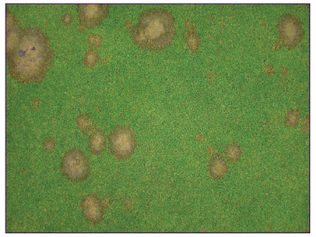
Outbreaks of powdery mildew on the cultivar Cascade were confirmed for the first time, and found to be associated with virulent strains of the fungus. This has increased knowledge and awareness of this threat and led to changes in management approaches that have undoubtedly reduced crop damage. Greater communication of disease outbreaks among growers, crop advisers and researchers developed because of this project.

Potential Impacts:

Knowledge generated in this project during 2014 led to selection of different parents in public and private breeding programs to develop disease-resistant cultivars. This may reduce future use of fungicides, worker exposure to pesticides and impacts on non-target organisms.

A spatially-explicit system was developed to map powdery mildew outbreaks on a regional level using Google Fusion Tables. Use of this system in the future to communicate disease risks can optimize disease-control inputs to reduce pesticide use when unnecessary and minimize crop damage when control measures are warranted.

Fungicide-Free Management Program for the Control of Microdochium Patch on Putting Greens



Project Director: Alexander Kowalewski, Oregon State University

Microdochium patch can be observed year-around in some cool, humid regions, and damages nearly all grass species in Western Canada and the Pacific Northwest. Historically, more money has been spent on fungicides to combat this disease in Western Canada and the Pacific Northwest than any other turfgrass disease. Currently, fungicides applied every three to four weeks to putting greens throughout the nine-month period of disease activity are the primary means for providing control of this pathogen, which equates to roughly $20,000 annually per golf course.

The goal of this research was to identify fungicide-alternative control measures, the practical application of these products and practices, and develop a fungicide-free, integrated pest management program for the control of Microdochium patch in the Pacific Northwest.

Field trials focusing on alternative products and biocontrol products took place in Corvallis, Oregon and Puyallup, Washington. Findings suggest that sulfur, iron sulfate and Civitas One, when applied with potassium phosphite, provide significant Microdochium patch control. However, continued application of these products at elevated rates will likely be detrimental to putting-green health and methods to alleviate problems associated with high sulfur rates and subsequent effects on the soil pH are needed.

Impacts Reported:

While adoption of these management techniques has not been documented, preliminary findings have generated substantial interest within the industry. A meeting to discuss fungicide-alternative methods for management of Microdochum patch was arranged by representatives from the Western Canada Turfgrass Association, and included board members from the Northwest Turf Association, Oregon Turf Association, Oregon Golf Course Superintendents Association and the United State Golf Association. With the help of these various associations and board members, findings from this research will be disseminated and promoted across North America.

Potential Impacts:

Initial calculations derived using promising preliminary findings translates to financial savings of $14,530 for the typical golf course, which spends an average $20,000 in fungicides to manage this pathogen. This translates to a savings of $4,520,955 in the Pacific Northwest. While these projected financial savings are significant, more important is that this control can be provided without the use of fungicidal pesticides, eliminating 11 to 18 applications per golf course annually – or as many as 14,877 fungicide applications across the Pacific Northwest each year.

Effect of Micronutrients On Iris Yellow Spot Virus of Onion

Project Director: Claudia Nischwitz, Utah State University

Iris yellow spot virus (IYSV) is the most important plant-disease problem for onions in the Western United States and is very difficult to control. IYSV is spread by onion thrips, tiny insects that feed on onions and in the process transmit the virus. Once an onion plant is infected, there is no cure. Current management practices are mainly focused on reducing onion thrips by applying insecticides. The control with insecticides alone is often insufficient and additional management options are needed.

This project explored mineral nutrients, such as potassium, magnesium, iron, copper, manganese or phosphorus, that have been reported to affect the amount of disease occurring in some plant species. Since every host-pathogen combination may be affected differently, general conclusion on the effect of specific nutrients cannot be drawn.

Soil samples from fields in Utah and Colorado were analyzed for their nutrient contents and plant leaves were tested for the presence of IYSV and visually rated for IYSV symptoms. Statistical analysis showed that the higher the level of potassium in the soil, the greater the possibility that onions became infected with IYSV. Increased magnesium and sodium levels also showed a relationship with increased IYSV. The ratio of soil potassium to phosphorus, and for Utah fields, the ratio of potassium and zinc, also seem to affect IYSV incidence. The mechanism behind these effects is currently unknown.

Potential Impacts:

If the results from our project are confirmed in follow-up studies this year, growers will be able to have the soil in their fields tested prior to planting and adjust the fertilizer levels to reduce IYSV incidence. This would be especially valuable in fields that have other risk factors that can affect IYSV incidence, such has dense weed populations along field edges that can serve as thrips and IYSV reservoirs.

IPM IMPLEMENTATION

Integrating Agricultural Conservation Practices into Idaho and Washington Farms

Project Director: Gwendolyn Ellen, Oregon State University

Teaching farmers functional agricultural biodiversity management can help restore important ecological services to farms. This can reduce production costs, raise or stabilize yields, improve quality, enable cost-effective compliance with environmental regulations and provide access to markets that require biodiversity-friendly production.

This project built upon five years of work of the Functional Agricultural Biodiversity Work Group to teach agricultural conservation practices and enhance their implementation in conventional and organic farms in Idaho and Washington. Our teachers were farmers and agricultural professionals who addressed beneficial organisms and native plants used in current farmer-adopted practices.

Four courses, a winter and a corresponding summer field course in both Washington and Idaho, were conducted. A total of 105 participants attended the courses, most farmers from rural farms and communities with a population less than 2,000. The participants represented a total of 34,678 acres of 25 diverse crops across 22 counties of Idaho, Washington and Oregon.

Impacts Reported:

There was increased awareness and broader knowledge of conservation practices that support agricultural biodiversity and how these fit within local farming systems. Agency conservation staff and agricultural consultants reported an intent to integrate this knowledge into their programs. This will increase implementation of these practices on farms and also within habitat-restoration projects undertaken by agencies, which can lead to increased technical aid to landowners and farmers from an array of regional conservation agencies. This addresses a major constraint to the adoption of conservation practices identified by participants.

Potential Impacts:

The increased understanding of the beneficial role of agricultural biodiversity should result in larger on-farm populations of beneficial organisms that can decrease crop-pest damage. This can result in a decreased use of pesticides and risks to human exposure and environmental degradations from agricultural pesticide use.

Western IPM Center

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Any opinions, findings, conclusions or recommendations expressed in this publication are those of the authors and do not necessarily reflect the view of the U.S. Department of Agriculture.