

First Biopesticide Workshop: A Successful New Approach

— by Krista Coleman, IR-4
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On September 10, 2014, IR-4 hosted its first Biopesticide & Organic Support Workshop to establish research priorities. The new approach proved successful and the Program will use this method (with some slight logistic adjustments) for setting future research priorities. The transition from a grant-based approach is based on the desire to be more informative, by allowing input from industry and international partners, and more effective in determining the needs of each region.

Over 180 people registered for the

workshop, confirming that the need for Biopesticide and Organic pest solutions is gaining momentum and interest.

Many attended to discuss problems and learn about solutions from members of the scientific and grower community. Bill Stoneman of the Biopesticide Industry Alliance (BPIA) provided a general overview of the association and noted that major crop protection companies are also investing in biopesticide companies or developing their own products.

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IR-4 Launches Digital Newsletter

For many people the end of summer marks the beginning of a new year, and this often brings with it changes in workplace technology. IR-4 is no different. The IR-4 Newsletter will be going electronic in 2014/2015. Beginning with this special Summer/Fall issue, we will give our readers the option to receive this in a hard copy or electronic format.

We will have a trial period where we will provide both options and will review the results in a year.

Please let us know how you feel about this and send an email to Sherri Novack at novack@aesop.rutgers.edu or call her at 732.932.9575 x 4632 with your preferred delivery option.

Executive Director Notes

Dear Friends,


With autumn approaching those of us living in the northern tier will see the glorious Fall colors. This seasonal change reminds us the only CONSISTENT thing within life is CHANGE. So what changes are brewing within IR-4?

IR-4 recently completed the latest version of the Project's Strategic Plan, appropriately titled "Vision 2020". Under this plan, IR-4 will continue to facilitate the regulatory approval of sustainable pest management technology for specialty crops and specialty uses to promote public well-being. On surface there is very little change in the new mission statement. However, when you peel back the layers, there are several aspects of the program that are being modified.

IR-4 will continue to concentrate activities to provide growers of specialty food and non-food crops with legal access to safe and effective pest management solutions, focusing efforts on new conventional chemical "Reduced Risk" pesticides and on biopesticides. IR-4 sees ample opportunities to integrate the latest generation of biopesticides with conventional chemical pesticides to intelligently manage pests, delay or eliminate pest resistance to pesticides, and lower chemical residues in the harvested food commodities. This September, IR-4 held its first ever Biopesticide Priority Setting workshop in association with the traditional Food Use Workshop. Here we introduced the new concept of directed research in biopesticides to answer stakeholder needs.

IR-4 will continue to help US growers to obtain access to global markets by eliminating pesticide residues in produce as a trade barrier. IR-4 sees increasing opportunities to work in cooperation with international partners and jointly develop data which will hopefully lead to harmonized Maximum Residue Levels (MRLs) and an opening of trade.

Vision 2020 also articulates the ability of IR-4 to respond to specific high priority needs within pest management with an expansion of sponsored research. For example, the citrus industry is facing a crisis situation with Citrus Greening. IR-4 is working with public and private sector partners to develop appropriate pest management technologies to combat both the bacterial disease and the vector pest psyllid. Others are requesting IR-4 involvement in developing new tools to manage Varroa mites that are considered part of the challenges facing some of the pollinators. Dave Soderlund, Chair of IR-4 Project Management, described IR-4's involvement and coined the phrase "IR-4 is pesticide registration for the public good".

The IR-4 Strategic Plan also notes the need for reinvestment in IR-4 infrastructure that has suffered through many years of budget shortfalls. The plan also acknowledges the vulnerability of IR-4 partnership with the Land Grant University system. As part of the partnership, the Agricultural Experiment Stations provide extensive in-kind funding as host of IR-4's research farms and laboratories. Additionally, they provide IR-4 approximately \$500,000 in direct funding. Many are questioning if this partnership can be sustained in the future because of budget challenges at the Land Grant Universities. IR-4 could not do what we do without their support. If you have an opportunity, please thank your state's College of Agriculture Deans and Directors for their continued support for the IR-4 partnership. 


Until next time, all the best.—Jerry

IR-4 NE Region to Relocate to



On August 20, 2014, IR-4 Northeast Region Director, David Soderlund, announced that the IR-4 Northeast Regional administrative offices will be moved from Cornell/New York Agriculture Experimental Station in Geneva, NY to Rutgers University in New Jersey. This change will occur by the end of 2015.

This change is due in part to personnel changes at Cornell, as retirements of the Regional Field Coordinator and the Northeast Regional Director are imminent. The change will also result in cost savings by housing the unit at Rutgers. Rutgers Administration is in full support of the relocation and is also very familiar with IR-4's structure, objectives, and funding sources.

Dan Rossi, Executive Director of the Northeastern Regional Association of State Agricultural Experiment Station Directors and who holds the role of IR-4 Administrative Advisor, will become a voting member on the IR-4 Project Management Committee representing the Northeast Region and their respective interests. 

Shares Priority Needs at NER Meeting

— by Edith Lurvey NE RFC, Bill Barney, IR-4 Biopesticide Senior Coordinator, and Michael Braverman, IR-4 Biopesticide & Organic Support Program Manager

This year, in addition to discussing northeast priorities for the IR-4 Food Use and Ornamental workshops, the Northeast Regional Meeting brought together scientists from the biopesticide and organic communities to share their most troubling pest management needs. This component of the NE meeting was put together to gain insight into the unique needs of these growers and was held in advance of the first IR-4 Biopesticide and Organic Support Program Priority Setting Workshop.

Many invited guests were strong proponents of organic production and this was their first opportunity to learn about IR-4 and the IR-4 Biopesticide Program. This focus of the meeting gave IR-4 personnel an opportunity to hear about the critical need for growers, such as biological controls for organic disease and weed management and important insect pests, such as spotted wing drosophila (SWD).

Brian Baker, an early participant in setting up the Organic Materials Review Institute (OMRI) gave an overview of US organic agriculture and a quick history leading to the OMRI listings. He identified what types of materials are allowed in organic production such as natural pesticides extracted from plants, microbes, and insects, as well as the few synthetic products that are also allowed, noting that there are exceptions to both categories. He suggested NE priorities for the biopesticide workshop should include weed management in all crops and organic solutions for the

brown marmorated stink bug.

Tom Green, president of the IPM Institute of North America, was representing the National Working Group for Organic and IPM Priorities, which was organized with funds from the IR-4 northeast region and the NCR IPM Centers. This collaborative effort is working to meet the needs of this region and the nation. Tom talked about biopesticides as rotational tools in IPM production as well as those working as a stand-alone organic product. His example was Regalia for Downy Mildew which works well in both systems. He also talked about Red Tomato & EcoApple (redtomato.org) an IPM marketing program that began in the northeast with local growers.

IR-4's Biopesticide Senior Coordinator, Bill Barney, discussed the restructuring of the Biopesticide priority setting process at the meeting. This year the Biopesticides and Organic Support program changed its process of selecting research from a grant method to the workshop priority setting structure. This process is similar to the Food and Ornamental Horticulture programs. Although the grant proposals have been creative in both products and scope, it has been getting more difficult to encourage good researchers to apply for small grants. More importantly the top priority research areas have not always been addressed.


Steve Young, NE IPM Center director, discussed a number of specific programs to develop

management tools for NER crops and urban problems. One of his examples was the need for bed bug management for this region that has large urban populations. Steve later discussed the potential for IPM Center/IR-4 interactions and collaborations.

Some unique approaches for SWD management were also discussed. Rich Cowles, from the CT Agricultural Experiment Station, presented a unique approach to the management of this pest that includes an attract and kill approach (see article on page 17). Another approach came from a small fruit grower who mentioned they are using untreated netting for SWD exclusion.

Overall, the regional meeting provided an avenue for good discussion of organic production and biopesticide needs that can be used as IPM rotational tools.

During the priority needs discussion, three Field Research Centers gave brief presentations on their research projects, and several IR-4 State Liaison Representatives brought up the need for food and ornamentals production in their states. There was significant discussion on common interests and management tools for both biopesticide, organic and conventional products.

The discussions gave NE Regional Field Coordinator, Edith Lurvey, a clear message of pest management needs in the region, which she shared at the workshops. 

Biopesticide

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An online voting system was used for recording interests from the audience. There was also a paper ballot used as a backup. Individuals had five votes to cover a range of over 100 priorities, or they could chose to focus all their attention on one, and cast their 5 votes for a single issue. The availability of both electronic and paper forms proved useful to clarify and track voter's preferences.

Most requests were pre-submitted through the IR-4 website, but participants were allowed to offer priorities from the floor. Votes were collected from the public sector and industry. Only the public sector votes were used to rank priorities. The industry votes, which were similar to the public votes, were used for informational purposes.

In the coming years, IR-4 will make this a more seamless and refined process, with preparation

beforehand stemming from an established cutoff date for requests. Improvements for coming years will include having the workshop materials available prior to the workshop and limiting the number or duration of speakers. This will afford time for more in-depth discussion.

This year's five priorities were chosen from the categories: Fruit, Organic, Ornamental crops, Public Health, Vegetables and Other (see table).

Looking forward, IR-4 is working on the establishment of a protocol system for efficacy data pertaining to biopesticides. IR-4's commitment to biopesticides and organics remains strong and IR-4 was encouraged to see renewed interest in its Biopesticide Program. All participant feedback was appreciated, and IR-4 will incorporate suggestions for improving the process into planning the next workshop.

The next step for IR-4 will be to work with industry to gather lists of



Meg McGrath, Plant Pathologist with Cornell showcasing a tomato plant disease during the Biopesticide Workshop.

products that might be active on the target pests, and together with input from the research and grower community, develop protocols to evaluate the products. Where applicable, emphasis will also be placed on developing integrated approaches between biopesticide and conventional products.

Overall, the new process was well received. For more information or to offer suggestions for future priorities contact: Michael Braverman, Bill Barney or Krista Coleman at 732.932.9575 or email them at braverman@aesop.rutgers.edu, barney@aesop.rutgers.edu, or coleman@aesop.rutgers.edu. Also, visit the Biopesticide & Organic Support webpage at ir4.rutgers.edu. 🌱

Biopesticide & Organic Support Workshop Results

Priority ranking	Fruit	Organic	Ornamentals & Turf	Public Health	Vegetables	Other
#1	Citrus greening/ Citrus	Fireblight / Organic apples	<i>Cryphonectria parasitica</i> / American Chestnut	Mosquitoes	Bacterial Diseases of Fruiting Vegetables - field & greenhouse	Varroa mite/ Honeybees
#2	Spotted wing Drosophila/ All crops	Weed control/ Organic crops	Botrytis leaf spot/blight / Bulb cut flowers	Bed bugs	Downy Mildew / Basil (field & greenhouse)	RNAi based technologies /All crops
#3	Brown Marmorated Stink bug/All	Mummy berry, Anthracnose, Alternaria / Organic blueberry	Weed Control in Nursery Seed & Transplant Beds / Ornamental	Ticks	Whitefly, Aphid, Psyllids/GH tomato	Fruit flies / Fruit and vegetables
#4	Aflatoxin/ Almonds	Late blight / Organic tomato	Turfgrass / Nematodes		Mites, Thrips, Aphids and whiteflies / vegetables	<i>Armillaria</i> / Fruit trees woody
#5	Brown Rot Blossom Blight and Fruit	Downy mildew / Organic pumpkin, squash	Bacterial diseases /Ornamentals		Thrips (especially chilli thrips) / all crops	Glyphosate resistant weeds
					<i>Phytophthora capsici</i> / Field vegetables	

New Research for BMSB Leads to IPM Solutions

— by Tracey Leskey, Research Entomologist with USDA-ARS and Cristi Palmer, IR-4 Ornamental Horticulture

In recent years, IR-4 has become more involved in developing and registering tools for invasive species management. One pest that has devastated many crops is the brown marmorated stink bug (BMSB). According to Tracy Leskey, Research Entomologist with USDA-ARS, this pest caused \$37 million of losses to Mid-Atlantic apple growers in 2010. To begin to ameliorate those losses, researchers have screened dozens of potential chemistries in several chemical classes. No single chemical class uniformly outperformed all the others, but representatives of each major class have demonstrated potential value for field use. IR-4 has selected two of the most effective, bifenthrin and dinotefuran, to conduct GLP (Good Laboratory Practices) MOR (Magnitude of Residue) studies to assist growers in short term management of BMSB.

Even at the highest doses of the most effective insecticides, BMSB are very hard to kill via contact with a dry residue. Their potential for recovery from “moribund” state was demonstrated for some pyrethroids and neonicotinoids. And residual activity in the field can be very short. Traditional chemicals can mitigate an immediate threat but with that comes



significant consequences. Currently identified products for BMSB management are upsetting IPM programs because of their broad spectrum nature plus disruptive affect on beneficials. There are also increased labor and inputs costs, as much as 4-times higher, for more frequent sprays due to BMSB and subsequent secondary pest outbreaks.

Leskey and a team of collaborating researchers are working on solutions that might help manage this pest using fewer chemical applications. She is working on monitoring tools that will help growers make informed decisions regarding chemical applications. Ideally, traps would provide accurate measurements of presence, abundance, and seasonal activity of BMSB. In her research, Leskey initially worked with a sex pheromone produced by the Asian stink bug, *Plautia stali*, to attract males to the inverted pyramid traps. When specific BMSB aggregation pheromones were identified in 2012, it was noticed that the *P. stali* male-attractive pheromone combined with the aggregation pheromones (pheromone complex) were synergistic in attracting BMSB male and female to the pyramid traps. When placed in the perimeter row of the orchard, routine counts of trapped BMSB provided guidance for pest management decisions. Using a threshold of 10 adults per trap, these researchers reduced insecticide applications by 40% in experimental orchard plots with no significant difference in injury at



Photos by
Tracey
Leskey

harvest compared with weekly calendar based applications. Currently, this trap-based treatment threshold is being evaluated in several mid-Atlantic commercial orchards. Future experiments to further validate and refine this approach are planned.

Another avenue of research with this pheromone complex is studying an attract-and-kill approach. Apple trees treated with pheromone (baited trees) are more attractive to both male and female BMSB than nearby non-baited trees. It is possible that baited trees sprayed with insecticide can reduce BMSB populations. Leskey and her team studied this approach by baiting apple trees with 10, 100, or 1000 mg BMSB pheromone plus *P. stali* pheromone. Forty-eight hours after treatment, bifenthrin was applied at a single rate across pheromone treatments, and the researchers counted the number of dead BMSB 6 hours and 6 days later. This approach demonstrated continuous mortality over a week with a strong pheromone dose response. Pending confirmation in future experiments, using this attract-and-kill approach holds promise for managing BMSB and enabling growers to re-establish their IPM programs for managing other orchard pests. 🌱

Biopesticides for Successful, Cost-effective Disease Management in Greenhouse Vegetable Production

— by Mike Bledsoe, Village Farms, Senior VP Food Safety & Regulatory Affairs and IR-4 Commodity Liaison Vice Chair

In just 25 years, the hydroponic greenhouse vegetable industry has grown from about 0.5% of retail grocery sales of tomatoes, to today's market for tomatoes that is greater than 60% in retail grocery sales. Additionally, the "Big Box" stores now have greater than 72% of sales from greenhouse production of tomatoes. The large scale greenhouse hydroponic vegetable industry grew very quickly from its first 10 acre location in the late 80's to today having 1000 acres of large (> 10 acre) greenhouse and 200 acres of smaller (< 10 acre) greenhouses, most of which are less than 1 acre in size. A large scale greenhouse can grow up to 30 times more pounds of tomatoes per acre using about 85% less water than traditional production due to the use of recycled water.

A forty acre greenhouse will host 450,000 plants, each grafted prior to planting and costing on average ~\$2.00 or more to propagate. That means there is close to \$1,000,000 invested in plants prior to planting them in a 40 acre greenhouse. I take time to point this out because the investment is great and it is a monoculture type of production, with all the risks associated with this mono crop system. The risk is great and so why does this industry continue to use more beneficials, biochemicals, and biologicals each year? "It just makes sense".

The greenhouse vegetable industry spends as much as \$10,000 per acre for beneficials such as *Bombus* (bees), *Encarsia formosa*, *Eretmocerus* sp., and *Amblyseius swirskii*. We additionally are a heavy user of biologicals/ biorationals/ biochemicals (referred to as biologicals). Remember we have a high value, expensive crop to establish and maintaining pest under thresholds is critical.

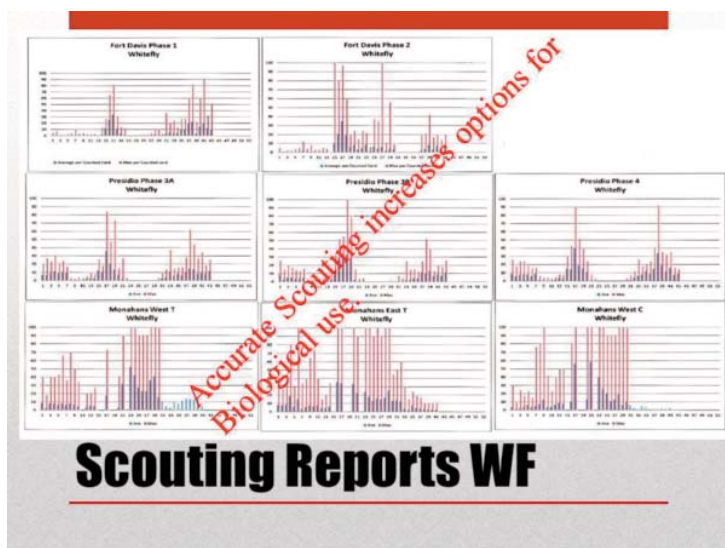
Growers scout for the number and

- Tomato: 94%
- Cucumber: 4%
- Pepper: 1%
- Eggplant: 1%



Hydroponic Vegetable %





concentration of pests. Scouting programs in hydroponic production are key and provide weekly readings on average numbers of pests (insect or pathogen) per greenhouse alongside the indication of the hot spots.

Growers prefer biologicals over standard chemistry due to two major reasons. First, the cost of establishing and maintaining beneficial organisms is high, and it is critical not to hurt these organisms, which is a risk with conventional products. Second, traditional chemicals affect production time due to longer pre-harvest and re-entry intervals.

Production is king, and anything that adversely affects production must be minimized whenever possible. Biologicals fit well with maintaining the lag phase of many

greenhouse pests, without affecting production. The lag phase is the initial growth that remains constant prior to a period of rapid growth.

Bacillus thuringiensis (B.t.) has long been the growers choice for Lepidoptera (worm) control. In fact, in most greenhouses this is all that is currently used for worm control.

Recently, our industry has begun to adopt *Bacillus subtilis* (Cease, Rhapsody, Serenade, etc.,) and products like potassium bicarbonate (Milstop) in combination to control Botrytis and powdery mildew on both tomatoes and cucumbers. This was originally adopted as a post-harvest material applied pre-harvest. Studies from Sally Miller's lab at the Ohio State University demonstrated the effectiveness of this combination when sprayed just before harvest to

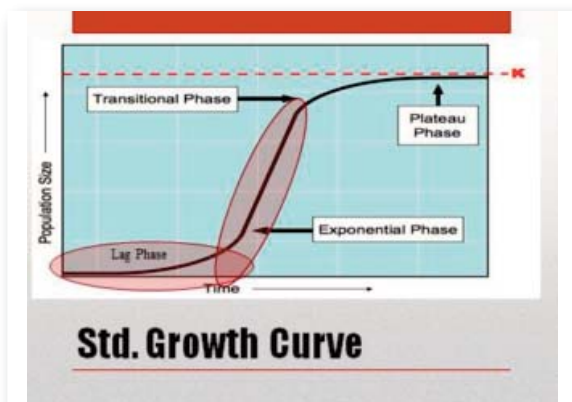
give several days' post-harvest control of Botrytis.

Today, *Bacillus subtilis* is routinely used to manage both Botrytis and powdery mildew to low enough levels that, in some cases, standard agricultural chemicals may not be needed. Let me be clear - we use biologicals to extend the lag phase of greenhouse pest thresholds (see figure below), but once the pest curve reaches the exponential growth phase we immediately begin to incorporate non biological materials as both curative and preventative materials. The conventional materials have been critical to our long season success in many cases.

Trichoderma harzianum (Rootshield, et al.) is becoming much more common in both vegetable and floral greenhouses. These products control root diseases like pythium and the grower achieves a very healthy root zone. This technique requires multiple application and monitoring, but the growers that have used it now stand behind these results.

Beauveria bassiana and *Metharhizium anisopliae* are great examples of biologicals used in greenhouses that offer good pest control. With whitefly and psyllid being some of the greatest insect challenges, growers are working these materials into the schedule.

In summary, with the greenhouse industry already heavily using beneficial insects, the idea of using biologicals was a natural transition. We still need, use and depend on conventional chemistries, but with the use of these combinations, we are able to achieve a substantial IPM effort. 🌱



This new section of the IR-4 Newsletter called 'New Product Corner' was suggested by grower stakeholders as a way for IR-4 to help inform specialty crop growers about new pest management tools recently registered by EPA. This is for informational purposes only as IR-4 does not endorse a particular product or registrant.

CYFLUMETOFEN

(Miticide – BASF)

Introduction: Unconditional registration for the new active ingredient (AI) cyflumetofen was granted by the EPA in May 2014 for various food uses and non-food uses on various ornamental horticulture plants. This new AI registration provides growers with a selective contact miticide active against all stages of various mite species. It is compatible with most biological control agents and can be used effectively in IPM and resistance management programs. Belonging to the beta-ketonitrile class of chemistry, cyflumetofen represents a unique mode of action, characterized by inhibition of the mitochondrial electron transport complex II enzyme in mite cells. The AI has been classified by the Insecticide Resistance Action Committee (IRAC) as the first Group 25 product in North America.

Other global registrations: Brazil, EU (ornamentals), Japan, Korea

US trade names/formulations: for food uses: Nealta® Miticide; for ornamental horticulture uses: Sultan™ Miticide (both 1.67 lb ai/gal suspension concentrate products)

US labeled crops*:

Food uses on Nealta® label: citrus fruit group (calamondin, citrus citron, citrus hybrids, chironja, grapefruit, kumquat, lemon, lime,

mandarin orange [sour & sweet], pummelo, Satsuma, tangelo, tangerine, tanger); grapes; pome fruit group (apple, crabapple, loquat, mayhaw, oriental pear, pear, quince); strawberry; tomato; tree nuts group (almonds, beech nut, Brazil nut, butternut, cashew, chestnut, chinquapin, filbert, hickory nut, macadamia nut, pecan, walnut [English and black]

Ornamental horticulture uses on Sultan label: ornamentals grown in outdoor nurseries, retail nurseries, residential and commercial landscapes, interiorscapes, greenhouses, lathhouses and shadehouses, containers and on forest and conifer nurseries and plantations

Nealta® and Sultan labeled mite pest spectrum: banks grass, brown almond, brown wheat, carmine, citrus red, European red, Texas citrus, and various spider mites (two-spotted, Pacific, spruce, strawberry, Willamette and Yuma)

Researchable IR-4 food use project requests (PR#): greenhouse tomato (11450), greenhouse cucumber (11452), greenhouse pepper (11451)

IR-4 Ornamental Horticulture Program current research: crop safety on 16 crops. 🌿

*See labels for specific use patterns and other general directions for use.

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IR-4 & IPM Collaborations NE

The Northeastern IR-4 program has been actively involved with the IPM Centers. In September of 2013, the NER IR-4 program funded the National Organic and IPM Working Group, and the group secured ongoing support from the North Central IPM Center through March 2015.

The National Organic and IPM Working Group provides a forum to exchange ideas and looks for opportunities to strengthen communication through professional events and networks. The Group also identifies common research priorities, policy and production needs, and develops collective knowledge expertise and resources in order to address emerging issues for organic and IPM stakeholders.

The group develops and maintains priorities and opportunities for research, outreach and public policy that will mutually benefit organic and IPM constituents, and communicates those priorities to funders and other stakeholders. Additionally, the working group undertakes projects to address top priorities once they are identified, which will meet stakeholder needs. The group pursues funding, plans and partners with other groups to host in-person roundtable discussions on a regular basis.

The Working Group is in the process of developing a collaborative whitepaper to be published in early 2015. The target audience for the whitepaper includes: decision makers, ag and public and private sector, practitioners, researchers, extensionists, and current and

future Working Group members. Chapters include: introduction; criticisms, misperceptions and differences; organic and IPM in the marketplace; opportunities for organic, conventional and IPM to learn from each other; and make recommendations for the future.

The Working Group will host a session focused on synergizing organic and IPM practices at the 2015 International IPM Symposium, March 23-26 2015 in Salt Lake City, Utah.

The Working Group website is a resource for meeting minutes, priorities lists, and more information on joining the group. The website can be found at organicipmwg.wordpress.com. For more information about this working group contact: Jane Petzoldt Project Coordinator IPM Institute of North America, Inc. (608) 232-1410 or email jpetzoldt@ipminstitute.org.

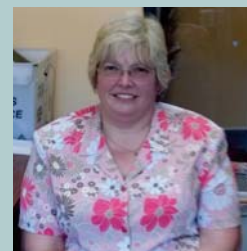
Meritorious Award

On Wednesday, August 20, 2014, the Northeast Regional Director, David Soderlund, presented the NE Meritorious Service Award to Andrew Senesac, from Cornell's Long Island Horticultural Research & Extension Center. The award was presented in recognition of his outstanding contributions to the IR-4 Program and Northeast Region in the conduct of ornamental horticultural research. Congratulations! 🌱



IR-4 HQ Welcomes Susan Bierbrunner

IR-4 Project Headquarters is pleased to announce the appointment of Susan Bierbrunner as a Unit Administrator, who will be assisting Diane Infante and others within IR-4 with database management, protocols & GLP archiving. Susan has over 20 years of Customer Service & Database Management experience.



Welcome, Susan! 🌱

Susan's contact information is:
bierbrunner@aesop.rutgers.edu

Learning the ABCs (Awareness of Bacterial Challenges) in Various Crops

Imagine you are a Florida citrus grower and upon entering your orange grove, you notice that your trees are losing leaves, and then just before you are ready for harvest, your fruit fall from the trees. You also notice that your fruit are misshapen, very small or large and atypical in color. Suddenly, it hits you...like countless other groves in Florida, your trees have become infected with HLB (Huanglongbing; also known as Citrus Greening Disease), and you know that there is no cure and a high percentage of your crop is a total loss.

This type of situation is affecting growers throughout the United States. And not just citrus, but with many other high value specialty crops including Solanaceous crops such as tomato, pepper and potato, stone fruits such as cherry and peach, pome fruits including apples and pears and even tree nuts, olives, and ornamental horticulture crops. In addition to causing devastating losses, bacterial pathogens are difficult or impossible to control; there is not much in the tool box.

As a major resource for supplying pest management tools for specialty crop growers, the IR-4 Project understands the need for control of bacterial diseases on specialty crops and has been receiving numerous Project Clearance Requests (PCRs) for assistance. Currently, there are several issues impeding the progress toward bacterial disease solutions. Eradication programs have not contained HLB. Genetic technology, including the development of resistant or tolerant plants takes years to develop. Few conventional and biopesticide compounds are available for

control, and many of the compounds that are available can result in pathogen resistance if used improperly. In addition to these challenges, many of the potential conventional bacterial disease control products are antibiotics and require additional testing and review by the Environmental Protection Agency (EPA). These reviews are in coordination with the Food and Drug Administration (FDA) and Centers for Disease Control and Prevention (CDC) to ensure human safety by means of preventing resistance to human diseases. These reviews must be completed before EPA tolerances are issued and products are labeled for use on food crops.

In an effort to obtain a greater understanding about the bacterial disease issues being faced by growers, researchers and government, IR-4 held its first Bacterial Challenges Mini-Summit entitled "Understanding the ABCs (Awareness of Bacterial Challenges) with Antibiotics in Crops". The summit was held September 11, 2014, following the IR-4 Food Use and Biopesticide Workshops in Atlanta, Georgia. The meeting started with a focus on the impact of bacterial diseases on various crops and the potential management strategies including but not limited to the use of antibiotics, genetic technology and biopesticides. Jim Dukowitz, the Commercial Products Manager of the Citrus Research and Development Foundation, Inc. (CRDF)¹, spoke about antimicrobial strategies for Florida Citrus including a discussion about the cause and symptoms of HLB, the

economic impact of the disease (estimated annual losses have reached \$1 billion), an overview of the mission and structure of CRDF, the research strategies that CRDF is focusing on and regulatory issues associated with this research. Jim Graham, a Soil Microbiologist at the University of Florida IFAS Citrus Research and Education Center, focused on the epidemiology and impact of another citrus disease, citrus canker, on grapefruit and a rationale for the use of streptomycin on citrus. Jim Adaskaveg, a Professor in the Department of Plant Pathology and Microbiology at the University of California, Riverside, spoke on bacterial diseases in a number of valuable tree crops grown in California including tree nuts, olive, stone fruits and pome fruits.

Adaskaveg, like other researchers, stressed the issues associated with copper being the only registered compound for bacterial disease control and the need for alternate compounds with different modes of action to reduce the chance of resistance development and excess copper accumulation in the soil. Ronald D. French, an Extension Plant Pathologist and Diagnostician at the Department of Plant Pathology and Microbiology at Texas AgriLife Extension Service in Amarillo, spoke about the cause of zebra chip of potato and the research strategies of controlling this disease. These options include an integrated approach of using antibiotics, insecticides, systemic resistance and nutrient supplements. Ken Johnson, a Professor of Plant Pathology at Oregon State University in

¹ A non-profit corporation to advance disease and production research and product development activities to ensure industry survival through innovation

ness of Bacterial Challenges)

us Crops

— by Kathryn Homa, IR-4 Fungicide Coordinator and Dan Kunkel, IR-4 Associate Director


Corvallis, spoke about the benefits of timing pesticide applications during different phases of growth and using an integrated control program with both conventional and biological compounds for Fire Blight control in pome fruit. George Sundin, a Professor, Tree Fruit Pathologist and Extension Specialist for the Department of Plant, Soil, and Microbial Sciences at Michigan State University, discussed weather conditions in Michigan that favor bacterial diseases of stone and tree fruit including Bacterial Canker, Bacterial Spot and Walnut Blight. Sundin highlighted both organic and conventional options for control, his positive experience with the use of kasugamycin in Michigan field trials and his studies on kasugamycin resistance.

Following these presentations, discussions moved on to biotechnology efforts to develop citrus that are resistant to HLB. Ed Stover, Ph.D. a Horticulturist and Plant Breeder with the USDA-ARS, focused on how transgenic citrus varieties are developed and why this technology is needed. Stover stressed that host resistance or tolerance to HLB will offer the promise of a sustainable long-term solution to maintain citrus production. Manjul Dutt, Ph.D. at the Citrus Research and Education Center in Lake Alfred, Florida, discussed his team's progress toward developing citrus varieties resistant to HLB and the use of RNAi technology to create trap plants that target the Asian Citrus psyllid vector. Both presenters discussed the pros and cons of the transgenic plants being accepted by consumers.

The final session focused on the processes and considerations undergone by EPA, CDC and FDA in addressing the use of antibiotics for various bacterial challenges as it relates to pesticidal efforts. Susan Jennings, the Public Health Coordinator of the Office of Pesticide Programs of EPA, spoke about the registration process and the added regulatory requirements when antibiotics are used on food crops including the data needs, interpretations and risk assessment. This includes studies on antimicrobial resistance and risk mitigation. EPA is required to consult with FDA and CDC when assessing the risks of antimicrobial resistance and protecting public health. Speakers were invited from these agencies to present their perspectives. Jean Patel D, the Deputy Director of the Office of Antimicrobial Resistance in the Division of Healthcare Quality Promotion of CDC, presented examples of the potential for development of antibiotic resistance in humans and the risks associated with pesticide antibiotic use. Heather Harbottle, of the Microbial Food Safety Team, Office of New Animal Drug Evaluation, Center for Veterinary Medicine of FDA, spoke about the microbial food safety risk assessment and the regulatory decisionmaking involved with the use of antibiotics in food producing animals. Harbottle focused on the Guidance to Industry #152 document and its intent on preserving antibiotic tools that are important for treating human disease. She shared experiences with antimicrobial drug resistance risk assessment. The session concluded with a

presentation by Shaunta Hill, Ph.D. Registration Division, Office of Pesticide Programs, EPA. Hill provided a detailed presentation on the registration process including the antibiotic considerations that were involved in the decision process to register kasugamycin bactericide (Kasumin® 2L) on Pome fruit Group 11-10. This was an IR-4 project that was a 2005 FUW priority with trials beginning in 2006.

Concluding with a Q&A session, the mini-summit provided an opportunity for attendees (125) including growers, university personnel, industry, and government to come together and discuss many issues that are occurring with bacterial diseases on crops and where they could share research efforts conducted thus far and the need for solutions. Speakers from EPA, FDA and CDC were also able to discuss antibiotic review processes and decisions that are involved when registering antibiotics for use in food crops. Hopefully it provided a better understanding of the information that is required for the registration of antibiotics on food crops. The Q&A session provided an opportunity for interaction between the speakers and audience. The mini-summit helped to enhance the dialogue and communication around bacterial disease, encouraging positive interactions between growers, researchers and government. This should pave the way for future summits and collaborations to help address disease issues affecting crops throughout the United States.

The proceedings from this mini-summit will be posted on the IR-4 website ir4.rutgers.edu soon. Please contact Kathryn Homa with questions at homa@aesop.rutgers.edu. 

A Decade: What has changed and what has stayed the same for pest needs?

First of three retrospectives on the IR-4 Ornamental Horticulture Survey.

— by Cristi Palmer, IR-4 Ornamental Horticulture Manager

Over the last decade, the IR-4 Ornamental Horticulture Program has conducted a survey of growers, extension personnel and people allied with the “Green Industry”. While the survey is not perfect, it has given a snapshot of the major pests, pathogens, and weeds with which growers battle. The intent is to find holes in the management tool box – those issues where control options are limited or non-existent – so that we can address problems where our limited resources would have the most regulatory impact. This update

focuses on pests along with being a call for participation in the upcoming 2014/2015 survey.

In general, the types of pests impacting ornamental horticulture crops have been relatively consistent (Table 1). Aphids, thrips, whiteflies, coleopteran insects, spider mites, scales and mealybugs routinely are in the top 7. One notable trend is that aphids went from a fairly high rank down to being a lower priority from the 2005 annual survey to the 2008/2009 biennial survey. This

may be a reflection of the slight word changes to focus the survey on pest management needs rather than which pest was most commonly encountered. Thrips and mites & spider mites tended to remain pests of concern, possibly because resistance can rapidly develop in these pests. Mealybugs, soft scale, and armored scale are problematic with armored scale often being the most difficult to manage.

Since 2005 (Figure 1), IR-4 has sponsored research on the top

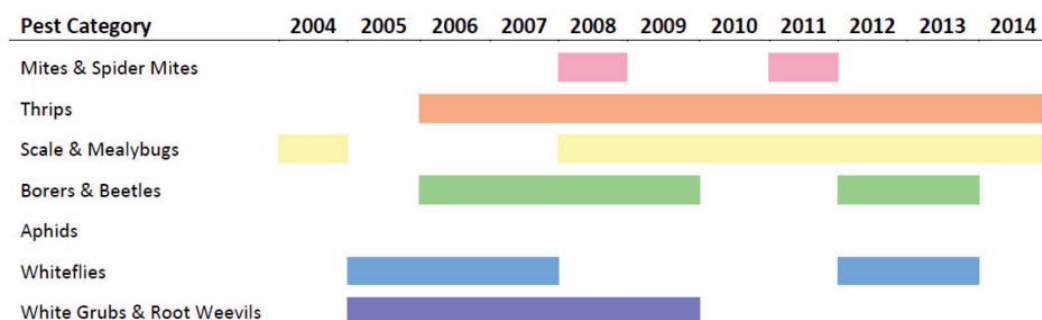
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Table 1. Ranks of the insect categories from the annual and biennial grower and extension surveys from 2005 through 2013.

#	2005	2006	2007	2008/2009	2010/2011	2012/2013
1	Aphids	Scale & Mealybugs	Mites & Spider Mites	Thrips	Thrips	Mites & Spider Mites
2	Thrips	Mites & Spider Mites	Aphids	Mites & Spider Mites	Mites & Spider Mites	Thrips
3	Spider mites	Thrips	Thrips	Scale & Mealybugs	Scale & Mealybugs	Scale & Mealybugs
4	Borers/Beetles/ White Grubs *	Whiteflies	Scale & Mealybugs	Borers & Beetles	Borers & Beetles	Borers & Beetles
5	Whiteflies	Aphids	Whiteflies	Whiteflies	Aphids	Aphids
6	Scales	Borers & Beetles	Borers & Beetles	Aphids	White Grubs & Root Weevils	Whiteflies
7	Fungus gnats and shore flies	White Grubs & Weevils	White Grubs & Root Weevils	White Grubs & Root Weevils	Whiteflies	White Grubs & Root Weevils

* In 2005, all the coleopteran species were grouped together. Starting in 2006, coleopterans attacking above-ground and those feeding below ground were separated into two categories.

Figure 1. Annual timing for national and regional research priorities.




A Decade

continued from previous page

seven pest categories with the exception of aphids. Thrips has been studied the most because the prevalence of western flower thrips and the introduction of chilli thrips. Western flower thrips (WFT) is polyphagous, feeding on over 240 ornamental horticulture crops, and vectors several destructive diseases including Impatiens Necrotic Ringspot and Tomato Spotted Wilt viruses. Because of its unsightly feeding damage, its vectoring ability, and concern about development of tolerance to the two primary tools at the time, WFT became a high priority project to screen for efficacy among the newer biological and chemical products.

After chili thrips was introduced into Florida and dispersed among many of the southern states, it was added to the list of researchable thrips species. This project has been very successful with several new products registered over the last decade: Aria 50SG (flonicamid), Conserve (spinosad, for chili thrips), Flagship 25WG (thiamethoxam), GrandEvo (*Chromobacterium subtsugae*), Hachi-Hachi (tolfenpyrad), Kontos (spirotetramat), Mainspring (cyantraniliprole), Met52 (*Metarhizium anisopliae*), Overture (pyridalyl), Pylon (chlorfenapyr), Safari 20SG (dinotefuran), and TickEx (*Metarhizium anisopliae*). Many of these have also been registered for use on specific scale, mealybug, whitefly, and coleopteran species.


To maintain our success, we need input on research priorities. Take about 10 minutes and participate in the survey today. Find the survey on the Ornamental Hort. webpage at ir4.rutgers.edu. 

Databases Are Changing

The IR-4 Biopesticide & Organic Support program has updated its database to include information about IR-4 grant funded projects from 1983-2014. The program also created a priority needs webpage where you can view current needs of biopesticides for organic food crops, ornamental and public health and submit your needs for research.

The IR-4 Food Use database has some new features too. Besides the new look, there are new options added to the database. For example, it is possible to go directly from the Food Crop tab to the Master Schedule, when the 'Full Search' button is clicked. Also available on this page is a "Help" feature where you can submit any questions, problems or suggestions to headquarters. New features on the "Master Schedule" are located at the bottom of the site where you can see the progress of a study as to where the data is (is the data still with the FRD or now at the Regional Office or at QA). We have also added additional choices on how you want your report listed. There is also a new "Keyword" feature that allows specific searching, viewing and printing of the Master Schedule.

Finally, the Public Health Pesticides database is undergoing a major expansion.

Please take a look at each program's webpage at ir4.rutgers.edu, and let us know what you think. 

Urban Greenery

— by Cristi Palmer, IR-4 Ornamental Horticulture Program Manager.

In August, I had the opportunity to visit Minneapolis, MN for the annual American Phytopathological Society meeting. In addition to visiting with plant pathologists from across the US and the world, moderating a symposium on Boxwood Blight and giving a talk on Chrysanthemum White Rust research, I had a few minutes of downtime to walk around Minneapolis. This city is hospitable on many levels: fine restaurants, easily walkable streets, and many, many green spaces. In a few block radius near the convention center,

I stumbled over numerous plantscapes. From large planned greenways to small gardens tucked into containers and between paved areas, flowers and foliage of every color welcomed residents and visitors alike.

In addition to fairly common woody ornamental bushes and trees (i.e. pines) and herbaceous annuals (i.e. petunias), there were a few surprises. In one sidewalk garden, an ornamental variety of kale was

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The Basics of Biopesticide Product Development

— by Matthew S. Krause, PhD, Product Development Manager, BioWorks Inc., Victor, NY

Translating a biological control agent technology or a naturally derived material into a commercially viable biopesticide product in the US requires multiple steps that may take 3-7 years, \$500,000 to \$2 million, and substantial human and other resources to complete. This article provides a general overview of the Biopesticide Development Process, the pathway that microbial or biochemical biopesticide technologies may undergo before becoming registered biopesticide products in the US. It can be broken-down into five phases: Discovery, Proof of Concept, Early Development, Advanced Development, and Pre Market Launch. Though specific aspects and names of phases of this process vary by company, many of the same elements are quite common. In addition, some of the phases described here frequently overlap.

Discovery

The desired outcome of the Discovery phase is a new active ingredient (AI) that has one or more unique selling propositions (USPs), has intellectual property (IP) protection, and is aligned with grower or market and company needs.

Activities during this phase can be grouped in one of two forms, depending on whether the type of discovery platform is primary or secondary.

Primary Discovery typically begins at the academic level or from exploratory research platforms. New biopesticide AIs are identified via laboratory screening of

uncharacterized strains or natural materials isolated from natural environments, extracted from organisms or bioprocesses, or recovered by reverse engineering of disease- or pest-suppressive systems. The next step is to obtain proof-of-concept (POC) data that can be used to support patent submissions. This data is also used to make decisions on continued development or to interest potential development partners or licensees. After POC, filing patent applications for IP protection is critical to the commercial development and marketing of new biocontrol technologies. Patents provide companies with USPs of an AI or technology that is protected for several years in the marketplace.

Secondary Discovery starts from a field of AIs that have been through some level of Primary Discovery. This step involves identifying an existing AI with potentially strong USPs that has IP protection, fits with market needs, and is aligned with a company's needs and profile. Agreements are signed with the technology owner to secure rights to evaluate the technology, in order to obtain strains or prototypes and to continue with full technical disclosure, and commercialization. The AI moves on to a vetting process that reviews data to identify information gaps, red flags and establishes priority for development.

Proof of Concept

The goal of this phase is to determine if an AI has well-founded commercialization potential. This is accomplished by testing the validity

of USP and IP claims, first in small-scale model bioassays under ideal conditions and then in growth chambers or greenhouse trials conducted on multiple crops under more realistic growing conditions.



Proof-of-concept evaluation of biopesticide products against root diseases.

Early Development

By the end of early development, an AI should possess the following: a defined production process with scale-up potential, prototype formulations with performance aligned consistently with its USPs, and a registration and commercialization plan. In this phase, bench-scale production systems are developed to consistently and cost-effectively generate needed yield and quality of active components. Prototype formulations are also developed to assure consistent performance. Larger-scale, broad-range trials are conducted to evaluate performance of multiple prototypes. These trials identify prototypes for further development as well as define strengths, limits, and performance expectations of each prototype. Once a production process and prototype formulation have been selected and performance is

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documented, a plan may be developed to direct future registration and commercialization efforts for products on specific crops and pests or diseases.

Advanced Development

Deliverables at the end of this phase should be a large-scale production system, final product formulations, a US EPA data package, a quality assurance/quality control system, and manufacturing and marketing cost models.

Attaining these begins with scaling-up and optimizing production of active components and finalizing the formulation and the formulation process.

Completing these steps precedes and directly supports registration activities, development of quality assurance and control systems, and establishment of cost-of-goods-sold models for different product configurations and markets. The IR-4 Biopesticide & Organic Support Program has been very helpful in the development of biopesticides and in label expansions of biopesticides. They

provide efficacy research funding, help small companies obtain EPA registrations and tolerance exemptions, and help evaluate and document efficacy and plant safety of products.

Pre Market Launch

The goals of this phase are to obtain EPA and state registrations, and to have technical and grower support resources in place ahead of market launch.

Obtaining registrations involves developing final labels, submitting registration applications and data packages, and EPA and state registration review and approval.


Since most biopesticides are applied and handled differently than synthetic chemical counterparts, companies should develop technical resources to promote grower success with their biopesticide products prior to market launch. This can be accomplished through continued research to build an in-depth technical knowledge base, and through online technical literature and other media for

growers and distributors to learn more about the products. Data should also be provided that discusses compatibility with other products, and the best-use practices on different crops and in different grower production systems. Other useful information should include strengths and limits of the product under different environmental conditions, specialized application equipment, efficacy data and research reports on selected crops. Having an accessible technical support staff and sales team is of great benefit, too.


Why register biopesticide products?

US EPA and state authorities require registration or a waiver of registration prior to marketing any product that makes crop-protection claims. Fulfilling US EPA data requirements represents the bulk of time, effort, costs, and risks associated with the development of a biopesticide product. Registration is particularly important to the grower, as it requires companies to document safety profiles for their products and holds them

accountable should serious issues with their products arise. As a result, registration demonstrates that companies are responsible and care about growers, the public and their own people that they will spend the time, effort and financial resources necessary to register their biopesticide products. 🌱



RootShield® Compatibility*



RootShield® Technical Bulletin

RootShield® is a liquid foliar fungicide for the control of many root diseases. The active ingredient is a living mold (*Trichoderma reesei* strain T-22) that protects the plant from pathogens.

The compatibility with RootShield® with other inputs has been extensively evaluated. The information below is limited into three (3) tables; moldicides in the first table are fully tank mix compatible; materials listed in the second table can be applied before or after the application of the compound; the third table lists incompatible fungicides. For incompatible fungicides, BioWorks, Inc. recommends that RootShield® be applied 10 to 14 days before or after chemical fungicide application.

*Note: The products listed have been evaluated for their impact on RootShield's active ingredient. The impact of RootShield® on the listed actives has not been evaluated.

Table 1: Tank Mix Compatibility

Fungicides			
Active Ingredient	Brand Name	Formulation	Tested Concentration
Acyobactin	Harlegno®	GL TL	3.6 oz/100 gal
Bacillus thuringiensis strain 3026	Ecogard® GN	SC	128 fl oz/100 gal
Boscalid plus Phthalophen	Powprof®	33% WP	35 oz/100 gal
Captan	Carbont® 35 WP	85% WP	1 oz/gal
Chlorothalonil	Chloronil® Ultra	82.5% WDG	0.6 oz/gal
Chloroxynil	Carbont® 4E	90% emulsifiable liquid	3.2 fl oz/gal
Diniconazoles	Statuo®	50% FL	12.5 oz/100 gal
Ethionazole and Thiophanate-methyl	Rovent®	44% WP	12 oz/100 gal
Fenarimol	FenStop®	44.4% liquid	28.5 oz/100gal
Fludioxonil	MoldShield®	50% WP	4.0 oz/100 gal
Propiconazole	Chopp® 36019 Pz	31.2% SL	0.25 fl oz/gal
Iprodione	Modulox®	50% soluble granules	0.04 oz/gal
Metazalyt 5F	Scout® 500F	21.3% FL	2.5 oz/100 gal
Seprinothrinol	Scout® 500F	20.4% SC	2.4.5 oz/100 gal
Streptomyces lydicus WYEC 108	Actinovate®	SP	12 oz/100 gal
Thiophanate-methyl	Cleanax 3336®	50% wettable powder Flowable	1.2 oz/gal
Tridemorph	SoyShield® 25 T&O	25% SG	0.11 oz/gal
Vinclozolin	Rovent® 0F	50% WP	0.04 oz/gal

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CEASE® Technical Bulletin

BioWorks®

CEASE® Compatibility

CEASE® is an excellent tank-mix or rotational partner in your disease control program, providing the benefits of improved efficacy, resistance management, and food, water, and environmental safety.

CEASE® effective activity, strain (OST 713) has been tested for physical compatibility with dozens of commonly used pesticides, nutrients, and adjuvants, and was found to be physically compatible with nearly all agents. Make applications of tank mix solutions as soon as possible after mixing.

Insecticide Compatibility

Brand Tested	Active Ingredients	Physical Compatibility
Agris [®] Variety [®]	Abamectin	Yes
Conserve [®] SC, Spinnor [®] Success [®]	Spinosad	Yes
DFP [®] Pro DF, Javelin [®]	Acetam. (thiophan)	Yes
Merit [®] , Provado [®] 1.9 WP, Marathon [®]	Imidacloprid	Yes
Procon, Atrache	Permethrin	Yes
SurfLo [®] X [®]	Mineral Oil	Yes
BotanGuard [®] 22WP, BotanGuard [®] ES, Mycelan [®] O	Bacillus thuringiensis, strain GHA	Yes

Adjuvant Compatibility

Brand Tested	Physical Compatibility
Bond [®]	Yes
Collaps [®]	Yes
Hacker [®]	Yes
Hypo-Active [®]	Yes
Intex [®]	Yes
Kinetix [®]	Yes
Nu-flo [®]	Yes
Quem [®]	Yes
R-11 [®]	Yes
R-30 [®]	Yes
Silvex [®] 1.75	Yes
Spray-Aid [®]	Yes
Sylgard [®] 300	Yes
Tactix [®]	Yes

Nutrient Compatibility

Brand Tested	Physical Compatibility
Fish Oil	Yes
Nutragen [®]	Yes
Nutro-phos [®] Ph	Yes

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Example of online technical literature (product compatibility charts)

Pheromones in Vector Control

— by Karl Malamud-Roam, IR-4 Public Health Pesticides Program Manager

While pheromones – non-toxic chemicals used as reproductive signals or other chemical cues – have long been used in agricultural pest management, their use in the control of disease vectors such as mosquitoes or ticks is a recent development. The IR-4 Project is working to help develop and register several pheromone-based products, and we expect their significance in the marketplace to expand in coming years.

In many insects, including pest species, specific chemicals are used to find potential mates of the right species, sex, and age; these chemicals have been used both to monitor pest populations, to disrupt reproduction, and/or to attract mate-seeking individuals to traps or toxicants. However, the search for specific mosquito sex pheromones has been challenging, and although publications have periodically noted that chemicals probably play a role in the aggregation of mosquitoes into mating swarms, specific usable chemicals of this type have not been identified. While this means that traditional pheromone-based management of mosquito populations have not been developed, other chemical cues are important throughout the life-cycle and are yielding promising control tools.



Sex pheromone used to monitor populations of fruit pests.



Mosquito mating likely requires chemical cues, although they have not been identified (photo courtesy FL Medical Entomology Lab)

The mosquito life-cycle includes many transitions, and while some of these are controlled largely by physiological pathways internal to the insect, others also require external chemical cues for their completion. Once an adult mosquito of either sex emerges from its pupal casing, it needs a sugar source to provide energy for flight and other activities, and this requires that the mosquito smells rotting fruit or another source of sugar. They also need water, though this may come from the food source. We have noted that the adults probably use chemical cues as part of their mating process, primarily to assist in aggregation. Once an adult female mosquito has been impregnated, she must find a source of blood, which is used primarily as a supply of protein to assist in egg production, and chemical cues including CO₂ are key in finding blood sources. Once a gravid female has digested the blood meal, she needs to find a safe place for oviposition (egg-laying), and in this she is also heavily dependent on chemical cues.

We can see several opportunities to use pheromones to intercept the adult mosquitoes and trap or poison them – when females or

males seek sugar or water, when females and males seek mates, when females seek blood meals, and when they seek oviposition sites. While chemical control of vectors has typically tried to prevent all bites by vectors (thus, killing before the first blood meal) as a sure protection vs. transmission of pathogenic organisms, it is increasingly recognized that any of these interventions can help reduce disease transmission by arthropods. This is because the disease-causing organisms very rarely move directly from mother to daughter, which means that a female mosquito must bite twice to collect germs from an infected host (the first bite) and transmit them to a vulnerable victim (the second bite). Thus, while products that kill mosquitoes seeking food, water, a mate, or blood can all prevent mosquito bites, products that kill female mosquitoes seeking egg-laying sites can also protect vs. disease transmission.

Products have recently been registered by EPA as Attractive Toxic/Targeted Sugar Baits (ATSB) and as Lethal Ovitraps, and new products in both classes are in development. In both cases, the availability of potent and selective attractants will be critical to

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Identification of good egg-laying (oviposition) sites also requires chemical cues.

Boric Acid as an Essential Tool to Combat SWD

— by Richard S. Cowles, CT Agricultural Experiment Station

The spotted wing drosophila (SWD), *Drosophila suzukii*, is extraordinarily difficult to



manage in North American fruit crops for the following biological and regulatory reasons.

- Eggs are laid in fruits just as they ripen; this necessitates use of insecticides close to harvest.
- SWD have a 10 - 14 day life cycle and a fecundity of about 300 eggs per female.
- SWD have a short adult maturation period of 1 – 2 days.

• The most effective insecticides have been pyrethroids and organophosphates.

• Use of pyrethroids and OPs are counterproductive to good IPM programs.

• Pyrethroid choice is limited by international MRLs for fruit intended for export.

• Spinosyns are highly effective, but their use is limited in the number of sprays per year to individual crops and to an entire farm, due to label restrictions intended to preserve insecticide susceptibility. Spinosyns are currently jeopardized by being the only effective insecticide available to organic fruit growers. Dow

AgroSciences and SWD researchers anticipate insecticide resistance will first occur for SWD to spinosyns on organic farms where Entrust is being used excessively.

• SWD develop in a wide array of cultivated fruits and wild hosts, so pest pressure is nearly guaranteed for every susceptible crop, every year.

• SWD are known to feed as adults on honeydew deposits in tree canopies, which places them near the boundary layer. Gusts of wind can then transport them medium to long distances. Rapid expansion from southern to northern New England in 2011 was coincident with Hurricane Irene.

Pheromone

continued from previous pg

attracting sufficient insects to impact pest populations. Luckily, sugar-feeding happens frequently and oviposition sites can be sparse enough that the artificial sites in traps can be attractive enough to catch a substantial percentage of the mosquitoes in an area. An additional twist to ovitraps recently has been the addition of Insect Growth Regulators (IGR) rather than direct toxicants, so that females may “autodisseminate” these potent chemicals to habitats where they disrupt development not only of their offspring, but of those of other mosquitoes sharing good egg-laying sites. Regardless of the life stage where pheromones may be used, they need to be potent enough to attract insects

that may find many naturally-occurring alternatives.

In addition to pheromones for mosquito control, there has recently been work on ticks, the other major type of arthropod disease vectors. While ticks don't fly or otherwise disperse quickly in response to volatile attractive chemicals, recent work has suggested that sex pheromones and possibly others can effectively disrupt key activities of ticks, reducing their life span or ability to spread disease. While this research is less well-developed than that with mosquitoes, the spread of Lyme Disease and other tick-borne infectious diseases argues strongly for continuing research in this direction as well. 🌿

An IPM-compatible pest management program should take advantage of the flies' high mobility and host breadth by exploiting behavioral weakness of being attracted to highly preferred odors. This has the potential to allow suppression of fly populations either through physical means (drowning in traps), or exposure to insecticides deployed with the attractant applied either to the surface of the trap or to the traps' immediate surroundings. However, our most effective traps were found in October 2013, to only drown 10 – 30% of flies visiting the outside of the trap. Between visits to the traps, flies probably lay eggs in surrounding fruit. However, flies are susceptible to additional behavioral manipulation because they exhibit a proboscis extension

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Hall of Fame Award

Lois Rossi, who has helped IR-4 through many challenges and once joked with Jerry that with all the work she does for IR-4, she should be inducted into the Hall of Fame, got her wish on September 9, 2014 at the IR-4 Food Use Workshop. When presenting the award, IR-4 Executive Director, Jerry Baron commented, "It is safe to say that without her efforts IR-4's success nationally and internationally would be significantly diminished. The impact of Lois's efforts on the success for IR-4 and availability of pest management products for specialty crop growers is huge."

Lois announced her plans to retire in the fall of 2014. A great champion of IR-4, Lois will be missed not only when the Technical Working Group meets but also from the many conferences, symposiums and tours where Lois has joined IR-4 participants and worked to make sure IR-4 had a seat at the table.

Have a great retirement Lois! IR-4 wishes you the best! 🌱



Greenery

continued from pg 13

paired with coleus, lamb's ears, pink allium, and red begonias. In a larger space between the sidewalk, a driveway and a building, a purple okra cultivar was planted in a bed of roses, daylilies and verbenas. Edible plants are becoming more common in residential and commercial landscapes for their attractive qualities and the interesting visual and textural contrasts they provide.

Edible plants are by definition

consumable. This can present challenges for growers. While growers are producing these edible plants for their uniquely attractive qualities, once placed into a landscape people can harvest them for consumption. Traditional ornamental horticulture growers did not have to think about whether the pest management tools had established residue tolerances. Now they do. The crop protection industry is addressing this conundrum and many labels now have appropriate use directions for edibles alongside

traditional ornamental horticulture crops.

Personally, I think the addition of unique edibles and the mixing of edible and non-edible plants within residential and commercial landscapes makes for more creative and diverse experiences. 🌱

Photos by Cristi Palmer



Boric Acid

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reflex when they encounter sucrose residues on a surface with their tarsi. Therefore, insecticides acting through ingestion can be efficiently used when combined with sucrose and applied to the outside of an attractant trap.

Boric acid has many characteristics which make it ideal for deploying as an SWD insecticide.

- Boron requires ingestion, and so can be used with sucrose to kill flies.
- Boron is used in various forms (including boric acid) to correct boron deficiencies in fruit crops.
- Boron is exempt from tolerance by US EPA, and can qualify for use in organic crops.
- Boron has a good human toxicity profile, with acute toxicity somewhat less than table salt. There are concerns about chronic toxicity.
- Application of boric acid as an insecticide must only be to the outside of attractant traps, as the insecticidal concentration could be injurious to plants. This could allay

concerns about potential consumer exposure to residues on fruit.

- Boron is a potent preservative, and so micro-organisms are not expected to be able to utilize sugars used for a boric acid/sucrose bait spray to traps.
- If spray residues on the outside of traps are protected from rain, they should last all season, since neither the sucrose nor the boron will be subject to decay.
- The mode of action for boron is to complex NAD, which prevents its reduction to NADH. This is an essential biochemical reaction that blocks glycolysis and production of ATP. It is not a mode of action for which target site resistance has ever been recorded, and so should be useful for delaying resistance to all other insecticides being used to target SWD.
- Deploying boric acid in conjunction with traps and attractants should only affect those insects attracted to these traps.

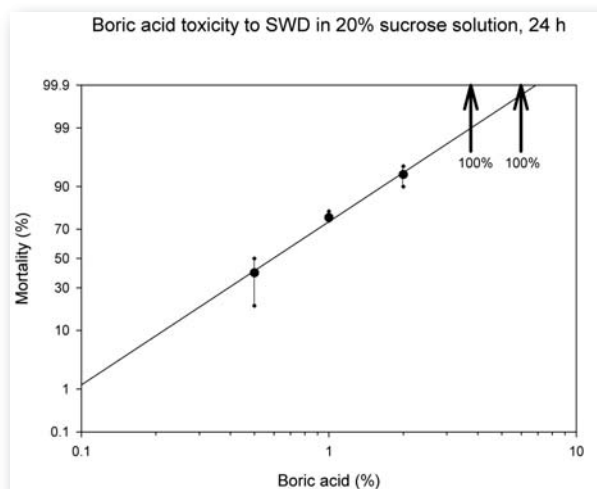


A prototype 16 fl. oz. cup trap for SWD, to be used with a spray to its exterior of boric acid plus sucrose. It has been slightly modified from the standard cup trap used for bait comparisons in 2013, and is about three times as efficient as Biolberica's modified McPhail trap. Key features of the trap are that it should be red or black, and that the holes be no larger than 3.2 mm. Holes (40) holes are placed about 2 – 4 cm from the top rim of the cup.

species of Drosophilids and Diptera, which obviously are subject to be non-target effects. However, our efforts are anticipated to result in more selective attractants for SWD.

- Boric acid could be sourced to be approved by the NOP and OMRI. It would immediately become a major tool for all organic fruit growers for managing SWD.
- Development of boric acid in conjunction with effective desiccants (silica gel dust) could provide a complete management system for SWD that would be a low-toxicity program for both humans and non-targets, and thus be IPM-compatible.

A wide array of highly attractive baits has been identified. A bait (Suzukii Trap) is currently being commercialized by Biolberica for mass trapping purposes in the US. Additional highly attractant baits are originating from my work, and include those derived from fruit volatiles, as well as a fermented material (kombucha), and a synthetic blend of attractant odors. Currently, kombucha could be immediately used by growers and is inexpensive for them to produce. Suzukii Traps may only have to be replenished (not discarded) every 2 - 3 weeks. Other baits may require more labor to keep fresh. 🌱



Dose-response for 24 h exposure of SWD flies to boric acid combined with 20% sucrose. The range is given for concentrations in which mortality was defined within the probability scale.

Currently, some baits do attract other

SOR Says Good-bye to Lori and Hello to Cristina

— by Robin Federline, Southern Region Program Assistant/Quality Assurance Support

Long overdue is a good-bye to Ms. Lori Gregg from Texas A&M University in Weslaco, TX. Lori was a great asset to the Southern Region IR-4 program and IR-4 in general. She started working with

IR-4 in August, 1995 and continued until 2014. Lori did great work and was always supportive of the program. She was always willing to participate in

training activities and communicating with other FRDs to help whenever needed. Lori is greatly missed but we all wish her the best with her new adventures.

We would like to welcome Cristina Marconi who will

Lori Gregg performing an equipment check.



The Southern Region welcomes new region 6 FRD Cristina Marconi to the IR-4 project.

become the new FRD at Texas A&M in Weslaco. Cristina started with the IR-4 Weslaco center in July 2014. Cristina comes to us with a Master's degree in Genetic Plant Breeding. Her specialization is in Soil Management. Cristina has begun her training on SOPs, GLPs, eQA, and general knowledge of the IR-4 program. We all look forward to working with her. 🌱

Rutgers, The State University of New Jersey • University of California • Cornell University • University of Florida • Michigan State University

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