The IR-4 Project
Pest Management Solutions for Specialty Crops and Minor Uses

Newsletter

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Thank You Bob Hollingworth! Welcome John Wise

In June, IR-4's North Central Region (NCR) Director, Bob Hollingworth will retire. Bob has been involved with IR-4 serving on the Project Management Committee (PMC, formerly known as the Technical Committee) since 1987. While he will step down as director, he will maintain his involvement with IR-4 through June of 2015.

Bob became Professor Emeritus in 1997 but continued several activities at MSU including acting as Director of the NCR IR-4 Project. During these years, Bob maintained the collaboration of 12 NCR states and was involved in the operation and upgrade of a modern IR-4 residue analytical laboratory at MSU.

In addition to working with IR-4, Bob has published approximately 130 reviewed articles and has edited or co-edited 8 books. For several years, he has acted as consultant on food safety issues on the Gates Foundation Grant to educate regulators for GMOs in Africa. He has taught modules on risk assessment and regulation for both chemical and biotechnological risks in foods in several international summer courses as well as at invitational meetings in a variety of countries. He has also served on a variety of state, national and international government panels and commissions dealing with pesticide and food safety issues, and has received awards from both the USDA and the American Chemical Society for his research in these areas.

IR-4 wishes to thank Bob for his many years of service to the IR-4 Project and for his leadership in steering the NCR through times of triumph and challenge, always with great distinction.

On July 1, 2014, John Wise, a professor in the MSU Department of Entomology, and Research and Extension Coordinator of the MSU Trevor Nichols Research Center in Fennville, MI, will become the NCR IR-4 Director. John received a B.S. in Natural Resources in 1984 from the University of Michigan, M.S. in Entomology in 1990 and a Ph.D. in Resource Development in 1999 from MSU. His primary research interest is studying the performance characteristics of new insecticide chemistries for control of fruit insect pests. He

continued on pg 2

Inside this issue...

Executive Director Notes

Dear Friends,

Spring is the time when many Headquarters team members visit agricultural chemical companies in order to help plan the following year's research. During these meetings we receive updates on the status of ongoing research and regulatory activities, exchange ideas on improving efficiency and discuss trends. IR-4's "Company Tour 2014" is partially complete, however, two striking trends have already emerged: biopesticides are being mainstreamed by conventional chemical companies, and there is increased emphasis on international activities.

The biopesticide focus became clearer with Bayer Crop Science's purchase of Agraquest for $0.5 Billion. Agraquest products have been integrated into Bayer's conventional chemical portfolio with the biopesticides to be used as part of a resistance management program or used for late season applications to reduce residues. Several other major companies are also investing in development and sales of new biopesticide products.

Responding to this trend, IR-4 is making fundamental changes in the biopesticide program. IR-4 will no longer solicit grant proposals but will focus on developing biopesticide efficacy data. The program will focus more on establishing a limited number of priorities on pest management voids and investigating if available biopesticides can provide a solution for the pest problem. To initiate this new process, IR-4 will host a Biopesticide Priority Setting Workshop that will be held immediately following this year's Food Use Workshop. Please contact Michael Braverman (braverman@aesop.rutgers.edu) or Bill Barney (barney@aesop.rutgers.edu) for more information about this new workshop process.

The other trend with the companies is a greater concern for harmonization of Maximum Residue Levels (MRLs or pesticide tolerances) with international trading partners. This issue is not new but more and more emphasis is being placed in minimizing problems with MRLs. IR-4 continues to take a strong leadership role in global harmonization of MRLs, with efforts funded through USDA-Foreign Agriculture Service, and IR-4 wishes to thank USDA-FAS for the resources to assist in this important area.

IR-4's international vision is to have a global network of qualified "IR-4-Like" programs cooperating on data development to support harmonized MRL's for specialty crops. This vision is founded on IR-4's activities with Canada's Pest Management Centre-Minor Use Programme. When a use is a priority in both countries, we work on the research together and submit the joint data to regulatory authorities in both countries. This model has been very successful and IR-4 wishes to offer congratulations to the Canadian Pest Management Centre as they celebrate their 10-year anniversary!

Also, hot off the presses, the Australian government will significantly expand their minor use program with a new investment of 8 million Australian dollars.

All the best — Jerry

John Wise

continued from pg. 1

also investigates alternative delivery systems for crop protection materials in fruit agroecosystems. John runs the Applied Insecticide Toxicology lab on the MSU campus, conducting research on the performance mechanisms and plant penetration attributes of pesticides, pesticide environmental fate and arthropod resistance.

He has developed a wide range of Integrated Pest Management and Good Agriculture Practices training programs, targeting large commercial farms as well as small underserved grower communities. These training programs have led to opportunities to offer training venues in other US states, like Wisconsin, Ohio, Indiana and New Jersey, as well as international train-the-trainer events in Chile, Mexico, Rwanda and India.

John has been a Field Research Director (FRD) for the IR-4 GLP field residue program in the north-central region for more than fifteen years. His research and team at Fennville were the feature article in IR-4's Focus on a Researcher Volume 38 Number 3 in July of 2007. John has also agreed to join the IR-4 Newsletter Committee representing the PMC and bringing an FRD perspective to the newsletter. Welcome John!

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.

CYANTRANILIPROLE (Cyazypyr®) (Insecticide - DuPont)

Introduction: On Feb. 5, 2014, tolerances were established by the EPA for the new active ingredient (AI) cyantraniliprole (Cyazypyr®) on multiple commodities. Regulatory scientists from EPA and counterpart agencies from several other countries conducted a global joint review of the dossier. This AI, discovered by DuPont, belongs to the anthranilic diamide class of chemistry. It is the second AI in this chemistry, but the first to provide growers with a new pest management tool for cross-spectrum control of chewing and sucking/sap-feeding pests. DuPont has developed single AI products, and two of those have been registered and approved by EPA under the brand names Exirel™ and Verimark™. Syngenta Crop Protection has rights to develop pre-mixes. With no cross resistance to other classes of insecticides, cyantraniliprole may be especially useful against target pests that have developed resistance to other insecticides. It is classified as a Group 28 insecticide by the Insecticide Resistance Action Committee (IRAC).

Other global registrations: Argentina, Australia, Canada, China; more country registrations are expected in the near future

US trade names/formulations: Exirel™ (0.83 lb AI/gal) and Verimark™ (1.67 lb AI/gal)

US labeled crops *

Exirel™ – bulb vegetables (crop group 3-07), leafy vegetables (crop group 4), Brassica leafy vegetables (crop group 5), fruiting vegetables (crop group 8-10), cucurbit vegetables (crop group 9), commercial crops grown to harvest in greenhouses (eggplant, bell/non-bell pepper, tomato), citrus fruit (crop group 10-10), pome fruit (crop group 11-10), stone fruit (crop group 12), bushberries (crop subgroup 13-07B), tree nuts (crop group 14-12)

Verimark™ – tuberous and corm vegetables (crop subgroup 1C), leafy vegetables (crop group 4), Brassica leafy vegetables (crop group 5), fruiting vegetables (crop group 8-10), cucurbit vegetables (crop group 9), citrus fruit (crop group 10-10, only for trees under 5 feet tall)

Ongoing IR-4 residue projects (PR#):

2009 – cranberry (10199); 2010 – GH cucumbers (10313); 2011 – carrot (10364), radish (10641), sunflower (10640 [& 10639]); 2012 – coffee (10874); 2013 – caneberry (11046), strawberry (10328)

Other researchable IR-4 database requests: ginseng (10731), GH lettuce (10327), papaya (11300)

PYRIFLUQUINAZON (Insecticide – Nichino America, Inc.)

Introduction: Unconditional registration for the new active ingredient (AI) pyrifluquinazon was granted by the EPA in January 2013 for non-food uses on ornamental horticulture plants grown in greenhouses. This new chemical registration provides greenhouse growers with a new pest management tool for use against various sucking (sap-feeding) insects such as whiteflies (including Q-biotype), aphids, mealybugs, leafhoppers and chilli thrips. Belonging to a novel class of chemistry, pyrifluquinazon represents a new mode of action, characterized by modification of insect feeding behavior (through contact and translaminar activity) which has not yet been classified by the Insecticide Resistance Action Committee (IRAC).

Other global registrations: Japan (for outdoor uses on over 20 food crops) and Korea

US trade names/formulations: For ornamental horticulture uses, pyrifluquinazon will be marketed by SePRO as Rycar™ (20SC).

US labeled crops*:

Known tolerant ornamental horticulture crops (although pyrfluquinazon can be applied after testing other species): Begonia, Impatiens, Marigold, Petunia, Verbena, Zinnia

General use pattern for non-food greenhouse uses: use in dilution rates of 1.6-6.4 fl. oz./100 gal, applied at a rate of 10 gal of spray solution/1,000 ft2, and maximum of 2 applications per crop cycle.

IR-4 Ornamental Horticulture Program current research: thrips outdoors, leafminers, crop safety.

IR-4 food use project requests (PR#) progressing toward registration: cantaloupe (10431), cucumber (10428), greenhouse cucumber (10793), greenhouse lettuce, head and leaf (11202), bell and non-bell pepper (10430), greenhouse bell pepper (10555), greenhouse tomato (10126), squash (10429), watermelon (10432)

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

Boxwoods, Boxwoods, Boxwoods, and not a Crop to Clip

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

At least that is the way it seemed at the second Boxwood Summit held at the National Agriculture Library in Beltsville, MD. This gathering of boxwood researchers, extension personnel and boxwood aficionados offered an opportunity to present the latest and greatest research results and discuss the next important research directions to preserve boxwoods against leaf miners, *Volutella* and, of course, the devastating boxwood blight.

Welcomed by Dr. Joseph Spence, the USDA-ARS Area Director for Beltsville highlighted historical happenings and introduced us to some of the interesting sites in the area.

The stage was set with Bennett Saunders showcasing his family's operation (Saunders Brothers, Inc.) which is about to celebrate 100 years in 2015. Over the years Saunders Brothers has grown many different crops including apples, peaches, annual vegetables and boxwoods. The secret to their success is diversity and flexibility, and a strong respect for family and community ties, as evidenced by Bennett's slides peppered with family members through the ups and downs of growing crops for so many years. Boxwood blight has shifted the Saunders Brothers operation again. While freely welcoming visitors in the past to browse their fields, now visitors must wear Tyvek suits and booties to prevent any accidental introduction of this devastating disease.

While boxwood blight dominated the conversations throughout the day, Richard Olsen (US National Arboretum) discussed the various breeding efforts for various traits including leafminer resistance. Mike Raupp (University of Maryland) presented biological characteristics of and management options for boxwood leafminer, and Beatrice Henricot (Royal Horticulture Society) conveyed information about *Volutella* blight, boxwood rust, *Phytophthora*, and the boxwood tree moth, an insect so far confined to portions of Europe.

Then, the focus became the research efforts on boxwood blight. Kurt Heungens (Institute for Agriculture and Fisheries Research) presented some of the key epidemiological findings from his laboratory including that clothing and utensils can carry the conidia and cause infections and that there are two distinct genetic types named G1 and G2, with G2 having been introduced later into Europe. Building on Heungens work,

Photo by Cristi Palmer

JoAnne Crouch (USDA-ARS) presented evidence that the two different genotypes may be two different species.
Len Coop (Oregon State University) demonstrated the power of using an epidemiological model to predict whether growers may need to consider preventative fungicide applications based on the length of time for adequate moisture and temperatures needed for conidia germination.
Studying the laboratory diagnosis of boxwood blight using HIS3 and ITS PCR, Bob Marra (Connecticut Agricultural Experiment Station) examined early infection and determined the fungus can be detected as early as one day after inoculation, prior to development of visual symptoms, and in water and soil samples.

Norm Dart (Virginia Department of Agriculture and Consumer Services) presented part of his epidemiological research on conidia and microsclerotia. Conidia are usually short-lived surviving about one week in soil at 300% field capacity, while microsclerotia under the same

soil conditions survived longer than 40 weeks. There are approximately 3,250 microsclerotia per boxwood leaf. If a boxwood plant has roughly 1,000 leaves, and that amount is typical of a small 2 – 3 foot shrub, an infected boxwood plant that has dropped its leaves has contributed more than 3 million microslerotia to about 9 sq ft of soil surface.

Photo by Gail Wisler

Complementing Dart's studies, Nina Shishkoff (USDA-ARS) examined whether infected leaves held at different temperatures with either dry or wet moisture will sporulate. Conidia formed on leaves that were wet from 0 to 20C while fewer conidia formed on all the dry leaves and on wet leaves at -10 and 30C . Microslerotia survived at both moisture levels and up 20C.

Sanitizing agents were effective at killing conidia (Sharon Douglas, Connecticut Agricultural Experiment Station). Label rates of bleach, Lysol, ZeroTol, OxiDate, and X3 were effective after 5 minutes. For microslerotia (Shishkoff), ethanol and ZeroTol were effective at 15 minutes.

Kelly Ivors (California Polytechnic Institute) ended formal presentations with slides ranging from showing symptoms *in situ* in 110 year old plantings to potential animal and bird spore vectors to the diversity of host resistance and fungicide management options.
We then moved into breakout sessions where we discussed research gaps for management of pests and pathogens, breeding for boxwood tolerance, and boxwood blight biology and epidemiology. Across all three sessions, it quickly became clear there were more questions than answers.

For the Management session, one of the gaps is understanding efficacy of tank mixing fungicides and insecticides for reducing populations of leafminer while at the same time managing boxwood blight. The other key questions are whether mulch can be used to reduce splashing of inoculum from the soil to the lower leaves and whether altering pruning practices to have more open canopies can reduce disease development and spread.

For the Breeding session, there were a number of research gaps identified including clarification of techniques to assess host resistance or tolerance and even what those terms mean for the boxwood/boxwood blight system. There is also the need to establish test plots in locations where boxwood blight has already been diagnosed so that new cultivars and species can be examined over several years under field level inoculum loads.

For Biology and Epidemiology, understanding survival parameters and the role of the sticky matrix surrounding the conidia are gaps in knowledge as are gathering empirical data in the US for how boxwood blight is affected by relative humidity, rain events, temperature, and pathogen movement through monitoring specific weather and disease development.

By the end of the Boxwood Summit, we became convinced that while this disease has been well studied over the last few years, more efforts are needed to protect this valuable plant for generations to come.

Boxwood Summit Organizing Committee
Jo Anne Crouch, USDA-ARS Beltsville
Margery Daughtrey, Cornell University LIHREC
Sharon Douglas, CT Ag. Exp. Station
Kelly Ivors, CalPoly
Cristi Palmer,IR-4 @ Rutgers University
Nina Shishkoff, USDA-ARS Fort Detrick
On behalf of the Boxwood Blight Working Group

IR-4's Effort to Combat "Laurel Wilt": A Threat to the Florida Avocado Growers

— by Michelle Samuel-Foo, IR-4 Southern Region Field Coordinator; Kathryn Homa, IR-4 Research Coordinator, Fungicides; and Jonathan Crane, Professor, University of Florida TREC

An aerial view of a typical avocado grove in South Florida quickly reveals the tell-tale sign that evokes trepidation among growers. Large, conspicuous patches of brown leaves among a sea of bright green canopies, that seemingly appear overnight. The culprits behind this phenomenon are redbay ambrosia (RBAB) beetles (*Xylebporus glabratus*) and their fungal symbiont *Raffaelea lauricola*. The fungus causes "Laurel Wilt" which is a devastating disease of redbays (*Persea borbonia*), avocadoes (*Persea Americana*) and other members of the Lauraceae family. The tiny beetles (~2mm in length) are exotic wood-borers that are native to South East Asia (India, Japan, Myanmar and Taiwan). Initial detection in the United States was near Savannah Georgia in 2002, in a survey trap. It is believed that the pest was accidently introduced into the US through some type of wood shipping material (e.g. wooden crate or pallet) at an overseas entry port. Accidental introductions of invasive species are unfortunately not uncommon and can be quite expensive to control. The discovery of the beetles did not raise serious concerns at the time as they were not known to cause significant tree mortality in their native ranges. By 2003 however, the beetle and its symbiont fungus were deemed responsible for redbay die-off's in Georgia and South Carolina. The pest was first discovered on redbays in Florida in 2005 (Duval county) and since that time, laurel wilt has spread as far south as Miami-Dade county where it is now threatening commercial groves and homeowner plantings.

An untreated avocado tree in a commercial planting that has succumbed to laurel wilt disease. *Photo by Jonathan Crane*

Most Ambrosia beetle species are attracted to stressed, dying or dead trees and plants. The plants may be stressed due to a number of factors such as drought, flooding, freezing temperatures etc. This is in contrast to the redbay ambrosia beetle which attacks healthy trees. Recent data has demonstrated that up to seven ambrosia beetle species are contaminated with the laurel wilt pathogen and two have been confirmed capable of transmitting the disease. Ambrosia beetles make pin-hole sized borings into the sapwood of the host trees creating galleries that become inoculated with the fungal pathogen. The spores eventually germinate and infect the host plant tissue. As the fungus spreads, the flow of water and nutrients in the xylem and phloem of the host tree becomes disrupted causing them to wilt and eventually die. As the fungus grows on the living wood of the trees, feeding on its sapwood, the beetle and its larvae that were hatched from the galleries, feed upon it. Following pupation, adult females carrying the *Raffaelea* fungus in their specialized mycangia (fungal carrying sacs) disperse and inoculate neighboring trees.

Laurel wilt poses a serious threat to Florida's avocado industry which covers about 7,400 acres and is estimated to be worth about $13 million annually. At present, recommendations to curtail the spread of the disease involve removal and destruction of infested trees. In an effort to aid in controlling this devastating disease, IR-4 is working closely with researchers at the University of Florida's Tropical Research and Education center in Homestead, along with cooperators at University of Puerto Rico Mayaguez and University of California Davis, to

Passive infusion system used in the Homestead FL trial. Blue dye is being used here to for illustrative purposes only.

Photo by Jonathan Crane

procure a registration for the fungicide propiconazole (Tilt) to protect the avocado trees.
This study is unique in that test material is applied directly into the avocado tree via trunk injections and root flair infusions. In this type of application, the test substance (propiconazole) is introduced systemically into the xylem (water and nutrient conducting tissue) of the tree. The application methods that are being used for the IR-4 study are passive and pressurized infusions via the flair roots (surface roots emerging from the base of the tree) and injections into the trunk using large syringes. With the pressurized infusion system, the test substance is injected into the xylem of the flair roots of the tree using a hand-held pressurized sprayer with a pressure gauge that is attached to vinyl tubing with macro-infusion tees. In the passive infusion system, an IV bag containing the test substance is hung from a branch on the tree, and the vinyl tubing attached to macro-infusion tees are inserted into the xylem of the flair roots. The test substance is then passively absorbed by the tree. To help visualize this, picture an IV treatment that a person would receive at a hospital. Both of these systems are low in cost and reusable although there are advantages and disadvantages to both methods of delivery. The passive system is less expensive to build, but can be slower. Although the pressurized system is faster, the system needs to be monitored for pressure loss during uptake. With both systems, the rate at which the fungicide is taken up depends on weather conditions and the physiological activities going on in the tree including growth and flowering. Applications can take anywhere from 20 minutes to overnight to complete. It should also be noted that the site must be prepared before beginning infusion applications. Debris from the base of the tree must be removed to expose the top section of the flair roots and the orchards need to be continuously irrigated ahead of the applications. Holes into which the macro-infusion tees will be inserted also have to be drilled. The rate of propiconazole being applied is calculated according to the size of the trunk diameter. Macro-infusion tees must be disinfected between infusions conducted on each tree.
The use pattern that is being tested in the IR-4 residue study includes 2 applications at intervals of 90 (± 7) days with pre-harvest intervals (PHI) being proposed at 0 and 7 days. Two trials (one at each field site) were conducted in Homestead, Florida and Riverside, California during 2013. In 2014, trials sites will include Homestead Florida, Juana Diaz, Puerto Rico and Riverside, California.
Currently, the use of the 'spot treatment' method is the recommended method used in order to protect avocado trees that are adjacent to avocado trees that are infected with Laurel Wilt disease. This method stops root transmission of the pathogen. Efficacy work conducted in Homestead, Florida by Dr. Jonathan Crane and others has demonstrated that infusion treatments have resulted in mature avocado trees being protected for approximately 18 months from the Laurel Wilt pathogen. When registered, propiconazole treatments will become a key component in controlling the spread of Laurel Wilt, along with maintaining tree health, sanitation, complete removal and destruction of infected trees, and direct control of ambrosia beetles via insecticides.

Layout of the pressurized infusion system is inserted into base of the tree and into its flare roots. The anatomy of the tree facilitates the uptake and spread of the fungicide. *Photo by Jonathan Crane*

Feature

Pheromone-Based Mating Disru
Dates and Results in New Regist

In the United States, commercial date, *Phoenix dactylifera* L., production occurs predominantly in the Coachella Valley (Riverside Co., CA), although recent plantings of dates have taken place in the Bard/Winterhaven area of Imperial Co., CA, and near Yuma AZ. In 2012, dates were harvested from 8400 acres, producing a crop worth $41.6 million (USDA 2013). Two varieties make up most of this production, Deglet Noor and Medjool. These dates are subject to attack by the carob moth, *Ectomyelois ceratoniae* (Zeller) (Figure 1), which first was observed in California in 1982 (CDFA 1983). Currently, it is the primary economic pest of commercial dates; fruit infested with larvae (Figure 2) can cause damage reaching 10-40% to the harvestable crop each year (Warner 1990a, Nay et al. 2006).

Figure 1. Carob moth, *Ectomyelois ceratoniae* (Zeller), adult on date fruit.

Figure 2. Carob moth, *Ectomyelois ceratoniae* (Zeller), larvae in date fruit.

Various carob moth management strategies are available for growers. These include over-winter (Carpenter and Elmer 1978) and in-season (Warner et al. 1990a, 1990b) removal of waste dates that fall to the garden floor. Dislodging abscised kimri dates (fully expanded, green dates) and khalal dates (fully expanded, brown, unripe dates) from bunches during August with a bunch cleaning tool (Nay et al. 2006, 2007) exposes larvae in the fruit to predation and heat (Nay and Perring 2005). Another strategy is center cut strand thinning of date bunches to facilitate abscised fruit drop to the ground (Nay and Perring 2009). Also, mesh bags can be used to exclude carob moth from the date bunch (Perring, unpublished data). In addition to these methods, there are 3 registered insecticides: Delegate (spirodiclofen), Intrepid (methoxyfenozide), which was registered through support by IR-4, and Malathion dust. Malathion dust (Figure 3) was the industry standard until 2010, when environmental concerns and the emergence of new chemicals and technologies, resulted in growers no longer using this material.

Mating disruption involves the use of a pheromone scent to interfere with male moths locating females. Through the collaborative efforts of the University of California, Riverside, ISCA Technologies, Inc., and the California Date Commission, a formate mimic of carob moth pheromone (Z7, E9, 11-dodecatrienyl formate), mixed in a 2% formulation with a biodegradable wax carrier (SPLAT®), was developed. This formulation, SPLAT EC™ (SPLAT *Ectomyelois ceratoniae)*, when applied in a 2.5 g "dollop" (Figure 4) to the date palm trunk (Figure 5) resulted in very low male trap counts, suggesting that males were confused by the pheromone scent and were unable to locate females. More importantly, a one-time application of SPLAT EC™ provided season-long control, resulting in a similar number of carob-moth infested fruit as the Malathion treatments, and significantly fewer infested fruit compared to non-treated controls.

Figure 3. Applicatio Malathion dust for c control in dates.

Figure 4. Sl EC-O "doll date palm t

Figure 5. Applic EC-O on date p hand applicator.

In 2007-2008, with Malathion as the only registered chemical for use against the carob moth, the IR-4 Biopesticide Grant Program funded a project to

ption Reduces Pest Attack on ration

—by Tom Perring,UC Riverside; Michael Braverman, IR-4 Biopesticide and Organic Support Program Manager; Agenor Mafra-Neto, President, ISCA Technologies, Inc. Riverside CA

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study the impact of application timing of SPLAT EC™ on male trap catches and subsequent fruit infestation. The results from this research showed that an application in early August did not protect the crop through the growing season, whereas an application in early September provided control. This prompted a second study funded in 2009-2010 by the Grant Program to evaluate application timing, placement in the date palm, and rate of SPLAT EC™ on trap shutdown and carob moth-infestation of dates at harvest. These parameters all have bearing on the final cost and adoption of the mating disruption strategy.

Studies were conducted using large plots (4 acres = approx. 200 palm trees) replicated 3 times. Experiments in 2009 showed that early August treatments resulted in trap shutdown. However, this did not hold through the season. A second treatment reduced the male moth catches. At harvest, there were no differences in the three timing treatments. Given that it is more expensive to apply multiple times throughout a season, a single application time around the first week of September appears best. In 2010, three rates (4%, 3%, and 1%) of the pheromone mimic were evaluated. With respect to the rate of application, all three rates shut down trap counts and had comparable infestations at the end of the season. This suggests that growers could apply 1%, 2% or 4% rates and achieve the same result. However, the study in 2010 showed higher male moth counts in late September and October than in 2009, and the overall infestation was higher in 2010 than 2009. This may have resulted from an overall lower amount of SPLAT EC™ that was distributed in the date garden in 2010 as compared to 2009, which resulted in more males finding females. This, in turn, resulted in a higher general infestation in the field in 2010. Based on these studies, a 4% application of SPLAT EC™ (2% in bunches and 2% on the trunk at chest height) during the first week of September consistently led to positive results over the past four years of study. Males are confused because they can't find a female to mate with. Mating disruption with a carob moth pheromone mimic protects the harvestable crop and is as effective as Malathion dust.

Registration

ISCA Technologies, Inc. (Riverside, CA) synthesized the carob moth pheromone mimic (Z7, E9, 11-dodecatrienyl formate) and developed and optimized the use of SPLAT® (Specialized Pheromone & Lure Application Technology) to apply the material. With the current label SPLAT EC-O (SPLAT *Ectomyelois ceratoniae* Organic), ISCA has provided US date growers access to semiochemical pest management tools that are as effective as synthetic chemicals. In 2012, IR-4 set up a meeting for ISCA Technologies with EPA to discuss the registration requirements. IR-4 also consulted in the development of some of the regulatory packages submitted to EPA. With some additional follow-up by ISCA Technologies, the carob moth pheromone active ingredient and user product, SPLAT EC-O, became registered with EPA at the national level in 2013. Registration at the state level ensued, and in April 2014 the product was approved by the California Environmental Protection Agency (Cal/EPA) for commercialization in the state.

ISCA Technologies has launched a regional marketing campaign

continued on page 13

Application of SPLAT pheromone using a hand applicator

IR-4 to Hold its First Biopesticide Workshop

—by Michael Braverman, Manager Biopesticide and Organic Support Program

The IR-4 Biopesticide Workshop will be held in Atlanta Georgia on September 10, 2014. Since 1995, the IR-4 biopesticide efficacy grant program has been based on receiving research proposals. Over the last 2 decades this has served us well, but there have been monumental changes in the industry and biopesticide technologies available and so, IR-4 is determined to address those changes. Foremost the workshop marks a shift to a system whereby grower needs are prioritized before deciding what products to evaluate. Biopesticides represent the diversity ranging from organics to biotechnology, and IR-4 is committed to embrace the full range of pest management tools.

The meeting will consist of presentations of research successes, exploration of needs and potential tools to fit the needs. These will fit within the context of the overall strategy of integration of biopesticides into conventional agriculture, resistance management, utilization of biopesticides for residue mitigation of conventional pesticides to avoid trade barriers, organic agriculture and biotechnology opportunities.

The scope of crops will include all specialty crops such as fruits and vegetables, ornamental horticulture and it will also include public health biopesticides.

The process will start with the collection of needs. To submit a request and for more information about the Workshop visit ir4.rutgers.edu. An exceptional group of expert speakers will include Ralph Scorza of ARS speaking about horticultural biotechnology, Steve Duke of ARS on weed management, Mark Whalon of Michigan State University on organic pest management and fruit insect management, and Jason Sandhal of USDA-FAS on residue mitigation.The meeting will culminate with an opportunity to vote on the highest crop-pest management needs. Mark your calendars for September 10th. Attend, discover and vote!

IR-4 Commodity Icon to Retire

It is with mixed emotions that we share that IR-4's long time friend, Rocky Lundy, has announced his decision to retire from his position with the Mint Industry Research Council. Since 1992, Rocky has served on the IR-4 Commodity Liaison Committee, first as an active member, then as Chair of the Committee from 1999 to 2012, and most recently as Chair, Emeritus. Rocky was never shy in taking the necessary moves to help his beloved IR-4 meet its challenges. To honor Rocky, the IR-4 Project Management Committee added him to the IR-4 Hall of Fame during the March 2014 meeting. The following words best describe Rocky's support for IR-4:

Rocky put his heart and soul into keeping IR-4 on the appropriate path to help mint and other specialty crop growers find solutions for their pest management problems. His efforts helped facilitate unprecedented expansion within the IR-4 Project. Equally important, Rocky often led fierce battles to protect IR-4 from funding cuts and government bureaucratic changes that threatened the Project.

Enjoy this new beginning as you retire Rocky. All of us at IR-4 will miss you!

Meet Rob Hedberg

In January 2014, Rob Hedberg was appointed to serve as the National Program Leader for Minor Use Pesticides in addition to his existing role as National Director for the Sustainable Agriculture Research and Education Program, a position he has held since January 2009. Both of these positions rely on active engagement with national and regional partnerships to guide highly relevant science targeted to solving growers' needs and concerns.

Hedberg has worked at USDA since 2005, first as a Science Policy and Legislative Affairs Advisor for CSREES and later as Acting Director of Legislative and Inter-governmental Affairs for the Research Education and Economics Mission area from 2007-2008.

Prior to joining USDA Hedberg acquired significant agricultural science policy experience from work on the staff of the U.S. Senate Agriculture Committee as an American Association for the Advancement of Science (AAAS) Fellow and as Director of Science Policy for the National and Regional Weed Science Societies.

Hedberg gained practical field experience in both the public and private sectors from positions as the director of agronomic business for a regional farm cooperative and as

Rob Hedberg left, with Jerry Baron at the IR-4/IPM Summit held at NIFA in October, 2012

a regional agronomy agent for the University of Vermont Extension service and as the owner of a crop consulting and research business.

After growing up on a small farm in Michigan, Hedberg received a Bachelor's degree in Crop and Soil Science from Michigan State University, a Master's degree in Plant Science from the University of New Hampshire and a Certificate of Graduate Studies in Management and Administration at Harvard University.

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Editor: Sherrilynn Novack
IR-4 Public Relations and Communication Manager, 732.932.9575 x 4632, novack@aesop.rutgers.edu

Newsletter Committee:
Northeast Regional Field Coordinator, **Edith Lurvey**, 315.787.2308.
North Central Regional Director, **Bob Hollingworth,** 517.432.7718.
Western Regional Assistant Field Coordinator, **Stephen Flanagan,** 541.688.3155.
Southern Regional Field Coordinator, **Michelle Samuel-Foo,** 352-392-1978 ext 406
Southern Region Program Assistant/Quality Assurance Support **Robin Federline** 352.392.1978 x 424.
Commodity Liaison Committee member, **Mike Bledsoe,** 407-493-3933 of Village Farms.

IR-4 HQ, 732.932.9575
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Research Analyst, **Kathryn Homa** x 4604

"All Natural" Mosquito Control?

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

Mosquito control has long made use of biocontrol and biopesticides, although the effectiveness of these "natural" control measures has been debated and their popularity has waxed and waned relative to "conventional" pesticides. Recently there has been significant interest in reducing the use of synthetic chemicals in vector control and elsewhere, and a range of traditional and novel practices have been suggested as alternatives. This article reviews some biological and biochemical approaches to mosquito management and discusses whether "all-natural" mosquito control is feasible.

The "mosquitofish" *Gambusia affinis*

A wide range of predators and pathogens help limit mosquito populations in nature and several have been adopted as mosquito control interventions. Rearing and stocking fish so that they can eat mosquito larvae is a time-honored form of biological control, to the extent that the top-minnow *Gambusia affinis* is widely known as the "mosquitofish." Applying natural products, such as oils of citronella or lemon eucalyptus, to the skin to repel adult mosquitoes is intended to reduce biting and the risk of disease transmission without reducing vector populations. Ditching is a form of habitat management used primarily to encourage dispersal of predaceous fish. The bacteria *Bacillus thuringiensis israelensis* (Bti) and *Bacillus sphaericus* (Bs) are both sold as EPA-registered biopesticides, but Bti is dead when applied to mosquito habitats while Bs is applied as a live culture with hopes that it will persist and grow. Methoprene is a synthetic insect juvenile hormone mimic which prevents emergence of adult mosquitoes without actually killing them. Oil from the chrysanthemum species known as pyrethrum includes natural biochemicals that are toxic to mosquitoes. Thus, it is possible to distinguish naturally-derived from synthetic chemicals, but it is difficult to make meaningful general statements about "natural" approaches to mosquito control.

As with synthetics, biocontrol organisms and natural products can target different mosquito life stages, and can be used either to kill or to repel pests. Mosquito biocontrol usually aims at killing larval mosquitoes, as this is the life stage that is most concentrated and least able to avoid predators. In addition to fish, predaceous aquatic beetles and other invertebrates can be encouraged with habitat manipulation. Bats and birds will sometimes eat adult mosquitoes, but do not effectively reduce mosquito populations; dragonflies are good predators of adult mosquito but hard to rear. Plant oils can be used to kill larval mosquitoes but require large quantities for effective control. On the other hand, many plant oils repel mosquitoes if one is willing to reapply frequently, and pyrethrum is very toxic to adult mosquitoes in small quantities. This means that botanical extracts are effectively used by individuals to repel adult mosquitoes and by organized programs to kill them; the markets for both of these product types is large and growing.

Citronella & its Oil

Some new biological materials and new application methods appear promising. Many strains

continued on next page

Pyrethrum flowers, the source for pyrethrins

Carob Moth

continued from page 9

aimed towards SPLAT EC-O availability to date growers. Other than removal of waste dates and using mesh bags, both of which can be expensive and very labor intensive, this is the only organic solution for the control of carob moth. The response in the date industry has been strong, and ISCA Technologies expects a fast adoption of the product in the date industry. Since this mating disruption product has been developed in close partnership between all of the stakeholders, including date growers, funding agencies (IR4 and USDA), academia (UCR) and private industry (ISCA Technologies), SPLAT EC-O is gaining popularity in the Coachella Valley.

Acknowledgement

We wish to thank the California Date Commission and Chairman, Albert Keck, for their support of this project.

References Cited

Carpenter, J. B., and H. S. Elmer. 1978. Pests and diseases of the date palm. USDA Agricultural Handbook No. 527.

(CDFA) California Department of Food and Agriculture. 1983. Carob moth in California, pp. 11-14. In R. Gill and S. Kaiser (eds.) California plant pest and disease report, vol. 2. CDFA, Sacramento.

Nay, J. E., E. A. Boyd, and T. M. Perring. 2006. Reduction of carob moth in 'Deglet Noor' dates using a bunch cleaning tool. Crop Protection 25: 758-765.

Nay, J.E. and T. M. Perring. 2005. Impact of ant predation and heat on carob moth (Lepidoptera: Pyralidae) mortality in California date gardens. J. Econ. Entomol. 725-731.

Nay, J. E., Y. L. Park, and T. M. Perring. 2007. Effect of bunch sanitation on spatial distribution of abscised fruit and phycitine moths (Lepidoptera: Pyralidae) in California date gardens. J. Econ. Entomol. 100: 1773-1780.

Nay, J. E., and T. M. Perring. 2009. Effect of center cut strand thinning on fruit abscission and Ectomyelois ceratoniae (Lepidoptera: Pyralidae) infestation in California date gardens. J. Econ. Entomol. 102: 948-953.

USDA 2013. Noncitrus fruits and nuts, 2012 preliminary summary. (usda.mannlib.cornell.edu/usda/current/NoncFruiNu/NoncFruiNu-01-25-2013.txt)

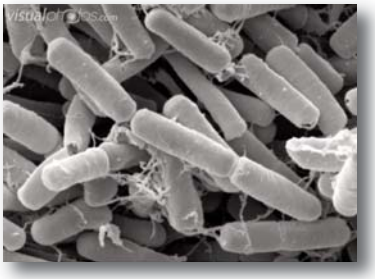
Warner, R. L., M. M. Barnes, and E. F. Laird. 1990a. Chemical control of a carob moth, Ectomyelois ceratoniae (Lepidoptera: Pyralidae), and various nitidulid beetles (Coleoptera: Nitidulidae) on 'Deglet Noor' dates in California. J. Econ. Entomol. 83: 2357-2361.

Warner, R. L., M. M. Barnes, and E. F. Laird. 1990b. Reduction of insect infestation and fungal infection by cultural practice in date gardens. Environ. Entomol. 19: 1618-1623.

Mosquitoes

continued from previous page

of entomopathogenic viruses and fungi have been screened for vector control use, and the fungus *Lagenidium giganteum* has been registered for mosquito control. In addition, botanical or bacterial extracts have been tested in volatile "spatial repellents" and in Attractive Toxic Sugar Baits, and short strands of RNA may form highly selective biopesticides. Public interest in natural products and their use in mosquito control is likely to increase. However, natural products vary in composition and effectiveness, are less potent than synthesized analogues, can be expensive, and are not as harmless as some may hope. They can have a significant role preventing mosquito bites, but it seems highly unlikely that they will fully replace synthetic chemical repellents, larvicides, or adulticides.



Bti bacteria forming spores

Varroa Mites in Honeybees Still a Major Concern

—by Michael Braverman, Manager Biopesticide & Organic Support Program

The Varroa mite *Varroa destructor* has been a pest in honeybees in the US since the 1980's. Varroa mites are a parasite that live on the outside of the bee's body and attack both adult and developing bees. The mite is consistently considered the primary pest in bees. While there are many theories on the cause of Colony Collapse Disorder, Varroa mite is thought to play a major role. The mite may be small to the eye but in comparison to the bee, it is huge. On a human scale, it has been described as being equivalent to the size of a dinner plate or basketball, sucking out the bee's hemolymph (blood-like fluids) and injecting viruses. The combination of fluid loss and disease can be devastating to the bee colony. Bees are extremely important in horticultural crops and pollination has been estimated to contribute 13 billion dollars in crop value to fruits and vegetables.

IR-4 has been assisting in the registration of several tools for managing Varroa mite including both conventional products and biopesticides. Just like plant mites, Varroa mites are champions when it comes to developing resistance to pesticides therefore new options for managing this pest are still needed. Several Section 18 registrations (Emergency use) have been approved by EPA over the last several years due to resistance issues including coumaphos (Check-Mite), fenproximate (Hivastan), hops beta acid (HopGuard) and amitraz (Apivar). IR-4 submitted the Section 3 registrations for coumaphos and hop beta acid. IR-4 also helped to get the first formic acid use approved as well as thymol (Api-Life Var) and sucrose octanoate (Sucrocide). Oxalic acid is also of interest to beekeepers, and IR-4 is still attempting to get this registered.


Varroa Mite on Honey Bee

Future developments in varroa mite control may include molecular approaches. An RNAi (RNA interference is explained in detail in IR-4 Newsletter Vol.45 No. 1) to decrease resistance of mites to some pesticides (through reductions in glutathione-S-transferase activity) has been developed but the method of efficiently administering this product is still under development. In addition, it would only overcome resistance issues so a pesticide would still be needed. Other RNAi approaches have been found to be possible in controlling several bee diseases. The fact that Varroa mite can transmit bee diseases (such as viruses) may enable Varroa to spread RNAi based products that manage bee viruses to other bees. Similarly, there has also been more recent evidence that a type of double stranded RNA (dsRNA) fed to honeybees in sucrose feeding solutions can be transferred to Varroa mites when mites suck on bee fluids. Several dsRNA targeting Varroa mites have been successfully transferred to Varroa mite including interference with the Varroa mites skeletal structure and cell death. These are still at the research phase.

Call for Nominations: IR-4 SOAR Award

The IR-4 Project has established the SOAR award to recognize those individuals who excel in serving growers of Specialty and Minor Use Crops. The awardees will have demonstrated clear Service toward enhancing the mission of IR-4 through participation on committees, advisory panels, or similar activities; excellent Outreach to growers educating growers on IR-4; Altruism by donating time and effort towards IR-4's mission; outstanding Research which contributes to expanded product labels and increased understanding of product use. In other words, awardees SOAR in supporting the IR-4 mission to provide growers registrations of new and expanded pest management tools.

The SOAR award will be given to a limited number of individuals annually, but no award will be given if there are no eligible nominees during a particular year. Awardees can be anyone associated with the IR-4 Project except active PMC members and active full-time IR-4 personnel. Past winners include: John Ahrens, Lori Berger, Dan Botts and Michael Benson.

The selected awardee(s) will demonstrate excellence in 3 of the 4 elements:

Service

- Such as Participation in standing committees and ad hoc committees
- Participation in advisory panels
- Participation in similar activities which enhance the direction and mission of IR-4

Outreach

- Such as Consistent vocal supporter of IR-4 with growers and/or Lawmakers
- Routinely includes recognition of IR-4 in print and visual media elevating IR-4's profile in the grower community

Altruism

- Such as Donation of time, extra research, plant materials, etc

Research

- Such as Participation in IR-4 Program for a minimum of 3 years
- Consistently produces stellar and timely research
- Research results contributed to new or enhanced product labels

The process to select awardee(s) will begin with a nomination made by peers or IR-4 personnel. Nominations must be made on the SOAR Award Nomination Form (found at www.ir4.rutgers.edu) and be accompanied by a minimum of 2 letters of support from individuals other than the nominator. Deadline for submission will be July 15, 2014. The SOAR award will be presented at a suitable venue.

Save the Dates

IUPAC Conference
August 10-14, 2014
San Francisco, CA

Northeast Regional Meeting
August 19 to 20, Best Western Airport, Albany, NY.
There will be a one day symposium on biopesticides in IPM and Organic Production in conjunction with this meeting
(half days Aug. 19 and 20).
Contact: Edith Lurvey
ell10@cornell.edu

North Central Regional Meeting
August 18-19, 2014
East Lansing, MI
Contact:Satoru Miyazaki
ncrir4@cns.msu.edu

2014 Food Use Workshop
September 9-10, 2014
The JW Marriott
Atlanta Buckhead, 3300 Lenox Road NE,
Atlanta, GA 30326-1333
Contact: Van Starner
starner@aesop.rutgers,edu

2014 Biopesticide & Organic Support Workshop
September 10, 2014
The JW Marriott
Atlanta Buckhead, 3300 Lenox Road NE,
Atlanta, GA 30326-1333
Contact: Michael Braverman
braverman@aesop.rutgers,edu

8th International IPM Symposium
March 23–26, 2015
Salt Lake City Utah

XXV International Congress of Entomology
September 25-30, 2016
Orlando, Florida

IR-4 Successes
February 2014 - April 2014

The trade names listed below are provided as a means to identify the chemical for which a tolerance has been established. A trade name listed here may not be the name of the product on which the new food use(s) will be registered. Only labeled products may be used on a food crop. Be sure to obtain current information about usage regulations and examine a current product label before applying any chemi-

Federal Register: Feb 07, 2014
Clothianidin
Trade Names: Arena, Belay
Crops: Green onion subgroup 3-07B, Papaya, Passionfruit, Spice subgroup 19B, Stone fruit group 12-12 (except cherry, chickasaw plum, and damson plum)
PR#: A10204, B10204, 11200

Federal Register: Feb 12, 2014
Linuron
Trade Name: Lorox
Crops: Cilantro/Coriander, Dill, Horseradish, Parsley, Dry Pea
PR#: 01625, 01432, 03609, 03035, 09651

Federal Register: Mar 05, 2014
Triflumizole
Trade Names: Procure, Terraguard
Crops: Greenhouse tomato, Small vine-climbing fruit (except fuzzy kiwifruit) subgroup 13-07F, Low-growing berry (except cranberry) subgroup 13-07G, Pome fruit group 11-10
PR#: 09299, 11048, 11049, 11050

Federal Register: Apr 02, 2014
Clomazone
Trade Name: Command
Crops: Head and stem Brassica subgroup 5A, Southern pea, Cowpea forage and hay, Rhubarb
PR#: A3569, 08934, 08724

The IR-4 Project
IR-4 Headquarters,
Rutgers, The State University
of New Jersey
500 College Road East
Suite 201 W
Princeton, NJ 08540

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