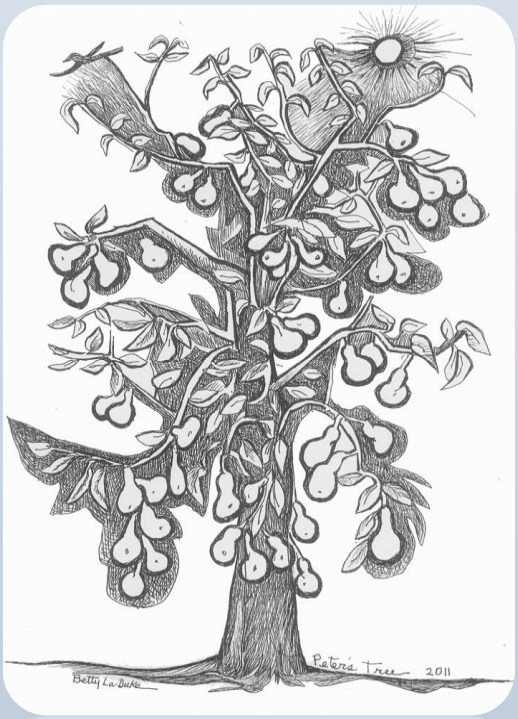


2015 Orchard Pest and Disease Management Conference

The 89th Conference is pleased to announce our keynote speaker:

Jay Brunner

Director and Professor of Entomology,
WSU Tree Fruit Research and Extension Center

Keynote Address:

Reflections on 45 Years of People, Projects, Places, and Purpose

Hilton Portland, Portland, Oregon
January 14-16, 2015

Dr. Jay F. Brunner

Dr. Brunner has been associated with tree fruit Entomology research and extension for 40 years. Dr. Brunner received his BA from Willamette University (1969), and his MS (1973) and PhD (1975) from Washington State University in Entomology. His first professional position was with Michigan State University as Assistant Professor in Entomology where he led the state's Tree Fruit Extension Pest Management Program (1975-1978) and conducted research on tree fruit pests.

During the last 37 years he has led a research and extension program at the Washington State University Tree Fruit Research and Extension Center in Wenatchee, and since 1998 has also served as Director of the Center. Dr. Brunner's research and extension focus has been in Integrated Pest Management, specializing in development of sampling methods and action thresholds, predictive models, biological control, mating disruption, insecticide control and mating disruption of tree fruit pests. He has published 82 peer review journal articles, eight book chapters, along with numerous Extension, popular articles, and technical reports, and mentored, or contributed to mentoring, 40 graduate students and post-docs.

In collaboration with colleagues, Dr. Brunner over his career has generated over $18 million in grant funding to support his program. In his role as director he oversaw the purchase and development of a new research orchard facility near Wenatchee and was instrumental in the Washington tree fruit industry donating $32 million in endowments to WSU for the support of tree fruit research and extension.

89th Annual Orchard Pest and Disease Management Conference

In Memoriam

Remembering those we lost in 2014

Michael J. Smirle passed away on July 27, 2014, at his home in Summerland, British Columbia (BC), while working in what he affectionately referred to as his Mother's garden. Mike graduated from the University of British Columbia in 1979 with a Bachelor of Science in Biochemistry. He completed his Masters and PhD degrees in Biological Sciences at Simon Fraser University in Burnaby, BC. Mike did a post-doctoral research fellowship at UBC with Dr. Murray Isman. Mike's post-doctoral research focused on the metabolism of secondary plant compounds in phytophagous insects. Mike joined the Pacific Agri-Food Research Centre (PARC) located in Summerland, BC in 1990. During his 24-plus years at PARC, Mike led a successful research team that focused on insect toxicology and determined the biochemical mechanisms of insecticide resistance. Outside of work, Mike's greatest joy was spending time with his boys. He loved every moment spent on the sidelines of soccer pitches and track and field venues, attending high school plays. Mike shared his lifelong love of as a regular organist at church, and singing with the Musaic Vocal Ensemble during his years in Summerland. Mike will be greatly missed by his family and friends.

Barry M. Wilk, co-founder of Scientific Methods, Inc., passed away on July 22, 2014. Barry lived an exciting and full life. For over 40 years, Barry's life work was devoted to sustainable agricultural practices and implementing IPM strategies. He was a consultant and friend to almond and walnut growers in California, but also traveled the world helping farmers and solving agricultural problems. As one grower put it at Barry's memorial service, "Barry would look at things from a different point of view. Even when he had bad news to deliver, it was always educational and light hearted". Barry was adventurous, curious, hard-working, and he loved people and life. He was highly regarded as an honest, intelligent, and gentle man. When Barry was not in the orchards, he could be found on the tennis court, playing basketball, reading, hiking, or playing poker with his lifelong friends. He is greatly missed by his family, friends and colleagues. Barry was an active member of WOPDMC.

Tom M. Burlando passed away at his home in Clarksburg, California on March 1, 2014. Born on August 24, 1951 in Stockton. Tom is survived by his wife Sandy and sons Michael and Christopher. Tom graduated from the University of California Davis with BSc in Botany and a Masters degree in Plant Pathology/Nematology. Tom worked at the University of California Davis as a Staff Research Associate for 18 years studying first nematodes of plants and later pathogens of insects. During this time Tom researched entomogenous nematodes, insect virus and bacterial diseases. Additionally Tom founded Western Diagnostic Service, a laboratory dedicated to analyzing soil for plant parasitic nematodes. In 1995 Tom joined Diamond Walnut Growers, the largest walnut handler in the world, as a field representative and plant manager. During his tenure with Diamond, Tom was responsible for a large territory handling more than 600 grower accounts. Responsibilities included all aspects of walnut production as well as pest and disease management. Tom joined Pacific Biocontrol in 2008 where he served as the Technical Sales Representative for California. Tom will be greatly missed by family, friends and his colleagues.

Orchard Pest and Disease Management Conference
Agenda for 2015 Conference

Note that the agenda is NOT a fixed time schedule and the actual time at which you are called to give your talk may vary. Below is the order in which the sessions will be given and the projected time slot in which they will occur.
Talks within a session will be in the order in which they are listed in the Table of Contents.

	Wednesday, January 14th
9:00 am	Opening Business—Jack Jenkins, OPDMC Chair, Steve Ela, Chair-elect
10:00 am	**Biological Control—Jeannine Lowrimore**
10:45 am	**Invasive Species—Peter McGhee**
12:00 pm	*Lunch*
1:30 pm	**Invasive Species—Peter McGhee (cont'd)**
2:30 pm	**Chemical Control/New Products—Chris Nobbs**
3:00 pm	*Coffee*
3:30 pm	*Keynote Address:* ***Reflections on 45 Years of People, Projects, Places, and Purpose,*** *Jay Brunner, Director and Professor of Entomology, Washington State University Tree Fruit Research and Extension Center*
5:00 pm	*Mixer (Lobby)*
	Thursday, January 15th
8:30 am	**Chemical Control/New Products—Chris Nobbs (cont'd)**
10:00 am	*Poster Session/Coffee (Lobby)*
11:00 am	**Biology/Phenology—Brad Higbee**
12:00 pm	*Lunch*
1:30 pm	**Mating Disruption/SIR—Larry Gut**
3:00 pm	*Break*
3:30 pm	**Mating Disruption/SIR—Larry Gut (cont'd)**
5:00 pm	*Adjourn*
	Friday, January 16th
8:00 am	**Implementation—Joe Grant**
9:00 am	**Thresholds/Monitoring—Reed Britt**
10:30 am	Closing Business— Jack Jenkins, OPDMC Chair, Steve Ela, Chair-elect
11:30 am	*Adjourn*

Content queries to Dr. John Dunley: jdunley@wilburellis.com

Orchard Pest and Disease Management Conference
Officers for the 2015 Conference

Chair
Jack Jenkins
Pacific Biocontrol
620 E Bird Lane,
Litchfield Park, AZ 85340
Phone: (623) 935-0512
Fax: (623) 935-0513
Email: jjenkins@pacificbiocontrol.com

Chair-Elect
Steve Ela
Ela Family Farms
30753 L Rd
Hotchkiss, CO 81419
Phone: 970-872-3488

Email: info@elafamilyfarms.com

Secretary
Diane Alston
Utah State University
5305 Old Main Hill
Logan, UT 84322
Phone: 435-797-2516
Fax: 453-797-1575
Email: diane.alston@usu.edu

Treasurer
Nancy Hays
Pacific Biocontrol Corporation
N.E. 13th Court, Ste. A
Vancouver, WA 98685
Phone: 360-571-2247
Fax: 360-571-2248
Email: nhays@pacifier.com

Program Co-Chair
John Dunley
Wilbur-Ellis Company
Agribusiness Division
404 East Mission
Cashmere, WA 98815
Phone: 509-782-2301
Email: jdunley@wilburellis.com

Program Co-Chair
Elizabeth Beers
Washington State University
Tree Fruit Research and Extension Center
1100 N. Western Avenue
Wenatchee, WA 98801-1230
Phone: 509-663-8181 ext. 234
Email: ebeers@wsu.edu

Executive Director
Don Thomson
OPDMC Executive Director
308 47 Avenue SW
Calgary, Alberta
Canada, T2S 1C2
Phone: 206-890-3754
Email: dthomson@pobox.com

Past Chair
Lucia Varela
UC Cooperative Extension
133 Aviation Boulevard
Suite 109
Santa Rosa, CA 95403
Phone: 707-565-2621
Email: lgvarela@ucdavis.edu

Web Content and Proceedings
Chris Sater
Washington State University, TFREC
Phone: 509-663-8181, ext. 232
Email: wopdmc@wsu.edu

Web Programming
Jerry Tangren
Washington State University, TFREC
Phone: 509-663-8181, ext. 231
Email: tangren@wsu.edu

For information, see: http://www.tfrec.wsu.edu/pages/wopdmc

Order of Presentations
FROM THE 89th ANNUAL

ORCHARD PEST AND DISEASE MANAGEMENT CONFERENCE

January 14, 15 & 16, 2015

Keynote Presentation, Wednesday, January 8, 2014, 3:30pm – 5:00pm

Reflections on 45 Years of People, Projects, Places, and Purpose
Jay Brunner, Director and Professor of Entomology, Washington State University Tree Fruit Research and Extension Center

Presentation ***Page***

Biological Control— Moderator: Jeannine Lowrimore 1

Moving to a Sensible and Stable Pheromone-based Pest Management in Orchard Crops: Can Biological Control Finally Flourish? (Thomson) 3

Mite-Flaring Impact of New Insecticides on European Red Mites and Predatory Mites of Apples (Zalinda) 4

Releases of Insectary-Reared *Galendromus occidentalis* in Washington Apple Orchards (Schmidt-Jeffris) 4

Invasive Species— Moderator: Peter McGhee 5

Spotted Wing Drosophila: Five Years in Eastern Washington (Beers) 7

Effects of Droplet Size, Density, and Concentration of Spinosad Attracticide on Control of *Drosophila suzukii* (Diptera: Drosophilidae) (Whitener) 8

Assessing Commercial Attractants for Monitoring Spotted Wing Drosophila (Shearer) 8

Control of Spotted Wing Drosophila in Cherry Using a New Low Volume, Reduced-risk Technique (Van Steenwyck) 9

Evaluation of Ovicidal Effects of Danitol and Malathion on Spotted Wing Drosophila (Poliakon) 9

Fixed Sprayer System for Optimizing Management of Spotted Wing Drosophila in High Tunnel Small Fruit Production (Agnello) 10

Phenology and Distribution of BMSB in Sacramento and the North Coast (Ingels) 10

Presentation ***Page***

Evaluation of Insecticide Sensitivities among Brown Marmorated Stink Bug Populations (Krawczyk) 11

Survival Analysis of Brown Marmorated Stink Bug on Field-Aged Insecticide Residues in Hazelnut (Wiman) 12

Chemical Control/New Products— Moderator: Chris Nobbs 13

Controlling San Jose Scale on Apple with Early Season Insect Growth Regulator Applications (Combs) 15

Application of Delegate in Pear Results in Increased Pear Rust Mite Populations and Other Non-target Impacts (Hilton) 15

Insecticidal Control of Navel Orangeworm in Almonds – Can we Deliver Ovi-Larvicides to the Target Site? (Higbee) 16

Control of Peach Twig Borer in Almond (Van Steenwyck) 16

Leaf-Footed Bug Control in Almond Orchards (Haviland) 17

Insecticide Evaluations for Walnut Husk Fly Control in English Walnuts – 2014 (Coates) 17

Insecticide Evaluations for Walnut Scale Control in English Walnuts (Hasey) 18

Efficacy of Intrepid Edge for the Control of Codling Moth in Walnuts (Hernandez) 18

Insecticide Evaluations for Control of Codling Moth in Walnut (Poliakon) 19

Biology/Phenology— Moderator: Brad Higbee 21

Role of Plant and Microbial Volatiles in Codling Moth Host Finding (Witzgall) 23

Assessing the Global Risk of Establishment of Codling Moth using Ecological Niche Models (Neven) 23

Temperature and Time Requirements for Walnut Husk Fly Emergence (Hernandez) 24

Ambrosia Beetles – A New Emergent Pest in Apple Orchards (Agnello) 24

Mating Disruption/SIR— Moderator: Larry Gut 25

25 Years On: What Have We Learned to Optimize Codling Moth Mating Disruption? (Thomson) 27

Remote Monitoring of Insects in Flight using Laser Radar Equipment (Taarnhøj) 27

Short- and Long-Term Effects on the Continued/Discontinued Use of Pheromone Mating Disruption on Populations and Control of Two Major Fruit Pests in Pennsylvania Apple Orchards (Hull) 28

Long Rope Formulation for Use in High Density Orchards and Field Crops (Ishibashi) 29

Performance of a Long Rope Pheromone Release Device in a High Density Exposed Canopy (Brunner) 29

Presentation ***Page***

Refining Aerosol Pheromone Dispenser use for Controlling Codling Moth in California Walnuts (Gut) 30

The Dream is Realized – Pear Ester is Legal (Knight)..... 30

High Dosage Codling Moth Aerosol Pheromone Emitters Enhance Rather Than Disrupt Attraction (McGhee)..... 31

The Status of Navel Orangeworm Mating Disruption in Almonds and Pistachios (Higbee) . 31

Mating Disruption of Filbertworm in Hazelnuts: Transitioning to Grower Adaptation (Miller) 32

Prionus californicus Mating Disruption and Lure Comparison in Sweet Cherry (Alston)..... 32

Towards Semiochemical-based Management of Apple Clearwing Moth: Decade of Experimentation (Judd) 33

Implementation— Moderator: Jack Jenkins 35

Using Decision Support Systems to Enhance Biological Control (Chambers) 37

Development and Evaluation of Intelligent Spray Systems in Oregon Nursery Production (Rosetta)..... 37

Developing a Management Strategy for Little Cherry Disease (Bixby-Brosi)..... 38

Thresholds/Monitoring— Moderator: Reed Britt 39

SuperPaco TriplePak for Tortricids (Knight) 41

Dispersal of Codling Moth Adults within Typical Agro-Ecosystems of Central Chile: Relevance of Unmanaged Hosts (Knight)..... 41

Comparing the Efficacy of Semios Traps and Delta Traps for Codling Moth and Non-Target Species (Eby)..... 42

Plume Reach and Trapping Radius for Codling Moth (*Cydia Pomonella*) (Adams)..... 42

Cherry Fruit Fly Distributions in Managed Cherry Orchards in Oregon and Washington (Yee) 43

Monitoring Navel Orangeworm with Phenyl Propionate and Pheromone in the Presence of Mating Disruption (Burks) 43

Poster Session.....45

The Effect of Applaud, Movento, IKI-3106 (Cyclaniliprole) and Beleaf on Western Grape Leafhopper (Hilton) 47

Evaluation of Sex Pheromone Blend and Ratio Released by Obliquebanded Leafroller, *Choristoneura rosaceana* Females (Huang) 48

Evaluation of Puffer Mating Disruption in Utah (Murray) 47

Minutes of the 88th Annual Meeting 49

Biological Control—

Moderator: Jeannine Lowrimore

Notes:

Biological Control

Moving to a Sensible and Stable Pheromone-based Pest Management in Orchard Crops: Can Biological Control Finally Flourish?

Don Thomson[1], Angela Gadino[2], Jay Brunner[2], and Jack Jenkins[1]
[1]Pacific Biocontrol Corporation, Vancouver, WA; [1]Washington State University, Tree Fruit Research and Extension Center, Wenatchee, WA

Keywords: sex pheromones, biocontrol, *Cydia pomonella*, grower surveys, biopesticides

Abstract: The potential of using sex pheromones to control insect pests was demonstrated over 40 years ago. The first mating disruption product to be registered for control of an insect pest *Pectinophora gossypiella* occurred over 30 years ago. Mating disruption technology is extensively used worldwide to control multiple pests of both agriculture and forestry. The use of mating disruption technology to control *Grapholita molesta* and *Cydia pomonella* in fruit growing regions around the world are acknowledged major success stories. The adoption of mating disruption technology has often been precipitated by crises, for example the loss of pest control due to resistance or the restrictions on the availability or use of insecticides. The incorporation of mating disruption technology into pest management systems especially when used in area-wide programs, was instrumental in end-users being able to re-establish control, harvest marketable crops and improve profitability. Environmental concerns and consumer preferences have led to increased regulatory and export restrictions resulting in the phase-out of many insecticides. Although new chemistries have been registered, these products are more expensive, difficult to use and often result in the outbreak of secondary pests. Together these factors have led to mating disruption technology becoming a standard practice in important pome fruit production areas around the world. The incorporation of mating disruption technology into pest management systems has led to improved control, less insecticide residues, increased use of biopesticides such as codling moth granulovirus, and increased natural enemy populations. In pome fruit systems in Washington State, biological control of secondary pests is now widespread and an important focus of industry and growers. Mating disruption technology has become the foundation that has allowed biological control to establish and become an important pest management tool. As environmental awareness increases, the use of mating disruption and other biopesticide products will continue to increase and biological control will flourish and will gain importance.

Biological Control

Mite-Flaring Impact of New Insecticides on European Red Mites and Predatory Mites of Apples

Raja Zalinda, John Wise, Mark Whalon and Larry Gut
Michigan State University, Trevor Nichols Research Center, Fennville, MI

Keywords: *Neoseiulus fallacis*, *Panonychus ulmi*, *Zetzellia mali*, mite flaring, Asana, esfenvalerate, Sevin, carbaryl, Assail, acetamiprid, Delegate, spinetoram, Altacor, chlorantraniliprole, Rimon, novaluron

Abstract: European Red Mite (Koch), *Panonychus ulmi* (Acari: Tetranychidae), is the principal phytophagous mite pest in Michigan apples. The phytoseiid mite, *Neoseiulus fallacis* (Garman) (Acarina: Phytoseiidae) plays an important role in biological control of European red mite in Michigan apple orchards. Episodes of mite flaring in association with specific insecticides were documented for two consecutive years on the population dynamics of *P. ulmi* and the predators, *N. fallacis* and *Z. mali* at the Michigan State University Trevor Nichols Research Center, in Fennville, Michigan. Season long field evaluations of ERM and predator mite populations were made following treatments of esfenvalerate, carbaryl, acetamiprid, spinetoram, chlorantraniliprole, novaluron and combinations of insecticides with carbaryl on apples trees (*Malus domestica* Borkhausen cv. Red Delicious). The synthetic pyrethroid esfenvalerate and carbamate carbaryl showed highest incidence of mite flaring, in terms of magnitude of ERM populations. Acetamiprid treatments showed evidence of mite flaring, however did not reduce populations of predator mites *N. fallacis* and *Z. mali*. Limited cases of mite flaring were seen in chlorantraniliprole, spinetoram and novaluron. Spinetoram treatments reduced predator mite populations while chlorantraniliprole and novaluron did not. Treatment combination of treatment insecticides with carbaryl yielded reductions of *N. fallacis* and *Z. mali* populations, consistently. Mite flaring and predator mite reduction in association with insecticides or combination of insecticides commonly used in apple IPM program is discussed.

Releases of Insectary-Reared *Galendromus occidentalis* in Washington Apple Orchards

Rebecca A. Schmidt-Jeffris, Elizabeth H. Beers, Thomas R. Unruh, & David R. Horton
Washington State University Tree Fruit Research and Extension Center, Wenatchee, WA

Keywords: western predatory mite, *Galendromus occidentalis*, European red mite, Panonychus ulmi, twospotted spider mite, *Tetranychus urticae*, apple rust mite, *Aculus schlechtendali*, Phytoseiidae, apple, biological control, inundative release

Abstract: *Galendromus occidentalis* (western predatory mite) is one of several phytoseiid species that are available for purchase to supplement local predator populations that are not providing sufficient control of spider mites. We performed a series of releases of commercially reared *G. occidentalis* in commercial apple orchards in Washington from 2010 to 2012. Releases of up to 50,000 mites per acre did not lead to an increase in populations of predatory mites or to a decrease in populations of pest mites. Assessments of mite numbers in shipments and quality (survival and fecundity) of those mites indicated that the commercial insectary was correctly estimating the number of predatory mites in their shipments, and that predator quality was not different than a laboratory colony. Finally, a predator-prey model that used the intrinsic rates of increase of tetranychid prey and the prey consumption rate of the predator indicated that the density of *G. occidentalis* required to control the prey at the action threshold was not economically feasible ($4,000-$6,000/acre). We conclude that *G. occidentalis* cannot be used to bring about short-term control via inundative releases in crops such as apple with large canopy volumes. Conservation of this predator is likely a better strategy for encouraging biological control.

Invasive Species—

Moderator: Peter McGhee

Notes:

Invasive Species

Spotted Wing Drosophila: Five Years in Eastern Washington

Elizabeth H. Beers[1], Doug Walsh[2], and Tim Smith[3]
Washington State University, [1]Tree Fruit Research & Extension Center, Wenatchee, WA; [2]Irrigated Agriculture Research & Extension Center, Prosser, WA [3]Chelan-Douglas Extension Educator, retired

Keywords: spinosad, Entrust, spinetoram, Delegate, lambda-cyhalothrin, Warrior, malathion, Fyfanon, carbaryl, Sevin, Exirel, cyantraniliprole, cyclaniliprole, Altacor, chlorantraniliprole

Abstract: Five years of experience with spotted wing drosophila (SWD) have given us a better understanding of its phenology and pest status in eastern Washington. The seasonal pattern of abundance of adults from bait traps has been very consistent: low throughout the winter, spring, and summer; increasing in the latter part of August, and peaking in fall (September-October or even November) until cold temperatures limit adult activity. Conversely, the first capture in traps in a given region has varied considerably from year to year. This appears to be more related to mid-winter cold events (single-digit and subzero) than with spring temperatures, because they influence overwintering survival (as opposed to development). Where and how SWD overwinter is still poorly understood, but may be critical in some areas to the densities available to attack vulnerable crops, especially in June and July (e.g., sweet cherries). Significant progress has been made in the area of sweet cherry fruit susceptibility and chemical control. The spinosyns (spinosad and spinetoram) provide high levels of contact mortality for 14-21 days. The pyrethroid lambda-cyhalothrin also provides long residual effect. The materials with shorter PHIs (cabaryl and malathion) have a much shorter residual activity. A newer class of chemistry, the diamides, have shown some promise for control, but with a lower residual mortality than other chemistries.

Invasive Species

Effects of Droplet Size, Density, and Concentration of Spinosad Attracticide on Control of *Drosophila suzukii* (Diptera: Drosophilidae)

Alix B. Whitener and Elizabeth H. Beers
Washington State University, Tree Fruit Research and Extension Center, Wenatchee, WA

Keywords: Attracticide, bait spray, spotted wing drosophila, *Drosophila suzukii*, sweet cherry, integrated pest management, spinosyn, GF-120® NF Naturalyte® Fruit Fly Bait, droplet size, droplet density, concentration rate

Abstract: Until the invasion of spotted wing drosophila, (SWD) (*Drosophila suzukii* (Matsumura)) organic cherry growers used spinosad attracticides to control Western cherry fruit fly and minimize nontarget effects on beneficial arthropods. Spotted wing drosophila control also relies on the active ingredient spinosad, but bait spray use, as opposed to canopy sprays, has been unsuccessful. To justify the reintegration of this technique into cherry pest management, we investigated the effects of droplet size, droplet density, and different concentrations of GF-120 on SWD in separate trials. We exposed female SWD to droplets placed on leaves in small insect cages, with fruit suspended in the foliage as an oviposition substrate. Oviposition punctures and mortality were evaluated. Higher droplet densities produced higher mortality levels at 24 h, but mortality was ~100% at 48 h in all treated cages. Oviposition punctures were suppressed by both densities of the 250-µl droplet study compared to the check, but only in the higher rate in the 25-µl droplet study. Droplets of all concentrations caused significantly higher mortality than the check, but not in order of increasing concentration. Similar to previous tests, mortality was ~100% by 48 h, and ranged from 26-54% at 24 h. Ovipositions were significantly lower than the check in the 1:3 dilution of GF-120, but not in other concentrations.

Assessing Commercial Attractants for Monitoring Spotted Wing Drosophila

Peter W. Shearer, Kaushalya Amarasekare and Steve Castagnoli
Oregon State University, Mid-Columbia Agricultural Research and Extension Center, Hood River, OR

Keywords: *Drosophila suzukii*, cherry, blueberry, AlphaScents, Bioberica, Suterra, Trece

Abstract: Commercially manufactured attractants for monitoring *D. suzukii* were assessed in Hood River, OR. The attractants that were based on a 4-component attractant developed by Dong Cha and Peter Landolt (USDA-ARS, Wapato, WA) were generally more effective in capturing *D. suzukii* than apple cider vinegar. The mass trapping attractant developed by Bioberica did not capture as many *D. suzukii* as other lures or a yeast+sugar bait.

Invasive Species

Control of Spotted Wing Drosophila in Cherry Using a New Low Volume, Reduced-risk Technique

Robert A. Van Steenwyk, Caroline R. Wise and Janet L. Caprile
University of California, Dept. of E.S.P.M., Berkeley, CA

Keywords: *Drosophila suzukii*, spotted wing drosophila, *Prunus avium* L., sweet cherry, attract & kill, chemical control, insecticide, Malathion, Danitol, fenpropathrin

Abstract: In an effort to develop a more integrated pest management (IPM) program for spotted wing drosophila, studies were conducted in California during 2013 and 2014 into the use of a low-volume technique using attractant bait combined with an insecticide. In 2013, studies demonstrated that low-volume (18.7 L/ha) applications of the combination of malathion or fenpropathrin with apple cider vinegar, Merlot wine and Monterey Insect Bait resulted in the significant reduction of D. suzukii infestation compared to bait alone and an untreated check. In 2014, studies demonstrated that low-volume (46.8 L/ha) applications of the combination of spinosad with Suzukii Trap bait resulted in the significant reduction of D. suzukii infestation compared to an untreated check. These studies are proof of concept studies; that is applications of low-volume reduced-risk insecticides combined with attractant bait can be a viable control option for D. suzukii as part of an IPM program. Growers can rapidly apply the bait and toxicant combination with potentially less disruption to beneficial insects and mites.

Evaluation of Ovicidal Effects of Danitol and Malathion on Spotted Wing Drosophila

Ruth Poliakon and Robert A. Van Steenwyk
Department of E.S.P.M., University of California, Berkeley, CA

Keywords: *Drosophila suzukii*, spotted wing drosophila, insecticide, ovicide, larvicide, infestation, cherry, Danitol 2.4EC, fenpropathrin, Malathion 57%, malathion

Abstract: A laboratory study was conducted to determine the ovicidal effects of Danitol and Malathion on spotted wing drosophila (SWD) on cherries. Two experiments of three treatments each were replicated 16 times in a randomized complete block design. Each replicate consisted of an individual cherry, which was placed in a cage with laboratory-reared SWD. After at least two deposited eggs were found on each cherry, the fruit was removed from the cage. The total number of eggs deposited in each fruit was counted and the fruit was held for 24 hours. The infested cherries were then dipped in experimental solutions of high and low labeled rates of either Danitol or Malathion, air-dried, and held for another 72 hours. The experiment was conducted at 23.5˚C in a constant temperature cabinet with 16:8 (L:D). After four days, the number of larvae hatched was determined using the sugar floatation method. Cherries were crushed into the solution and larvae were removed and counted as they floated to the surface. Each cherry was evaluated for a maximum of one hour of floatation. Danitol 2.4EC did not provide significant ovicidal control of SWD at either a low or high rate compared to the untreated check, while Malathion 57% at both the low and high rates provided significant ovicidal control of SWD compared to the untreated check.

Invasive Species

Fixed Sprayer System for Optimizing Management of Spotted Wing Drosophila in High Tunnel Small Fruit Production

Arthur Agnello, Andrew Landers, and Greg Loeb
Department of Entomology, Cornell University, NYS Agric. Expt. Station, Geneva, NY

Keywords: raspberry, pesticide application, microsprinklers, solid-set

Abstract: Spotted wing drosophila (SWD) is widely distributed in New York, with raspberries being especially vulnerable. Its invasion has forced berry growers to dramatically increase insecticide applications to produce marketable fruit, a significant logistical challenge for high tunnel production. A spray system fixed into the tunnel structure was used to apply pesticide sprays to control SWD in research and commercial bramble plantings from July-Sept 2013. All sprays were applied through a system of microsprinkler nozzles attached to polyethylene tubing running along the top of the tunnel and supplied by a central tank/pumping station. Identical applications were made in control tunnels using backpack sprayers. SWD traps were deployed in both treatments to check for adult presence, and weekly fruit samples were held to rear out larvae infesting the berries. Results were variable, ranging from equal low levels for fixed vs. control at the commercial site to 4X higher infestations in the fixed sprayer blackberry planting vs. the control. Trials were repeated in 2014 at the commercial farm, with a center overhead line installed to improve inside row coverage. An air compressor was also incorporated to blow residual spray solution out of the system after an application. SWD adults emerged from the fruit were at comparable levels to 2013, with higher levels often (but not uniformly) observed in the fixed spray treatment. Fixed sprayer systems may be particularly cost-effective in high tunnels since the scaffolding for the fixed lines is already present.

Phenology and Distribution of BMSB in Sacramento and the North Coast

Chuck A. Ingels, Lucia G. Varela, and Rachel B. Elkins, Robert Van Steenwyk
University of California Cooperative Extension, Sacramento County, CA

Keywords: *Halyomorpha halys*, monitoring, trapping, phenology, host species

Abstract: In March 2014, 10 pyramid brown marmorated stink bug (BMSB) traps were placed in the midtown Sacramento infestation area, 20 traps were placed south of Sacramento to Walnut Grove, and 18 were placed in interphase of agricultural and urban areas in Lake and Mendocino counties and checked weekly to biweekly. No BMSB were found south of Sacramento or in Lake or Mendocino. In midtown Sacramento, nymphal stage and adult sex were determined; one-minute searches for adults and nymphs were conducted outside each trap and on host trees in the infestation area. The first eggs were found on 5 May and the first nymphs were found in traps on 3 June. Only four traps caught substantial numbers of BMSB through the season. A small population peak of adults was seen in the traps in early July, and a large peak of adults and nymphs was seen in mid-September. According to the BMSB development model, there were two complete generations. In addition to BMSB, over 100 *Astata occidentalis* (a large, solitary, predatory wasp that is known to feed on adults and nymphs of stink bugs) were found in the Sacramento area traps through the season. Foliage searches found season-long BMSB adults and nymphs on only tree of heaven. Very large populations were found in late August and September on trident maple and waxleaf privet; these species and Chinese pistache were added to the BMSB host plant list.

Invasive Species

Evaluation of Insecticide Sensitivities among Brown Marmorated Stink Bug Populations

Greg Krawczyk, Travis Enyeart and Nicolas Ellis
Pennsylvania State University, Department of Entomology, Fruit Research and Extension Center, Biglerville, PA

Keywords: *Halyomorpha halys*, brown marmorated stink bug, insecticide resistance, pome fruit, stone fruit

Abstract: Brown marmorated stink bug (BMSB) *Halyomorpha halys* (Stäl) (Heteroptera- Pentatomidae), continues to define fruit pest management in Mid-Atlantic region. Despite advances in our ability to detect and monitor BMSB, only insecticide treatments applied at a set time intervals provide adequate control of this stink bug.

During the 2014 season four BMSB populations were collected from distinct areas in PA and tested for their sensitivities to five insecticides: methomyl, acetamiprid, bifenthrin, lambda-cyhalothrin and a mixture of lambda – cyhalothrin and thiamethoxam. Two BMSB populations originated from fruit orchards, one population from woods surrounding orchards and one population from a residential area. The sensitivity of each population was evaluated during laboratory direct contact adult bioassays by exposing BMSB males and females to 20, 50 and 100 percent of the field rate of insecticide. Three categories describing the status of treated bugs: live, dead and moribund were used during the mortality readings at 3, 24 and 48 hours after the application.

No consistent insecticide sensitivity patterns emerged from the data to suggest tested BMSB populations exhibit different insecticide sensitivities based on their origin or sex. Discrepancies in the form of significant effects of site and sex interactions visible mostly at the lower concentrations and/or shorter evaluation time may only indicate the possibility of early stages of insecticide resistance; however, they can also simply result from inadequate deposition of solutions on the insects' cuticles, as insects moved during application. It is possible that cuticular composition, or other physiological factors, did somehow enable the "recovery" of affected insects, which were recorded either as "moribund" or "dead". Given the potential of *H. halys* to cause significant economic losses and the aggressive treatment regimens prescribed for it, future monitoring of its susceptibility to registered compounds is highly recommended.

Invasive Species

Survival Analysis of Brown Marmorated Stink Bug on Field-Aged Insecticide Residues in Hazelnut

Nik G. Wiman, Vaughn M. Walton, and Danny Dalton
Oregon State University, Corvallis, OR

Keywords: *Halyomorpha halys*, insecticide, invasive pest

Abstract: Brown marmorated stink bug (BMSB) is regarded as a severe threat to Oregon's flourishing hazelnut industry. To test a variety of chemical products targeting BMSB adults and nymphs, we used a backpack sprayer to treat hazelnut trees in a randomized block design at the Lewis Brown Horticulture Farm near Corvallis, OR. We examined effects of high and low rates of DoubleTake, Dimilin 2L, and Warrior against field-collected adults and late-instar nymphs. We compared these products against untreated controls and the grower standard (Asana XL), important for controlling the key pest filbertworm, *Cydia latiferreana* (Walsingham) (Lepidoptera: Tortricidae). We collected foliage with nuts from sprayed trees 1, 7, and 14 days post-application by clipping twigs from the trees. Foliage and nuts were held in large plastic cups designed to confine the BMSB on living plant tissue. Adults and nymphs were placed on the foliage and their survival (nymphs and adults) and molts (nymphs only) were monitored for 15 days. Dimilin, DoubleTake, and Asana provided good control when BMSB were exposed on day 1, but mortality took a few days to occur. In general, all products tested were more efficacious against nymphs compared to adults. Dimilin, Asana, and DoubleTake had long periods of residual activity, but long periods of exposure were needed to see the mortality effects.

Chemical Control/New Products—

Moderator: Chris Nobbs

Notes:

Chemical Control/New Products

Controlling San Jose Scale on Apple with Early Season Insect Growth Regulator Applications

Dave Combs and Art Agnello
Cornell University, New York State Agriculture Experimental Station, Geneva, NY

Keywords: Centaur, buprofezin, Esteem, pyriproxyfen, San Jose scale, *Quadraspidiotus perniciosus*, apple, chemical control, insecticide

Abstract: The efficacies of two different insect growth regulators were tested against the over-wintering generation of San Jose scale. Three replications of 4 tree blocks were randomized and materials were applied with air-blast equipment at a rate of 100 gal/acre. Samples were taken pre and post insecticide application to determine over-wintering survival, as well as insecticide efficacy. Samples were taken from 1st year wood for the over-wintering generation, and from fruit from the 1st and 2nd summer generations. Centaur was applied at tree phenology 'delayed dormant' or 'pink'. Esteem was applied only at 'pink'. Both materials regardless of timing controlled San Jose scale well throughout the growing season.

Application of Delegate in Pear Results in Increased Pear Rust Mite Populations and Other Non-target Impacts

Richard J. Hilton[1] and Robert A. VanSteenwyk[2]
[1]Oregon State University, Southern Oregon Research and Extension Center, Medford, OR
[2]University of California, Dept. of Environmental Science, Policy, and Mgmt., Berkeley, CA

Keywords: spinetoram, *Epitrimerus pyri*, *Forficula auricularia*, *Quadraspidiotus perniciosus*

Abstract: Trials evaluating the effects of Delegate in pears have been conducted in northern California and southern Oregon beginning in 2005 and 2007 respectively. The results from 11 field trials were examined and substantial increases in the population of pear rust mite were observed in 8 of the trials and in 4 of those cases the increase was statistically significant. Additionally, measurements of fruit russet in northern California field trials indicate that the use of Delegate and the resulting increase in levels of pear rust mite can lead to significantly higher levels of russeting to the fruit. In trials conducted in southern Oregon, lower numbers of some natural enemies have been observed when Delegate has been used, specifically parasitic hymenoptera (*Encarsia sp.*) and the European earwig. These effects on natural enemies have been associated with higher levels of some pests such as San Jose scale but this effect is inconsistent. The causal mechanism behind the stimulatory effect of Delegate on pear rust mite has yet to be determined.

Chemical Control/New Products

Insecticidal Control of Navel Orangeworm in Almonds – Can we Deliver Ovi-Larvicides to the Target Site?

Bradley S. Higbee
Paramount Farming Company, Bakersfield, CA

Keywords: *Amyelois transitella*, navel orangeworm, insecticides, spray coverage, almond, reduced risk, mating disruption, Altacor, chlorantraniliprole

Abstract: The thresholds for navel orangeworm (NOW) damage in almonds continue to decrease. At the same time, crop value and acres planted have increased. Available registered insecticides for NOW target eggs and larvae, with the exception of the pyrethroid class. But that insecticide class is losing effectiveness due to resistance development. We suspected spray coverage as a limiting factor for insecticides that target eggs and larvae in efficacy studies from 2006-2009. In a series of experiments from 2010 through 2013 that examined vertical distribution of residues and damage as a result of treating trees with various sprayers, speeds, and nozzling arrangements, we found that 50% coverage (mean of 5.3 µg/nut of chlorantraniliprole) overall was not surpassed. However, as much as 70% coverage (8.5 µg/nut) was achieved in the lower half of the tree with ground rigs using flat fan, full cone and hollow cone nozzles employing one or two manifold booms. In 2014, we looked at the impact of helicopter applications in conjunction with ground applications on coverage, residue deposition and NOW infestation levels at four levels in almond trees. These results will be compared to previous results and discussed in the context of reduced risk chemical applications.

Control of Peach Twig Borer in Almond

Robert A. Van Steenwyk
Department of E.S.P.M., University of California, Berkeley, CA

Keywords: *Cydia pomonella* L, codling moth, *Amyelois transitella*, navel orangeworm, Intrepid, methoxyfenozide, Delegate, spinetoram, Altacor 35 WDG, chlorantraniliprole, Intrepid Edge, walnut, insecticide, infestation, chemical control

Abstract: Two replicated studies were conducted in commercial walnut orchards in Tracy, CA and Butte City, CA. Intrepid Edge and Altacor 35 WDG were evaluated for first generation control of codling moth (CM). Treatments were replicated four times in an RCB design. Replicates in Tracy were 3.7 to 4.3 acres in size, and replicates in Butte City were 1.2 acres. Treatments were applied using grower operated speed sprayers operating at 2 mph with a 100 gal/acre finished spray volume. Two pheromone traps were placed high in the orchard canopy to monitor CM flight populations and set biofix for the timing of the applications. Intrepid Edge and Altacor were applied for the 1A & 1B CM flight. Control of CM was evaluated by counting the number of CM-infested dropped nuts from 5 center trees in each replicate from mid-May through mid-June. At the Tracy site, CM-infested dropped nuts were significantly reduced by all experimental treatments as compared to the untreated check. Also, replicates treated with Intrepid Edge had significantly lower CM-infested dropped nuts than those treated with Altacor. At the Butte City site, the CM-infested dropped nuts were not significantly different among any treatment. However, dropped nuts were numerically higher in the untreated check compared to the experimental treatments.

Chemical Control/New Products

Leaf-Footed Bug Control in Almond Orchards

David Haviland[1], Stephanie Rill1, Brad Higbee[2] and Kris Tollerup[3]
[1]UC Cooperative Extension, Kern Co; [2]Paramount Farming Company; [3]UC Statewide IPM Program

Keywords: chemical control, insecticide, almond, leaf-footed bug, Brigade, bifenthrin, Warrior II, lambda cyhalothrin, Belay, clothianinin, Bexar, tolfenpyrad, Sivanto, flupyradifurone, Beleaf, flonicamid, Exirel, cyantraniliprole, Sequoia, sulfoxaflor, Lorsban, chlorpyrifos, Agri-Mek, abamectin

Abstract: During the last decade leaf-footed bugs (*Leptoglossus* sp.) have become significant pests in almond orchards in the lower San Joaquin Valley of California. We evaluated 10 insecticides for the effects of leaf-footed bug when sprayed directly on the insects and when insects were caged on aged residues. The industry standard chlorpyrifos provided excellent activity by direct contact and one week of residual control. The two pyrethroids Brigade and Warrior II provided excellent contact activity and at least four weeks of residual control. Other insecticides provided a range of effects by direct contact but did not provided any control once residues dried in the field.

Insecticide Evaluations for Walnut Husk Fly Control in English Walnuts - 2014

William W. Coates and Robert A. Van Steenwyk
University of California Cooperative Extension, Hollister, CA

Keywords: *Rhagoletis completa*, walnut husk fly, *Juglans regia*, English walnut, chemical control, insecticide, Malathion, Leverage 360, imidacloprid, β-cyfluthrin, Athena, bifenthrin, avermectin B1, Belay, clothianidin, Danitol, fenpropathrin, Assail, acetamiprid, NuLure insect Bait, Exit

Abstract: The efficacy of several insecticides was tested against adult walnut husk flies in a 'Hartley' walnut orchard south of Hollister, CA. Treatments were applied to four single tree replicates. Applications were made one week after the first substantial fly captures in Trécé AM/NB traps baited with ammonium carbonate in "UC supercharged" lures. Additional sprays were applied at about three week intervals through the season with a total of three sprays. Foliar sprays were applied with an orchard hand-gun sprayer operating at 250 psi with a finished spray volume of 300 gal/acre. Walnut husk fly damage was assessed by visually examining 125 nuts per replicate just prior to harvest. The WHF population in the test orchard was very high and damage in the check reached 47.4%. Assail, Leverage 360 and Danitol + Belay provided excellent WHF control. Athena provided moderate control while Malathion provided little or no control. All treatments including the check had the addition of NuLure Insect Bait and Exit adjuvant.

Chemical Control/New Products

Insecticide Evaluations for Walnut Scale Control in English Walnuts

Janine K. Hasey and Robert A. Van Steenwyk
University of California Cooperative Extension, Yuba City, CA

Keywords: *Quadraspidiotus juglandsregiae*, walnut scale, English walnut, Assail, acetamiprid, Movento, spirotetramat, Brigadier, bifenthrin/imidacloprid, Closer, sulfoxaflor, Centaur, buprofezin, Seize, pyriproxyfen

Abstract: The efficacy of several insecticides was tested against the adult walnut scale at post delayed dormant on 8 April or against the crawler stage on 6 May in a 'Vina' walnut orchard south of Marysville, CA. Four single-tree replicates were sprayed with a hand held orchard sprayer operating at 250 psi with a finished spray volume of 200 gal/acre. There was an untreated buffer tree between each sprayed tree. Fifty scale-infested twigs were removed and 100 female scales were examined for species identification prior to treatment and the population was entirely walnut scale. Walnut scale crawler populations were evaluated weekly using double-sided sticky tape from 25 March through 2 June. Centaur at delayed dormant provided excellent control and was superior to Seize applied at the same time which gave acceptable control. Assail (high rate), Centaur, and Brigadier applied at crawler stage gave acceptable control. Closer, Movento, and Assail (low rate) provided no control compared to the untreated check.

Efficacy of Intrepid Edge for the Control of Codling Moth in Walnuts

Alyssa M. Hernandez and Robert A. Van Steenwyk
Department of E.S.P.M., University of California, Berkeley, CA

Keywords: *Cydia pomonella* L, codling moth, *Amyelois transitella*, navel orangeworm, Intrepid, methoxyfenozide, Delegate, spinetoram, Altacor 35 WDG, chlorantraniliprole, Intrepid Edge, walnut, insecticide, infestation, chemical control

Abstract: Two replicated studies were conducted in commercial walnut orchards in Tracy, CA and Butte City, CA. Intrepid Edge and Altacor 35 WDG were evaluated for first generation control of codling moth (CM). Treatments were replicated four times in an RCB design. Replicates in Tracy were 3.7 to 4.3 acre in size, and replicates in Butte City were 1.2 acre. Treatments were applied using grower operated speed sprayers operating at 2 mph with a 100 gal/acre finished spray volume. Two pheromone traps were placed high in the orchard canopy to monitor CM flight populations and set biofix for the timing of the applications. Intrepid Edge and Altacor were applied for the 1A & 1B CM flight. Control of CM was evaluated by counting the number of CM-infested dropped nuts from 5 center trees in each replicate from mid-May through mid-June. At the Tracy site, CM-infested dropped nuts were significantly reduced by all experimental treatments as compared to the untreated check. Also, replicates treated with Intrepid Edge had significantly lower CM-infested dropped nuts than those treated with Altacor. At the Butte City site, the CM-infested dropped nuts were not significantly different among any treatment. However, dropped nuts were numerically higher in the untreated check compared to the experimental treatments.

Chemical Control/New Products

Insecticide Evaluations for Control of Codling Moth in Walnut

Ruth Poliakon and Robert A. Van Steenwyk
Department of E.S.P.M., University of California, Berkeley, CA

Keywords: *Cydia pomonella* L, codling moth, *Amyelois transitella*, navel orangeworm, walnut, *Chromaphis juglanicola*, walnut aphid, *Trioxys pallidus*, walnut aphid parasitoid, *Tetranychus urticae*, twospotted spider mite, *Eotetranychus willamettei*, Willamette spider mite, *Tetranychus turkestani*, strawberry spider mite, walnut, insecticide, infestation, Altacor 35WDG, chlorantraniliprole, Assail 30SG, acetamiprid, Athena, bifenthrin, avermectin, Belt 4SC, flubendiamide, Brigadier, imidacloprid, Delegate 25WG, spinetoram, Gladiator, zeta-cypermethrin, Leverage 360, cyfluthrin, Proclaim, emamectin benzoate, Voliam Xpress, lambda-cyhalothrin

Abstract: A study was conducted in a commercial walnut orchard near Tracy, CA for control of codling moth (CM). Nine treatments were replicated four times in an RCB design. Each rep was an individual tree with at least one buffer tree between each treatment. A pheromone trap was placed high in the orchard canopy to monitor CM flight populations and set biofix for timing of applications. Walnut aphid (WA) infestation was determined by inspecting 5 terminal leaflets per rep for numbers of WA and walnut aphid parasitoid (WAP). Spider mites were evaluated by sampling 10 terminal leaflets per rep. CM infested dropped nuts were monitored weekly from 13 May to 18 Jun. CM and navel orangeworm (NOW) infestation was determined based on 125 nuts per rep at commercial harvest on 15 Sep. There were no significant differences among treatments in the mean number of mites, WA or WAP. Belt 4SC followed by Leverage 360 and the untreated check had significantly higher cumulative dropped nuts than all other treatments. At harvest, all experimental treatments provided significant CM and NOW control compared to an untreated check. However, Belt 4SC followed by Leverage 360 had significantly higher mean percent total CM and NOW infested nuts than all other treatments except Assail 30SG followed by Delegate 25WDG. Delegate 25WDG followed by Brigadier was the most efficacious CM and NOW treatment.

Biology/Phenology—

Moderator: Brad Higbee

Notes:

Biology/Phenology

Role of Plant and Microbial Volatiles in Codling Moth Host Finding

Peter Witzgall and Alan Knight
SLU Alnarp, Sweden and USDA Yakima, WA

Keywords: Codling moth, *Cydia pomonella*, Lepidoptera, Tortricidae, apple, pear, host finding, plant volatiles, microorganisms

Abstract: Codling moth, larvae and adults, are attracted to plant volatiles produced by their main host plants, apple and pear. In addition, codling moth has also been shown to respond to volatiles produced by microorganisms. We have studied the volatile metabolome of two microorganisms which are frequently found on codling moth larvae, *Metschnikowia pulcherrima* and *Cryptococcus* spec. We have also re-investigated the volatiles released from apple and pear. The results contribute to our ongoing effort to identify the volatile signals that encode host finding in codling moth.

Assessing the Global Risk of Establishment of Codling Moth using Ecological Niche Models

Lisa G. Neven, Sunil Kumar, Hongyu Zhu, and Runghi Zhang
USDA-ARS Yakima Agricultural Research Laboratory, Wapato, WA

Keywords: *Cydia pomonella*; species distribution modeling, pest risk analysis, insect pests, quarantine pest, climate

Abstract: Accurate assessment of insect pest establishment risk is needed by national plant protection organizations to negotiate international trade of horticultural commodities that can potentially carry the pests and result in inadvertent introductions in the importing countries. We used mechanistic and correlative niche models to quantify and map the global patterns of the potential for establishment of codling moth (*Cydia pomonella* L.), a major pest of apples, peaches, pears and other pome and stone fruits, and a quarantine pest in countries where it currently does not occur (e.g., Colombia, Japan and South Korea). The mechanistic model CLIMEX was calibrated using species-specific physiological tolerance thresholds whereas the correlative model MaxEnt used species occurrences and climatic spatial data. Projected potential distribution from both models conformed well to the current known distribution of *C. pomonella*. None of the models predicted suitable environmental conditions in countries located between 20th parallels (e.g., Colombia, Peru, Taiwan, and Venezuela) potentially because of shorter photoperiod, and lack of chilling requirement (<60 days at or below 10°C temperature) in these areas for *C. pomonella* to break diapause. Models predicted suitable conditions in South Korea and Japan where *C. pomonella* currently does not occur but have its preferred host species (i.e., apple). Average annual temperature and latitude (a surrogate for length of day light hours) were the top environmental variables associated with *C. pomonella* distribution at global level. Our results show the global risk of establishment of *C. pomonella*, and can be used for monitoring potential introductions of *C. pomonella* in different countries and by policy makers and trade negotiators in science-based decision making.

Biology/Phenology

Temperature and Time Requirements for Walnut Husk Fly Emergence

Alyssa M. Hernandez and Robert A. Van Steenwyk
Department of E.S.P.M., University of California, Berkeley, CA

Keywords: *Rhagoletis completa* Cresson, walnut husk fly, emergence, eclosion, pupae

Abstract: A study was conducted during two years to evaluate the temperature and time requirements for walnut husk fly (WHF) adult eclosion. WHF infested nuts were collected from Hollister, CA on 31 August, 2012 and from Escalon, CA on 21 August, 2013. Infested nuts were placed in containers with sand and were held at room temperature for 3 weeks to allow larvae to pupate into the sand. Pupae were floated out of the sand, dried and stored in a 5.5°C refrigerator without light 0:24 (L:D). In 2012/13, at 30-day intervals for 4 months, 200 pupae were removed from the refrigerator and placed in an environmental chamber set at 23.9°C with 16:8 (L:D) with relative humidity uncontrolled. In 2013/14, at 30-day intervals for 5 months, 200 pupae were removed from the refrigerator and placed in environmental chambers set at 18.3°C, 23.9°C and 29.4°C with 16:8 (L:D) with relative humidity uncontrolled. All pupae were inspected 3 times a week and emerged flies were counted and sexed. Adult eclosion was then examined for each chilling period and temperature. In 2012/13, an increased chilling interval resulted in greater total eclosion, as well as a faster rate of eclosion after the first adult emergence. In 2013/14, the previous years' pattern was seen in all temperature cabinets, with a few exceptions in regards to total eclosion.

Ambrosia Beetles – A New Emergent Pest in Apple Orchards

Arthur Agnello, Deborah Breth, and Elizabeth Te
Department of Entomology, Cornell University, NYS Agric. Expt. Station, Geneva, NY

Keywords: black stem borer, *Xylosandrus germanus*, apples, trunk damage, adult trapping

Abstract: Black stem borer (BSB), an ambrosia beetle established in the US for over 80 years, is causing increasing damage in NY and other northeastern states. Normally a pest of hardwood trees, BSB has been documented in 25 apple orchards since 2013, causing tree death and decline in mostly young dwarf plantings of trees ranging from 2–10 inches in trunk diameter. The tiny (~2 mm) adults overwinter in galleries at the base of infested trees, and emerge in spring to infest new sites after 2–3 days with max temps of 68°F, usually by mid-late April; a second flight takes place in August. The adult female drills a ~1 mm-dia. hole and hollows out a channel into the heartwood of small trees, and starts to culture a fungal food source, *Ambrosiella hartigii*, laying eggs in the chamber. She lines the chambers with the ambrosia fungus for the larvae (3 instars) to feed on before pupating. The larvae feed on this fungus in the brood chambers, not the tree's tissues, but the tree reacts to the attack by shutting down its vascular system, which causes, wilting, yellowing, decline and death. Although these borers are known to attack physiologically stressed trees that are emitting ethanol volatiles, they also have been reported to attack apparently healthy trees. We used ethanol traps to document their occurrence and timing, and assessed trunk and tree damage with and without trunk insecticide sprays.

Mating Disruption/SIR—

Moderator: Larry Gut

Notes:

Mating Disruption/SIR

25 Years On: What Have We Learned to Optimize Codling Moth Mating Disruption?

Don Thomson (and Many Others)
Pacific Biocontrol Corporation, Vancouver, WA

Keywords: sex pheromones, mating disruption, *Cydia pomonella*

Abstract: The first identification of an insect sex pheromone was published in 1959. Since then, the sex pheromones of more than 1,600 species have been identified. The potential of using sex pheromones to control insect pests was first demonstrated in 1967. In 1978, the first commercial mating disruption product, for control of the pink bollworm, was registered by the EPA. There are now close to 130 mating disruption products registered by the EPA for control of more than 20 insect species. In 1991, the first codling moth mating disruption product was registered by EPA. Worldwide, there are now over 200,000 hectares of pome fruit and nuts treated with codling moth mating disruption products. In Washington State, approximately 90% of the pome fruit area is now treated with pheromones. Similar rates of adoption have occurred in Argentina, the South Tyrol and South Africa. In 1991, the mechanisms of codling moth mating disruption were poorly understood. Over the last 25 years, there has been extensive research to understand the mode of action of codling moth mating disruption with the goal of improving implementation and performance. What have we learned to optimize the use of codling moth mating disruption in pome fruit and walnuts? The cost and availability of labor is forcing growers to adopt different methods of deploying codling moth mating disruption. These issues will be discussed in depth in this presentation.

Remote Monitoring of Insects in Flight using Laser Radar Equipment

Frederik Taarnhøj
FaunaPhotonics, Frederiksberg, Denmark

Keywords: Insects, pollinators, agricultural insect pests, integrated pest management, biodiversity, ecology, species identification, remote monitoring, laser radar, LiDAR.

Abstract: A major limitation in ecological entomology is that insect abundance assessment is based on sweep nets and light-, pheromone- or CO_2-traps. Placing and emptying the traps are tedious operations and constitute a major effort, and the results are biased with respect to species, sexes and age groups caught. Although trapping allows precise studies with microscopes, mass spectrometry or genetics, online optical monitoring allows quantitative measures in terms of insect individuals per m^3 per hour. Light Detection and Ranging (LiDAR) is a technology for profiling the atmosphere for various constituents such as aerosols or fauna. LiDAR is used in monitoring small, airborne particles and is deployed in increasingly portable forms. Whereas atmospheric LiDARs operate at low repetition frequencies of 10-20Hz, Co-Founder of FaunaPhotonics, Dr. Mikkel B. Sørensen, has developed LiDAR with sampling rates of several kHz allowing retrieval of a harmonics spectrum of insect wing beats. The system transmits a laser beam into the atmosphere and measures backscattered laser light from small flying insects. The monitored air volume is typically ø10cm, and extends from 20 m to 2 km (larger distances possible). The system has reached more than 104 observations per m^3 per hour in field campaigns. Data on body and wing size is derived from time-resolved measurements of reflected, backscattered light.

Mating Disruption/SIR

Short- and Long-Term Effects on the Continued/Discontinued Use of Pheromone Mating Disruption on Populations and Control of Two Major Fruit Pests in Pennsylvania Apple Orchards

Larry Hull[1] and Greg Krawczyk[2]
[1]Hull Pest Management Services LLC, Biglerville, PA
[2]Penn State University, Fruit Research and Extension Center, Biglerville, PA

Keywords: *Cydia pomonella*, codling moth, *Grapholita molesta*, oriental fruit moth, mating disruption, apple

Abstract: This paper contains our findings on the continued/discontinued use of pheromone mating disruption (MD) on codling moth (CM) and oriental fruit moth (OFM) populations within an area-wide MD project. Our primary objectives were: 1) follow CM/OFM populations and the resulting fruit injury in orchards that either used MD for five consecutive years or removed MD after three years of use and relied upon insecticidal control only, 2) determine if growers who continued to use MD for consecutive years can further reduce insecticide usage targeted for these two pests, 3) define how rapidly CM/OFM adults reinvade an orchard that no longer uses MD as the principal control tactic, and 4) determine what are the short and long-term consequences of not using MD after three years of continuous use. The project was conducted in 21 and 22 apple blocks that received MD for a 4th and 5th year, respectively, and 16 apple blocks that removed MD after three years of use. Pheromone monitoring traps were used and fruit injury observations were made in all orchards to assess CM and OFM populations. Seasonal captures of CM/OFM adults continued to remain low in all MD treated blocks except one, while in apple blocks that relied upon just insecticides for control during both years, CM/OFM adult populations rapidly started to increase in size following the stoppage of MD use. Fruit injury in all MD treated orchards also remained low, except for one block, while it increased 1.3 fold in orchards receiving just insecticides in the 2nd year, and overall fruit injury was 2.2 times higher in insecticide only blocks than in all corresponding MD blocks. The mean amount (lbs) of insecticide active ingredients (AI) used by MD growers was similar for the last 3 years of the 5 year study. Insecticide AI for CM/OFM control used by insecticide-only growers increased by 18% from previous MD use levels in the 2nd year following no MD and increased by 38.6% over that used by MD growers after 5 years of MD use. When the costs of MD and supplemental insecticides needed for CM/OFM control are calculated for MD users in the 5th year, their costs were still $46.73 per acre higher than growers using only insecticides for CM/OFM control.

Mating Disruption/SIR

Long Rope Formulation for Use in High Density Orchards and Field Crops

Naoki Ishibashi[1], Tastuya Fujii[1], Takehiko Fukumoto[1], Takeshi Kinsho[1], Takayuki Naito[2], Fumiaki Mochizuki[2], Nobuaki Ishizawa[2]
[1]Shin-Etsu Chemical Co., Ltd., Specialty Chemicals Research Center, Niigata, Japan
[2]Shin-Etsu Chemical Co., Ltd., Fine Chemicals Department, Tokyo, Japan

Keywords: sugarcane, mating disruption, pheromone, Okinawa, *Melanotus sakishimensis*, *Melanotus okinawensis, Dasylepida ishigakiensis*, *Sesamia inferens*, *Tetramoera schistaceana*

Abstract: Okinawa is the southernmost area of Japan and comprises hundreds of Ryukyu Islands. Its climate, weather and geography have made sugarcane one of the most important agricultural plants in Okinawa. Several lepidopteran and coleopteran pests have caused serious damage to sugarcane in Okinawa. We have developed biodegradable long rope pheromone dispensers for mating disruption of those pests, which has successfully reduced sugarcane damage. Dispensers for sugarcane click beetle and pink borer have already been registered and resulted in commercial success.

Performance of a Long Rope Pheromone Release Device in a High Density Exposed Canopy

Jay Brunner and Bonnie Ohler
Washington State University, Tree Fruit Research and Extension Center, Wenatchee, WA

Keywords: sex pheromones, mating disruption, long rope release device, *Cydia pomonella*

Abstract: The success of pheromone-mediated mating disruption (regardless of formulation) is often limited in high density orchards with extensive wind exposure. One possible explanation for the lack of efficacy is that the canopy is not developed enough to hold the pheromone in the orchard as the plumes are “washed” away by the wind. The long rope release device has a much lower release rate compared to other codling moth formulations. However, pheromone release occurs along the entire surface of the rope. The long rope release device was applied to four 10-acre blocks in the same high density orchard with an open and exposed canopy. Blocks were the same with respect to size, shape, slope and history of horticultural and pest management practices. The long rope device was applied prior to codling moth flight at the rate of 1,200 m/hectare (534 yards/acre). The long rope placed uniformly throughout the orchard starting at the border row and applying it to every 4th row to ensure uniform and even application. Isomate CM Flex was the positive control and applied at a rate of 400 dispensers per acre to four 10-acre blocks. The orchard had historical trapping data documenting low codling moth populations. Sterile codling moths obtained from the sterile insect rearing facility in Osoyoos, British Columbia were released. Trap capture data will be presented.

Mating Disruption/SIR

Refining Aerosol Pheromone Dispenser use for Controlling Codling Moth in California Walnuts

Larry Gut[1], Peter McGhee[1], Joe Grant[2], and Jeannine Lowrimore[2]
[1]Michigan State University, East Lansing, MI
[2]University of California Cooperative Extension, San Joaquin County, CA

Keywords: codling moth, *Cydia pomonella*, walnut, mating disruption, aerosol dispenser

Abstract: Adoption of aerosol dispenser based pheromone mating disruption for codling moth in California walnuts has plateaued at around 12,000 acres (approximately 6% of bearing acreage) over the past few years. A major barrier to increased adoption is product cost, which can be greater than that of conventional insecticide codling moth programs, especially those used in orchards of late-leafing and/or less susceptible cultivars. Recent efforts to refine this technology and increase its cost-competitiveness in walnuts have focused on elucidating the functional relationship between aerosol dispenser density and disruption efficacy and evaluating the effectiveness of dispensers designed to release smaller than standard amounts of pheromone active ingredient per orchard area. Large-scale experiments conducted in commercial walnut orchards in 2013 and 2014 demonstrated that aerosol dispensers containing half the standard amount of pheromone and/or programmed to dispense pheromone for the first seven hours of the night suppress male catch in traps equally as well "full rate" dispensers operating 12 hours through the night. The results of aerosol dispenser density trials conducted in 2014 confirm competitive attraction as the principal operative suppression mechanism in walnuts and showed that disruption of males is achievable at dispenser densities less than those currently in use.

The Dream is Realized – Pear Ester is Legal

Alan Knight
USDA, ARS, Wapato, WA

Keywords: Codling moth, insecticides, mating disruption

Abstract: It took a while, but during 2014 three new products received EPA registrations: Cidetrak CM-DA Combo PP, Cidetrak CM-DA Combo Meso, and Cidetrak DAMEC. Studies with the Meso and DAMEC conducted during 2013 and 2014 will be presented. Particular attention will be given to the uses of DAMEC. The behavioral effect of pear ester on both the larval and adult stages of codling moth allows this product to have several possible uses for growers during the season. Your attention will be directed to its use to supplement existing sex pheromone-based mating disruption programs. Strengthening grower's management during peak periods of pest pressure and in localized 'hot spots' is a reasonable approach to start to capitalize on the potency of pear ester.

Mating Disruption/SIR

High Dosage Codling Moth Aerosol Pheromone Emitters Enhance Rather Than Disrupt Attraction

Peter McGhee, Larry Gut, Jim Miller
Michigan State University East Lansing, MI

Keywords: codling moth, mating disruption, pheromone, aerosol emitter

Abstract: Field studies in Michigan apple orchards documented the effects of codlemone, (E, E) 8,10 dodecadien1ol, released from aerosol pheromone emitters (Suterra CM Puffer and Isomate CM MIST) on subsequent male codling moth behavior. Pheromone plumes originating from a single aerosol emitter reduced male captures in baited traps up to 180 m away. Traps within 5 m of the emitter captured many males. Catch of released, marked, and sterilized moths demonstrated that males moved preferentially from areas of no or low pheromone concentration towards aerosol emitters, where they were captured in nearby traps. Additionally, moths bypassed baited traps placed between the release and recapture locations. Dispersal of released moths in aerosol treated orchards (1 unit/ha) was twice that of moths in orchards treated with high point source density pheromone dispensers (Isomate CM FLEX, 1000 ha1) or those left untreated. Moths caged for 24 h on aerosol treated foliage and then released into apple orchards had an elevated response to traps than were males exposed to 2 Isomate FLEX dispensers or caged on untreated foliage. Overall, these findings suggest that aerosol emitters operative competitively, by causing males to displace away from females. We propose the term *induced allopatry* for the phenomenon of mating disruption by spatial segregation of the sexes where movement towards and aggregation near the high pheromone sources diverts males away from females that are releasing very low quantities of pheromone.

The Status of Navel Orangeworm Mating Disruption in Almonds and Pistachios

Bradley S. Higbee
Paramount Farming Company, Bakersfield, CA

Keywords: *Amyelois transitella*, navel orangeworm, mating disruption, sex pheromone, almonds, puffers, pistachios

Abstract: A commercial product for navel orangeworm (NOW) mating disruption (MD) was introduced in 2005. Since then it has been used in a relatively low number of acres (50-60k out of ca. 1.2 million acres of almonds and pistachios). The cost of the technology was initially an impediment, but as global demand increases, almond and pistachio grower returns have also increased. At the same time, damage thresholds for NOW have decreased. Insecticide programs in high pressure situations are often not able to reduce NOW damage below current damage tolerances. However, when NOW MD is used in combination with insecticides, results have been better than either approach separately. Paramount Farming Company has adopted this technology incrementally, initially in almonds, then in pistachios. Performance and overall economics of NOW pest management programs will be compared and contrasted.

Mating Disruption/SIR

Mating Disruption of Filbertworm in Hazelnuts: Transitioning to Grower Adaptation

Betsey Miller and Vaughn Walton
Oregon State University, Horticulture Department, Corvallis, OR

Keywords: Mating disruption, filbertworm, *Cydia latiferreana*, hazelnut, filbert, pheromone

Abstract: Mating disruption of filbertworm (FBW) was tested for two consecutive seasons (2012 and 2013) in hazelnut orchards in the McKenzie River Valley, Oregon. Two pheromone formulations (simple and complex) were compared to standard industry controls (esfenvalerate) on a total of 270 acres. In addition to pheromone dispensers, mating disrupted plots also received application of methoxyfenozide to the outer two rows (to protect orchards from immigrating females). Male seasonal sum of catches of FBW per pheromone-baited trap were 7.5 and 9.4 times greater in control plots than in those treated with complex and simple pheromone, respectively. Percent of nuts infested with FBW was statistically similar ($P < 0.01$) in all plots and was below the industry-accepted threshold of 1%. Plots treated with the complex formulation had numerically higher rates of nut infestation (marginally significant at $P = 0.07$), which exceeded the industry-accepted threshold. In 2014, we began a transition to area-wide application of mating disruption in the McKenzie River Valley. Pheromone dispensers (simple formulation) were applied to 250 acres from the previous study. Orchards then received border or 'rescue' applications of esfenvalerate based on FBW pheromone trap counts. Outcomes of this case study will be presented.

Prionus californicus Mating Disruption and Lure Comparison in Sweet Cherry

Diane Alston[1], Michael Pace[1], James Barbour[2], and Glenn Thayer[3]
[1]Utah State University, Logan, UT, [2]University of Idaho, Parma, ID,
[3]Pacific Biocontrol Corp., Wenatchee, WA

Keywords: Coleoptera, Cerambycidae, (3R,5S)-3,5-dimethyldodecanoic acid, mating disruption, mass-trapping

Abstract: Larvae of *Prionus californicus* (Coleoptera: Cerambycidae) feed on the roots of many woody perennial crops and can be serious pests of stone fruits and hops in the northwestern and intermountain regions of the U.S. Adult males are strongly attracted to a volatile sex pheromone, (3R,5S)-3,5-dimethyldodecanoic acid, produced by females. Four years of mating disruption trials with an experimental dispenser (Pacific Biocontrol Corp.) in sweet cherry orchards of northern Utah found trap shutdown rates of 88-99% at dispenser application rates of 50 and 100 per acre (124 and 247 per hectare). Life history traits of *P. californicus* make it suitable for management by mass trapping: adults are non-feeding and short-lived, thus under strong selection pressure to quickly locate mates; adults are active only 8-10 weeks per year; and a long generation time (3-5 years) may slow recovery of suppressed populations. Our observations of sharp declines in *P. californicus* numbers after consecutive years of pheromone use support the mass-trapping approach. Two commercially available pheromone lures, Contech (30 mg pheromone) and Alpha Scents (10 mg), caught more males than a new Isomate lure. Lures performed equally well when deployed for 4 and 8 weeks. Mating disruption and mass trapping provide viable management options for this root boring pest.

Mating Disruption/SIR

Towards Semiochemical-based Management of Apple Clearwing Moth: Decade of Experimentation

Gary Judd, Marius Aurelian, Chelsea Eby, Maya Evenden, Jessica Kwon, Regina and Gerhard Gries
Agriculture and Agri-Food Canada, Pacific Agri-Food Research Centre,
Summerland, British Columbia, Canada

Keywords: *Synanthedon myopaeformis*, Sesiidae, invasive species, mass trapping, mating disruption, attract-and-kill, monitoring, pheromones, kairomones

Abstract: In 2005, apple clearwing moth (ACM), *Synanthedon myopaeformis* Borkhausen (Lepidoptera: Sesiidae), was discovered in several apple growing areas of British Columbia (BC), including the Similkameen Valley, where 60% of apples were grown organically and virtually no insecticides were applied under an area-wide codling moth sterile insect program. Populations of ACM quickly increased to extreme levels and during the last decade have shown few signs of any decline. ACM has moved east and north into the Okanagan Valley and is now threatening most of the BC apple industry. ACM is a serious problem in high-density orchards where size-controlling rootstocks are attacked by the wood-boring larvae. Repeated feeding bouts girdle the tree bark and lead to pathogen infections which can kill the trees. When ACM infestations are restricted to rootstock graft-union regions high-volume (2000 L/ha) trunk sprays of Rimon® are an effective conventional control, but ACM is now infesting limbs higher in the tree and is even entering and killing pruned tree leaders. Control of these secondary aerial infestations is problematic because air-blast use of Rimon® leads to secondary pest problems. Organic apple producers still have no effective control options because Entrust®, the mainstay of organic pest management, provides minimal suppression even when applied several times.

Our 10-year search for semiochemical-based solutions is reviewed, but has yielded mixed success and seen us examine pheromone-based mating disruption (aerosol, hand-applied, and mobile moth delivery systems), mass trapping and attract-and-kill SPLAT® technologies as control tactics. Observations that these day-flying moths feed on flowering weeds and various damaged fruits, and catches of moths in juice-baited traps were equivalent to those of pheromones, prompted search for kairomone attractants. After several years we have developed a multi-component, bisexual, kairomone lure that has true pheromonal potency, but has yet to be commercialized. Entering 2015, our intent is to supplement pheromone-based mating disruption with kairomone-based female mass trapping with hopes of finally developing a robust, multi-tactical semiochemical-based management system for ACM.

Implementation—

Moderator: Jack Jenkins

Notes:

Implementation

Using Decision Support Systems to Enhance Biological Control

Ute Chambers, Carl Jackson, Vince Jones, Jay Brunner and Angela Gadino
Washington State University, Tree Fruit Research & Extension Center, Wenatchee WA

Keywords: natural enemies, conservation biological control, pesticide effects, phenology models

Abstract: Pesticides applied to control orchard pests can have negative effects on natural enemy populations as a result of the pesticides' acute toxicity or sublethal effects. In addition, the timing of pesticide exposure relative to the natural enemy's phenology can modify the severity of any negative effects. Therefore, knowing what natural enemies are present and if and when they are vulnerable to pesticides is valuable information in the effort to enhance biological control in orchards. To deliver this information into the hands of the pest management decision makers new decision support tools have been created and integrated into existing ones.

The new Orchard Pesticide Effects on Natural Enemies Database (OPENED, http://enhancedbiocontrol.org/opened) summarizes acute toxicity and population growth effect ratings for selected insecticides compiled from various sources and most current research for common natural enemies in western orchards. The OPENED pesticide risk ratings are integrated into the pesticide recommendations on the WSU Decision Aid System (DAS, http://das.wsu.edu). New phenology models for natural enemies in orchards, including two green lacewing species (*Chrysopa nigricornis* and *Chrysoperla plorabunda*) and the syrphid *Eupeodes fumipennis*, have been developed and are being validated. These models, once integrated into WSU-DAS, will show pest management decision makers when natural enemies are expected to be present and exposed to potentially detrimental effects from pesticides. This information will guide pesticide choice and application timing, thereby strengthening the conservation biological control component in and overall effectiveness of IPM programs.

Development and Evaluation of Intelligent Spray Systems in Oregon Nursery Production

Robin Rosetta, Heping Zhu, Derek Wells, Adam Clark
Oregon State University, North Willamette Research and Extension Center, Aurora, OR

Keywords: precision spray technology, powdery mildew, *Phyllactinia guttata*, dusky winged oak aphid, *Myzocallis granovskyi*, *Myzocallis walshii*, honeylocust pod gall midge, *Dasineura gleditchiae*, Pacific Coast pear rust, *Gymnosporangium libocedri*, pear sawfly, *Caliroa cerasi*, sustainable nursery production, pesticide

Abstract: A team of scientists from USDA, Oregon State University, The Ohio State University, and University of Tennessee developed and evaluated intelligent variable-rate spray systems in nursery production. In Oregon we evaluated two prototype spray systems using either laser or ultrasonic sensors to detect targeted plant presence and size and adjust the spray output to match the tree row characteristics. In nine separate efficacy trials in commercial nurseries in four years, reductions in spray volume of the variable rate spray applications compared to the constant rate applications ranged from 34-76.8% while maintaining equivalent control of the key pests sampled. The new spray systems significantly advanced the technology for efficient pesticide spray applications to increase growers' production profitability, worker safety and environmental stewardship.

Implementation

Developing a Management Strategy for Little Cherry Disease

Andrea Bixby Brosi, Elizabeth Beers, Ken Eastwell, Tim Smith
Washington State University, Tree Fruit Research and Extension Center, Wenatchee, WA

Keywords: Little cherry disease, Little Cherry Virus, apple mealybug, *Phenacoccus aceris*, grape mealybug, *Pseudococcus maritime*, insect vector control, cherry

Abstract: Little cherry disease (LCD) is a serious viral disease of sweet cherry caused by three viral pathogens, Little Cherry Virus 2 (LChV2), Little Cherry Virus 1 (LChV1), and Western X phytoplasma. Trees with LChV2 produce cherries of small size and poor flavor making the fruit unmarketable and results in unpicked limbs/trees, tree removal, and even orchard removal. Our study focuses on developing a comprehensive management plan to stop the spread of LCD by controlling insect vectors and early detection and removal of infected trees.

Little Cherry Virus 2 is transmitted via insect vectors, Apple mealybug (AMB), *Phenacoccus aceris*, and, grape mealybug, *Pseudococcus maritimus*. Apple mealybug was only recently recorded for the first time on sweet cherry in Washington; therefore, little is known about its phenology in this region. In 2014, a large, naturally occurring AMB population was monitored weekly in a conventional apple orchard, at WSU's Sunrise Orchards. While grape mealybug control has been studied (primarily on pear), Washington currently has no recommendations for control of AMB. During the 2014 growing season, a field experiment was conducted in the aforementioned AMB infested orchard, to determine the effects of chemical insecticides on AMB populations. Delayed dormant treatments included Lorsban+oil, Diazinon+oil, and oil targeting overwintering females. Lorsban +oil (2.0 ± 0.4 crawlers/leaf) was the only compound that showed significantly lower crawler numbers later in the season, compared to the control (15.2 ± 5.2 crawlers/leaf). Two systemic compounds, Ultor+oil (foliar) and Admire Pro (soil drench), were applied 14 days after petal fall, however seasonal crawler averages were similar to the control. Finally, we applied Admire Pro (foliar), Centaur, Diazinon, and Actara to target active crawlers on leaves. Trees treated with Diazinon (2.1 ± 0.5 crawlers/leaf) had significantly lower crawler numbers than the control trees (15.2 ± 5.2 crawlers/leaf), while all other treatments targeting crawlers had similar seasonal crawler averages compared to the control. Our results suggest that a delayed dormant spray in combination with a spray targeting the crawler stage will provide the best control.

Visual diagnosis of LCD is made difficult by partial recovery in the appearance of fruit, the potential confusion of symptoms with those of other pathogens occurring in sweet cherries, and certain types of nutrient deficiencies. Molecular diagnosis is most reliable, however it is expensive hence, growers delay sampling and analysis, increasing the risk of inoculating nearby trees with virus. A diagnostic kit for LChV2, based on the reverse transcription recombinase-polymerase amplification (RT-RPA) technology, was developed and made available during the 2014 growing season. During May to June, samples from symptomatic trees showing LCD symptoms (e.g., small fruits) were tested for the presence of LChV2 by RT-RPA assays. However, many samples from symptomatic trees did not give positive results in the RT-RPA assay format. When a subset of these discrepancy samples, known to be LChV2 infected, was examined, we found that testing symptomatic trees by RT-RPA during the latter part of the growing season (beginning early July) provided much more accurate virus detection. This improved detection during the latter part of the season is presumably due to decreased carbohydrate inhibitors present in crude sap and the increase in concentration of LChV2 in infected tissue. In addition, a new genetic variant of LChV2 was discovered in Washington orchards. This genetic variability contributes to reduced sensitivity of the assay systems. Finally, Western X has been found to be an important pathogen associated with LCD in Grant and Chelan counties. It was previously primarily associated with LCD in Yakima County.

Thresholds/Monitoring—

Moderator: Reed Britt

Notes:

Thresholds/Monitoring

SuperPaco TriplePak for Tortricids

Alan Knight
USDA, ARS, Wapato, WA

Keywords: Tortricidae, Monitoring, thresholds, codling moth, oriental fruit moth, leafrollers

Abstract: How can we improve monitoring of the various tortricid pests attacking tree fruits and nuts? Two things are likely true: everyone is scared of change especially when they think "if it works, why change it?", and everyone thinks it is better to catch more pest insects in traps in order to avoid failing to detect low population densities. Well, what if I told you that you could use one trap to monitor all of your tortricids? And, what if by doing this your catches of some species would be lower than if you used many separate traps each with a sex pheromone lure? Would it be possible to create this change with the growers if moth catches continued to be highly correlated with pest pressure? This issue will not be resolved here today but I will present data and discuss our options.

Dispersal of Codling Moth Adults within Typical Agro-Ecosystems of Central Chile: Relevance of Unmanaged Hosts

Alan Knight[1], Esteban Basoalto[2], Marcela A. Rodríguez[3], Wilson Barros-Parada[3] and Eduardo Fuentes-Contreras[3]
[1]USDA, ARS, Wapato, WA; [2]Universidad Austral de Chile, Valdivia, Chile;
[3]Millennium Nucleus Centre in Molecular Ecology and Evolutionary Applications in the Agroecosystems (CEM), Universidad de Talca, Chile

Keywords: Codling moth, dispersal, immunomarking

Abstract: With the aim to identify patterns of codling moth dispersal by adult flight in agro-ecosystems from central Chile, an immunomarking experiment was performed in apple orchards surrounded by various unmanaged host plants. Potential host-plants were sprayed with low-cost protein antigens (egg whites, cow's milk and soy milk) to allow self-marking of codling moth adults that made contact with sprayed trees, combined with a trap grid design for capture male and female moths inside commercial orchards.

Marked codling moth were caught at distances of approximately 35-425 m. Walnut was the most common unmanaged host found, and the main source of marked moths in our study. Interestingly, walnut was a secondary source of moths when pip fruits (apple, pear or quince) were present at the same place. This data suggest that the success of any future codling moth areawide management program in central Chile must consider unmanaged hosts.

Thresholds/Monitoring

Comparing the Efficacy of Semios Traps and Delta Traps for Codling Moth and Non-Target Species

Chelsea Eby and Michael Gilbert
semiosBIO Technologies Inc., Vancouver, BC, Canada

Keywords: wireless mesh network, camera traps, pest monitoring, codling moth, *Cydia pomonella*

Abstract: The Semios system allows for remote aerosol mating disruption and monitoring of insect pests, with codling moth being the first targeted species. Semios traps are equipped with cameras whose images are wirelessly uploaded to and accessible via an on-line graphical user interface (GUI). The number of images taken per day is flexible and is set using the GUI. The GUI also enables the user to count and record the number and type of pests on each image. During the summer of 2014, red and white Semios traps were compared with standard white delta traps for their efficacy in capturing codling moth. By-catch rates of Hymenoptera and Diptera were also examined. Red Semios traps caught significantly more moths than both white Semios and white delta traps. White Semios traps caught significantly more Hymenoptera than red Semios traps or white delta traps. White delta traps caught the most Diptera, but not significantly more than red or white Semios traps. These data indicate that red Semios traps are suitable for monitoring codling moth.

Plume Reach and Trapping Radius for Codling Moth (*Cydia Pomonella*)

Christopher Adams, Pete McGhee, Larry Gut and Jim Miller
Michigan State University, Tree fruit Research, East Lansing, MI

Keywords: Codling moth, *Cydia pomonella*, monitoring, trapping radius, plume reach, trapping area

Abstract: Insights from computer simulations of stochastic movers in a cyber space arena containing a trap have resulted in a novel way of interpreting catch data from a single trap multiple release experimental design. We demonstrate how to measure the plume reach and the trapping radius for a standard Trécé Delta codling moth monitoring trap in Michigan apples. Field experiments using marked sterilized moths have validated models and reveal what proportion of a known population is caught. Using these tools we can now accurately calculate the absolute rather than relative pest density. The plume reach for a Trécé Delta Trap baited with an L2 lure is 2 m. The maximum dispersion distance of a population of codling moths is 240 m. These two measures together give the trapping radius and allow us to calculate a trapping area of 45 acres with an overall proportion catch of 1% on average.

Thresholds/Monitoring

Cherry Fruit Fly Distributions in Managed Cherry Orchards in Oregon and Washington

Wee L. Yee[1], Robert B. Goughnour[2], and Peter W. Shearer[3]
[1]USDA-ARS, Yakima Agricultural Research Laboratory, Wapato, WA; [2]Washington State University, Vancouver, WA; [3]Oregon State University, Hood River, OR

Keywords: *Rhagoletis indifferens*, sweet cherry, tart cherry, spatial distribution, border trees, interior trees, yellow sticky traps, adult flies, larval infestations

Abstract: The presence of adult and larval western cherry fruit flies in border and interior trees in insecticide-managed sweet and tart cherry orchards was determined in Oregon and central Washington from 2011 to 2014. Gravid flies were detected on traps in the orchards. Low infestations of fruit by immature stages were also detected. Results suggest cherry fruit fly continues to be a threat to cherry orchards in the northwestern U.S.

Monitoring Navel Orangeworm with Phenyl Propionate and Pheromone in the Presence of Mating Disruption

Charles S. Burks[1], Lodewyk P. Kuenen[1], and Kent M. Daane[2]
[1]USDA, Agricultural Research Service, San Joaquin Valley Agricultural Sciences Center, Parlier CA
[2]UC Berkeley, Department of Environmental Science, Policy, and Management, Berkeley, CA

Keywords: navel orangeworm, almonds, pheromone, kairomone, monitoring, lure

Abstract: A recently-developed sex pheromone lure improves options for monitoring navel orangeworm in conventionally-managed almonds, but is minimally effective in the presence of mating disruption. Phenyl propionate is a non-pheromonal attractant for the navel orangeworm. Experiments were conducted to determine if these attractants act in an additive or synergistic manner when presented together. In the absence of mating disruption, traps baited with phenyl propionate captured significantly fewer adults than traps baited with a sex pheromone lure. There was no significant difference in the number of adults captured in traps with both attractants when mating disruption was not used. In the presence of mating disruption, pheromone traps were completely suppressed, and traps with both pheromone and phenyl propionate captured significantly more adults than traps baited with only phenyl propionate. Traps with only phenyl propionate captured equal numbers of both sexes, whereas traps with both attractants had significantly more males. These findings demonstrate that phenyl propionate is potentially useful for monitoring navel orangeworm in the presence of mating disruption. Further studies on formulation and dose-response are needed.

Poster Session

Notes:

POSTER
Chemical Control/New Products

The Effect of Applaud, Movento, IKI-3106 (Cyclaniliprole) and Beleaf on Western Grape Leafhopper

Richard J. Hilton and Shannon Davis
Oregon State University, Southern Oregon Research and Extension Center, Medford, OR

Keywords: buprofezin, flonicamid, spirotetramat, *Erythroneura elegantula*, grapes

Abstract: This study evaluated Applaud, Movento, IKI-3106 (cyclaniliprole), and three rates of Beleaf for control of pests in wine grapes. Significant populations and results were only seen with respect to western grape leafhopper. The Applaud and IKI-3106 treatments resulted in very significant reductions in the initial nymphal level with the effect of Movento being intermediate. The Beleaf treatments showed no reduction in leafhopper nymph numbers relative to the check during the first summer generation of nymphs. During the subsequent generation of leafhopper nymphs, the Beleaf treatments resulted in higher levels of nymphs than the check, usually significantly higher, while the Applaud, IKI-3106, and Movento treatments had lower numbers of leafhopper nymphs than the check with the Applaud treatment having the lowest level of nymphs on most sample dates.

POSTER
Mating Disruption/SIR

Evaluation of Puffer Mating Disruption in Utah

Marion Murray
Utah State University, Logan, UT

Keywords: mating disruption, peach twig borer, Checkmate Puffer PTB, Checkmate PTB-XL

Abstract: This project tested the efficacy of Checkmate Puffer PTB (not yet registered in the USA; Suterra LLC) for season-long peach twig borer control as a labor-saving alternative to hand-applied dispensers. Puffers (1.2/acre) were deployed on one grower farm located in Utah County, UT, in 2014. This farm had been using Checkmate PTB-XL hand-applied dispensers for four years, but the peach twig borer population was increasing each year. Trap catch and injury results in the Puffer-treated block (52 acres) were compared to two neighboring blocks, one using Checkmate PTB-XL at 200/acre (15 acres), and another using conventional pesticides (12 acres). Both average weekly trap catch and shoot strike injury were significantly different between the Puffer and conventional blocks, and not significantly different between the Puffer and Checkmate PTB-XL blocks, and between the Checkmate PTB-XL and conventional blocks. Fruit injury was 1.4% in the Puffer block, 3.6% in the Checkmate PTB-XL block, and 5.2% in the conventional block.

POSTER
Mating Disruption/SIR

Evaluation of Sex Pheromone Blend and Ratio Released by Obliquebanded Leafroller, *Choristoneura rosaceana* Females

Juan Huang, Larry Gut, and Matthew Grieshop
Michigan State University, East Lansing, MI

Keywords: volatile emissions, volatile collection system, GC-MS, attraction, Obliquebanded leafroller, mating disruption

Abstract: Management of obliquebanded leafroller (*Choristoneura rosaceana*) (OBLR) has become increasingly difficult due to the development of resistance to insecticides. Mating disruption for this species has been largely ineffective and attract-and-kill for this species has not been well evaluated. Attract and kill tactics require excellent attraction to a toxicant or other killing device, and an optimal pheromone blend of OBLR is lacking. The objective of our study was to compare and quantify volatile emissions from calling females and commercial lures, and use that information to develop improved OBLR lures. Sex pheromone collection was done on groups of OBLR in a laboratory based volatile collection system and evaluated using GC-MS. Surprisingly, only two components, (Z)-11-tetradecenyl acetate (Z11-14:Ac) and (Z)-11-tetradecenol (Z11-14:OH) were detected by GC compared to the 3- or 4-component pheromone blends reported from direct glandular extractions consisting of the major component Z11-14:Ac and 2 or 3 minor components E11-14:OAc, Z11:14OH, and Z11-14Ald. In comparison, a commercial lure released a major component Z11-14:Ac with two minor components E11-14:Ac and Z11-14OH. Moreover, the ratio between the major and minor components collected from the females was dramatically different from those reported in previous literature. Based on this new ratio, we developed 2- and 3-component lures and studied their attraction in a field trapping study. Traps with 3-component lures caught 38% more OBLR moths than traps with 2-component lures, indicating that the minor component E11-14:Ac under the detection level likely plays an important role in male's attraction. Moreover, this 3-component lure caught two times more OBLR males than the commercial lure. Therefore, the blend ratio released into the atmosphere instead of the ratio in the substrate is likely more relevant and crucial for the attraction of OBLR males.

Minutes of the 88th Annual Meeting

Orchard Pest & Disease Management Conference
Hilton Hotel, Portland, Oregon
January 8 -10, 2014

I. Call to Order

The **88**th Annual Meeting was called to order by the Chair Lucia Varela at 9:00 am on January 8, 2014. Chair Varela welcomed attendees, asked for each attendee to introduce themselves, and introduced session leaders. They were:

Thresholds/Monitoring	- Walt Bentley
Biological Control	- Mike Devencenzi
Invasive Species	- Larry Gut
Chemical Control	- Peter Shearer
Biology/Phenology	- Bob Van Steenwyk
Mating Disruption/SIR	- Jack Jenkins
Implementation	- Janet Caprile

II. Old Business

A. Approval of 2013 Minutes: Secretary Alston announced that the 2013 minutes are posted on the OPDMC website and printed in the back of the abstract booklet. Betsy Beers proposed an amendment to the 2013 minutes to recognize Chris Sater for assisting the conference with obtaining pesticide credits and preparing the abstracts. It was moved, seconded, and voted to approve the amended 2013 minutes.

Chair Varela called for other old business. There was none.

III. New Business and Conference Information

A. Call for New Business

Chair Varela called for new business.

- Betsy Beers called for a volunteer to manage Oregon pesticide credits (it is more complex than for other states). Peter Shearer, OSU, volunteered as liaison to Oregon Dept. of Ag. to arrange for pesticide credits for OR at next year's meeting.
- Diane Alston thanked Don Thomson for negotiating with the Hilton staff to include wifi in lodging room rate.

B. Meeting Information

General meeting information was presented by Executive Director Thomson:

- Over 200 pre-registrations for the conference with more on-site registrations.
- Coffee will be served at 3:00 pm today and 10:00 am tomorrow.
- The keynote address will be presented by Dr. Stephen Welter at 3:30 today; Steve's abstract is in the program.
- Social mixer in the foyer today at 5:00 pm following the keynote address.
- Poster session at 10:00 am Thursday in the foyer.
- Concurrent disease session Wed and Thurs.

- Pollinator presentation will be moved to Thursday; there is a pollinator questionnaire by the poster in the foyer that you are requested to fill out.

Chair Varela provided speaker instructions:

- 15 min per talk; at 13 min the moderator will give a signal to the speaker; help the conference stay on schedule.

C. Call for Volunteers for Committee Positions

Chair Varela called for volunteers for committee positions. The following committee assignments were made:

Audit: Bob Van Steenwyk (Chair), Chuck Ingels, and Barat Bisabri
Nominations: Larry Gut (Chair), Jay Brunner, and Becky Ela
Resolutions: Dave Epstein (Chair), Peter McGhee, and Rick Hilton

D. In Memoriam

Chair Varela called for names of conference participants who passed away in the last year. There were none.

Chair Varela called for a motion, second, and vote to adjourn the opening business meeting, which was concluded until the closing business meeting on Friday.

IV. Closing Business Meeting

The closing business meeting was called to order by Chair Varela at 10:25 am on January 10, 2014.

A. Board Meeting Report

Secretary Alston provided a summary of the 2014 Board of Directors' Meeting which was held on January 10, 2014 at 6:45 am. The following information items were presented:

- Pre-registration through PayPal worked well; pre-registration is highly encouraged. Conference registration fees will be the same for 2015: 1) pre-registration online $40 and $10 for the printed abstract booklet, and 2) registration on-site $50 and $10 for the abstract booklet. The board voted to keep the $10 increase for on-site registration to encourage pre-registration.
- The board approved the purchase of a new PC computer with a faster processor to facilitate quicker loading of slideshow presentations during the conference.
- The board agreed to try to better coordinate conference communications with the Plant Disease Session and Pacific Northwest Crops Conference. The board will attempt to post agendas from the other meetings on the website and have printed copies of the agenda at the registration desk.
- Pre-loading slideshows using AirDropper worked very well and will continue to be used. Presenters are encouraged to submit their slideshows by the deadline to make it easier for Don and program co-chairs.
- Request to drop off name tags at registration desk to be re-used next year.

B. Further New Business

Chair Varela called for further new business:

- A request to include affiliations on nametags.
- A request to revise pre-registration format on the PayPal website so that names and affiliations of all attendees could be entered.

C. Committee Reports
Chair Varela called for the committee reports.

1. Nominations
Chair Larry Gut made the following nominations:
President-Elect: Steve Ela (Ela Family Farms, CO)
Secretary: Diane Alston (Utah State University)
Treasurer: Nancy Hays (Pacific Biocontrol Corp.)
Executive Director: Donald Thomson (Pacific Biocontrol Corp.)
Program Co-Chairs: Betsy Beers (Washington State University) and John Dunley (Wilbur Ellis)
Jack Jenkins (Pacific Biocontrol Corp.) will serve as Chair in 2015
A motion was made and seconded to accept the recommendations of the nominations committee. The motion was passed.

2. Audit
Chair Bob Van Steenwyk reported that the committee examined the Report of the Treasurer and recommended that the membership accept the report. It was moved, seconded, and approved.

3. Resolutions
Chair Dave Epstein proposed the following resolutions:
1. Be it resolved that this conference extend written appreciation to the management and staff of the Hilton Hotel for the courteous service and fine accommodations provided.

2. Be it resolved that the members of the conference express their appreciation to Executive Director Don Thomson, the Past Chair Dave Epstein, Chair Lucia Varela, Chair-Elect Jack Jenkins, Secretary Diane Alston, Treasurer Nancy Hays, and Program Co-Chairs John Dunley and Betsy Beers for their leadership and dedication in organizing the 2014 meeting.

3. Be it resolved that the members of the conference extend their appreciation to the Tree Fruit Research and Extension Center, Washington State University, and in particular, Chris Sater, for applying for pesticide applicator credits from participating states and preparing the meeting abstracts, and Jerry Tangren for maintaining the OPDMC website.

4. Be it resolved that the members of the conference extend their appreciation to the session leaders: Walt Bentley, Mike Devencenzi, Larry Gut, Peter Shearer, Bob Van Steenwyk, Jack Jenkins, and Janet Caprile for ably overseeing the entomology sessions of the 2014 conference.

5. Be it resolved that the members of the conference extend their appreciation to Tamla Blunt, Colorado State University, for ably overseeing the disease management session of the 2014 conference.

It was moved, seconded, and approved to accept the resolutions.

D. Treasurer Report
Treasurer Hays gave the Treasurer Report

Beginning cash balance	$1,727.26
Income	$26,052.70
Expenses	$14,288.78
Total cash & PayPal balance as of 12/31/13	$13,491.18

E. Call for Nominations for the Rubber Chicken Award

Chair Varela called for nominations:

1. Larry Gut nominated Doug Light for blatantly promoting his own product during his presentation.

2. Lucia Varela nominated John Dunley for answering the phone during his presentation and not editing down his lengthy presentation even though he said he would several times during the presentation.

3. Peter Shearer nominated Alan Knight for soliciting an invitation for his keynote address.

4. Steve Ela nominated Chelsea Eby for including a graphic video of maggots eating a mouse caught in an insect trap during her presentation.

Chair Varela called for a vote from the membership by a show of hands. It was competitive vote, but Doug Light won his second rubber chicken award.

Chair Varela presented Executive Director Thomson with two bottles of wine for his meritorious service to the conference: one bottle from Argentina (a neighbor to her native country of Uruguay), and one from her current home in Sonoma Valley.

Chair Varela passed the gavel to the 2015 Chair Jack Jenkins, who adjourned the meeting.

Conference dates for next year are January 7-9, 2015. It will be held once again at the Portland Hilton.

Respectfully Submitted,
Diane Alston
Secretary
2014 Orchard Pest and Disease Management Conference

The Rubber Chicken Award

An enduring tradition of informality is the nomination, voting, and awarding of the Rubber Chicken to one of the presenter during the closing business meeting. The Rubber Chicken may be awarded for a variety of reasons, but egregious behavior in some aspect of presenting a scientific talk is the underlying theme: too long, too short, poor organization, illegible slides, and over-spinning research results are frequently cited. '**Winners' in the Modern Era** (following about a 15 year hiatus, the award was revived during the 75th anniversary meeting):

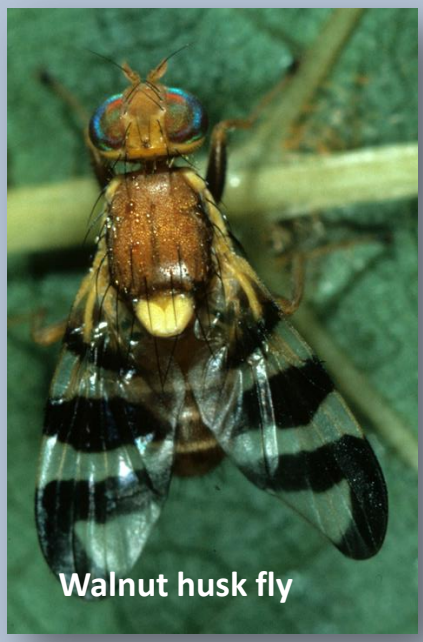
- **Rachel Elkins (2001)**, University of Calif., Clear Lake, for using an overhead projector in a digital age.
- **Jay Brunner (2002)**, Washington State University, Wenatchee, for giving one of the looooongest talks in the history of the WOPDMC (Seriously. His 10-minute talk was an hour).
- **Doug Light (2003)**, USDA, Albany, California, for showing incomprehensible data slides again and again and again. (Chemists….)
- **Stephen Welter (2004)**, University of California, Berkeley, for inappropriate behavior by leaving the meeting prior to giving his presentation.
- **Alan Knight (2006)**, USDA-ARS, Wapato, Washington, for not submitting a talk.
- **Andy Kahn (2007)**, Wenatchee, Washington, for giving a much too long presentation and refusing to yield the podium - Andy subsequently decapitated our alopeciate friend.
- **Jim Miller (2008)**, Michigan State University, for attempting to coerce the entire membership into his cult of the pheromone, and for admitting to having intimate relations with codling moths; Jim was responsible for the demise of yet another unfeathered friend.
- **Peter Shearer (2009)**, Oregon State University, Hood River, for forgetting, like Dorothy, that he was not in Rutgers anymore (For those of you not present, he gave his talk as the new director of the Hood River Station MACAREC, using the Rutgers template).
- **Harvey Reissig (2010)**, Cornell University, Geneva, for his presentation that introduced a new web-based IPM decision support system for NY apple growers that was actually a chemical spray calendar disguised as an IPM program (well played, Harvey, well played…).
- **John Dunley (2011)**, Wilbur-Ellis, Cashmere, Washington, for not being present each morning to turn on the lights, the projector, and the laptop computer before the meeting began. He also assumed that at least one of the many well-educated members of the Conference (ahem, BrocZoller), most of whom were lugging their own laptops, would be able to find the correct button to turn on the conference laptop, and that labels on the two (!) cords would make the connections between the laptop and projector clear. He was proven to be incorrect.
- **Larry Gut (2012)**, Michigan State University, for now conducting research on pheromone puffers (and finding them effective) after 'pooh-poohing' them for many years.
- **Don Thomson (2013)**, DJS Consulting Services, for delivering the keynote speaker's address in his introduction of Camille before she had a chance to deliver her own presentation. Also, Don temporarily lost the rubber chicken in the foyer, but he did later recover it.
- **Doug Light (2014)**, USDA ARS, Albany, California, for blatantly promoting his own product during his presentation.
- **Brad Higbee (2015)**, Paramount Farms, CA, for delivering an extended talk under false pretenses, breaking the new OPDMC computer, and bragging about his 40 acre research plots.

Adult pear psylla

Brown marmorated stink bug

Woolly apple aphid

Western cherry fruit fly


Walnut husk fly

Apple maggot

Navel orangeworm

Spotted wing drosophila

Codling moth