# 2011 Orchard Pest & Disease Management Conference

The 85th Conference is pleased to announce our keynote speaker

Dr. Larry Hull

Penn State University

Keynote Address:

"Arthropod IPM Research in the Mid-Atlantic States: A Look Back and a Glimpse Into the Future"

---

## New in 2011: Invasive Species Session


*Invasive Species Session Keynote:*

Dr. Greg Simmons, USDA-APHIS

"The USDA-APHIS-PPQ Mission to Stop the Establishment and Spread of Invasive Plant Pests: Pest Risk Analysis, Survey and Detection, Regulatory Response, and Technology Development"


Hilton Portland, Portland, Oregon

January 12-14, 2011

WESTERN ORCHARD PEST AND DISEASE MANAGEMENT CONFERENCE
"The Portland Spray Conference"
(1926 - 2010)

**Our History:** One of the oldest and most appreciated Entomology-Plant Pathology meetings in the Pacific Northwest is the Portland Spray Conference. It dates back to 1926. It was on June 30 of that year at the suggestion of J. R. Parker, Associate Entomologist, Montana Agricultural Experiment Station, that the first meeting was held in Tacoma, Washington. The "Western Cooperative Oil Spray Project" as it was formally named was organized at that meeting. Participants included representatives of Idaho, Montana together with representatives of the USDA and the Canada Department of Agriculture. Mr. Parker was named Chairman. Another meeting was held in Spokane, Washington on December 5, 1926 and thereafter, over the past 80 years, this has been an annual gathering. The meeting continues to grow and we now have participants from all fruit growing areas of North America and other countries including Argentina, Chile, and Switzerland.

**Our Focus:** The meeting has always been one focused on research, without any emphases on the commercial aspects of the applications of the research. Not so long ago (thirty or so years ago), the meeting was small, forty or fifty people, and limited to only research scientists from public institutions. Then extension agents were invited in, then one representative from each chemical company (about twenty years ago), then opened to everyone. Now the meeting participants include researchers, extension personnel, manufacturing reps, fieldmen from agricultural chemical companies, private consultants, and growers. Everyone is invited to give presentations and there is a strong commitment amongst all members to keep presentations scientific not only out of a respect to the origins of the meeting but also to ensure that the meeting is a valuable experience to all participants.

**Rubber Chicken Award:** In an effort to ensure that presenters and participants maintain the highest standards of conduct and etiquette, WOPDMC members annually award the prestigious but unwelcome "Rubber Chicken Award". Recipients of this high distinction (awarded at the conclusion of the meeting) receive a featherless, rubber chicken appropriately hung by its feet.

**'Winners' in the Modern Era** (following about a 15 year hiatus, the award was revived during the 75th anniversary meeting)

**Rachel Elkins (2001),** Univ. of Calif., Clear Lake, for using an overhead projector in a digital age.
**Jay Brunner (2002)**, Wash. St. Univ., Wenatchee, for giving one of the looooongest talks in the history of the WOPDMC.
**Doug Light (2003)**, USDA, Albany, California, for showing incomprehensible data slides again and again and again.
**Stephen Welter (2004)**, Univ. of Calif., Berkeley, for inappropriate behavior by leaving the meeting prior to giving his presentation.
**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)**, Mich. St. Univ., for attempting to coerce the entire membership into his cult of the pheromone - and Jim was responsible for the demise of yet another unfeathered friend.
**Peter Shearer (2009)**, Ore. St. Univ., Hood River, for forgetting, like Dorothy, that he was not in Rutgers anymore.

**Orchard Pest and Disease Management Conference**
**Agenda for 2011 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.

Talks within a session will be in the order in which they are listed in the agenda found on the following pages.

| | | |
|---|---|---|
| **Wednesday, January 12** | | |
| 9:00am | Opening Business | Peter Shearer, WOPDMC Chair |
| 10:00am | Biology/Phenology | Art Agnello, Session Manager |
| 10:30am | Mating Disruption / SIR | Jeff Olson, Session Manager |
| 12:00pm | Lunch | |
| 1:30pm | Mating Disruption / SIR (cont.) | Jeff Olson, Session Manager |
| 2:30pm | Implementation | Tim Smith, Session Manager |
| 3:00pm | Coffee | |
| 3:30pm | **Keynote Address:** Arthropod IPM Research in the Mid-Atlantic States: A Look Back and a Glimpse Into the Future. Larry Hull, Penn State University | |
| 5:00pm | Mixer (Lobby) | |
| **Thursday, January 13** | | |
| 8:00am | Implementation (cont.) | Tim Smith, Session Manager |
| 8:30am | Thresholds / Monitoring | Chris Nobbs, Session Manager |
| 9:15am | Biological Control | Dave Biddinger, Session Manager |
| 10:00am | Poster Session / Coffee Break | |
| 11:00am | Invasive Species | Bob Van Steenwyk, Session Manager |
| 12:00pm | Lunch | |
| 1:30pm | Invasive Species (cont.) | Bob Van Steenwyk, Session Manager |
| 3:30pm | Break | |
| 4:00pm | Invasive Species (cont.) | Bob Van Steenwyk, Session Manager |
| **Friday, January 14** | | |
| 8:00am | Chemical Control | Dan Skoczylas, Session Manager |
| 11:00am | Closing Business | Peter Shearer, WOPDMC Chair<br>Tom Unruh, Chair-elect |
| 12:00pm | Adjourn | |

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

# Western Orchard Pest and Disease Management Conference

## Officers for the 2011 Conference


**Chair**
Peter Shearer
Oregon State University
3005 Experiment Station Drive
Hood River, OR 97031
Phone; 541-386-6190
Fax: 541-386-1905
Email: peter.shearer@oregonstate.edu

**Chair-Elect**
Tom Unruh
USDA – ARS
5230 Konnowac Pass Road
Wapato, WA 98951
Phone: 509-454-6563
Fax; 509-454-4224
Email: unruh@ars.usda.gov

**Secretary/Treasurer**
Nancy Hays
Pacific Biocontrol Corporation
14615 N.E. 13th Court, Ste. A
Vancouver, WA 98685
Phone: 360-571-2247
Fax: 360-571-2248
Email: nhays@pacifier.com

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

**Executive Director**
Don Thomson
DJS Consulting Services, LLC
3015 S.W. 109 Street
Seattle, WA 98146
Phone: 206-444-5770
Fax: 206-444-0255
Email: dthomson@pobox.com

**Proceedings**
Christina Mayer
Washington State University
Tree Fruit Research and Extension Center
Wenatchee, WA 98801
Phone: 509-663-8181, ext 210
Fax: 509-662-8714
Email: wopdmc@wsu.edu


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

# Order of Presentations
# FROM THE 85th ANNUAL
# ORCHARD PEST AND DISEASE MANAGEMENT CONFERENCE
# January 12, 13 & 14, 2011

**Keynote Presentation, Wednesday, January 12, 3:30pm – 5:00pm**

**Arthropod IPM Research in the Mid-Atlantic States: A Look Back and a Glimpse Into the Future.** Larry Hull, Penn State University

***Presentation*** ***Page***

***Presentation*** ***Page***

# ABSTRACTS

# BIOLOGY/PHENOLOGY—

ART AGNELLO, SESSION MANAGER

---

Notes:

Biology/Phenology

## Stink Bug Biology and Management in North-central Washington

Michael D. Doerr[1], Jay F. Brunner[1] and Jocelyn Millar[2]
[1]Washington State University Tree Fruit Research and Extension Center, Wenatchee, WA
[2]University of California, Riverside, CA

*Keywords:* Consperse stink bug, *Chlorochroa ligata*, pheromone, monitoring, insecticide

*Abstract:* Stink bugs have been considered a localized pest of apple in Washington. However, since the expansion of sweet cherry production to higher elevations and adoption of later maturing varieties, this crop has come under attack by stink bugs, in some cases causing severe injury. Stink bugs in general represent a threat to tree fruit production, but they are a particular threat to organic production because there are no effective, organically certified products available to control these bugs. The consperse stink bug and *Chlorochroa ligata* are the two main species causing fruit damage in north-central Washington. While the consperse pheromone is in commercial production, improving the synthesis of the pheromone for *C. ligata* and optimizing its release rate for attraction would provide another useful tool for management of this pest. Better characterization of the life history and ecology of *C. ligata* will provide a sound basis for developing tactics to manage it. A high density of traps placed along orchard borders to intercept invading stink bugs may represent a viable attract-and-kill system for both conventional and organic orchards.

The synthesis process of the *C. ligata* pheromone was challenging due to two of the five steps, which had low yield, still 20 grams of pheromone were delivered on 1 April and release rates studies were begun. The release rate of *C. ligata* pheromone from polyethylene lures of different thicknesses did not differ significantly as the relatively large molecule has a very slow evaporative rate. The same lures provided a very good release profile for the consperse pheromone, which is a smaller molecule relative to that of *C. ligata*. Field attraction with *C. ligata* lures reflected the release rates observed in the laboratory where there was little or no difference between them. There was some hope that using multiple lures in the same trap could enhance the attraction of *C. ligata*. Pyramid traps with a gallon plastic jug at the top provided a consistent and durable monitoring tool. The trap could be constructed cheaply by growers with plywood or other composite materials. It was apparent that these two species have only one generation per year. *C. ligata* adults began appearing in early July with captures peaking in late July and early August. New *E. conspersus* adults did not appear until late July with a definite peak in mid-August. These data could have been influence by orchard border spraying, which began in mid- to late-July in most orchards. We evaluated several different insecticides against stink bugs. Insecticide residues that were most toxic in the initial laboratory screen were the carbamates Lannate and Carzol, the chlorinated hydrocarbon Thionex, and the synthetic pyrethroids Danitol and Warrior. Most of the newer insecticides were not effective. Some of residue from the cups in the field of the best insecticides from the initial screen was exposed to adult *E. conspersus*. Thionex provided good kill through 28 days of testing. Warrior residues were not as effective and had a short longevity under field conditions.

Biology/Phenology

## Identification of a Sex Attractant Pheromone for Male Pear Psylla

Christelle Guédot[1], Jocelyn G. Millar[2], David R. Horton[1], and Peter J. Landolt[1]
[1]USDA, ARS, Wapato, WA; [2]University of California, Riverside, CA

*Keywords:* Mate location, hydrocarbons, *Cacopsylla pyricola*

*Abstract:* Pear psylla, *Cacopsylla pyricola* (Förster) (Hemiptera: Psyllidae), a major economic pest of pears, has been shown to use a female-produced sex attractant pheromone. We compared the chemical profiles obtained from cuticular extracts of diapausing and post-diapause winterform males and females, with goals to isolate and identify the pheromone. Post-diapause females produced significantly more of the cuticular hydrocarbon 13-methylheptacosane than post-diapause males and diapausing females. In olfactometer assays, males were attracted to synthetic racemic 13-methylheptacosane whereas females were not, indicating that the behavioral response to this chemical is sex-specific. Furthermore, 13-methylheptacosane was as attractive to males as an extract of females, suggesting that this chemical was largely responsible for the female attractiveness. A field study showed that males but not females were attracted to 13-methylheptacosane, confirming the olfactometer results. This study provides evidence that 13-methylheptacosane is a sex attractant pheromone for *C. pyricola* winterform males. This is the first identification of a sex pheromone in the Psylloidea. Results open the path to developing monitoring tools and possibly new strategies for integrated pest management of this insect.

## Apple Flea Weevil: An Emerging Pest in Organic Orchards

Anne L. Nielsen and Matt Grieshop
Department of Entomology, Michigan State University, East Lansing, MI

*Keywords*: Apple flea weevil, organic, apple, overwintering, emerging

*Abstract:* Apple flea weevil (AFW) has emerged as a serious pest in organic Michigan apples in recent years. The cause for its reemergence is unknown and parasitoid populations and climatic variables are being investigated. Adults emerge in early spring, feeding on developing bud tissue during the pink and green stages causing bud abortion. Organic growers in Michigan have experienced >90% fruit loss due to bud feeding. Adults also feed on leaf material causing "shot hole" damage. After developing within the leaf, the new generation of adults appears to feed for a few days before moving to the leaf litter in July to overwinter. We conducted a preliminary management trial targeting the overwintering adults to reduce critical damage to blossoms. A biopesticide (Mycotrol O), entomopathogenic nematode *Steinernema carpocapsae*, and burning were evaluated at reducing AFW populations. Only the burning treatment significantly reduced AFW populations. Proper application timing of the Mycotrol O and EPN treatments needs to be investigated. Since treatment applications were applied to the soil, the foundation of organic practices, the impact on non-target soil dwelling arthropods of each treatment was also evaluated. The burning treatment significantly reduced populations of spiders and other predators.

# MATING DISRUPTION/SIR—

JEFF OLSON, SESSION MANAGER

---

Notes:

Mating Disruption / SIR

## Examining the Position of Pheromone Dispensers for Mating Disruption – Does it Really Matter Where They are Placed in the Tree?

Bradley S. Higbee and Ring T. Cardé
**Paramount Farming Company, Bakersfield, CA**

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

*Abstract*: Mating disruption (MD) for control of navel orangeworm (NOW, *Amyelois transitella*) in almonds, using the major female sex pheromone component, ((*Z,Z*)-11,13-hexadecadienal)), and dispensed from low density, high emission devices (puffers), has been used commercially with positive results. From the beginning of work on mating disruption for codling moth, the recommendation for dispenser placement has been that they should be placed in the upper third of the tree canopy. This was based on the idea that mating occurred in that region and because the released formulations were heavier than air, they would tend to move downward from the release point, effectively penetrating the canopy. Studies over the last three years in our respective laboratories strongly suggest that in the relatively calm conditions (detectable horizontal and vertical air movement of less than 1m/sec) occurring at night in the San Joaquin Valley of California, air movement tends to be lateral and upwards for a majority of the scotophase. We conducted an experiment in 2010 comparing placement of puffers in the traditional high position (upper third of canopy) to puffers positioned at the bottom of the canopy ($\pm$ 2 m from the ground). Three replicates of three treatments (Low MD, High MD, or Conv) were established in mature almond orchards, with each plot covering 160 acres. We collected data from pheromone and oviposition attractant-baited (egg) traps at five vertical positions from the ground to the top of the tree canopy, and examined nut infestation and damage at harvest. All pheromone traps were nearly completely shut down in all MD plots after puffer deployment, with the exception of the pheromone traps in the upper two positions in the Low MD plots for the first week after puffers were installed. After that first week, the Low MD plots achieved 99.77% pheromone trap shutdown while the High MD plots had 99.78% fewer males trapped than the Conv plots. Previous work has documented reductions in egg trap counts in areas under MD. In this study, the low MD had a 67% reduction in oviposition while the High MD treatment reduced egg laying on traps by 58% compared to the Conv plots. Nut damage at harvest was examined in two ways, samples taken by farm personnel (Huller samples) from trucks as they were loaded at the field site, and samples taken directly from specific locations in each plot and examined by research personnel (Exp samples) The Huller samples reflected overall damage levels from NOW of 0.8, 0.8, and 0.4% for the Conv, High MD and Low MD treatments, respectively. The Exp samples had damage levels of 1.3, 1.1, and 0.6% for the Conv, High MD and Low MD treatments, respectively. This initial study suggests that puffers placed in the lower canopy of almond trees are at least equally effective in reducing NOW damage when compared to placement in the upper canopy.

Mating Disruption / SIR

## Using Sterile Insects to Standardize and Supplement Codling Moth Mating Disruption Trials and Management Programs

Gary Judd[1] and Donald Thomson
Agriculture and Agri-Food Canada, Pacific Agri-Food Research Centre,
Summerland, British Columbia, Canada

*Keywords*: *Cydia pomonella*, codling moth, mating disruption, sterile insect technology

*Abstract*: Conducting, and more importantly, interpreting results from field experiments examining the mechanisms of pheromone-mediated mating disruption, or comparing commercial pheromone products, are challenging for several reasons. Not the least of these challenges is that wild codling moth populations are inherently low, often aggregated, and variable within and between commercial orchards. This variability adds a strong stochastic element to standard measures of disruption based on trap catches. One solution has been the use of a standardized environment, like a large field cage; into which small known codling moth populations are introduced and trapped. An alternative approach, and one taken here, has been to use large standardized populations of sterile codling moth released by the Okanagan-Kootenay SIR Program and repeated mark-release-recapture tests in commercial orchards over multiple years. In 2009, three 100+acre test sites were established to begin examining multiple-species mating disruption in apples while maintaining control of codling moth. One objective was to compare the efficacy of Isomate-CM Flex, Isomate-CM/LR and Isomate-CM/LR/ESBM as codling moth treatments, but with each targeting increasing numbers of tortricid pest species (1, 5, and 6, respectively). Test sites were specifically chosen because the histories and population densities of wild codling moth were well known and similar. In this year-two summary, pheromone release-rates of each dispenser type are presented, and relative disruption of codling moth based on catches of wild and sterile males with different lures are compared and contrasted. Disruption of wild codling moths was extremely variable and appeared strongly dependent on very small population differences and trap catches. Among the three pheromone treatments, CM/LR/ESBM released the greatest amount of codlemone, and caused the greatest disruption of wild moths. In contrast, disruption of sterile males was consistent across locations and years, and relatively large recaptures allowed robust statistical comparisons with small standard errors. Disruption of sterile males led to the conclusion that CM Flex caused the greatest levels of disruption even though it released the least codlemone. These results are at the same time both contrary (wilds) and supportive (steriles) of the competitive-attraction model of disruption. More extensive use of sterile moths and studies calibrating their behaviour against wild moths may allow robust testing of this disruption hypothesis, and others, in unconstrained open field systems.

Mating Disruption / SIR

## Release of Sterile Codling Moth to Challenge Mating Disruption Technologies in Commercial Orchards

Jay F. Brunner and Michael D. Doerr
Washington State University Tree Fruit Research and Extension Center, Wenatchee, WA

*Keywords:* Codling moth, *Cydia pomonella*, sterile moth release, mating disruption

*Abstract:* Finding a method to compare mating disruption technologies that provides a consistent and repeatable result is difficult. Growers unwilling to allow damage to develop in their orchard confound fruit injury data, and background populations and pressure gradients bias moth captures in pheromone-baited traps. Further factors that confound mating disruption research is the inability to work in orchards with enough acreage to have large replicated plots, an even distribution codling moth populations across all treatments, and grower willingness to accommodate an untreated control. Two scenarios that are commonly encountered, both seen again in 2010, illustrate the difficulty in analyzing results from side-by-side demonstration-style experiments even if the trial was replicated in several orchards. First, even under pest high pressure, a density gradient exists making treatment comparisons difficult or impossible. Second, an orchard with a historically high pest problem does not develop a measurable population during the current year because it had received an intensive control program the previous year.

By using the release of sterile moths to challenge pheromone treatments trials were conducted in orchards with very low codling moth pressure that received minimal insecticide applications. In these situations growers were convinced to leave portions of their orchard untreated (with pheromone) providing a true non-pheromone control. Further, the entire study could be replicated across several sites and the release of sterile moths eliminated one of the most important sources of variance, background pressure gradients.

In 2010, three different mating disruption technologies were evaluated using sterile moths releases; a standard hand-applied dispenser (Isomate Flex), an experimental meso dispenser (Isomate Ring), and a commercially available aerosol mist dispenser (Suterra Puffer). Sterile moths were released in the center of each treatment weekly. Recovery of sterile moths was evaluated in 12 large delta traps baited with a female mimic pheromone lure (0.1 mg) distributed around the release site. All three technologies provided a high level of trap shutdown, with little apparent difference among the Suterra Puffer at 1/acre, the Isomate Ring at 32/acre, and Isomate Flex at 320/acre. The trial was replicated at three locations and each of the treatments was rated as the best in one of the replicates. The average trap shutdown relative to the untreated control across the three sites was; 94.9% for the Isomate Flex dispenser, 93.7% for the Suterra Puffers, and 92.8% for the Isomate Ring dispenser. Data variance was higher in the Isomate Ring and Suterra Puffer treatments than the Isomate Flex treatment.

Mating Disruption / SIR

## Movement of Male Codling Moths in Puffer Treated Apple Orchards

Peter McGhee and Larry Gut
Michigan State University East Lansing, MI

*Keywords: Cydia pomonella*, codling moth, Puffer, mating disruption, pheromone

*Abstract:* Experiments in three replicated paired 10-acre apple orchards were conducted to investigate male codling moth behavior under disruption using puffers vs. those in orchards not treated with pheromones. Twenty LPD traps baited with L2 lures were deployed in a grid over 10 acres at one trap per 0.5 acre. Significantly fewer codling moths were captured in the no pheromone control compared to the Puffer treated orchard. This somewhat unexpected result prompted further studies using sterile marked male moths released in the two plots. The pattern of moths recaptured was similar to that recorded for wild population moths. In a third study, male moths marked with one of five colors of Dayglo® powder were released in the no mating disruption control and at varying distances from the emitter within the puffer plot. Recaptures indicated that moths moved upwind and toward the pheromone source from all released distances. Moreover, moths released from neighboring areas not treated with pheromone moved into the treated orchard, with the greatest numbers of moths recaptured nearest to and upwind of the emitter. The possibility that low catches in puffer treated plots are the result of males being displaced from areas downwind of the puffer will be proposed.

## Effect of Pheromone Dose Reduction on the Plume of Aerosol Puffers: Preliminary Studies

Daniel Casado, Frances Cave and Steve Welter
Department of Environmental Science, Policy and Management, University of California, Berkeley, CA

*Keywords*: mating disruption, aerosol puffers, walnut, pear, codling moth, pheromone dose

*Abstract*: Aerosol puffers are successfully used for mating disruption of codling moth in pear and walnut orchards. The pheromone emission by puffers and their density were initially selected to match the daily amount of pheromone per acre emitted by hand-applied dispensers. Later, the density and time of activity have been progressively reduced on the basis of empirical observations. Nowadays, puffers are displayed at densities of one unit per one to two acres. Previous studies have found that the area of influence of a puffer is much larger, and that the program may be redundant in the amount of pheromone used. In 2010, we conducted preliminary assays on the effect that reducing pheromone load in puffers may have in their area of influence. Uniform grids of pheromone-baited traps were set in a walnut, and a pear orchard. The effect of puffers emitting 100, 50, 10 and 1 percent of the standard amount of pheromone, on trap suppression was recorded. The study was initially conducted on wild moths, but later in the season releases of sterile insects were also conducted to increase population densities. We found that a reduction to the 50% of the pheromone did not have clear impacts on plume size, and the area of influence still exceeds widely the two acres. Furthermore, the 10% treatment also showed a clear plume, though smaller. Although data are only preliminary, it seems clear that a reduction in the amount of pheromone in the program is feasible.

Mating Disruption / SIR

## Reducing the Number of Point Sources per Acres: Meso Dispensers in Walnuts and Pears

Stephen Welter[1], Frances Cave[1], Joe Grant[2], Carolyn Pickel[3], and Rachel Elkins[4]
[1]University of California, Department of Environmental Science, Policy, and Management, Berkeley, CA
[2]UC Cooperative Extension, Stockton, CA [3]UC Cooperative Extension, Yuba City, CA
[4]UC Cooperative Extension. Lakeport, CA

*Keywords*: codling moth*, Cydia pomonella*, walnuts, pears, mating disruption, pheromones, meso dispensers

*Abstract:* Two pheromone dispensers were evaluated for mating disruption of codling moth in walnuts and pears. The dispensers, which are collectively referred to as meso dispensers, are designed to release higher rates of pheromone per dispenser but are hung at 20-40 units per acre. The Suterra membrane dispenser at 18 units per acre releases approximately the same amount of pheromone per acre as standard pheromone programs, whereas the Pacific Biocontrol "ring" dispenser at 20 units emits ca. 50% of the standard pheromone CTT program. Codling moth counts in traps baited with 1X pheromone lures were typically suppressed by 90% or more, but the counts were ca. 10-15% higher on average in plots using the standard pheromone programs. However, damage levels in the full rate Suterra membrane plots were statistically significant from the control plots and provided control comparable to traditional pheromone programs across a broad range of codling moth pressures. The lower emission rate of 50% from the Pacific Biocontrol ring plots did not provide control similar control to the standard pheromone programs in orchards with high codling moth pressures.

## Improved Disruption of Female Codling Moth with Dispensers Loaded with Sex Pheromone and Pear Ester

Alan Knight
USDA, ARS, Wapato, WA

*Keywords:* Mating disruption, *Cydia pomonella*, kairomone

*Abstract:* A variety of studies over the past six years have examined the effectiveness of a novel, polyvinyl chloride dispenser type loaded with various blends of sex pheromone and pear ester (Combo) to disrupt codling moth sexual communication. These Combo dispensers have been compared to similar dispensers (Cidetrak™ CM) and to Isomate™-C Plus dispensers loaded with only sex pheromone in replicated small plots. Results from 2006 to 2009 have consistently shown that the Combo dispensers are more effective in reducing male catch in virgin female-baited traps. In contrast, male catch in traps baited with a synthetic sex pheromone lure have not differed between Combo and pheromone dispensers. Replicated, larger plot studies were conducted during 2010 and the proportions of mated females within wild populations of codling moth were significantly lower in plots treated with a Combo versus a pheromone dispenser. Residual data on the release characteristics of these polyvinyl dispensers will be reported. The effectiveness of monitoring codling moth in plots treated with Combo dispensers with different lures will be addressed. Two formulations of the Combo dispenser that differ in loading and dispenser density are expected to be registered with product launches expected in southern hemisphere in 2011 and in the U.S. in 2012.

Mating Disruption / SIR

## Using High Densities of Pheromone-Baited Traps for Control of Codling Moth and Obliquebanded Leafroller

Michael Reinke, Larry Gut, and James Miller
Michigan State University, East Lansing, MI

*Keywords:* mating disruption, mass trapping, attract and remove, codling moth, *Cydia pomonella*, obliquebanded leafroller, *Choristoneura rosaceana*

*Abstract:* Recent caged plot studies have shown that removal of moths from an apple orchard using traps is more effective at reducing capture in monitoring traps than a mating disruption regime. Here two studies using open orchard 0.2 hectare plots comparing an attract and remove scenario to mating disruption confirm those results. The first study targeted obliquebanded leafroller. Treatments included a no pheromone check, Isomate OBLR/PLR+ applied at 500/ha, and Pherocon IIB traps baited with Trécé OBLR lures applied at 500/ha. Mating disruption reduced capture in monitoring traps by 69%. The attract and remove treatment reduced capture by 85%. The second study targeted codling moth. Treatments included a no pheromone check, Isomate CM FLEX applied at 500/ha, non-sticky traps baited with Trécé CM lures applied at 500/ha, and sticky traps baited with Trécé CM lures applied at 500/ha. The traps used were of a novel design that is small, easy to apply and potentially inexpensive to produce. Mating disruption using Isomate CM FLEX and non-sticky traps reduced capture in monitoring traps by 58% and 71%, respectively. The attract and remove treatment reduced capture by 92%. Both studies show that an attract and remove approach has the potential to provide superior control of moth populations compared to that achieved using mating disruption.

Mating Disruption / SIR

## Novel Mating Disruption Technologies and Strategies for Managing Fruit Pests

Larry Gut, Mike Reinke, Peter McGhee, Mike Haas and James Miller
Michigan State University, East Lansing, MI

*Keywords: Cydia pomonella*, codling moth, mating disruption, pheromone, attract-and-remove

*Abstract:* Recent efforts to develop new mating disruption formulations have been guided by studies examining the mechanisms by which mating disruption is achieved. The greatest efficacy of reservoir dispensers should occur when numerous point sources are distributed uniformly within the orchard. Reservoir dispensers that are amenable to mechanical application should facilitate achieving this. A new pheromone delivery system, called the Tangler®, consists of a module loaded with pheromone and a launcher operated by compressed gas. As a result of the bola design, the propelled modules readily become tangled in the tree branches. The Tangler® showed promise in field tests conducted in 2009 and 2010. A single application provided codling moth control equal to commercially available hand-applied dispensers. Moreover, automated deployment of the modules was nearly 4 times faster than hand application of dispensers. Sprayable microencapsulated formulations appear to operate by camouflage. Their major limitations are that capsules only hold enough pheromone to last a few weeks and capsules are dislodged by heavy rainfall. A solid-set system that delivered a small dose of pheromone-filled nanocapsules each evening was tested in 0.25-acre apple plots. The 'pherogation' system provided orientation disruption superior to that achieved through airblast sprayer application. Attract-and-remove (A&R) technologies appear to offer the possibility of a superior option for disruption. A&R systems based on the use of small, highly effective traps deployed at the rate of several hundred per acre show promise for control of some key tree fruit pests.

## Determining Mechanisms of Mating Disruption of Oriental Fruit Moth Using Large Field Cages

Mike Reinke, James Miller, Larry Gut and Piera Siegert

*Keywords: Grapholita molesta*, mating disruption, pheromone, competitive attraction

*Abstract:* Studies were performed to determine the mechanisms under which mating disruption acts for Oriental fruit moth. Large field cages permitted control of experimental variables including moth density and findability of pheromone sources. The effects of point source density and release rate on capture of male moths in a central monitoring trap were examined. At lower release rates, increases in dispenser density had a diminishing effect on captures of Oriental fruit moths in the central trap. At higher release rates, as dispenser density increased, capture in the central monitoring trap decreased at a linear rate. Results indicate, at low release rates, mating disruption for Oriental fruit moth operates via competitive attraction. Under higher release rates, commonly found in association with commercially available dispensers, Oriental fruit moth disruption works via a non-competitive mechanism.

Mating Disruption / SIR

## IPM of Filbertworm in Oregon Hazelnuts by Use of Mating Disruption

Vaughn M. Walton, Christopher Hedstrom, Ute Chambers and Jeff Olsen
Oregon State University Department of Horticulture, Corvallis, OR

*Keywords:* hazelnut, *Cydia latiferreana*, mating disruption

*Abstract:* Filbertworm is a key pest in hazelnut in Oregon. This pest is currently managed by applying pesticides. Applications are timed by use of pheromone traps and an online phenology model. Untreated orchards have reported up to 50% damage by filbertworm during harvest. Growers often report damage despite pesticide applications. Research indicates that nut damage can occur for extended periods during the season, which explains the lack of control reported by growers. In this work the potential use of mating disruption by using synthetically produced pheromones applied as dispensers at different rates in hazelnut orchards during 2009 and 2010 will be reported. Placed pheromone dispensers have been formulated to provide a cloud of pheromone for up to six months during the growing season. Mating disruption may therefore provide protection against filbertworm damage for these extended periods. Results indicate changes in flight behavior of male filbertworm in blocks where pheromones were dispensed. Crop damage has not been found in mating disruption treated plots for the two-year period. Continued work is needed to confirm that this method of control consistently results in filbertworm control.

## Control of Dogwood Borer with Mating Disruption Using an Antagonistic Sex Pheromone

David Kain and Arthur Agnello
Cornell University, NYS Agricultural Experiment Station, Geneva, NY

*Keywords*: apple, dogwood borer, *Synanthedon scitula*, control, mating disruption, antagonist, Lorsban, Isomate-LPTB

*Abstract:* The increased number of apple trees grown on dwarfing rootstocks, which have a tendency to form burr knots, has led to increased problems with dogwood borer (DWB), which infests rootstocks through these burr knots. One insecticide, chlorpyrifos, effectively controls both overwintered larvae and the summer brood with one application. However, chlorpyrifos is under increasing regulatory scrutiny, prompting a search for alternatives. In addition, growers are reluctant to apply sprays to control borers because, to be effective, they must be applied with a handgun, which entails considerable labor and potential for worker exposure. One possible alternative to using insecticides to control DWB is mating disruption. An experiment to determine the efficacy of mating disruption using an antagonistic pheromone, Isomate LPTB, was conducted in commercial plantings in 2008–2010. In all years, nearly 100% trap shutdown occurred in the treated orchards. Burr knots were also examined in subplots within those orchards, and compared to samples in untreated orchards, to determine treatment effect on larval infestation. While differences in burr knot infestation by DWB larvae were not always statistically significant, infestation was apparently reduced by about 50% in treated orchards in 2008. In 2009–2010, infestation was significantly reduced in each treated orchard by approximately 70–90%.

Mating Disruption/SIR

## Management of the Sessiid Borer, *Synanthedon Scitula* (Harr.) with Mating Disruption and Mass Trapping in Michigan Apple Orchards

David L. Epstein, Larry J. Gut, Luis Teixeira, and Matthew Grieshop
Department of Entomology, Michigan State University, East Lansing, Michigan

*Keywords:* pheromones, *Synanthedon scitula (Harr.*), mating disruption, mass trapping

*Abstract:* Dogwood Borer (DWB) (*Synanthedon scitula (Harr.*)) principally attacks burr knot and vascular tissue on the trunks of apple trees, reducing tree vigor and potentially killing young trees. Trunk sprays with organophosphorous insecticides (OP's) have been the main control method for borers over the past half-century in eastern North America, but the cancellation and/or restriction of several OP's is driving the development of alternative methods for managing borer pests. Reports will be given on field trials being conducted to develop mating disruption and mass trapping of DWB. Dose–response experiments with a new Isomate®-DWB pheromone dispenser conducted in 2009 in four replicated 0.1 ha plots at rates of 0, 10, 20, 63, 188 and 375 dispensers per ha showed increasing orientation disruption of male moths to pheromone-baited traps with increasing numbers of uniformly distributed pheromone dispensers. These results along with video recordings of moth attraction to dispensers in disrupted and non-disrupted orchards show the mechanism of disruption to be competitive attraction. Trials are current in 2010 in four replicated 2 ha plots to test rates of 0, 75, 225 and 375 dispensers per ha. We will also report on DWB mass trapping studies being conducted in 2010 in four replicated 0.4 ha plots at densities of 0, 75, and 225 traps per ha and one treatment of 75 traps plus 150 dispensers per ha. In addition, to address the question of whether mating disruption or mass trapping is more efficacious for insect control, relative dispenser activity (*Relative* $D_a$) from the competitive attraction equation to compare the disruptive activity of the devices used in mating disruption and mass trapping will be presented. Moth catch in each plot is determined using a centrally placed, pheromone-baited monitoring trap. The *Relative* $D_a$ measurement is important for an informed decision when choosing a method for management of Pyralidae and Sesiidae tree-boring pests. *Relative* $D_a$ can be used to compare devices for pheromone-based behavioral manipulation of these and other species that are competitively attracted to artificial pheromone sources.

Mating Disruption/SIR
POSTER

## Determining Effectiveness of Currant Borer Mating Disruption in Utah

Marion Murray and Diane Alston
Utah State University Department of Biology, Logan, UT

*Keywords*: currant borer, mating disruption, *Synanthedon tipuliformis,* raspberry, predators, parasites, parasitoids

*Abstract*: Production of black and red currants in the U.S. is limited due to infestation by the clearwing moth, currant borer (*Synanthedon tipuliformis*). Infestation causes stunted plants, weak canes, shoot dieback, uneven bud break, and fruit yield reduction by up to 50%. Mating disruption is available for currant borer, although is not currently registered in the U.S. This study compared the use of mating disruption in a heavily infested five-acre site in northern Utah to an untreated field located 0.5 mile away, for control of currant borer in 2009 and 2010. Raspberry fields surround both currant fields. Dispensers were hung at a higher than recommended rate of 300 per acre in the interior of the test field, and 400 per acre in a 30-foot perimeter. Every seven days during moth flight, moth capture was monitored in 11 pheromone-baited traps (five traps in the treated field, two in the untreated, and four dispersed in the adjacent raspberry fields). One hundred canes were cut from the treated block and 40 canes from the control block each spring and fall and cane injury rating, number of larvae within each cane, and occurrence of predators and parasitoids was recorded. Thirty canes were also cut from the adjacent raspberry fields to determine if raspberry could be an asymptomatic host. Trap shut-down was observed within the treated field, while all other traps caught between 65-100 moths each during peak flight in each year. Larval infestation within currant canes in the mating disruption field, however, increased from spring to fall each year (by 50% in 2009 and by 27% in 2010). A five percent infestation was found in the raspberry canes examined. It was determined that currant borer mating disruption was ineffective in a field as small as five acres where the initial population was high, and that raspberry may serve as a secondary host.

Mating Disruption/SIR
POSTER

## The Okanagan Kootenay Sterile Insect Release (SIR) Program— Where Will The Next Chapter Lead Us?

Cara McCurrach, Scott Arthur, Gary Judd
Okanagan Kootenay Sterile Insect Release Program, Osoyoos, British Columbia, Canada

*Keywords:* codling moth, *Cydia pomonella, granulosis virus,* sterile insect technique, area-wide pest management, mass rearing facility, x-ray irradiation technology, mating disruption

*Abstract:* The Okanagan-Kootenay Sterile Insect Release (SIR) Program in British Columbia (BC), Canada, is the longest-running, most successful area-wide program for control of codling moth (CM) in the world, and until very recently, the only one founded on sterile insect technology. Annually rearing 250 million healthy and competitive sterile codling moths at its mass-rearing facility in Osoyoos, BC, the SIR Program currently treats 9200 acres of pome fruit in three treatment zones within BC. For the last decade the Program's mandate has been sustaining CM populations below economic levels and has achieved less than 0.2% damage in at least 90% of all commercial pome fruit acreage. This achievement has been accompanied by dramatic reductions in pesticide use for CM. This success now gives the program the opportunity to explore the use of low-level targeted moth releases or mating disruption, and combinations of both, to maintain low pest prevalence within the area-wide pest management zones. Local industry is using these achievements to pursue an international designation as an Area of Low Pest Prevalence and advance market opportunities. Now in its 19th year of operation, the SIR Program is examining ways to maintain its economic viability as it transitions into an era of lower local demand for sterile insects and a smaller industry base. Reduced local demand for sterile codling moths provides an opportunity to directly utilize excess production capacity through sales of egg sheets, larvae, pupae or even adults to interested parties. With excess rearing capacity and unique expertise in codling moth production there is an obvious interest in partnerships to produce *Cydia pomonella granulosis virus* (CpGV) products. The SIR Program is also considering ways to use excess irradiation capacity and looking to develop and collaborate on alternative x-ray irradiation technology for *Cydia Pomonella* and other pests. Applications of the sterile insect technique and the area-wide SIR Program have been very successful in providing both farmers and residents of the Okanagan valley a healthier environment for over 19 years. Preserving our excellent achievements while evolving as a program makes transitioning to the future exciting times indeed!

# IMPLEMENTATION—

TIM SMITH, SESSION MANAGER

---

Notes:

Implementation

## Revisiting Web-Based Apple IPM Programs in New York, 2010

Harvey Reissig and Art Agnello
Department of Entomology, Cornell University, Geneva, NY

*Keywords:* Web-based IPM, sampling, monitoring

*Abstract:* Two different web-based IPM programs that were originally tested in 2009 were evaluated again in the same orchards in 2010: (1) A sampling and monitoring program in which sprays for internal lepidoptera, obliquebanded leafroller (OBLR), and apple maggot (AM) were recommended whenever pest levels exceeded threshold levels, and (2) A Web-optimized program in which an initial spray was applied to coincide with the hatch of the summer brood of OBLR eggs and internal Lepidoptera and a second spray was applied when later at peak AM emergence into orchards and estimated peak hatch of the second generation of internal Lepidoptera. Also, in the monitoring plots a reduced IPM sampling program for fruit damage was compared to the standard research protocol of monitoring 1000 apples per week. In the monitoring plots, sprays were recommended in four of the 12 orchards and recommendations were similar in both the research protocol and the reduced IPM system, which required only three sampling bouts of examining a total of only 500 apples. AM catches were relatively high in the research orchards again in 2010 and one spray was recommended in seven orchards, two sprays were recommended in four orchards, and three sprays were recommended in one orchard. Fruit damage was low in both treatments in most of the orchards. After two years of testing, there were very few differences in pest control in both of the programs. Spray records have not yet been collected from the orchards in 2010, but growers probably applied more sprays in both treatments than were recommended. Future cooperative studies will be conducted with private crop protection consultants to determine if they can encourage growers to implement these programs in the future.

Implementation

## Site Specific Management of Codling Moth Continues to Save $$ - Year 3

Alan Knight [1], Loys Hawkins [2], Matt Borman & Kathleen McNamara [3], and Rick Hilton[4]
[1]USDA, ARS, Wapato, WA, [2]Suterra LLC, Bend, OR, [3]Bear Creek Orchards, Inc., Medford, OR, and [4]Oregon State University, Medford OR

*Keywords:* Precision, monitoring, *Cydia pomonella*, codling moth

*Abstract:* Use of a site specific approach to manage codling moth continued to expand during its third year since inception to include 300 acres of apple in central Washington and 400 acres of pear in southern Oregon. The objective of this approach is to reduce total management costs by offsetting an incremental increase in monitoring costs with a significant drop in spray costs. Studies were conducted in orchards treated with an internal grid of aerosol puffers and border applications of hand-applied dispensers. Growers are using one delta trap baited with the Combo lure per two-four acres, which is equivalent to a spray tank delivering 100-200 GPA. Action thresholds based on the cumulative captures of males (5-10) and female (1) moths were employed to recommend the use of supplemental insecticide sprays. Moth catches in traps exceeding these thresholds triggered sprays, which were applied only to the local management area surrounding the trap, or in some situations the area surrounding adjacent traps. Cumulative moth counts were zeroed and subsequent counts were not considered for the next one to two weeks depending on the insecticide's residual activity. Using this approach the codling moth control program costs were reduced up to 75% compared with grower's previous management programs. However, in one apple site which experienced high moth catches no savings were achieved. The grower's need to manage other pests, such as leafrollers and pear psylla with insecticides that also impact codling moth can reduce the overall savings of this program. An overview of how growers can employ site-specific management tools will be presented.

Implementation

## Local Cost of Farming Pears Next to Unmanaged Orchards and Near Rootstock Re-growth of Former Orchards in Lake County, California

Broc G. Zoller
The Pear Doctor Inc., Kelseyville, California

*Keywords: Cydia pomonella,* codling moth, *Phytoptus pyri*, pear leaf blister mite, *Cacopsylla pyricola*, pear psylla, unmanaged neighbors, costs, mating disruption, pear

*Abstract:* Declining economic conditions in the Lake County, California pear industry in recent years have resulted in many cases of implementation of codling moth control using mating disruption next to unmanaged orchards, orchard remnant trees and orchard rootstock re-growth. Five commercial pear orchard blocks adjacent whole, unmanaged blocks each were paired with more distant, but separately sprayed blocks, in the same orchards. Insect and disease control costs (utilizing a common price list for materials) were compared. Five additional paired locations were chosen to similarly compare managed blocks next to adjacent pear orchard remnant trees and/or orchard rootstock re-growth. In a third situation, codling moth trap catches, pear leaf blister mite and pear psylla percentage shoot infestations were compared at intervals up to 0.66 miles from the border of an adjacent, unmanaged orchard. Proximity to unmanaged orchards added an average $147.84 per acre cost (P= 0.0.0001). Proximity to unmanaged re-growth added an average $45.27 per acre cost (P= 0.04). Regression analyses of increasing fractional mile distance yielded, for (1) season codling moth catch, $y = - 7.9774x + 6.6476$, $R^2 = 0.3385$, $P = 0.06$; (2) psylla levels, $y = -21.17\text{Ln}(x) – 12.961$, $R^2 = 0.769$, $P = 0.04$; and (3) blister mite levels, $y = -139.02x + 90.73$, $R^2 = 0.9258$, $P = 0.005$.

Implementation

## UAPTOP: Addressing the Problem that Unmanaged Apple and Pear Trees Pose for IPM Programs in Pears

Rachel Elkins[1], Rick Hilton[2], Kris Lynn-Patterson[3], Gabriele O'Niell[1], and Philip VanBuskirk[2]
[1]UC Cooperative Extension, Lakeport CA, [2]OSU Southern Oregon Research & Extension Center, Central Point OR, [3]UC Kearney Agricultural Center, Parlier CA

*Keywords:* codling moth, mating disruption, Cyd-X, granulosis virus, apple, pear

*Abstract:* IPM programs based on mating disruption (MD) for control of codling moth have been developed and implemented in pear orchards resulting in reduced insecticide inputs and associated costs while also limiting pest infestation. One side effect of these MD based IPM programs is greater susceptibility to fruit injury from pests moving into the orchard from unmanaged hosts in the local vicinity. The Unmanaged Apple & Pear Tree Outreach Program (UAPTOP) is aimed at mitigating these problems through public education and information dissemination. A website hosted at UC Kearney Ag Center allows homeowners in Lake County, CA and Jackson County, OR to determine how close their property is to a commercial orchard and the risk that unmanaged apple and pear trees at that location pose to nearby commercial orchards. Since both Lake County and Jackson County have ordinances prohibiting property owners from generating pest problems that impact the local pear industry, attempts are being made to identify those apple and pear trees which are located near commercial orchards so that landowners can be informed of the situation and take remedial action. For those homeowners who do not want to remove or replace their trees, information on management options such as granulosis virus for control of codling moth, is provided. The use of granulosis virus by homeowners has been greatly facilitated by the availability of Cyd-X packaged in small containers suitable for use on backyard orchards.

Implementation
POSTER

## Virtual Weather Stations in DAS

Ute Chambers, Vincent P. Jones and Gary Grove
Washington State University, Tree Fruit Research and Extension Center, Wenatchee, WA

*Keywords:* IPM, Decision Aid System, temperature, degree-day accumulation, codling moth, models

*Abstract:* The WSU Decision Aid System (DAS) uses WSU-AgWeatherNet (AWN) data and forecasts for these AWN stations provided by the National Oceanic and Atmospheric Administration (NOAA) to run insect and disease models. While AWN has 132 monitoring sites in Washington, there are still areas with substantial tree fruit production that are underserved based on distance and varied topography between the stations and production areas. The possibility of using "virtual weather stations" in DAS that are based on site-specific forecasts from NOAA (done on a 5 x 5 km grid) to fill in those underserved areas is being evaluated.

In 2009 and 2010, degree-day (DD) accumulations were calculated from AWN temperature data and from 1-day NOAA forecast data using parameters for codling moth (CM) and six other insect models. Comparisons show a strong linear relationship between the DD accumulations from AWN and NOAA. However, slope and intercept varied resulting in considerable differences in predictions, which can be sufficiently corrected using linear regression. For projected percentage CM egg hatch, for example, the mean deviation between AWN and raw NOAA DD was 4.4 ± 0.1 days, and 1.6 ± 0.04 days when using the corrected NOAA data. Since NOAA uses AWN data to make their forecasts, NOAA forecast data was compared with data from 48 independent weather stations maintained by Wilbur-Ellis (WE). For CM predictions, the mean deviation between the NOAA raw data and the WE station averaged 5.3 ± 0.3 days, and the difference using the corrected data was 1.4 ± 0.1 days. Importantly, the empirical relationship between the DD accumulations from AWN and NOAA did not change between 2009 and 2010 allowing the use of the same correction method once it is determined for each location. This suggests that virtual weather stations in DAS are possible. Data analyses will be repeated in 2011 to validate this concept and its applicability for all other insect and disease models in DAS.

# THRESHOLDS/MONITORING—

CHRIS NOBBS, SESSION MANAGER

Notes:

Thresholds / Monitoring

## Evaluation of Yellow Rectangles with Hot Melt Pressure Sensitive Adhesive Against Tephritid Fruit Flies

Wee L. Yee
USDA-ARS. Yakima Agricultural Research Laboratory, Wapato, WA

*Keywords*: Western cherry fruit fly, apple maggot fly, yellow color, trap design, sticky gel, hot melt pressure sensitive adhesive, citrus solvent

*Abstract*: Rectangle traps of different yellow colors, the Alpha Scents Yellow Card coated with hot melt pressure sensitive adhesive, and the Pherocon® AM trap coated with sticky gel, were evaluated against western cherry fruit fly and apple maggot fly. Flies captured on both traps and held in the laboratory and field did not escape their surfaces. In field tests, Alpha Scents traps baited with an ammonium bicarbonate lure captured significantly more flies of both species than Pherocon® traps baited with the same lure. Various tests suggested the yellow color of the Alpha Scents traps was more attractive than the yellow color of the Pherocon® trap. Overall, the Alpha Scents trap is a viable alternative to the Pherocon® trap for monitoring tephritid fruit flies in the Pacific Northwest.

## Pheromone Monitoring of Mealybugs in the Winegrape Growing Regions of Oregon

Richard Hilton, Vaughn Walton, Marcus Buchanan, Danny Dalton, Amy Dreves, Steve Castagnoli, Clive Kaiser, Jocelyn Millar, Steve Renquist, Philip VanBuskirk
OSU Southern Oregon Research & Extension Center, Central Point, OR

*Keywords:* grape mealybug, vine mealybug, obscure mealybug, longtailed mealybug, monitoring, pheromone traps, wine grapes

*Abstract:* In 2009, a survey of grape-infesting mealybugs was conducted using pheromone baited traps in over 40 vineyards encompassing all major Oregon grape growing areas in order to get baseline data of current infestation levels. Pheromone trapping was continued in 2010 and expanded to cover the entire season. In both years lures for four mealybug species were compared: vine mealybug, obscure mealybug, longtailed mealybug, and grape mealybug, along with a mixture of all four mealybug pheromones. Over 200 traps were placed in both 2009 and 2010 and more than 120,000 mealybug were trapped during the two years. Almost all of the mealybugs were trapped with either the grape mealybug or mixed pheromone lures and the numbers of mealybugs caught with those two lures were highly correlated. The trap capture was unevenly distributed with trap captures being highest in southern Oregon near Medford while catches were low throughout the Willamette Valley. The pattern of male trap capture in 2010 combined with observations from on-vine surveys indicate that there were two distinct generations of grape mealybug in those areas of southern Oregon where high trap catches were observed.

Thresholds / Monitoring

## Attraction and Ovipositional Stimulation of Female Navel Orangeworm by Almond Volatiles in Flight Tunnel Bioassays

Douglas Light, James Baker, and John Beck
USDA-ARS, Western Regional Research Center, Plant Mycotoxin Research Unit, Albany, CA

*Keywords:* navel orangeworm, *Amyelois transitella,* kairomones, monitoring, GC-MS, flight tunnel, attraction, oviposition, volatile organic compounds, almonds

*Abstract:* Navel orangeworm (NOW), *Amyelois transitella*, is the chief moth pest associated with the introduction of *Aspergillus* mold and occurrence of aflatoxin in almonds, pistachios, and walnuts. Currently, a season-long dependable monitoring lure is lacking for NOW. A pheromone-based lure is unavailable due to its instability and monitoring with egg-traps baited with almond presscake is only seasonally effective from winter through spring but ineffective/unreliable at the crucial summer "hull-split" pre-harvest period of highest vulnerability of nuts to NOW attack. Investigations have suggested that certain volatiles from almonds, especially with damaged husks, exhibit semiochemical attraction and ovipositional stimulation of NOW females. The ambient emission of volatile organic compounds (VOCs) from almond orchards was collected by Tenax traps at four intervals during 2009. GC-MS analysis followed by laboratory flight tunnel and field bioassays are being used to identify attractant volatiles. Five VOCs were consistently found in relatively high orchard volatile densities and were formulated into a blend (Blend-V) and tested in flight tunnel bioassays. Female NOW moths showed ovipositional preferences to Blend-V over almond meal though both were equally attractive. Future trials will assess this VOC blend's ability to monitor orchard NOW populations.

# BIOLOGICAL CONTROL—

ART AGNELLO, SESSION MANAGER

---

Notes:

Biological Control

## Control of Codling Moth and Oriental Fruit Moth with a New CpGV Isolate

Daniel Zingg[1], Iris Kraaz[1], Markus Züger[1], Edith Ladurner[2], Massimo Benuzzi[2],
Marketa Broklova[3], Gyula Laszlo[4], Franz Bollhalder[1]
[1]Andermatt Biocontrol AG, Grossdietwil, Switzerland, [2]Intrachem Bio Italia S.p.A., Cesena, Italy,
[3]Biocont Laboratory Ltd., Brno-Slatina, Czech Republic,
[4]Biocont Magyarorszag Kft., Budapest, Hungary

*Keywords: Cydia pomonella* granulovirus, CpGV, codling moth, *Cydia pomonella*, apple, oriental fruit moth, *Grapholita molesta*, peach, nectarine, biological control

*Abstract:* A new CpGV isolate for the control of both codling moth (*Cydia pomonella*) and oriental fruit moth (*Grapholita molesta*) has been developed and tested by Andermatt Biocontrol, Switzerland. The product was tested in bioassays and in field trials in eight different European countries. The bioassays were conducted with five to six different virus concentrations and analyzed using Probit analysis. Randomized small plot field trials were carried out with at least four replications and the infestation was recorded on fruits for codling moth and on fruits and shoots for oriental fruit moth. The trials showed promising efficacy levels for both pest species. Results will be discussed in the oral presentation.

Biological Control

## Evaluation of Reduced Rates of Codling Moth Granulovirus in Conventional Orchards

Michael D. Doerr and Jay F. Brunner
Washington State University Tree Fruit Research and Extension Center, Wenatchee, WA

*Keywords:* Codling moth, *Cydia pomonella*, granulovirus

*Abstract:* Incorporating codling moth granulovirus (CMGv) into conventional management programs has been difficult. Cost and frequency of reapplication makes a management program that relies on CMGv inefficient. However, if growers could frequently apply CMGv at reduced rates in combination with other spray mixtures the potential exists to enhance control in a conventional program and place further downward pressure on the population in a cost effective manner. In 2010 Cyd-X was applied at the manufacturer's recommended rate (3.0 fl oz/acre), and reduced rates of 1.0 and 0.3 fl oz/acre (33% and 10% rates) at 7-10 day intervals through the entire season.

All treatments significantly reduced the number of live larval entries following the first generation, with no differences noted among the treatments. However, typical of CMGv trials, a large number of stings (unsuccessful attempted entries) were noted thus resulting in no significant reduction in total CM injury. A subsequent sample was conducted three weeks later during the hottest part of the summer, at a time when CMGv residual control can be compromised due to UV degradation. Fruit injury was reduced 37.5-64.1% in the treatments relative to the untreated control (UTC) but this reduction was not statistically significant in any of the treatments. However, the standard rate of Cyd-X and the 33% rate significantly reduced the number of live CM larvae dissected from injured apples. Following the second generation, the treatments reduced total CM injury by 41.2-60.4% with no differences noted among the treatments. In the Cyd-X treatments 70.3-79.6% of the CM injuries were scored as stings, while only 15.1% of the injuries in the UTC were stings. At several sampling dates the number of larvae recaptured in burlap bands was significantly reduced in the treatments relative to the UTC, however at no time were differences among the treatments significant. At the end of the season cumulative larval captures were reduced 56.5-83.5% in the treatments with no differences noted among the treatments. The first adult emergence from the bands was delayed by five weeks in standard Cyd-X rate, resulting in a 90.9% reduction relative to the UTC. The differences among the treatments were not statistically significant, but only the standard rate was different than the UTC.

Biological Control

## Lethal and Sublethal Effects of Fungicides on the Natural Enemy *Deraeocoris brevis* (Hemiptera: Miridae)

Kaushalya G. Amarasekare, Peter W. Shearer and Amanda A. Borel
Oregon State University, Mid-Columbia Agricultural Research and Extension Center, Hood River, OR

*Keywords:* Kumulus DF, sulfur, Kocide 3000, copper hydroxide, Manzate Pro Stick, *Deraeocoris brevis*, pears, natural enemies, biological control, fungicides

*Abstract:* This study focused on lethal and sublethal effects of Kumulus DF [sulfur] and a mixture of Kocide 3000 [copper hydroxide] and Manzate Pro Stick [mixture of manganese, zinc and ethylenebisdithiocarbamate] tested against adult (males and females) and second instar *Deraeocoris brevis* (Hemiptera: Miridae). Products were tested using concentrations equivalent to the high label rate (1x) and 1/10th of that amount (0.1x) dissolved in 100 gallons of water. Kumulus DF appeared to be toxic to nymphs at both rates while only the high rate was toxic to adults. The mixture of Kocide 3000 and Manzate Pro Stick caused less toxicity to both nymphs and adults. The materials tested did not affect longevity of adult males and females. Survival of treated nymphs to adults was negatively affected by both rates of Kumulus DF. Sex ratio of adults that emerged from treated nymphs was not affected by these treatments.

## Effects of Codling Moth Control Programs Using Spinetoram on Woolly Apple Aphid Biological Control

David J. Biddinger, Larry A. Hull, & Tim Leslie
Pennsylvania State University Fruit Research & Extension Center, Biglerville, PA

*Keywords:* Delegate, spinetoram, Belt, flubendiamide, codling moth, *Cydia pomonella*, woolly apple aphid, *Eriosoma lanigerum, Aphelinus mali,* conservation biological control, *Typhlodromus pyri, Zetzelia mali*

*Abstract:* Since the commercial introduction of Delegate (spinetoram) in 2008 for codling moth, *Cydia pomonella* (L.), control, outbreaks of the woolly apple aphid (WAA), *Eriosoma lanigerum* (Hausmann), have increased in Pennsylvania apple orchards. Intensive biodiversity samples taken from colored pan traps in commercial orchards from 2007-2009 show reductions in woolly apple aphid biocontrol agents that correlate with higher WAA populations in orchards treated with spinetoram. In 2010, yellow sticky cards were used for weekly monitoring of the WAA parasitoid, *Aphelinus mali* (Haledman), in commercial orchards for the first time. In paired plots from five commercial apple orchards, significantly lower populations of *A. mali* were found in orchards treated with spinetoram for first generation codling moth control than in plots where codling moth was treated with the insecticide Belt (flubendiamide). In these same plots, WAA populations reached higher levels and were more persistent in the Delegate plots than in the Belt treated plots. No effects were observed with Spinetoram on predatory mites.

Biological Control

## Effects of Flowering Plants on Syrphid Attraction and Woolly Apple Aphid Suppression

Lessando Gontijo[1], Elizabeth Beers[1], William Snyder[2]
[1] Tree Fruit Research and Extension Center, Wenatchee, WA,
[2]Department of Entomology, Washington State University, Pullman, WA

*Keywords*: woolly apple aphid, biological control, cover crop, syrphids, apple

*Abstract:* Woolly apple aphid, *Eriosoma lanigerum,* has become a pest of increasing importance in Washington apple orchards for the past few years. The increase in aphid outbreaks appears to be associated with the changes in pesticide programs where broader spectrum pesticides that kept this pest in check are being gradually replaced by pesticides that have higher pest specificity. Nevertheless, there is a good potential for biological control of this pest. A preliminary survey of natural enemies has indicated that syrphids (Diptera: Syrphidae) are one of the most common predators found in woolly apple aphid colonies. One approach to enhance biological control is the conservation of natural enemies. This may be achieved by altering crop systems to provide necessary resources for beneficial insects. Adult syrphids are known to rely on the ingestion of nectar for energy and pollen for gametogenesis. Thus, engineering the orchard ecosystem to include flowering plants that provide these resources to adult syrphids should enhance biological control. In this work the effect of Sweet Alyssum *Lobularia maritima* on the attraction of syrphids and suppression of woolly apple aphid was investigated. Sweet Alyssum showed a high attractiveness to syrphids. A faster response to woolly apple aphid infestation was observed on Sweet Alyssum plots, however; the aphid suppression tended to equalize with the control plots over time.

# INVASIVE SPECIES—

BOB VAN STEENWYK, SESSION MANAGER

Notes:

Invasive Species

## Integrated Pest Eradication: Trends, Tools and Technologies for Horticultural Pests

David Maxwell Suckling[1], Lloyd D. Stringer[1] and John Kean[2]
[1]The New Zealand Institute for Plant and Food Research Limited, Christchurch, New Zealand,
[2]AgResearch, Lincoln, New Zealand

*Keywords*: Eradication, range expansion, horticultural pests, surveillance, pheromones

*Abstract:* More invasive species than ever are extending their geographic and host plant ranges and impacts on horticultural production have included a destabilization of IPM programs through a return to broad-spectrum insecticides. An analysis of more than 300 officially sanctioned eradication programs targeting horticultural pests in 43 countries shows that North America leads with close to 200 such programs, followed by Oceania (Australia, New Zealand and Pacific island nations) and Europe. Programs targeting Lepidoptera are followed by those targeting Diptera, Coleoptera and Hymenoptera, with few attempts against other groups, possibly due to a lack of delimitation tools and other factors. Programs are increasingly successful (more than 180 globally), with medfly the greatest single target, but an increasing diversity of pest organism targets is evident. Not all taxa have the same tools available for eradication, and not all IPM tools can be used in urban or other sensitive ecosystems. Comparatively benign approaches, including semiochemicals, will have an increasing role to play to combat this challenge but the response to aerial application of pheromones against light brown apple moth in California represents a new social challenge. More investment in tools for surveillance and eradication of unwanted organisms is warranted, in order to mitigate greater long terms costs of pest management. Better integration of tactics to maximize Allee effects at low population densities will also generate improvements.

## Status of Spotted Wing Drosophila as a Pest in Hot Inland Valleys of California

David R. Haviland and Stephanie M. Rill
University of California Cooperative Extension, Kern County, CA

Keywords: Spotted wing drosophila, *Drosophila suzukii*, SWD, cherry, blueberry, phenology

Abstract: Spotted wing drosophila (SWD), *Drosophila suzukii*, was found for the first time in the lower San Joaquin Valley of California in late February 2010, approximately six weeks prior to cherry harvest. Since that time traps placed in citrus, cherries and blueberries have been used to monitor the establishment of SWD and prevalence within these three crops. Trap data have also been used to answer questions regarding the general phenology of SWD, particularly related to the effects of the hot, dry climate on fly populations. Data have shown significant increases in fly populations in the spring and fall with a significant decline during the summer. The presentation associated with this abstract will focus on SWD phenology and regressions documenting the influence of temperature on in-field fly populations under natural ambient conditions.

Invasive Species

## Control of Spotted Wing Drosophila in Cherry

R. A. Van Steenwyk and L. Novotny
Dept. of E.S.P.M., University of California, Berkeley, CA

*Keywords:* Spotted wing drosophila, *Drosophila suzukii*, cherry, chemical control, insecticides, Delegate, spinetoram, Entrust spinosad, Danitol, fenpropathrin, Baythroid, beta-cyfluthrin, Pounce, permethrin, Mustang, zeta-cypermethrin, Warrior, lambda-cyhalothrin, Provado, imidacloprid, Actara, thiamethoxam, Assail, acetamiprid, Malathion, Diazinon, Sevin, carbaryl

*Abstract*: Field trials were conducted to evaluate the potential insecticides for control of spotted wing drosophila (SWD) in cherry. Insecticide treatments were replicated four times in a randomized, complete block design. Each replicate consisted of an individual tree. There was at least one untreated buffer tree between each replicate. Treatments were applied with a hand-held orchard sprayer operating at 250 PSI with a finished spray volume of 200 gallons per acre. The treatments were the maximum field rate of Delegate, Entrust, Danitol, Baythroid, Pounce, Mustang, Warrior, Provado, Actara, Assail, Malathion, Diazinon, Sevin and an untreated check. In addition, low field rate of Delegate, Entrust, Diazinon and Malathion were evaluated with and without NuLure. Treated foliage was transported to the laboratory at one, three, and seven days after treatment (DAT) and exposed to 10 adult laboratory reared male and female SWD. Pyrethroid insecticide treated foliage was also examined at 14 DAT. Male mortality was always higher than female mortality. Organophosphates (OP) caused higher mortality at one DAT than spinosyns but OP mortality decreased to near zero at seven DAT. Spinosyns caused moderate mortality at one DAT but mortality decreased to near zero at seven DAT. Pyrethroids caused mortality similar to spinosyns but provided moderate mortality to 14 DAT. Neonicotinoids and Sevin provided adult mortality at or below the level of Entrust. The addition of NuLure to OP and spinosyns had inconsistent results. However, the addition of NuLure to Malathion provided significant increased mortality at one DAT.

Invasive Species

## Management of Spotted Wing Drosophila in Oregon Cherries: Year 1 Post Invasion

Peter W. Shearer, Steve Castagnoli, Lynn Long and Amanda Borel
Mid-Columbia Agricultural Research and Extension Center, Oregon State University,
Hood River, OR

*Keywords:* Spotted wing drosophila, *Drosophila suzukii,* cherry, Assail, acetamiprid, malathion, malathion ULV, Sevin XLR, carbaryl, Delegate, spinetoram, Entrust, spinosad, Provado, imidacloprid, Warrior, lamda-cyhalothrin, cyazypyr, ARY-0556-001, chemical control, insecticide, invasive

*Abstract:* The spotted wing drosophila, *Drosophila suzukii* (Matsumura) (Diptera: Drosophilidae) is an Asian species that was detected in California in late 2008 and in Oregon during 2009. In early 2010, representatives from the Oregon cherry industry met to develop a management strategy that included monitoring and pest management options. Trapping with apple cider vinegar baited-traps revealed low levels of *D. suzukii* in the mid-Columbia cherry district through the harvest period. Populations increased rapidly afterwards in terms of fly numbers captured in traps and larvae in un-harvested cherries. Field and laboratory studies demonstrated that organophosphorous insecticides, including malathion ULV, pyrethroids, spinosad and spinetoram, were effective insecticides for *D. suzukii*. Acetamiprid, cyazypyr and imidacloprid did not provide quick knockdown but appeared to reduce the number of offspring produced from infested fruit. There were no reports of *D. suzukii* infested cherries during harvest from commercial orchards in the mid-Columbia area of Oregon this past growing season.

Invasive Species

## Spotted Wing Drosophila in Eastern Washington, 2010

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

*Keywords*: Spotted wing drosophila, *Drosophila suzukii*, trapping, dimethoate, imidacloprid, Provado

*Abstract*: Spotted wing drosophila (SWD) was found for the first time in Eastern Washington in late June of 2010. Traps had been deployed in February in the high-risk areas of the southern growing regions near the Oregon border, where an infestation was discovered the previous year. After the first find, the trapping effort was expanded considerably, extending from the Canadian border to the north, through the Columbia River valley, Columbia Basin, Yakima valley, to the Tri-Cities in the southeast. A total of ca. 583 locations were trapped, about 456 for five or more weeks. The majority of the traps were baited with apple cider vinegar, although wine- and yeast-based baits were also used. Traps were deployed (% of samples checked) in cherries (53%), grapes (23%), peach/nectarine (6%), apricot (3%), raspberry/blackberry (15%), blueberry (7%), strawberry (1%), apple (1%) and pear (0.2%). Most of the traps were located in commercial fields, but packinghouses, backyard trees and feral host plants were also trapped. SWD was detected in all regions where traps were deployed, although there were some "hot spots" around the Wenatchee and Orondo areas, and one near Royal City. Overall, SWD densities tended to highest north of I-90. A small percentage of the traps (12%) remained negative throughout the season; the majority of those traps (91%) were located south of I-90. In paired tests of the deli cup trap vs. the Contech, the deli cup caught about 38% more flies, with no apparent bias between males and females. Both dimethoate and Provado appear to kill larvae in fruit post-harvest, with dimethoate the more effective material; interestingly, both products were much more effective against SWD than other *Drosophila* species.

Invasive Species

## Laboratory Survival of *Drosophila suzukii* Under Simulated Winter Conditions of the Pacific Northwest

Daniel T. Dalton and Vaughn M. Walton
Oregon State University Department of Horticulture, Corvallis, OR

*Keywords:* overwintering, *Drosophila suzukii*, spotted wing drosophila, phenology, berry pest insect, Pacific Northwest

*Abstract: Drosophila suzukii* was first documented in Oregon in August 2009. Knowledge of the cold tolerance of this berry pest will help in development of computer models to forecast its seasonal population growth and decline. Of 1,500 adults or pupae, 22 (1.4%) individuals survived the 84-day experimental window. Most (86%) of the survivors were subjected to 10°C temperature treatments. Survival decreased significantly at other temperature treatments. Freezing temporarily increased the mortality rate but did not significantly affect overall mortality over the trial period. Flies that emerged from pupae are estimated to die after 103-105 days at 10°C. This work indicates that adults emerging from acclimated pupae have a survival advantage compared to insects subjected to 10°C as acclimated adults. Survival of pupae at all tested treatment temperatures appears low.

## *Drosophila suzukii*, A New Invasive Pest of Stone Fruit and Grapes in British Columbia

Susanna Acheampong, Howard Thistlewood, Molly Thurston, Charlotte Leaming,
Duane Holder, Tamara Richardson, Linda Edwards and Bradley J. Sinclair
Ministry of Agriculture and Lands, Kelowna, BC, Canada

*Keywords*: Spotted wing drosophila, *Drosophila suzukii*, monitoring, apple cider vinegar trap, cherries, peaches, nectarines, apricots, grapes, wild hosts, Delegate, spinetoram, Entrust, spinosad, Malathion, Ripcord, cypermethrin

*Abstract*: Spotted wing drosophila, *Drosophila suzukii* is an invasive pest from Asia that was first detected in the interior of British Columbia in September 2009. A summary of the results of monitoring of adult populations with apple cider vinegar-baited traps in ca. 340 locations in 2010 is presented. A combined industry-government response including provision of diagnostic tools, emergency use registrations for four insecticides, and an extensive communications effort with factsheets, warning posters, talks to growers, weekly updates, and visits to fruit stands is discussed. A summary of reported damage to crops, challenges experienced in crop protection and sanitation, and some thoughts for the future is presented.

Invasive Species

## Monitoring, Damage Assessment & Mass Trapping of Spotted Wing Drosophila in the Northern San Joaquin Valley

Janet Caprile
University of California Cooperative Extension, Contra Costa County, Pleasant Hill, CA

*Keywords:* Spotted Wing Drosophila, *Drosophila suzukii*, SWD, monitoring, damage, mass trapping

*Abstract:* Spotted Wing Drosophila (SWD) flight was monitored in orchards in the Northern San Joaquin Valley with deli style traps baited with apple cider vinegar. Flight began in early April, peaked for several weeks around cherry harvest in May and June, dropped to low levels in August and September and peaked again in late October and early November. In orchards with a complete harvest, flight dropped off quickly after harvest. In orchards with fruit left after harvest, flight continued for another six weeks through July. From emergence in spring through harvest, the male flight was typically lower and later than the female flight making treatment decisions based on male capture difficult. After harvest, male and female flights were similar. Other *Drosophila spp.* were also attracted to these traps with very high catches throughout May, obscuring the SWD in traps during a critical treatment decision window.

White wine was compared to apple cider vinegar as bait in deli style traps in a randomized, replicated trial in an unsprayed orchard over a 14-week period from April through June. Traps were rotated and bait changed weekly. Apple cider vinegar caught significantly more SWD and other *Drosophila spp*. than the white wine.

The longevity of the apple cider vinegar bait in deli traps was evaluated in a replicated trial during June and July. Traps were checked and rotated daily and a new set of traps baited with fresh vinegar put out weekly. The attractiveness of the vinegar dropped off during the course of the week and was no longer catching after six days.

A damage survey was conducted in 10 orchards with differing SWD management practices. In the five sprayed orchards damage ranged from 0-37% with those that applied 3-4 well timed, effective sprays in the month before harvest having no or minimal damage. Damage in the four unsprayed orchards ranged from 0-45%. Bing typically had about twice as much damage as Rainier in the same orchard. The two unsprayed or minimally sprayed orchards that had very low damage (0-3%) at harvest despite high SWD trap catches both had very dry orchard floors, open canopies, and strong prevailing winds.

Using mass trapping to control SWD was evaluated in 10 residential sites with unsprayed cherry trees. Mass trap were paired with control sites by climate and variety. The mass trap sites hung four deli style traps per tree baited with a wine, molasses, and baker's yeast mixture that was changed weekly. At harvest there was no significant difference in damage between the mass trap sites (62.1%) and the control sites (63.2%).

Invasive Species

## Interaction of Acetic Acid and Ethanol as Attractants for the Spotted Winged Drosophila, *Drosophila Suzukii*, (Diptera: Drosophilidae)

Peter J. Landolt[1], Todd Adams[2] and Helmuth Rogg[2]
[1]USDA, ARS, Yakima Agricultural Research Laboratory, Wapato, WA,
[2] Oregon State Department of Agriculture, Salem, OR

*Keywords:* trap, lure, attractant, bait, detection, monitoring

*Abstract:* Recommendations for monitoring Spotted Winged Drosophila (SWD) in the western U.S. and Canada call for the use of vinegar or wine as a bait for traps, which may be due largely to the evaporation of acetic acid and ethanol from those traps. Numbers of both male and female SWD flies in traps baited with a mixture of acetic acid and ethanol were significantly greater than numbers in traps baited with vinegar alone or wine alone. Similarly, traps baited with the combination of vinegar and ethanol captured many more SWD flies than traps with acetic acid, or traps with wine. These results indicate a synergy of the two chemicals, and of the two materials, in attracting SWD. A comparison of acetic acid with ethanol versus vinegar with wine, showed also stronger attraction of the vinegar/wine solution, indicating attractiveness of chemicals in addition to acetic acid and ethanol.

## Preliminary Findings Regarding the Detection and Rearing of a Potential New Parasitoid (Hymenoptera: Pteromalidae) of Spotted Wing Drosophila, *Drosophila suzukii*

Preston H. Brown, Peter W. Shearer, Jeffrey C. Miller, and Amy J. Dreves
Oregon State University, Mid-Columbia Agricultural Research and Extension Center,
Hood River, OR

*Keywords:* Spotted wing drosophila, *Drosophila suzukii*, parasitoid, Hymenoptera, Pteromalidae, biological control, emergence, rearing, host plant, cherry, blackberry, raspberry, golden raspberry, blueberry, laurel, rosehip, cherry tomato, strawberry

*Abstract:* Fruit was collected from native, wild, and cultivated plants to expand the knowledge of *D. suzukii* hosts and to rear out potential parasitoids of *D. suzukii*. Fruit from 20 species of host plants were collected in the fall, 2010 and nine of these had fruit infested with *D. suzukii*. The highest infestation rates were in blackberries and cherries, which had 61% and 26% *D. suzukii* infested fruit, respectively. Parasitoids of *D. suzukii* were only reared from infested cherries. The parasitoids, a Pteromalidae, were placed into arenas with a food source (honey), *D. suzukii* larvae and drosophila diet. Parasitoid oviposition was observed on *D. suzukii* pupae. Rearing techniques resulted in 2nd generation parasitoids. Parasitoids emerged from 79% of *D. suzukii* pupae exposed to parasitoids in preliminary tests. Adult *D. suzukii* emerged from 11% of pupae exposed to parasitoids compared with 85% adult *D. suzukii* emergence from pupae not exposed to parasitoids. This parasitoid is active against *D. suzukii*; however additional research is needed to determine its effectiveness and potential importance.

Invasive Species

## Lessons Learned in the First Year of Control of European Grapevine Moth, *Lobesia botrana* (Lepidoptera: Tortricidae) in California Vineyards

Lucia G. Varela and Robert Van Steenwyk
University of California Cooperative Extension and Statewide IPM Program, Santa Rosa, CA

*Keywords*: European grapevine moth, *Lobesia botrana*, exotic pest, grape, Vitis, tortricid, berry moth

*Abstract*: *Lobesia botrana* (Denis & Schiffermüller), European grapevine moth, was found in mid-September of 2009 for the first time in the United States in vineyards in California. This moth belongs to the family Tortricidae, sub-family Olethreutinae. The initial find and the highest populations were detected in Napa County. It has since been found in Fresno, Mendocino, Merced, Monterrey, San Joaquin, Santa Clara, Santa Cruz, Solano and Sonoma counties, although at much lower densities and very limited geographic distribution.

During the 2010 season we compared commercial available *Lobesia botrana* lures to monitor populations with traps. Rubber septa lures caught significantly more moths early in the season (March), while membrane lures caught significantly more moths on some dates during late spring and summer. Three insecticide efficacy trials were conducted comparing *Bacillus thuringiensis*, chlorantraniliprole, indoxacarb, methoxyfenozide, spinetoram and spinosad against first and second generation larvae. All treatments were effective; significant difference among treatments will be presented.

## The Brown Marmorated Stink Bug: An Early Perspective

Peter W. Shearer, Jeff Aldrich and Ashot Khrimian
Mid-Columbia Agricultural Research and Extension Center, Oregon State University, Hood River, OR

*Keywords:* Halyomorpha halys, Brown Marmorated Stink Bug, *Plautia stali*, *Thyanta* spp., methyl (2*E*,4*E*,6*Z*)-decatrienoateare, methyl (2*E*,4*Z*,6*Z*)-decatrienoate, pheromone trap, invasive

*Abstract:* The Brown Marmorated Stink Bug, *Halyomorpha halys* (Stål), is an exotic insect that is native to Asia. *Halyomorpha halys*, also called the yellow-brown stink bug or East Asian stink bug, is considered an important agricultural pest in Japan where it attacks soybeans and various tree crops. It was first collected in the United States in Allentown, PA, during the fall of 1996. Since then it has spread to 27 states. It has been observed feeding on many horticultural and agronomic crops in addition to non-cultivated plants. It is also a nuisance pest when it overwinters in homes. Traps baited with either the aggregation pheromone of the brown-winged green bug, *Plautia stali*, (methyl (2*E*,4*E*,6*Z*)-decatrienoateare) or the pheromone of *Thyanta* spp. (methyl (2*E*,4*Z*,6*Z*)-decatrienoate), as well as the mixtures of geometric isomers, are attractive to *H. halys*. Early predictions that *H. halys* would become an agricultural pest have come true.

Invasive Species

## The Brown Marmorated Stink Bug: The Next Bad Pest Coming Your Way

Helmuth Rogg and James LaBonte
Oregon Department of Agriculture, Salem, OR

*Keywords:* Brown Marmorated Stink Bug, Halyomprpha halys

*Abstract:* The brown marmorated stink bug (BMSB), *Halyomorpha halys*, is an Asian species first found in North America in Pennsylvania in 1996 and in Oregon (Portland) in 2004. It is now established in at least 15 states and specimens have been found in at least 14 others. Until 2010, it was not known to be established in Oregon outside of the Portland metropolitan area, although a few specimens had been found in Salem and in Sandy. As of 2010, BMSB established in Aurora, McMinnville, Salem, and from Portland west to Hillsboro, south to Tualatin, and east to Sandy.

BMSB is considered a major agricultural pest in Asia, attacking many crops. It is a significant agricultural pest in some areas of the eastern US, attacking tree fruits, peppers, tomatoes, corn, berries, grapes, soybeans, melons, and even damaging young trees by feeding through the bark. BMSB is known to feed on more than 80 species of plants and undoubtedly attacks many more. No commercial agricultural damage by BMSB has yet been reported in Oregon, although some home gardeners have reported extensive damage to beans, cucumbers, raspberries, and several species of ornamental plants.

## Monitoring and Management of Brown Marmorated Stink Bug

Ann Nielsen
Michigan State University

*Keywords:* Brown Marmorated Stink Bug, pentatomid, Management tools, phenology, control

*Abstract:* Brown Marmorated Stink Bug (BMSB) has become a serious threat to US agriculture since its introduction in the late 1990's. As of 2010 it has been detected in 25 states and considered a major economic problem in New Jersey, Maryland, Pennsylvania, West Virginia and Virginia. Brown marmorated stink bug is highly polyphagous and extremely mobile. It causes damage to tree and small fruit, corn, soybeans and vegetables. Season long damage has been documented in New Jersey, Pennsylvania, and West Virginia with grower losses ranging from 25-90%. Where it is univoltine, it emerges from overwintering sites and feeds initially on apple and pear, later migrating to other susceptible crops. Populations peak on tree fruit in August and September, coinciding with the critical periods of fruit development. This pest also been shown to become the dominant pentatomid species within a few years of establishment. Management tools are still being developed but a potential phenological model will be described. Chemical management of the pest is complicated because efficacious insecticides have long pre-harvest intervals.

Invasive Species

## Brown Marmorated Stink Bug *Halyomorpha halys* (Stäl) (Heteroptera: Pentatomidae): Pennsylvania Experience from the 2010 Season

Greg Krawczyk and Larry A. Hull
Penn State University, Department of Entomology,
Fruit Research and Extension Center, Biglerville, PA

*Keywords:* Invasive species, new pest, brown marmorated stink bug, fruit pest, chemical control

*Abstract:* Brown marmorated stink bug (BMSB), *Halyomorpha halys* (Stäl) (Heteroptera-Pentatomidae), is an exotic insect species naturally occurring in Asia. Since late 1990's BMSB became established in North America with the first official record from Allentown, PA. At the time of the initial identification, the species was already well established and reported to cause damage to various home garden produce or ornamental plants as well as frequently reported as a nuisance to homeowners. As of December 2010, the BMSB was reported in most counties in Pennsylvania and more than 20 states across US.

Feeding damage on fruit caused by BMSB can occur throughout entire season; it can result in misshapen fruit (early season injury) or fruit with necrotic tissue (corking) close to the skin surface (late in the season). During the 2009 harvest season significant fruit injuries caused by BMSB were reported from southeast Pennsylvania counties and northern regions of Maryland and West Virginia. The following year, the range of affected orchards encompassed all south and south-central Pennsylvania as well as orchards, vineyards, gardens and field crops (i.e., soybean and corn) also in New Jersey, Delaware and Virginia. Although the levels of damage varied significantly among locations, in some stone or pome fruit orchards we observed more than 60 percent of injured fruit.

The ability to survive and reproduce on various host plants and unrestricted movement of adult stink bugs among various hosts are likely the main factors contributing to continuous and quite unpredictable presence of this pest in orchards. Limited field trials during the 2010 summer suggested that only broad-spectrum, contact insecticides (e.g., pyrethroids, methomyl or neonicotinoids) provided reduction in the numbers of observed BMSB present in orchards after application. Unfortunately, none of tested insecticides provided residual activity and therefore multiple, frequent applications of broad-spectrum insecticides were necessary.

Invasive Species
POSTER

## Brown Marmorated Stink Bug: What's in it for Virginia Vineyards

Douglas G. Pfeiffer
Department of Entomology, Virginia Tech, Blacksburg, VA

*Keywords:* Brown marmorated stink bug, *Halyomorpha halys* Stål, grape, vineyard, *Vitis*, chemical control, insecticide, PyGanic, pyrethrin, Belay, clothianidin

*Abstract:* Brown marmorated stink bug (BMSB), *Halyomorpha halys* Stål, was introduced into the US about 1996, and first reported from Allentown, PA. Although it was first recorded in Virginia in 2004, high numbers were not reported in fruit crops until the 2010 season. Though grape is seldom listed on host lists for this species, some vineyards reported high populations, with stink bugs seen in clusters as harvest approached. Potential avenues of injury include destruction of berries, elevation of rot infection, and taint of finished wine. Issues with chemical control of BMSB are discussed, including efficacy, recovery, continued immigration, and induction of secondary pests. A pre-harvest trial to eliminate BMSB from harvested clusters explored efficacy of two 0-day PHI insecticides, PyGanic (pyrethrin) and Belay (clothianidin). BMSB was show to use grapevines as reproductive hosts as well as feeding hosts.

# CHEMICAL CONTROL—

DAN SKOCZYLAS, SESSION MANAGER

---

Notes:

Chemical Control/New Products

## Materials and Methods for Control of Cherry Fruit Fly

Timothy J. Smith and Esteban Gutierrez
Washington State University Chelan County Extension, Wenatchee, WA

*Keywords:* Cherry fruit fly, western cherry fruit fly, *Rhagoletis indifferens*

*Abstract:* All products, rates and timings were tested under pest pressure conditions far in excess of those existing in commercial orchards. Tolfenpyrad was effective when applied at 7-day intervals, less effective at 10 days. Spirotetramat greatly reduced the level of fruit infestation, but fruit was infested in all trees and sites.

| Product in Trials and Rate/A | Years in Trial | Total Trees / Total Sites | Total Fruit Inspected | Total Larvae Found | Larvae Per 1000 Fruit |
|---|---|---|---|---|---|
| **Current Untreated Checks** | 2010 | 1 tree | 1,000 | 580 | 580 |
| Treated checks Imidacloprid 6 fl.oz. | 2010 | 2 trees 2 sites | 2,000 | 0 | 0 |
| **NAI-2302 14 & 17 fl. oz.** (tolfenpyrad) ***7 day intervals*** | 2010 | 9 trees 9 sites | 9,000 | 0 | 0 |
| **NAI-2302 17& 21 fl. oz.** (tolfenpyrad) ***10 day intervals*** | 2010 | 8 trees 8 sites | 8,000 | 33 | 4.1 |
| **Spirotetramat 10 fl. oz**. (Ultor) 10 day intervals | 2010 | 4 trees 4 sites | 4,000 | 94 | 23.5 |
| **Spirotetramat 14 fl. oz.** (Ultor) 10 day intervals | 2010 | 4 trees 4 sites | 4,000 | 40 | 10 |

Summary 2010 results of Cherry Fruit Fly control efficacy trials, with other related data.

| | | Emergence Period – Larvae / Interval | | | | | | | | | Total Live Larvae | % of Untreated Control |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Product** | **Rate/ A** | 6/26 | 6/28 | 6/30 | 7/2 | 7/6 | 7/7 | 7/8 | 7/11 | 7/12 | | |
| Provado Pro 192 SC | 8 fl. oz. | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **2** | **0.5** |
| Ultor | 10 oz | 2 | 2 | 9 | 14 | 9 | 5 | 7 | 6 | 7 | **61** | **15.1** |
| Ultor | 14 oz | 1 | 2 | 5 | 3 | 2 | 8 | 2 | 2 | 4 | **29** | **7.2** |
| Untreated | na | 3 | 5 | 21 | 18 | 83 | 104 | 62 | 58 | 31 | **403** | **100** |

**2010 After-harvest control of larvae inside of fruit**. Emergence of cherry fruit fly larvae from 250 fruit treated on separate parts of the same highly infested tree, treated June 24, harvested June 25, 2010.

Chemical Control/New Products

## Avoid Tipping the Scale

Alan Knight [1], Rick Hilton [2], and Allison Walston [3]
[1] USDA, ARS, Wapato, WA, [2] Oregon State University, Medford OR, [3] Nichino America, The Dalles, OR

*Keywords:* San Jose Scale, *Diaspidiotus perniciosus*, Codling moth, *Cydia pomonella*, green aphid, *Aphis* spp., rosy apple aphid, *Dysaphis plantaginea*, woolly apple aphid, *Eriosoma lanigerum*, twospotted spider mite, *Tetranychus urticae*, phytoseiid mites, *Galandromus occidentalis*, Assail, Acetamiprid, Altacor, Rynaxypyr, Delegate, Spinetoram, Centaur, Tourismo, Flubendiamide, Buprofezin, Horticultural oil

*Abstract:* Studies were conducted in replicated small plots (9 -12 trees, N = 5) to assess the impact of 14 selected insecticide spray programs targeting codling moth on a number of secondary pests including, San Jose scale (SJS), aphids; woolly apple (WAA), rosy apple (RAA), green apple (GAA), and twospotted spider mites (TSSM); and their natural enemies. Levels of codling moth injury were generally low in all plots (ca. 2.0% in oil alone and unsprayed), and did not increase after mid-season. Only the seasonal Assail and the early Altacor timing programs did not significantly reduce injury compared with the untreated. Adding oil to Assail improved its control. Levels of SJS fruit injury were very high in the research orchard (68% in untreated plots). The percentage of injured fruits more than doubled from mid-season to pre-harvest in most treatments, unless Assail was used at least once in the 1st or 2nd flight. Assail alone and Assail plus oil were the best treatments, < 5.0% injury. No differences were found in SJS injury between the untreated and mixed Altacor/Delegate seasonal programs, except when oil was added. Oil alone was suppressive of SJS. Extremely high levels of WAA were found in the orchard by mid-season. Only two spray programs which both included Delegate had significantly higher WAA populations than the control. Interestingly, the two spray programs which started at 100 DD had lower WAA populations than similar programs beginning at 250 DD. WAA colony densities dropped dramatically in the second half of the year in most treatments except when Delegate was applied without any use of Assail. No significant differences in WAA colony density was found among treatments at the end of the season, but four treatments had one or more replicates with high levels of aphids. All of these treatments contained at least two sprays of Delegate. Interestingly, the use of Delegate in the 2nd flight after the early Altacor program during the first flight did not flare WAA. The use of oil with either Delegate or Altacor did not improve control of WAA. Extremely high levels of both RAA and GAA were present in the orchard in the first half of the season. Assail and the early timing of Intrepid followed by Delegate reduced GAA populations. The distribution of RAA in the orchard was so uneven that no treatments provided a significant reduction versus the untreated control. GAA densities were observed to be much lower in the second half of the season. The repeated use of Assail was associated with the highest levels of TSSM at the end of the season. Spray programs including Altacor and Tourismo + Centaur had the highest levels of parasitism of RAA and programs with Assail and Delegate had the lowest at mid-season. Similar results were found with parasitism levels of WAA, except that Assail did not seem as disruptive. The effect of spray programs on predatory mites was unclear though the use of 1.0% oil appeared to lower their population densities.

Chemical Control/New Products

## Sulfoxaflor: A Novel Insecticide for Sap-feeding Pests of Tree Fruits and Nuts

Barat Bisabri[1], Harvey Yoshida[2], Brian Olson[3], Boris Casro[4], James Thomas[5],
Jesse Richardson[5] and John Richburg[6]
Dow AgroSciences, LLC, [1]Orinda, CA, [2]Richland, WA, [3]Geneva, NY, [4]Fresno, CA,
[5]Indianapolis, IN, [6]Hesperia, CA, [7]Headland, AL

*Keywords:* sulfoxaflor, sulfoximine, chemical control, insecticide

*Abstract:* Sulfoxaflor[1] is a new insecticide under development by Dow AgroSciences. It is a member of a new chemical class of insecticides called sulfoximines and is active on aphids, plant bugs, whiteflies, plant hoppers, scales and other sap feeding insects. Field studies conducted on pome fruit, stone fruit and tree nuts in different geographies in the United States, during the growing season of 2010, showed excellent efficacy against target pests. Use of Sulfoxaflor in an IPM program will be discussed.

[1]*Sulfoxaflor has not yet received federal registration; registration is pending. The technical information in this presentation is not an offer for sale.*

## The Use of Trunk Injection to Deliver Insecticides for Apple Pest Management

John C. Wise, Anthony VanWoerkom, and Christine VanderVoort
Michigan State University, Trevor Nichols Research Complex, Fennville, MI

*Keywords:* trunk injection, imidacloprid, emamectin benzoate, obliquebanded leafroller

*Abstract:* Trunk injection technology was used to deliver insecticides to semi-dwarf apple trees. In 2010 low and high rates of two insecticides currently formulated for trunk injection, imidacloprid (Imajet™) and emamectin benzoate (TREE-age™), were tested for season-long control of spotted tentiform leafminer (STLM), *Phyllonorycter blancardella* (Fabr.), potato leafhopper (PLH) *Empoasca fabae* (Harris), obliquebanded leafroller (OBLR), *Choristoneura rosaceana* (Harris), Oriental fruit moth (OFM), *Grapholita molesta* (Busck), and Japanese beetle (JB), *Popillia japonica* (Newman). Seasonal field observations and semi-field bioassays were used to measure effectiveness of treatments. Imidacloprid was most active on PLH, STLM and JB, and limitedly on OFM and OBLR. Emamectin benzoate was highly active on OBLR and OFM, but had no effect on PLH. The bioassays showed one injection of emamectin benzoate to be highly active on OBLR larvae throughout the entire growing season.

Chemical Control/New Products

## Evaluation of Altacor and Delegate for Control of Codling Moth in Problematic Edges of Walnut Orchards under Pheromone Mating Disruption

L.M. Novotny & R.A. Van Steenwyk
Department of Environmental Science, Policy and Management,
University of California, Berkeley, CA

*Keywords:* Codling moth, *Cydia pomonella*, walnut, *Jugulans regia*, chemical control, insecticides, Delegate, spinetoram, Altacor, chlorantraniliprole

*Abstract:* Field trials were conducted to evaluate efficacy of Altacor and Delegate treatment regimes for control of CM in problematic edges of orchards under pheromone mating disruption, and in orchards in the first year of pheromone mating disruption. Insecticide treatments were replicated four times in a randomized, complete block design. Each replicate in the edge experiment consisted blocks of trees five rows wide by eight trees long, adjacent to the orchard edge. The first year experiment replicates were eight rows by eight. Treatments were monitored weekly for CM infested drop nuts in the first flight. Aphid, unemerged parasitized aphids, two-spotted spider mites, western predatory mites and European red mites were monitored biweekly. Infestation at harvest was determined as a percentage of infested nuts taken from an average of five center sample trees. Treatment regimes had significantly lower infestation at harvest compared to the untreated check. There was no significant difference among the treatment regimes.

## First Generation Codling Moth Control with Proclaim SG® (emamectin benzoate)

Christopher Clemens[1] and Roy Boykin[2]
[1]Syngenta Crop Protection, Inc., Richland, WA, [2]Syngenta Crop Protection, Inc., Greensboro, NC

*Keywords:* Codling moth, *Cydia pomonella*, Proclaim SG, emamectin benzoate, Group 6, chemical control, insecticide

*Abstract:* Codling moth (CM), *Cydia pomonella* (Linnaeus), is one of the most important apple pests worldwide, and in the Pacific Northwest; it has been the key insect pest since the early 1900s. Growers in Washington have available a number of tactics for CM control including pheromone-based mating disruption, web-based decision assist systems, newer, effective sprayer technologies, and chemical insecticides. Among these chemical insecticides, new highly active, selective active ingredients have been registered over the last two years, and these registrations have been timely with the ongoing phase-out of azinphos-methyl (Guthion). Proclaim SG® was registered in Washington apples in 2006 for suppression or control of several lepidopteran insect pests, but has been primarily used in Washington for oblique banded leaf roller. A Section 2ee label in 2007 followed by a 2008 Section 3 label amendment changed the original Proclaim CM suppression-only claim to control of first generation CM only on apples grown East of the Rocky Mountains. Since then, Proclaim SG has been used successfully on a commercial basis in the East for internal lepidoptera when applied at 4.8 oz/A + an adjuvant on a 14-day application interval. Efficacy data with one vs. two applications of Proclaim SG® will be will be presented. Preservation of CM insecticide susceptibility is important to Integrated Pest Management. Proclaim SG®, a group 6 compound, offers a unique mode of action that will contribute to the preservation of insecticide susceptibility as azinphos-methyl is phased out.

Chemical Control/New Products
POSTER

## Affect of Spray Activator Adjuvant Material and Rate on Peach Twig Borer Control in Almond

Franz Niederholzer
University of California Cooperative Extension, Yuba City, CA

*Keywords:* adjuvant, almond, peach twig borer, *Anarsia lineatella*, non-ionic surfactant, modified seed oil, horticultural oil, organosilicone surfactant

*Abstract:* The influence of combining spray activator adjuvant with a labeled pesticide application for peach twig borer (*Anarsia lineatella*) control in almond was evaluated in two separate case studies. In 2009, Asana was applied at delayed dormant timing. In 2010, Intrepid was applied at 200-250 DD after initial biofix (May 12-13). Complete coverage in all tests was delivered using a motorized backpack sprayer. In 2009, Asana (8 oz/acre) was applied to pruned, 2nd leaf almond trees alone or with one of a range of oil based adjuvants. All Asana treatments reduced average strikes per tree from 11 (untreated control) to <2 when measured in April 2009. Higher rates (0.5%) of esterified seed oil, horticultural oil, or orange oil + surfactant and the 4% horticultural oil treatment significantly ($p<0.05$) reduced the median number of PTB strikes compared with the Asana only treatment. In 2010, Intrepid (16 oz/acre) was applied to unpruned, 3rd leaf almond trees alone or with one of a range of in-season adjuvants at different rates. Combinations of Intrepid and an organosilicone were also tested at reduced spray volumes compared to Intrepid alone. At full spray volume, addition of an adjuvant did not significantly reduce PTB strikes/tree. At reduced spray volumes, addition of an organosilicone (0.016%) did improve PTB control compared to untreated trees, but not when 0.032% rate was used.

POSTER

## Field Characterization of Sulfoxaflor, a New Insecticide for Control of Sap-Feeding Pests

Harvey Yoshida, Barat Bisabri, James Mueller, Anthony Weiss and James Thomas
Dow AgroSciences, LLC, Indianapolis, IN

*Keywords:* sulfoxaflor, sulfoximine, chemical control, insecticide

*Abstract:* Sulfoxaflor[1] is a new broad-spectrum insecticide under development by Dow AgroSciences. It is a member of a new chemical class of insecticides called sulfoximines and is active on aphids, plant bugs, whiteflies, planthoppers, scales and other sap feeders. Field trials conducted in the US demonstrated rapid knockdown and extended residual control of key pests of tree fruit, tree nut and vine crops. The favorable environmental and toxicological profiles of sulfoxaflor make it an effective tool in IPM and resistance management programs.

[1]*Sulfoxaflor has not yet received federal registration; registration is pending. The technical information in this presentation is not an offer for sale.*