2014 Orchard Pest and Disease Management Conference

The 88th Conference is pleased to announce our keynote speaker:

Stephen Welter

Vice President for Research and Dean of Graduate Affairs,
San Diego State University

Keynote Address:

A Tale of Two Systems: Social and Technical Evolution of Mating Disruption Systems in the Western US and the WODPM

Hilton Portland, Portland, Oregon
January 8-10, 2014

Dr. Stephen Welter

Dr. Stephen Welter is the Vice President for Research and Dean of Graduate Affairs at San Diego State University. His research interests span the applied – fundamental spectrum of biological sciences emphasizing insect ecology and behavior as they relate to understanding how natural and agricultural systems are regulated. His interests in orchard pest management have focused on development and implementation of pheromone mating disruption programs using a variety of application systems including hand-applied and aerosol emitters.

In concert with his long-time collaborator, Frances Cave, initial efforts started in 1993 with areawide mating disruption programs using hand-applied dispensers in pears were later modified and translated for application to other cropping systems, e.g. coding moth in walnut. More recent research efforts included defining the functional space of aerosol plumes, effects of point source number using higher emission sources, and trying to define key variables driving program efficacy, e.g. release rates, pulse frequency, or inter-crop movement of pests. His efforts to develop sustainable alternatives to insecticides were recognized in a series of state, regional, and national technology transfer awards as part of large multi-PI, multi-institutional consortiums.

Dr. Welter received his BS in Entomology in 1976 from UC Davis, and later attended the University of California, Riverside, where he received his Ph.D. in Entomology in 1981. Dr. Welter's first served as an Assistant Professor at San Diego State University in the Biology Department from 1981-1984. For 27 years, he was a member of the faculty at the University of California, Berkeley as a member of the Department of Entomology (1984-1993) and Department of Environmental Science, Policy, and Management (1993-2011). During this period, he also served in a variety of administrative positions including division chair, Associate Dean of Instruction and Student Affairs, and Executive Associate Dean for the College of Natural Resources. He has served as a member and chair of numerous state and federal advisory or granting programs such as the USDA National Research Initiative or the Division of Agricultural and Natural Resources Program Council in CA.

Orchard Pest and Disease Management Conference
Agenda for 2014 Conference

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

	Wednesday, January 8
9:00 am	Opening Business—Lucia Varela, OPDMC Chair
10:00 am	**Thresholds/Monitoring—Walter Bentley**
11:30 am	**Biological Control—Joseph Grant**
12:15 pm	*Lunch*
1:30 pm	**Invasive Species—Larry Gut**
3:00 pm	*Coffee*
3:30 pm	*Keynote Address:* ***A Tale of Two Systems: Social and Technical Evolution of Mating Disruption Systems in the Western US and the WODPM,*** *Stephen Welter*
	Vice President for Research and Dean of Graduate Affairs, San Diego State University
5:00 pm	*Mixer (Lobby)*
	Thursday, January 9
8:00 am	**Invasive Species—Larry Gut (cont'd)**
9:00 am	**Chemical Control/New Products—Peter Shearer**
10:00 am	*Poster Session/Coffee (Lobby)*
11:00 am	**Chemical Control/New Products—Peter Shearer (cont'd)**
12:00 pm	*Lunch*
1:30 pm	**Chemical Control/New Products—Peter Shearer (cont'd)**
2:30 pm	**Biology/Phenology—Robert Van Steenwyk**
2:45 pm	**Mating Disruption/SIR—Jack Jenkins**
3:00 pm	*Break*
3:15 pm	**Mating Disruption/SIR—Jack Jenkins**
	Friday, January 10
8:00 am	**Mating Disruption/SIR—Jack Jenkins (cont'd)**
8:45 am	**Implementation—Janet Caprile**
10:30 am	Closing Business—Lucia Varela, OPDMC Chair, Jack Jenkins, Chair-elect
11:15 am	*Adjourn*

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ORCHARD PEST AND DISEASE MANAGEMENT CONFERENCE

January 8, 9 & 10, 2014

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

A Tale of Two Systems: Social and Technical Evolution of Mating Disruption Systems in the Western US and the WODPM

Stephen Welter, Vice President for Research and Dean of Graduate Affairs, San Diego State University

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Thresholds/Monitoring—

Moderator: Walter Bentley

Notes:

Thresholds/Monitoring

Monitoring Insect Pests Using Semios Automated Camera Traps

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

Keywords: wireless mesh network, camera traps, invasive species, pest monitoring

Abstract: Semios traps are equipped with cameras whose images are wirelessly uploaded to and accessible via an on-line graphical user interface (GUI). The number of images taken per day is flexible and is set using the GUI. The GUI also enables the user to count and record the number and type of pests on each image. During the summer of 2013, Semios traps were deployed on 50 sites in Europe, Canada and the US. These traps captured images once per day and were used to remotely monitor various pest species in apple, pear, walnut, peach, grape and cole crops. Pests as small as 6-8mm in length were positively identified from images on the GUI. In a trial conducted in British Columbia, a similar number of sterile codling moth were caught in Semios traps and standard delta traps. Improvements to the Semios trap design for reduction of by-catch are discussed. Applications for this technology include monitoring for invasive species, monitoring for IPM, and monitoring for research trials.

Development of an Improved Lure for Monitoring Female Codling Moth

Ashraf M El-Sayed, Alan L Knight, Lyn Cole, Mailee Stanbury, Andrew Twidle, David M Suckling
The New Zealand Institute for Plant & Food Research Limited, New Zealand

Keywords: Codling moth, *Cydia pomonella*, *Malus domestica*, apple volatile, pear ester, kairomone, monitoring

Abstract: The current lure for codling moth has not performed similarly in different fruit production areas in terms of the relative magnitude of moth catch, especially the proportion of females caught. This work was undertaken to identify host volatiles from apples and investigate whether these can be used to enhance the efficacy of host kairomone for monitoring female and male codling moths. Volatiles from immature apple trees were collected in the field during the active period of codling moth flight. Using Gas Chromatography/Electroantennogram detector (GC/EAD) analysis, six compounds elicited responses from female antennae. These compounds were identified by GC/MS and authentic standards as nonanal, 4,8-dimethyl-1,3(E),7-nonatriene, methyl salicylate, decanal, (Z,E)-α-farnesene, and (E,E)-α-farnesene. When the EAD active compounds were tested individually in the field; no codling moths were caught. However, addition of 4,8-dimethyl-1,3(E),7-nonatriene, methyl salicylate, decanal, and (E,E)-α-farnesene to pear ester in a binary mixture enhanced the efficacy of pear ester for attracting female codling moths compared to pear ester alone. Addition of the 6-component blend to the pear ester resulted in a significant increase in the number of males and enhanced the females captured compared to pear ester alone, while the number of males and females caught was similar to that with the pear ester plus acetic acid combination lure. The new apple-pear ester host kairomone blend should be helpful for monitoring female codling moth and provide the bases for further improvement of codling moth kairomone.

Thresholds/Monitoring

May We Improve Trapping in Mating Disrupted Vineyards? The Effect of Pheromone Lure and MD Technology.

Claudio Ioriatti, Mario Baldessari, Andrea Lucchi, David R. Lance, Julia Mackay, Victor Mastro
Fondazione Edmund Mach, Trento, Italy

Keywords: *Lobesia botrana*, European Grapevine Moth, grape, mating disruption, monitoring, lure, pheromone traps.

*Abstract***:** Pheromone traps baited with 1 mg of the main sex pheromone component of *Lobesia botrana* (E)-7,(Z)-9-dodecadienyl acetate (hereafter referred as standard) are used to monitor the moth flight. Moreover, the same traps are currently used to evaluate mating disruption (MD) efficacy with limited accuracy. Actually, zero capture in the traps is still considered a "necessary but insufficient" indicator of effective MD.

In the present study we aimed at assessing if either overloaded standard pheromone lures or addition of minor components of the natural blend could improve the effectiveness of the pheromone traps as early and accurate warning tools.

A field trial was set up in large plots (min. 4 ha) treated with either commercial (Isonet L plus - Shin Etsu CBC; Rak 2 Max - BASF) or experimental (Puffer Lb – Suterra; No Mate Lb – Syngenta; Hercon® disrupt EGVM - Hercon Environmental; Splat Lobesia - Isca Technologies) MD dispensers. The pheromone release rate ranged from 325 to 900 mg/ha per day approximately, depending on the pheromone formulation.

Addition of minor components did not significantly increase the captures in MD-treated plots compared to the standard lure at the same dose. Male catches in MD-treated plots significantly increased when the pheromone load of the trap bait was increased to 10 mg. Overloaded traps were more prompt in detecting male flight than the standard in MD treated plots. Indeed, when the infestation level was low, overloaded traps generally captured males at least a week before the standard lure.

Thresholds/Monitoring

Comparison of Trap Types for Optimized Efficiency of Monitoring for Navel Orangeworm with an Artificial Pheromone Lure

Charles Burks[1] and Bradley Higbee[2]
[1]USDA, Agricultural Research Service, Parlier, CA
[2]Paramount Farming Company, Bakersfield, CA

Keywords: navel orangeworm, *Amyeolis transitella*, almond, trap, pheromone lure

Abstract: The navel orangeworm is an important pest of almonds, pistachios, and walnuts. Previously commercial monitoring was done using egg traps. Pheromone trapping was done using unmated females as a pheromone source, primarily for research purposes. An effective commercial pheromone lure for this pest (NOW Biolure, Suterra LLC, Bend, OR) first became publicly available in 2013. We compared effectiveness of this synthetic lure between common commercial trap design and with unmated females in wing traps, a previous *de facto* standard. Orange wing traps captured significantly more males than orange large plastic delta (LDP) traps when each were baited with females. This difference disappeared, however, when differences in glue area were taken into consideration. Wing traps baited with NOW Biolure captured numerically fewer males than wing traps baited with unmated females, but the difference was not significant. In contrast, LDP traps baited with NOW Biolure captured significantly fewer males than wing traps baited with NOW Biolure. Generally bucket traps baited with NOW Biolure captured similar numbers of males as LDP traps with NOW Biolure, although the bucket traps occasionally outperformed the other trap types during periods of peak abundance. These data indicate that monitoring with NOW Biolure generally provides similar result to monitoring with unmated females and that, for optimum results, NOW Biolure should be used with wing traps.

Navel Orangeworm Pheromone and Egg Trap Data for Management in Almonds

Charles Burks[1] and Bradley Higbee[2]
[1]USDA, Agricultural Research Service, Parlier, CA
[2]Paramount Farming Company, Bakersfield, CA

Keywords: navel orangeworm, *Amyeolis transitella*, almond, pheromone trap, egg trap, monitoring

Abstract: The navel orangeworm is the principal insect pest of California's multibillion dollar almond crop. A commercial pheromone lure, first available in 2013, is similar in effectiveness to unmated females. We used a 4-year data set, collected from 32 1-ha plots spread over 220,000 ha of Kern County, CA to compare the phenology of pheromone and egg traps, and to examine the relationship between counts in pheromone and egg traps and subsequent damage. Fluctuations were more similar between pheromone and egg traps in the second flight than in the first or third flights. On a regional and yearly level, patterns of first flight eggs and damage were similar to each other, whereas patterns of male abundance bore little resemblance to damage patterns. On the level of individual plots, the association with subsequent damage was weak for both egg traps and pheromone traps. These observations suggest that monitoring with egg traps in almonds for the first flight only would provide useful information about risk of navel orangeworm infestation relative to previous years. Pheromone traps are probably sufficient for timing hullsplit insecticide applications.

Thresholds/Monitoring

Walnut Husk Fly Trap Type and Lure Evaluations

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

Keywords: Rhagoletis completa Cresson, walnut husk fly, ammonium carbonate, green leaf alcohol, caryophyllene, Trécé, Alpha Scents, Suterra, walnut, monitoring, trap, lure

Abstract: A study was conducted in a commercial walnut orchard near Hollister, CA to evaluate the efficacy of different walnut husk fly (WHF) trap/lure combinations. Eleven trap-lure combinations were evaluated, including a blank trap. The trap types included the Trécé Pherocon® AM/NB trap, the Alpha Scents back-folding trap and the Suterra WHF trap. Lures included ammonium carbonate, green leaf (GL) alcohol blend, caryophyllene and commercially available lures from Trécé, Alpha Scents and Suterra. Treatments were replicated four times, and were placed at about 6 ft above the ground and were 3 trees apart from each other. Traps were placed in each orchard on 27 Jun and monitored and positions rotated weekly through 11 Sep. Traps and lures were changed monthly, or earlier if the trap surface lost its stickiness. Ammonium carbonate lures were changed weekly. Alpha Scents traps with Alpha Scents or Mega lures caught more WHF than Trécé traps with Alpha Scents and Mega lures. Also Suterra traps with Suterra lures caught more WHF than Trécé traps with Suterra lures. When the Trécé traps were used with various lures, the UC Super-charged lure caught more WHF than the other lures but was only significantly better than the Trécé's Dual-Pak lure. There was no difference between the Trécé trap with GL alcohol blend and caryophyllene lures, and the blank trap.

Yellow Plastic Sheets Outperform Yellow Cardboards for Capturing Western Cherry Fruit Fly

Wee Yee
United States Department of Agriculture, Agricultural Research Service,
Yakima Agricultural Research Laboratory, Wapato, WA

Keywords: *Rhagoletis indifferens*, trapping, red spheres, yellow spheres, yellow panels

Abstract: Sticky yellow plastic sheets and various yellow cardboard traps were used to capture western cherry fruit fly. Traps baited with ammonium carbonate were hung in randomized block designs in wild and unmanaged cherry trees in Washington. The yellow plastic sheets captured twice as many flies as the yellow cardboard traps. Tests suggested that this was caused in part by the plastic sheets being more translucent than the cardboard traps. Results suggest yellow plastic traps should be used instead of yellow cardboard traps for monitoring this fly.

Thresholds/Monitoring

Consperse Stink Bug Management Using Multiple Techniques in Bartlett Pears

B.G. Zoller
The Pear Doctor, Inc., Kelseyville, CA

Keywords: Consperse stink bug, *Euschistus conspersus*, pears, cut fruit monitoring, centers herbicide treatment, mass trapping

Abstract: Consperse stink bug (CSB) infestation in a 55 ha Bartlett pear orchard in the Upper Sacramento Valley of California was followed weekly on orchard interior and perimeter cut fruit clusters at 58-9 days before harvest (DBH) in 2000-2013. Aggregation pheromone traps (AlphaScents^{TM}) were utilized for monitoring and mass trapping perimeter locations. These monitoring techniques suggested that the use of contact herbicide treatments to the orchard centers once in the early spring in 2007-2013 (compared with no use of these treatments 2000-2006) may have resulted in lower resident CSB in the orchard interior. Whereas total orchard CSB treatments were required in 2000 and 2002-2007, the monitoring knowledge resulted in use of only perimeter spot treatments for CSB at 20-30 days before harvest in 2008-2010 and no treatments at all needed in 2011-2013. This cut fruit technique, which is also used to monitor codling moth and oriental fruit moth oviposition in mating disrupted pear orchards, had been earlier reported to be helpful in monitoring levels of consperse stink bug (CSB), as well (OPDMC Proceedings 2004).

Biological Control—

Moderator: Joseph Grant

Notes:

Biological Control

Effects of Field-Aged Residues of Reduced-Risk and OP-Replacement Insecticides on *Chrysoperla johnsoni* (Neuroptera: Chrysopidae)

Kaushalya G. Amarasekare, Preston H. Brown and Peter W. Shearer,
Oregon State University, Mid-Columbia Agricultural Research and Extension Center, Hood River, OR

Keywords: Chlorantraniliprole [rynaxypyr (Altacor®)], spinetoram (Delegate®), lambda- cyhalothrin (Warrior II®), pears, natural enemies, predator, bioassay

Abstract: A large-scale field-laboratory bioassay was initiated to investigate the lethal and sublethal effects of field-aged residues of two reduced-risk insecticides cholrantraniliprole (Altacor) and spinetoram (Delegate) and an organophosphate-replacement insecticide lambda-cyhalothrin (Warrior II) on the green lacewing *Chrysoperla johnsoni* Henry, Wells and Pupedis (Neuroptera: Chrysopidae). Pear trees were treated with formulated pesticides using concentrations equivalent to the high label rate dissolved in 100 gallons of water per acre. Pear leaves with field-aged residues were collected at 1, 7, 14 and 21 days after treatment and exposed second instar and adult male and female lacewings. Results will be presented.

Indigenous Spotted Wing Drosophila Biological Control Agents in Oregon

Daniel T. Dalton, Betsey Miller, Vaughn M. Walton, Jeff Miller, Peter Shearer,
Kent M. Daane, and Xingeng Wang
Oregon State University Department of Horticulture, Corvallis, OR

Keywords: *Drosophila suzukii*, spotted wing drosophila, *Pachycrepoideus vindemmiae*, *Leptopilina*, biological control, raspberry, parasitoid

Abstract: Sentinel traps baited with larvae of *Drosophila suzukii* and *D. melanogaster* were deployed weekly during the growing season in six sites throughout the Willamette Valley, Oregon in 2012 and 2013. Emergent parasitoids were collected from sentinel traps up to three months after deployment, and colonies of these natural enemies were established in the laboratory. Significant factors of parasitoid recovery included substrate medium, initial presence or absence of larvae, and life stage of the *Drosophila* host. Parasitoid developmental phenology was slightly earlier in cups seeded with *D. melanogaster* larvae, compared to cups seeded with *D. suzukii* larvae. Overall parasitism rates were low, highlighting the potential role of foreign exploration for augmentative parasitoid release. This study establishes baseline parasitism data against drosophilid hosts in the Willamette Valley. The field methodology established in this study is transferrable to collection of parasitoids in other environments.

Biological Control

Evaluation of Cyd-X HP and the Use of Codling Moth Granulosis Virus in Pear IPM Programs

Richard Hilton
Oregon State University, Southern Oregon Research & Extension Center, Central Point, OR

Keywords: codling moth, *Cydia pomonella*, granulosis virus, Cyd-X HP, Madex HP, Monterey Insect Bait, Altacor, chlorantraniliprole, pear

Abstract: Cyd-X HP was tested for control of codling moth in Bartlett pears at two rates, 0.5 and 1.5 oz per acre, along with Madex HP at 1.5 oz per acre, and with the addition of Monterey Insect Bait to the 0.5 oz rate. The four treatments with codling moth granulosis virus (CMGV) were compared to Monterey Insect Bait alone, a water check, an untreated check, and a standard treatment of Altacor at 3 oz (form.) per acre. Treatments were applied at a two week interval except for the Altacor standard which was applied every three weeks. There were no significant differences among the four CMGV treatments. All of the CMGV treatments provided significantly better control of codling moth injury than any of the check treatments but had significantly higher levels of codling moth injury than the Altacor standard. These results are compared to previous studies and the use of CMGV in organic and IPM programs in pears, both with and without codling moth mating disruption, will be discussed.

Invasive Species—

Moderator: Larry Gut

Notes:

Invasive Species

Drosophila suzukii and Wine Grapes: Host Suitability and Other Possible Impacts

Claudio Ioriatti, Gianfranco Anfora, Alberto Grassi, Simone Maistri, Daniel Dalton,
Elizabeth Tomasino, and Vaughn Walton
Fondazione Edmund Mach, Trento, Italy

Keywords: *Drosophila suzukii*, spotted-wing drosophila, grape, susceptibility, surface penetration force, *Acetobacteria,* vector

Abstract: *Drosophila suzukii* is a global pest attacking various berry crops. *D. suzukii* lays eggs in damaged as well as in intact wine grape berries of the most soft-skinned varieties. Here we describe the relative host suitability of different wine grape cultivars (international and local), compared to other berry crops. Assessment has been performed both in the field and in the laboratory and results were correlated to the change in the surface penetration force and harvest time of the tested varieties. *D. suzukii* flies can be found feeding on damaged wine grapes during the harvest period, especially when the skins of berries are impacted by cracking, disease and bird damage. From the results of the present study, it is inconclusive that *D. suzukii* is a vector of *Acetobacteria* in wine grapes during the latter portion of the season. Further investigation of the interactions between *D. suzukii* and *Acetobacteria* would be necessary to determine whether increased levels of *Acetobacteria* due to *D. suzukii* activity levels will impact production cost and quality of high-value wines.

Spotted Wing Drosophila Report for 2013

Elizabeth H. Beers, Douglas B. Walsh and Timothy J. Smith
Washington State University, Tree Fruit Research and Extension Center, Wenatchee, WA

Keywords: *Drosophila suzukii*, trapping, chemical control, Warrior, lambda-cyhalothrin, Fyfanon, malathion, Sevin, carbaryl, Diazinon, Delegate, spinetoram, Entrust, spinosad

Abstract: The seasonal pattern of abundance of spotted wing drosophila SWD has remained fairly consistent over the 4 years of monitoring: low in winter, spring and summer, increasing in late August, and peaking in Sept-Nov (until subzero temperatures inhibit activity). For the first time in 2013, adults were captured in every month of the year due to the mild winter. Two new commercial lures from Trécé were tested for attraction to SWD. Overall, these lures tended to catch the most flies, and also caught flies 1-4 weeks earlier than apple cider vinegar (ACV). Using ACV may increase the capture of the Trécé lures. In general, trap capture increased with larger bait volumes. Fyfanon caused high levels of mortality through 4 DAT; Sevin and Diazinon through 10 DAT, and Entrust and Delegate through 14 DAT. Fruit protection dropped off much more quickly. Rimon+Warrior provided high levels of mortality through 21 DAT. Three application methods of Warrior (100 and 400 gpa airblast, and handgun) produced similar levels of residual control.

Invasive Species

Spotted Wing Drosophila Monitoring and Damage Assessments in Grapes in the Okanagan Valley of British Columbia, Canada

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Keywords: spotted wing drosophila, *Drosophila suzukii*, monitoring, apple cider vinegar trap, damage assessment, table grape, wine grape

Abstract: Spotted wing drosophila (SWD) has been confirmed as a very serious pest of soft fruit and berries since its first detection in British Columbia, Canada in 2009. We report on its seasonal abundance in apple cider vinegar traps in table and wine grapes in the Okanagan valley of British Columbia. Results from damage assessments of SWD in grapes in the Okanagan will also be presented. SWD flies were reared from only damaged wine and table grape varieties sampled, not from intact grape samples. Damaged grape samples with both SWD and other drosophila species had very low numbers of SWD compared to other drosophila species.

Trapping and Monitoring Spotted Wing Drosophila, *Drosophila suzukii* (Diptera: Drosophilidae), in the Mid-Columbia Region of Oregon

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Keywords: Spotted wing drosophila, *Drosophila suzukii*, monitoring, invasive, sweet cherry, Mid-Columbia region, apple cider vinegar, yeast and sugar water, Cha-Landolt lure, lure, attractant, abundance, Trappit Dome trap, red solo cup, trapping

Abstract: This trapping and fruit monitoring study evaluated three attractants and two traps for monitoring spotted wing drosophila (SWD) in sweet cherry orchards in the Mid-Columbia. Orchards were located in Dallesport, WA; and The Dalles, Hood River and Parkdale, OR. At each orchard, six yellow Trappit dome traps and six 16 oz red cup traps were deployed. Two traps of each type were baited with one of the following attractants: apple cider vinegar (ACV), yeast+sugar+water (YSW), or the experimental Cha-Landolt (CHA) 4-component lure.

Traps were placed in orchards when the majority of the fruit were green. The CHA attractant was the most effective bait tested during the cherry growing season. Traps baited with this attractant captured more SWD than traps baited with either ACV or YSW. Traps baited with YSW caught more flies than traps containing ACV. The Trappit dome trap captured more SWD than the red cup trap. Significantly more flies were captured in orchards at the earliest ripening location (Dallesport) than in orchards at other locations. SWD were captured in these earliest ripening orchards when the fruit was mostly green.

Fruit samples were collected to assess SWD infestation and fruit color. Fruit was crushed using a cherry crusher and then placed in brown sugar + water to asses for internal larvae. One SWD larvae was found during the last sample date in a Parkdale orchard well after the first female SWD was captured.

Invasive Species

Diel Periodicity and Infestation by Canopy Height of Spotted Wing Drosophila

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Keywords: Drosophila suzukii, spotted wing drosophila, diel periodicity, sweet cherry, citrus, riparian, canopy height

Abstract: Two studies were conducted in order to better elucidate the biology of spotted wing drosophila (SWD) in northern California. The first study examined the diel periodicity of SWD. The second examined the infestation of cherries by SWD in relation to canopy height and tree density. Four trials were completed in the diel periodicity study. The first two trials were conducted in Feb in a riparian zone, the third in cherry in Apr, and the fourth in Oct in commercial citrus. In each trial six side wire traps baited with soaped 2:3 Merlot: ACV were positioned 6-12 in. from the ground and monitored every 1-2 hr, for a minimum of 24 hrs. When temperatures are favorable (approx.50 °F or above) SWD flight activity is crepuscular.

In the study of SWD infestation by canopy height, larval infestation was determined for samples from low, mid and high positions in sweet cherry canopies in 2011 and 2013. Samples collected in 2011 from commercial orchards in Stockton and Santa Clara CA, with 18'x22' tree spacing showed larval infestation decreases with canopy height. Fruit collected in 2013 from a densely planted experimental orchard (5-10'x15') at UC Davis showed no significant differences in infestation by canopy height. Greater distance between trees prevents canopy intergrowth, and thus prevents the shaded microclimate preferred by SWD in the upper portions of cherry canopies.

IPM CPR: The Application of Behaviorally-Based Strategies for Successful Management of BMSB in Peach

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Keywords: Invasive, IPM, border sprays, brown marmorated stink bug, *Halyomorpha halys*

Abstract: The brown marmorated stink bug (BMSB) has disrupted IPM programs with growers drastically changing their management practices. As BMSB disperse into orchards they initially colonize the perimeter. Current management tools in peaches rely exclusively on weekly season-long whole field or ARM applications of broad-spectrum insecticides that are costly and detrimental to natural enemies. We developed a crop perimeter restructuring (CPR) program that combines border only insecticide applications with traditional IPM tactics into a strategy we have termed "IPM-CPR." Through a combination of observational sampling and protein-marking, we monitored BMSB abundance, damage, and dispersal into peach orchards. We evaluated the use of an IPM-CPR program compared with current management for key NJ peach pests. In 2012 and 2013 there was no significant difference in catfacing injury or OFM injury in either treatment. The use of IPM-CPR can reduce insecticide input by up to 75% approach and is more economical for growers, saving approximately $12/acre compared to ARM applications. Our results suggest that IPM-CPR provided BMSB and OFM control at levels equal to current management recommendations, and may be even more effective along the crop perimeter.

Invasive Species

Feeding Patterns of BMSB: Implications for Sampling and Management

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Keywords: brown marmorated stink bug, *Halyomorpha halys*, epg, electronically monitored feeding

Abstract: Brown marmorated stink bug, *Halyomorpha halys* (Hemiptera: Pentatomidae), is an emerging pest in Oregon's Willamette Valley and Columbia Gorge, where high-value specialty crops including tree fruits, small fruits, and hazelnuts are produced. The cryptic nature of this and other pentatomid pests can make it difficult to sample in crops and often damage has been the primary indicator of infestation. Our study investigated how feeding patterns of BMSB are affected by temperature and photoperiod across the season. An electronic feeding monitor system was designed to log DC waveforms produced by up to 15 feeding BMSB simultaneously. Field-collected *H. halys* were monitored with this system over 48-hour periods in two environmental chambers. One chamber was programmed to mimic a double sine function representing temperatures over a warm day, and the other chamber a cool day based on 30-year average temperatures for the Willamette Valley. Climate controls were reprogrammed each month to closely mimic ambient photoperiods and temperatures. *Halyomorpha halys* were collected 2-3 times per week from host plants using beat sheets. These insects were weighed, and sex was determined before they were placed into the feeding system in either the morning or the evening hours. Feeding frequency, duration, and other patterns of feeding in these insects will be discussed along with future and alternative applications of this technology.

Invasive Species

Monitoring Brown Marmorated Stink Bug – Lures, Traps and…

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

Abstract: Brown marmorated stink bug (BMSB) *Halyomorpha halys* (Stäl) (Heteroptera- Pentatomidae), an established exotic insect pest species introduced from Asia continues to challenge fruit growers in Eastern U.S. With no effective BMSB monitoring system in place, only frequent insecticide treatments applied at a set time interval provide satisfactory control of this stink bug.

During the 2013 season, trials (n = 9) were established in orchards to evaluate currently available BMSB lures and trap designs. Evaluated lures included: BMSB MDT Smart lure (commercial, Ag-Bio, Inc.), BMSB Rescue lure (commercial model SBTA, Sterling International), ARS #20 (experimental, manufactured by ChemTica Int., S.A), BMSB Alpha Scent lure (experimental, Alpha Scents, Inc.) and X lure (commercial native stink bug lure, Ag-Bio, Inc.). The effectiveness of lures was tested either for each individual lure or lure combinations. The two separate pouches (green and yellow) inside the Rescue lure were tested individually and/or together as well as in combinations with other lures. The BMSB trap designs included: tall black pyramid trap (Ag-Bio Inc.), tall green pyramid trap (Ag-Bio, Inc.), short black pyramid trap (Great Lakes IPM, Inc.) and Rescue Stink Bug Trap Model SBTR (Sterling International).

Various trap/lure combinations were placed either at the edge of the orchards bordering woods (expected source of migrating stink bugs). Each border trial was replicated at least three times within orchard.

During early season observations (from April until mid-July) none of the individual lures or lure combinations provided effective BMSB monitoring. During that part of the season, only visual observations (6-12 min per site) were effective in detecting BMSB. However, starting from late July, all tested lures and lure combinations started attracting BMSB nymphs and adults. Overall, in evaluated trials, the BMSB Rescue lure attracted the highest numbers of BMSB adults and nymphs, followed by a combination of BMSB MDT Smart lure plus ARS#20, MDT Smart lure plus green Rescue pouch, and MDT Smart lure plus lure X.

Invasive Species

Feeding Damage by Brown Marmorated Stink Bug (*Halyomorpha halys*) on Commercial Hazelnuts

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Keywords: Halyomorpha halys, stink bug, hazelnut, brown marmorated stink bug, damage, feeding

Abstract: Halyomorpha halys (brown marmorated stink bug, Hemiptera: Pentatomidae), an invasive insect pest, has established populations in Oregon. *H. halys* is a potential pest of many specialty crops in the Willamette Valley, including hazelnuts (*Corylus avellana* L.). The objectives of this study were to characterize the damage caused to hazelnut kernels by feeding of *H. halys* adults, to determine how the timing of feeding during kernel development could influence the types of damage and to determine if shell thickness had an effect on feeding activity. In field trials conducted in 2012 and 2013, adult male *H. halys* were allowed to feed on developing nuts for one-week periods from initial hazelnut development until harvest. Developing nuts unexposed to insect feeding served as control. Damage appeared to correspond with the hazelnut kernel's physiological development periods. Results suggested that when stink bugs fed on hazelnuts before kernel expansion, development of the kernels could cease. When the insects fed during kernel expansion, kernels appeared malformed. When stink bugs fed on mature nuts, greater proportions of kernels with white, necrotic kernel tissue resulted, compared to kernels unexposed to feeding *H. halys*. Shell thickness had no effect on the proportion of damaged kernels observed in the field tests or in lab choice tests.

Postharvest Impact of Brown Marmorated Stink Bug in Wine

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Keywords: Halyomorpha halys , brown marmorated stink bug, Pinot noir, consumer rejection threshold, trans-2-decenal

Abstract: Brown marmorated stink bug (BMSB) is an exotic pest from Asia and is currently found in 42 states across the country. BMSB damages a wide range of agricultural crops through cosmetic and secondary pest attacks. However for wine, contaminated grapes also produce problems postharvest. The objectives of this study include: a) understanding the effect of wine processing steps on BMSB taint, b) provide control levels to wineries, and c) determine the consumer rejection threshold (CRT) of BMSB taint. This work focuses specifically on the impact of BMSB to Pinot noir wine.

While BMSB taint comprises a number of compounds, initial work has shown that trans-2-decenal is the only compound with a strong aroma that is present in finished wine made from contaminated grapes. CRT for trans-2-decenal in Pinot noir was measured to be 4.8 µg/L. Four treatment levels of contaminated grapes were investigated to determine the corresponding level of contamination with CRT: a) the control (no bug); b) T1 (1 bug per 3 clusters; c) T2 (1 bug per cluster); and d) T3 (3 bugs per cluster). BMSB taint decreased during fermentation but was reintroduced during pressing, performed post fermentation. Higher taint levels occurred for heavier presses. All treatments produced wine with measurable levels of taint. Therefore, BMSB can impact wine quality when present with grapes during wine processing.

Chemical Control/New Products—

Moderator: Peter Shearer

Notes:

Chemical Control/New Products

The Concern and Reality of Resistance to OP Alternatives

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Keywords: resistance, OP-alternatives, *Choristoneura rosaceana*, leafroller

Abstract: The introduction of OP-alternative insecticides brought a major change in tree fruit pest management programs. For many years OP insecticides dominated control of the key pest, codling moth (*Cydia pomonella*), and leafrollers. Previous research showed that the obliquebanded leafroller (OBLR), *Choristoneura rosaceana*, could develop resistance when exposed to Altacor (chlorantraniliprole) and Delegate (spinetoram) after two generations and that resistance increased through four to six generations. The same research showed that low levels of resistance to these products were detected in field populations of OBLR before they were ever exposed to them. While there might have been the expectation that field populations of OBLR would show cross-resistance between Success/Entrust (spinosad) and Delegate, the resistance to Altacor was unexpected. Previous evaluations of field populations of OBLR to Success showed that resistance showed up only four years after the product had been registered for use in apple. Recently, two populations of OBLR have been evaluated because of concerns about control failures after using Entrust and Altacor. These data are presented along with a discussion about the spread of resistance and the need to follow sound resistance management principles in order to conserve the effectiveness of OP-alternatives.

Enhancement of Insecticides with Sugar Baits for Control of Western Cherry Fruit Fly

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Keywords: Actara, thiamethoxam, Delegate, spinetoram, Mustang Max, zeta-cypermethrin, Warrior II, lambda-cyhalothrin, neonicotinoid, pyrethroid, spinosyn, sugar, western cherry fruit fly, *Rhagoletis indifferens*, spotted wing drosophila, *Drosophila suzukii*, cherry

Abstract: A primary source of cherry fruit fly (CFF) infestation in orchards is immigration of reproductively mature females which need to be killed within about 2 hours to prevent oviposition. Management of CFF with bait sprays is desirable because of rapid adult mortality, and lower spray volume and canopy coverage as compared to full cover sprays. However, the arrival of spotted wing drosophila (SWD) has greatly reduced the use of bait sprays because of low efficacy against this new pest. We hypothesized that adding sugar to some insecticides would enhance efficacy against CFF. Pyrethroid and spinosyn insecticides that are effective against SWD could be baited with sugar to enhance control of CFF as well. We evaluated two pyrethroids (zeta-cypermethrin and lambda-cyhalothrin), one neonicotinoid (thiamethoxam), and one spinosyn (spinetoram) with and without sugar baits in cherry orchards for CFF control (SWD was not present). Under high external CFF pressure, thiamethoxam and spinetoram mixed with a 1% concentrations of sugar reduced larval infestation the most. Sugar did not enhance performance of the two pyrethroids, and control was poorer. Under lower CFF pressure, all insecticides with and without sugar were equally effective, but only thiamethoxam, spinetoram, and zeta-cypermethrin completely eliminated larval infestation.

Chemical Control/New Products

Insecticide Evaluations for Control of Codling Moth with and without Sugar/Yeast Adjuvant in Pears

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Keywords: Cydia pomonella, codling moth, Entrust SC, spinosad, Assail SG, acetamiprid, Intrepid F, methoxyfenozide, Altacor WDG, chlorantraniliprole, Delegate WG, spinetoram, Belt SC, flubendiamide, sugar, yeast, adjuvant, insecticide, chemical control, pear

Abstract: A study was conducted in an effort to determine whether sugar and yeast were viable adjuvants to increase larval feeding and thus improve control of *Cydia pomonella* (codling moth, CM) in pears with conventional materials in northern California. Conventional materials were tested at 75% maximum label rate for CM in pears with and without the addition of 1 lb granulated sugar/100 gal and 3 lb Baker's yeast/acre. Treatments targeted egg hatch/deposition and were applied at 126DD and 243DD (A peak) and 590DD and 663DD (B Peak) after the first CM flight biofix and again at 136DD and 250DD (A peak) and 520DD and 685DD (B peak) after the second CM flight biofix. CM damage was evaluated at the end of the first CM generation and again at harvest. Secondary pests (i.e., pear psylla, web spinning mite, etc.) were monitored weekly from 1 Jul until harvest by brushing 20 leaves and counting the plates under magnification in the laboratory. The efficacy of the conventional materials were not significantly improved by the tested rate of sugar and yeast adjuvants with regard to CM or secondary pest spp., however Entrust SC was numerically (not significantly) improved by the addition of 1 lb granulated sugar/100 gal and 3 lb Baker's yeast/acre.

Laboratory and Field Tests of Pre-mixed Insecticides against the Apple Maggot, *Rhagoletis pomonella*

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Keywords: apple maggot, *Rhagoletis pomonella*, laboratory bioassays, field tests, pre-mixed Insecticides

Abstract: In 2013 pre-mixed insecticides, Voliam Xpress (Lambda-cyhalothrin + Chlorantraniprole), Endigo (Lambda-cyhalothrin + Thiamethoxam), Voliam Flexi (Thiamethoxam + Chlorantraniprole), Leverage (Imidacloprid + β-cyfluthrin) were tested in the field and bioassayed in the laboratory against the apple maggot (AM), *Rhagoletis pomonella*. Calypso (Thiacloprid) was used as a standard insecticide in both laboratory bioassays and field trials. These materials were applied in field tests with an airblast sprayer (150 gpa) to 12 tree plots (4 x 3 rows) of 'Jonagold' and 'Cortland' apple trees along the edge of a commercial apple orchard in Wayne Co., NY. Plots were replicated 3 times in a RCB design. These trees along the edge of this orchard have traditionally been subjected to high AM pressure from nearby abandoned, unsprayed apple trees nearby. Four sprays of each insecticide were applied shortly after the first capture of AM on 19 Jul, and repeated on 30 Jul, 12 Aug, and 27 Aug.

Harvest evaluations were conducted on 12 Sep by picking and inspecting 100 apples/replication. Damage was rated as a sting if the depth of punctures was less than 1/8 in. and as 'tunnels' if deeper larval tunneling was observed when apples were cut. Red Delicious apples were dipped in a solution of the formulated insecticides and allowed to dry. Treated apples were put individually into plastic cups with five

gravid AM females. After 24 hours, mortality of females was monitored, punctures were counted on apples, and apples were incubated on wire racks over water in a growth chamber until larval emergence was completed (80 °F, 16:8 LD). Egg deposition in punctures on treated apples was estimated by dissecting punctures on one treated apple/replication to see if they contained eggs.

Calypso was not very toxic to the flies in laboratory bioassays (33% mortality), but was effective in reducing oviposition punctures and completely prevented larval emergence from apples. Volium Flexi and Endigo were the most toxic mixtures to the flies in laboratory tests (80% mortality) and the rest of the treatments were less toxic. The relatively high toxicity of Volium Flexi to AM adults is surprising because neither Thiamethoxam nor Chlorantraniprole alone has ever been toxic to flies in previous laboratory studies. Even though the mixtures were not highly toxic to adults, all treatments significantly reduced oviposition punctures. None of the treatments significantly reduced the percentages of oviposition punctures that had eggs. Both Volium Xpress and Endigo have lambda-cyhalathrin, which probably is toxic to flies, but only Endigo killed a high percentage in the laboratory, perhaps because the concentration of the pyrethroid in the Endigo mixture is higher. Agri-flex wasn't highly toxic to the flies in the laboratory and not as effective in reducing punctures as some materials, but was as effective as Calypso in reducing larval emergence from apples. Therefore this material may kill eggs and/or larvae inside the apple.

The relative activity of the treatments in the field was fairly similar to that in the laboratory bioassays, but none of the treatments significantly reduced the numbers of stings compared to the untreated checks and the Calypso treatment actually had significantly more punctures than the untreated checks. However, the percentage of stings in untreated apples in the field is generally low, because most larvae survive and eventually produce deeper tunnels. All of the treatments significantly reduced the percentages of apple maggot tunnels, except Agri-Flex. Although the percentages of tunnels in the Voliam Xpress, Endigo and Leverage were numerically lower than in the Calypso standard, these differences were not statistically significant. Also, considering the effectiveness of Calypso in the laboratory in preventing larval emergence from treated fruit it is likely that even though some deeper larval tunneling was observed, very few larvae would actually survive in the field in apples sprayed with this material.

Chemical Control/New Products

Insecticide Management of Spotted Wing Drosophila in Sweet Cherry: 2013 Update

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Keywords: Warrior II, lambda-cyhalothrin, Danitol, fenpropathrin, Sevin, carbaryl, Delegate, spinetoram, *Drosophila suzukii,* spotted wing drosophila

Abstract: A replicated large plot grower-applied trial using three sequential applications of either carbaryl (3 qt/A), Delegate (7 oz/A) or Warrior II (2 apps at 2.56 oz/A) followed by Danitol (11 oz/A) prevent damage from spotted wing drosophila (SWD) in Sweetheart cherry.

Chemical Control/New Products

Insecticide Evaluations for Walnut Husk Fly Control in English Walnuts - 2013

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University of California Cooperative Extension, Hollister, CA

Keywords: Rhagoletis completa, walnut husk fly, *Juglans regia,* English walnut, chemical control, insecticide, Leverage 360, imidacloprid, β-cyfluthrin, CHA-062, Malathion, IKI-3106, Calypso, thiacloprid, Athena, bifenthrin, avermectin B1, Brigadier, Brigade, Stallion, zeta-cypermethrin, chlorpyrifos, Belay, clothianidin, Danitol, fenpropathrin, Assail, acetamiprid

Abstract: The efficacy of several insecticides was tested against adult walnut husk flies in a 'Hartley' walnut orchard south of Hollister, CA. Treatments were applied to four single tree replicates three days after the first substantial fly captures in yellow sticky traps baited with ammonium carbonate. Additional sprays were applied at about three week intervals through the season with a total of four sprays. Foliar sprays were applied with an orchard hand-gun sprayer operating at 250 psi with a finished spray volume of 300 gal/acre. Walnut husk fly damage was assessed by visually examining 125 nuts per replicate just prior to harvest. All experimental treatments provided acceptable to excellent control of walnut husk flies except the low and middle rates of CHA-062. Excellent control was provided by Leverage 360, IKI-3106 (high rate) and Stallion/Brigadier. The CHA-062 formulation of Malathion did not perform as well as Malathion 57%.

Intrepid Edge - Control of First Generation Codling Moth in Walnuts

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Keywords: Codling moth, *Cydia pomonella*, Intrepid, methoxyfenozide, Delegate, spinetoram Altacor, chlorantraniliprole, Intrepid Edge, walnut, chemical control, insecticide

Abstract: Two replicated studies were conducted in commercial walnut orchards in Stockton, CA. Intrepid Edge, Intrepid+Delegate and Altacor were evaluated for first generation control of codling moth (CM). Treatments were replicated three times in a RCB design. Each replicate was 0.8 to 1.8 ac in size. Treatments were applied using a grower operated speed sprayers operating at 2 mph with 100 gal/ac finished spray volume. Treatments were applied for the 1B CM flight. The entire plot was treated with Lorsban Advanced for the 2A CM flight. Control of the CM was evaluated by counting the number of CM-infested dropped nuts from 5 center trees in each replicate from mid-May through mid-Jun and by counting the number of CM-infested nut pairs per 100 pairs per replicate from the center of each replicate at the end of the first generation. In orchard 1, Intrepid+Delegate had significantly lower cumulative CM-infested dropped nuts and percent infested nut pairs compared to the untreated check and there was no significant difference in Intrepid Edge and Altacor compared to the untreated check. In orchard 2, Intrepid+Delegate and Intrepid Edge had significantly lower cumulative CM-infested dropped nuts compared to the untreated check and Intrepid+Delegate, Intrepid Edge and Altacor had significantly lower percent infested nut pairs compared to the untreated check.

Chemical Control/New Products

Insecticide Evaluations for Control of Codling Moth in Walnut

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Keywords: Cydia pomonella L, codling moth, *Amyelois transitella*, navel orangeworm, walnut, insecticide, infestation, Assail 30SG, acetamiprid, Altacor 35WDG, chlorantraniliprole, Belay 2.13L, clothianidin, Belt 4SC, flubendiamide, Leverage 360, imidacloprid, beta-cyfluthrin, IKI-3106 0.47SL, cyclaniliprole, Voliam Xpress, lambda-cyhalothrin, Delegate 25WG, spinetoram, Athena, bifenthrin, Brigade WSB, Brigadier, Lorsban Advanced, chlorpyrifos, Agri-Mek 0.15EC, abamectin, Imidan 70W, phosmet

Abstract: A study was conducted in a commercial walnut orchard near Stockton, CA for control of codling moth (CM). Thirteen treatments were replicated four times in a randomized complete block design. Each replicate consisted of an individual tree with at least one buffer tree between each treatment. A pheromone trap was placed high in the orchard canopy to monitor CM flight populations and set biofix for timing of applications. CM and navel orangeworm (NOW) infestation was determined based on 125 nuts per replication at commercial harvest on 11 October. At harvest, the mean percent CM infestation was significantly higher in the untreated check compared to all experimental treatments and there was no significant difference among the experimental treatments except Assail followed by Altacor, which had significantly lower infestation compared to Delegate followed by Brigade. The mean percent NOW infestation was not significantly higher in the untreated check compared to all experimental treatments except Assail followed by Altacor. Total infestation (CM+NOW infestation) was significantly lower in all experimental treatments except Leverage 360 followed by Belt and the low rate of IKI-3106 as compared to the untreated check. Assail followed by Altacor had significantly lower total infestation compared to Leverage 360 followed by Belt, the low rate of IKI-3106 and untreated check.

Chemical Control/New Products

Navel Orangeworm Control in Almonds – the Challenge of Delivering Ovi-larvicides to the Target Site

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

Abstract: The thresholds for navel orangeworm (NOW) damage in almonds continue to decrease. At the same time, crop value and acres planted have increased. Available registered insecticides for NOW have remained static, or in the case of the pyrethroid class, are losing effectiveness due to resistance development. We identified spray coverage as a limiting factor for insecticides that target eggs and larvae in previous studies starting in 2010. In a series of experiments from 2010 through 2012 that examined vertical distribution of residues and damage as a result of treating trees with various sprayers, speeds, and nozzling arrangements, we found that 50% coverage (mean of 5.3 µg/nut) overall was not surpassed. However, as much as 70% coverage (8.5 µg/nut) was achieved in the lower half of the tree with ground rigs using flat, cone and hollow fan nozzles employing one or two manifold booms. In 2013, we looked at the impact of helicopter applications in conjunction with ground applications on coverage, residue deposition and NOW infestation levels at four levels in almond trees. These results will be compared to previous results and discussed in the context of the almond agroecosystem.

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

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Keywords: raspberry, pesticide application, microsprinklers, solid-set, spotted wing drosophila, *Drosophila suzukii*

Abstract: SWD is widely distributed in NY, with raspberries being especially vulnerable. Raspberries grow well in high tunnels and produce exceptionally high quality fruit over an extended growing season. The invasion of SWD has forced berry growers to dramatically increase insecticide applications to produce marketable fruit, a significant logistical challenge for high tunnel production. A spray system fixed into the tunnel structure was used to apply pesticide sprays to control SWD in research and commercial bramble plantings from July-Sept. All sprays were applied through a system of microsprinkler nozzles attached to polyethylene tubing running along the top of the tunnel and supplied by a central tank/pumping station. Identical applications were made in control tunnels using backpack sprayers. SWD traps were deployed in both treatments to check for adult presence, and weekly fruit samples were collected and held to rear out any larvae infesting the berries. Results were variable depending on site, ranging from equal low levels of infestation for fixed vs. control at the commercial raspberry site (mean: 10 SWD/50 raspberries over the season) to 4X higher infestations in the fixed sprayer blackberry planting vs. the control (78 SWD/sample vs. 20, respectively). Fixed sprayer systems may be particularly cost-effective in high tunnels since the scaffolding for the fixed lines is already present.

Chemical Control/New Products

Low Volume Control of *D. suzukii* in Sweet Cherry

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

Keywords: Drosophila suzukii, spotted wing drosophila, Danitol, fenpropathrin Malathion 57%, malathion, Entrust SC, spinosad, Monterey Insect Bait, merlot, apple cider vinegar, attractant, toxicant, low volume, chemical control, sweet cherry

Abstract: Two studies were conducted to examine the viability of a low volume 'attract & kill' strategy for the control of *Drosophila suzukii* (spotted wing drosophila). The foliage mortality study was conducted in a mature cherry orchard in San Joaquin Co., CA. Treatments consisted of combinations of three toxicants (Danitol 2EC, Malathion 57%, and Entrust SC) and 2 attractant solutions (1:0.75:0.75 MIB:ACV:Merlot and 1:0.75:0.75 MIB:ACV:Water) with a check. Cherry leaves were treated in the field with 5 drops (10 µl/drop) per leaf of treatment solution and covered with exclusion cages. Leaves were then transported to the lab at 1, 3, and 7 days after treatment (DAT) where female SWD mortality was determined at 24 hrs. All bait-toxicant solutions exhibited mortality of 80% or greater at all DAT and there were no consistent significant differences among toxicants. Greater mortality was observed in attractants than the untreated check at 7 DAT. In the field fruit-infestation study, treatments were applied at 2 gal/ac in two mature cherry orchards, located in San Joaquin and Contra Costa Co., CA. Treatments consisted of Malathion 57% + attractant (1:0.75:0.75 MIB:ACV:Merlot), Danitol 2EC + attractant, attractant-only and an untreated check. Infestation per 100 fruit was determined weekly for 6 weeks. Danitol had significantly lower infestation than both checks, and Malathion showed significantly lower infestation than the untreated check. Significant phytotoxicity was observed in all foliage treated with attractant.

Bexar™, a Novel Insecticide for the Management of Key Pests in Stone Fruit

Jessica Samler, Allison Walston, Pedro Hernandez, and James Adams
Nichino America, Inc. Wilmington, DE

Keywords: Bexar, tolfenpyrad, western cherry fruit fly, *Rhagoletis indifferens,* obliquebanded leafroller, *Choristoneura rosaceana,* forked-tailed bush katydid, *Scudderia furcata*, spotted wing drosophila, *Drosophila suzukii,* powdery mildew*, Podosphaera clandestine*

Abstract: Bexar 15SC (tolfenpyrad) is a new contact insecticide for the management of key pests in stone fruit. Bexar has shown in trials to provide excellent control of western cherry fruit fly, obliquebanded leafroller, katydids, and powdery mildew while also suppressing populations of spotted wing drosophila. Bexar is pending registration at the EPA and should be available for use in the 2014 growing season.

Biology/Phenology—

Moderator: Robert Van Steenwyk

Notes:

Biology/Phenology

Drosophila suzukii **Population Estimation**

Vaughn Walton, Nik G. Wiman, Samantha L. Tochen, Daniel T. Dalton, Peter W. Shearer, Christopher A. Hamm, Hannah J. Burrack, Alberto Grassi, Claudio Ioriatti, and Gianfranco Anfora
Department of Horticulture, Oregon State University, Corvallis, OR

Keywords: temperature-dependent matrix model, risk, life table, spotted wing drosophila, *Drosophila suzukii*

Abstract: Spotted wing drosophila (SWD), *Drosophila suzukii* Matsumura (Diptera: Drosophilidae: Drosophilini) is a global pest attacking ripening small and stone fruits. Laboratory studies were conducted to determine temperature-dependent survival and fecundity of SWD. A temperature-dependent matrix model using these data was applied to determine if population pressure of *D. suzukii* could be predicted based upon environmental conditions. As an example, different pressure levels were found in two distinctly different seasons in the Willamette Valley of Oregon. The model was also applied to determine the effects of population factors such as regional climatic differences, microclimates, bacterial infection and parasitism. The population model is an additional tool for SWD risk-prediction. Pest management practitioners can make timely management decisions as the crop ripens using this model. The limitations and benefits of using this model are discussed.

Mating Disruption/SIR—

Moderator: Jack Jenkins

Notes:

Mating Disruption/SIR

Codling Moth Olfaction and Ecology - Red, Green and Yellow

Peter Witzgall and Alan Knight
Chemical Ecology Group, SLU Alnarp, Sweden and USDA-ARS Yakima, Washington

Keywords: codling moth, *Cydia pomonella,* mating disruption, yeast, *Metschnikowia,* olfactory, volatiles

Abstract: The larva of codling moth *Cydia pomonella* (Tortricidae, Lepidoptera) is mining the apple for food. Red: Pheromone-mediated disruption of mating is a widely used alternative control method. However, mating disruption is most efficient at low population densities and in large orchards. Green: Research on plant cues that attract gravid codling moth females to egglaying sites has been driven by the idea that plant volatiles would provide tools to supplement mating disruption. Yellow: Microbial odors, a third type of olfactory signal, have now been shown to contribute to finding behavior. Codling moth lives in close association with yeasts of the genus *Metschnikowia*. Yeast is an essential part of the larval diet and promotes larval survival by reducing fungal infestations in the apple. Larval feeding, on the other hand, enables yeast proliferation on unripe fruit. Chemical, physiological and behavioral studies demonstrate that codling moth senses and responds to yeast aroma. Female moths are attracted to fermenting yeast and lay more eggs on yeast-inoculated than on yeast-free apples. In addition, larvae of codling moth respond to yeast, which enables novel control strategies, towards further development and areawide application of semiochemicals for sustainable insect control.

Three Years of Trials with Aerosol Emitters for Codling Moth Control

Jay Brunner and Bonnie Ohler
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Keywords: sex pheromones, mating disruption, codling moth, *Cydia pomonella*, aerosol dispensers

Abstract: In Washington State, pheromone-mediated mating disruption technologies have become a key component of apple IPM programs as growers have transitioned away from the use of organophosphate (OP) insecticides for codling moth (CM) control. Aerosol pheromone emitters for CM control have been used for many years in walnut and have been used more in apple in recent years. Over the past three years, two aerosol pheromone emitter technologies, Checkmate CM-O Puffer and Isomate CM MIST, have been evaluated for their ability to suppress capture of codling moth adults in attractant traps. These emitter technologies have typically been compared to a hand applied pheromone treatment, Isomate CM Flex, as it was difficult to find a true untreated pheromone control at most locations. Because CM populations in commercial orchards in WA are typically very low, we released sterile CM obtained from the Sterile Insect Release Program's facility in Osoyoos, British Columbia, Canada, to challenge pheromone treatments. After three years of experiments, we conclude that aerosol emitter technologies such as Checkmate CM-O Puffer and Isomate CM Mist are at least as good as a hand-applied Isomate CM Flex treatment and they therefore represent a viable alternative in most WA apple orchards. Concerns with the use of aerosol emitters include vulnerability of untreated orchard boarders and mechanical reliability. The failure of even a small proportion of aerosol emitters in a treated orchard could provide gaps in treatment where CM mating and injury could occur.

Mating Disruption/SIR

Influence of Aerosol Dispenser Height on Mating Disruption Effectiveness for Codling Moth in Tall Walnut Canopies

Charles Burks[1], Joseph Grant[2], Carolyn Pickel[3], Rick Buchner[4], Cyndi Gilles[4], Larry Gut[5], Peter McGhee[5], Frances Cave[6], and Jay Brunner[7]

[1]USDA, Agricultural Research Service, Parlier, CA, [2]University of California Cooperative Extension, San Joaquin County, [3]University of California Cooperative Extension, Sutter/Yuba Counties, [4]University of California Cooperative Extension, Tehama County, [5]Michigan State University, East Lansing, MI, [6]University of California, Berkeley, CA, [7]Washington State University, Wenatchee, WA

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

Abstract: Aerosol dispensers have generally provided successful management of the codling moth in walnuts, where it is a principle pest. In older and taller orchards, however, results have sometimes been less consistent. We used recapture of released sterile codling moth males in pheromone traps to assess the importance of dispenser height for suppression of male location of pheromone sources in 1.2 ha plots in high walnut canopies in the Sacramento and San Joaquin valleys. The effect of dispensers placed at 4 meters or in the upper canopy was examined using traps placed at 2 meters, 4 meters, or in the upper canopy. The upper canopy height ranged from 6.8 to 13.5 meters, and was more variable within plots than between plots or locations. Mating disruption with either low or high aerosol dispensers resulted in fewer males captured compared to no mating disruption, but there was no significant difference in the number of males recaptured between mating disruption provided by low vs. high aerosol dispensers. These findings indicate that heterogeneity in canopy structure in mature walnut orchards is a more important factor in mating disruption efficacy than the height at which aerosol dispensers are placed.

Mating Disruption/SIR

Optimizing Pheromone Aerosol Emitters for Codling Moth Mating Disruption in Apple

Peter McGhee, Larry Gut, Mike Haas, Don Thomson*
Michigan State University East Lansing, MI
*Pacific Biocontrol, Vancouver, WA

Keywords: codling moth, *Cydia pomonella* mating disruption, pheromone, aerosol emitter

Abstract: Isomate® CM MIST aerosol emitters (Pacific Biocontrol Corp, Vancouver, WA) containing codlemone, (*E, E*)-8,10-dodecadien-1-ol, were used to deduce the optimal characteristics for CM control. MIST units were deployed at various densities, (0, 0.25, 0.5, 1, 3, and 6 units/ac) in 10 ac commercial apple orchard plots to generate dosage-response profiles in order to elucidate the behavioral mechanism of disruption. Moth captures decreased asymptotically as Isomate® CM MIST densities increased. Data fit to Miller-Gut and Miller-de Lame plots yielded straight lines, with positive and negative slopes respectively. Catch of male moths decreased from 28/trap in the control to 0.9/trap at the highest emitter density. Disruption of > 90% was realized at emitter densities greater than 3 units per acre. The resulting set of profiles explicitly matched the predictions for competitive rather than non-competitive disruption. Thus, these devices likely disrupt by inducing false plume following rather than by camouflaging traps and females. Two MIST units per ac would be necessary to achieve the same level of CM control provided by a standard pheromone treatment with hand-applied dispensers.

The second and third studies examined two options for reducing the amount of pheromone required. The mist unit currently emits pheromone over a 12-hour period beginning at 5 pm. We compared disruption efficacy of MIST units loaded at the 50% pheromone rate, and releasing for 3, 6 or the standard 12 hours at 15 minute intervals. There was no difference in efficacy. In a final experiment looking at reducing pheromone usage, we compared disruption efficacy of MIST units loaded at the 50% pheromone rate, and releasing once, twice or the standard four times per hour all on a 12 hour cycle. There was no difference in efficacy. Thus releasing pheromone for 3 hours or only once rather than four times per hour could further reduce the amount of pheromone required. Either of these options could reduce the pheromone requirement and thus cost related to the expensive active ingredient by 4-fold on top of the 50% savings in the initial loading rate.

Mating Disruption/SIR

Combining Kairomone and Pheromone in Low-'Density "Meso" Dispensers Enhances the Disruption of Female Mating in the Codling Moth

Doug Light and Joe Grant
USDA - ARS, Western Regional Research Center, Foodborne Toxin Detection & Prevention Research Unit, Albany, CA

Keywords: Cydia pomonella, codling moth, Lepidoptera: Tortricidae, mating disruption, "Meso" dispensers, codlemone, pear ester

Abstract: Mating disruption studies were conducted in commercial walnut orchards for two years using high-load - low-density "Meso" dispensers emitting codlemone pheromone combined with pear ester kairomone (CM-DA COMBO MESO, Trécé, Inc.). Meso dispensers were hung at a low-density of 20 dispensers per acre and compared with pheromone-alone dispensers, CM-Meso (Trécé) or Ring (Pacific Biocontrol), hung at 20 or 40 dispensers per acre. Mating disruption efficacy was assessed by capture of native moths and trap shut-down of both males by pheromone-baited delta traps (CM-L2 Lures and Pherocon VI Traps, Trécé) and females by traps baited with a combinational lure (CM-DA Combo Lure + AA – acetic acid Lure, Trécé). Significant differences in the mating status of caught females were observed consistently for both years between the CM-DA COMBO MESO treated plots and both pheromone-alone dispenser plots and untreated - grower standard plots. A higher frequency of unmated – virgin and a lower frequency of multiple-mated females were found for the pheromone – kairomone Meso dispenser treatments than for the untreated and pheromone-alone treatments. This supports assessing mating disruption by targeting the evaluation of female mating status in additional to the shut-down of male capture in pheromone traps.

Mating Disruption/SIR

MESO Pheromone Dispensers for Effective Disruption of Codling Moth in Apple

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*Trécé Inc. Adair, OK

Keywords: codling moth, *Cydia pomonella,* mating disruption, pheromone, MESO dispenser

Abstract: Pheromone dispensers, called MESO's, fall between hand applied high density and aerosol low density dispensers. A MESO dispenser releases substantially more pheromone than the standard, hand-applied dispenser, but far less than an aerosol emitter. The idea is that the higher release can allow for application of MESO dispensers at much lower rates, 10-40 per acre and thus greatly reduce the labor required for hand application while still providing efficacious control. Trials were conducted using Trécé Cidetrak® CM dispensers. In year 1, a direct comparison of 1) Cidetrak® CM MESO, 2) CM/PE MESO (CM + Pear ester), 3) CM/PE puzzle, and 4) a no-mating disruption (No MD) negative control, was conducted in Michigan apple. Pheromone treatments were applied at densities of 32 and 320 respectively for MESO and Puzzle dispensers.

Year 2 trials consisted of a direct comparison of 1) an 8 in. Cidetrak® MESO CM/PE strip deployed as one unit per point source, a 20 in. MESO CM/PE strip deployed as two units per point source, 3) a 20 in. MESO CM/PE 20 in. strip deployed as 4 units per point source, and 4) a no-mating disruption (No MD) negative control. All dispenser treatments were initially deployed at four point sources per ac. An equal number of 8 in. and 20 in. units were field aged off site and later added as 4 additional point sources per ac, increasing the total dispenser density from 4 to 8 discrete pheromone point sources per ac. Evaluations for all trials consisted of moth captures in L2 baited traps and fruit injury assessments.

Year 1, CM captures in MESO plots was significantly reduced compared to the no MD control and was not significantly different than the Puzzle dispenser treatment. The addition of pear ester did not improve disruption compared to the CM only MESO. Fruit injury in all orchards was very low with less than 0.5% recorded in any treatment.

Year 2, there were no statistically significant differences between any of the Cidetrak® MESO treatments deployed at either 4 point sources or 8 point sources per ac. Disruption levels of ca. 85% was achieved and indicate that greater than 8 MESO units per acre. will be necessary in pursuit of high level (>94%) mating disruption achieved using hand applied dispensers at 300-400 units/acre.

Attract & Kill in Temperate Tree Fruit

Alan Knight
USDA, ARS, Wapato, WA

Keywords: Pest management, codling moth, *Cydia pomonella,* spotted wing drosophila, *Drosophila suzukii*

Abstract: The concept of using behaviorally-active chemicals with a killing agent (insecticide, drowning, or adhesive) to manage insect pests is widely-known, yet a more seldom practiced approach than sex pheromone-based mating disruption in tree fruits. There have been many practical limitations to using this approach to manage moth pests, including cost, efficacy, and cumbersomeness. We have been entertained by several presentations on this topic over the years. Research with A&K continues and recent studies on codling moth and spotted wing drosophila conducted by our laboratory will be presented.

Mating Disruption/SIR

A New Attract and Kill Tactic for the Oriental Fruit Moth

Juan Huang, Matthew Grieshop, Larry Gut
Michigan State University

Keywords: deltamethrin, pheromone, attract-and-kill, Oriental fruit moth, *Grapholita molesta*

Abstract: A simple, inexpensive, and long lasting attract and kill device not only provides a large surface area for moths to interact with, but also encourages moths staying near the source. In contrast to conventional attract and kill formulations which directly mix sex pheromones and insecticides into small droplets, this new design separated sex pheromones from the insecticide to minimize or delay desensitization by insects due to direct contact. Exposure of Oriental fruit moth males to this attract and kill device resulted in nearly 100% kill in a wind tunnel. Orientation of the device significantly affected numbers of contact on the device. In a field experiment of comparing this attract and kill device with mating disruption, it outperformed mating disruption at a low rate: 50 devices/acre. An experiment testing variable rates of the devices —0, 50, 100, 200 per acre showed near total trap shutdown (98%) at all three rates across the treatments, further confirming that few devices are required to disrupt Oriental fruit moth.

Mating Disruption of Filbertworm in Oregon Hazelnuts

Betsey Miller, Vaughn Walton and Daniel Dalton
Department of Horticulture, Oregon State University, Corvallis, Oregon

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

Abstract: Hazelnut production in the United States is centered in Oregon and is mainly found in the Willamette Valley. Key pests on hazelnut include hazelnut and filbert aphids, leafrollers and filbertworm (FBW). Filbertworm, *Cydia latiferreana*, is a direct key pest that needs management on a yearly basis. Management methods for this pest include monitoring with pheromone-baited sticky traps, a degree-day model, flailing of the orchard floor and well-timed pesticide applications. Here we will focus on the use of pheromone mating disruption trials conducted during 2012 and 2013.

Trap shutdown was obtained compared to chemical control plots using two formulations of pheromone during both seasons. Similar levels of crop loss were recorded in all treatments due to FBW damage. Fewer pesticide applications for FBW control were necessary in mating disruption treated blocks compared to control blocks. FBW mating disruption may provide an organically approved alternative to growers in this production area.

Mating Disruption/SIR

The Status of Navel Orangeworm Mating Disruption in Almonds and Pistachios

Bradley S. Higbee
Paramount Farming Company, Bakersfield, CA

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

Abstract: A commercial product for navel orangeworm (NOW) mating disruption (MD) was introduced in 2005. Since then it has been used in a relatively low number of acres (20-30k out of ca. 1.2 million acres of almonds and pistachios). The cost of the technology has been an impediment, but as global demand increases, almond and pistachio grower returns have also increased. At the same time, damage thresholds for NOW have decreased. Insecticide programs in high pressure situations are often not able to reduce NOW damage below current damage tolerances. However, when NOW MD is used in combination with insecticides, results have been better than either approach separately. Paramount Farming Company has adopted this technology incrementally, initially in almonds, then in pistachios. Performance and overall economics of NOW pest management programs will be compared and contrasted.

Implementation—

Moderator: Janet Caprile

Notes:

Implementation

Pesticides and Pollinators: Interaction and Impacts within Crop Production Systems and Natural Areas

Vicki Wojcik, Laurie Davies Adams, and Kelly Rourke
Pollinator Partnership, San Francisco, CA, www.pollinator.org

Keywords: pesticides, beneficial insect interactions, pollination services, bees, Best Management Practices (BMPs), non-target effects, crop protection, yield protection, stakeholder outreach and education, apple, almond

Abstract: Pollinators, especially bees, are required for the production of the vast majority of tree fruit and nut crops; yet many common agricultural and crop protection practices can negatively impact pollinators and their pollination services. Primary among these practices is the application of insecticides to crops at or near bloom, resulting in direct interactions with bees. Weed control and pest management throughout the growing season can result in a suite of indirect effects. Protecting the health and function of pollinators is of primary importance to pollinator-dependent agriculture. Tools and techniques exist to mediate impacts in many cases, but they are not universally used. Informed and coordinated communication between growers and beekeepers regarding the use of best management practices (BMPs) to mitigate potential risk of pesticide use to bees must be practiced. Recent examples of pollinator deaths associated with incorrect product application (Oregon Bumble bee deaths) and off-site drift (Honey bee deaths in Iowa and Ontario) highlight the need to educate all stakeholders on the full scope of pollinator interactions that can occur. Here we present current BMPs, research and development in the field, and examine gaps in knowledge and regulation. We highlight interactions in apple and almond pollination systems, and anticipate an audience awareness survey.

Federal Pesticide Update

David Epstein
USDA Office of Pest Management Policy, Washington, DC

Keywords: Endangered Species Act (ESA), USEPA Registration Review, pollinator health and labeling

Abstract: A brief review of federal regulatory activities concerning the Pesticides General Permit, the Endangered Species Act (ESA) in relation to biological opinions issued from consultation between NOAA Fisheries, US Fish and Wildlife Service and the USEPA, and USEPA registration review will be presented.

Implementation

Solid Set Canopy Delivery System

Keith Granger and Jay Brunner
Washington State University Tree Fruit Research & Extension Center, Wenatchee, WA

Keywords: Solid Set Canopy Delivery System, SSCDS

Abstract: The Solid Set Canopy Delivery System (SSCDS) is a USDA SCRI funded Coordinated Ag Project with a research and extension team from Michigan, Washington, and New York. The goal has been to develop and evaluate a solid set canopy delivery system for apples and cherries. The SSCDS is an innovative way of applying crop protection chemicals and plant growth regulators to these crops. The development of a SSCDS is a logical next step to replace tractor-mounted sprayers in high-density fruit orchards.

Water sensitive cards showed a weakness for coverage of the underside of leaves in the initial SSCDS design (2012). The modified SSCDS design used in 2013 improved coverage on the underside of leaves but at the cost of reduced coverage on the top surfaces. Tartrazine Dye, used to measure spray distribution, showed that both the 2012 SSCDS design and the modified 2013 SSCDS design distributed spray material within the tree canopy similar to an airblast sprayer application. In season-long trials (2012 and 2013) the SSCDS provided codling moth control that was statistically similar to airblast applications despite the less than optimal coverage. There were no differences relative to codling moth control when SSCDS applications were made at 100 gallons per acre in 2012 versus 200 gallons per acre in 2013. Future work will need to focus on improving coverage with the SSCDS and developing a method for filling spray lines that reduces the amount of excess spray material so that SSCDS can be up-scaled to larger plots.

The Washington State SSCDS Team includes: Jay Brunner and Keith Granger (WSU-TFREC, Wenatchee); Gwen Hoheisel (WSU Extension); Matt Whiting, Gary Grove, Ajay Sharda, Manoj Karkee and Qin Zhang (WSU-IAREC, Prosser, WA); and Tory Schmidt and Ines Hanrahan (Washington Tree Fruit Research Commission).

Apple IPM?

Alan Knight
USDA, ARS, Wapato, WA

Keywords: Pest management, apple, insecticides, sex pheromone, resistance

Abstract: ‘IPM’ are just three alphabet letters that somehow when arranged thus designate a holy tenet of the applied entomologist’s world - Integration. We swear on our diploma to think broadly and solve complex problems by breaking the issues down and linking partial solutions together to create a sustainable program. Yet, when I attended Oregon State in the 1970’s they required a three term class call IPM which stood for ‘Insect Pest Management’. Perhaps the catalog had not been revised for a period of time because certainly the teachings were on the integration of tactics as well as the life history attributes of the pests. My talk today will discuss the changes in the definition or emphasis of these letters during and between 1954, 1974, 1994, and 2014. Reference to the stellar history of WOPDMC will be used to emphasize this flow of time.

Implementation

Developing a Management Strategy for Little Cherry Disease

Andrea Bixby-Brosi, Elizabeth Beers, Ken Eastwell, and Karina Gallardo
Washington State University, Tree Fruit Research and Extension Center, Wenatchee, WA

Keywords: apple mealybug, *Phenacoccus aceris*, chemical control, grape mealybug, *Pseudococcus maritimus,* insect vector, Little Cherry Disease, Little Cherry Virus 1, Little Cherry Virus 2, Western X phytoplasma

Abstract: Little cherry disease (LCD) is a serious viral disease of sweet cherry caused by three viral pathogens, Little Cherry Virus 2 (LChV2), Little Cherry Virus 1 (LChV1), and Western X phytoplasma. This disease has been present in low levels in Washington State since the 1940s, but became increasingly apparent during 2011-2013, resulting in unpicked limbs/trees, tree removal, and even whole orchard removal. Trees with LCD produce cherries with small size and poor flavor making the fruit unmarketable, particularly with the current industry emphasis on premium fruit size and quality. While the exact amount of infected acreage is unknown, LCD is suspected or verified in many Washington orchards. The history of LCD in Canada has shown that if left unchecked this disease can completely wipe out entire sweet cherry production regions.

The number of unknown factors in the spread of LCD makes it difficult to develop a comprehensive management plan. Trees may be non-symptomatic for several years after acquiring LCD, but serve as a reservoir during that time. Symptoms are not expressed to the same degree every year or by every variety. Transmission is thought to occur either by root grafting or insect vectors. Apple mealybug, *Phenacoccus aceris*, the historical vector of LChV2, has been recorded for the first time on sweet cherry in Washington. In addition, grape mealybug, *Pseudococcus maritimus,* was shown for the first time to be a capable vector of LChV2 in 2012. While grape mealybug control has been studied (primarily on pear), Washington currently has no recommendations for control of apple mealybug. Little is known about the vector/disease relationship: how long do they need to acquire the virus, how persistent is the virus in the vector, what mealybug stages are most likely to disperse to a healthy tree? Visual diagnosis of LCD is made difficult by partial recovery in the appearance of fruit, the potential confusion of symptoms with those of other pathogens, and certain types of nutrient deficiencies. In order to develop a management strategy and grower decision tools to reduce the incidence of LCD, it is necessary to understand the key factors governing its spread, economic losses generated, and the cost and benefits of strategies to mitigate losses.

Implementation

Low Volume Spray Technique Control of Walnut Husk Fly in Walnuts

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

Keywords: *Rhagoletis completa*, walnut husk fly, speed sprayer, modified spray technique, low volume, low concentration, high concentration, toxicant, walnut

Abstract: Studies were conducted in 2012 and 2013 to compare the conventional full cover walnut husk fly (WHF) technique with new low volume (LV) techniques. LV techniques were applied at ~20 gal/acre to every other row using a modified standard speed sprayer operating at 3-9 mph. All nozzles were closed except the top pair, which was replaced with ¼ in. barb adapters. The adapters provided high-pressure, solid streams of toxicant. Air baffles were adjusted to direct the air-flow vertically, enabling the fan to push the toxicant 40-50 ft in the air before spilling back over the upper canopy. The 2012 study treatments (4) were: low concentration LV, high concentration LV, full cover grower standard (GS) and untreated. The 2013 study treatments (3) were: high concentration LV, GS and untreated. Each treatment was replicated once per orchard in 3 orchards per year; each replicate was 5-15 acre. Adult WHF was monitored weekly by 1 ammonium carbonate super-charged yellow panel AM/NB trap/treatment/orchard. WHF infestation was evaluated weekly by examining 300 nuts per treatment in each orchard for external damage. The results showed the high concentration LV treatment to be as efficacious as the GS technique, while the low concentration LV treatment was not (2012). The GS and high concentration LV techniques both had significantly lower infestation compared to the untreated check.

Poster Session

Notes:

POSTER
Invasive Species

Argyresthia pruniella (Lepidoptera, Argyresthiidae), the Cherry Blossom Moth: What We Know about a New Exotic Pest in Washington State.

Chris Looney and Eric LaGasa
Washington State Department of Agriculture, Olympia, WA

Keywords: exotic pest, cherries, Cherry Blossom Moth, *Argyresthia pruniella*, Argyresthiidae, Lepidoptera

Abstract: In 2011, the WSDA pest program detected *Argyresthia pruniella*, the Cherry Blossom Moth, for the first time in the United States. This species is a cherry pest in its native Europe. Larvae feed in developing buds in early spring, and can destroy up to 90% of cherry buds during outbreak years. Surveys in Washington in 2011 and 2012 detected the species at 21 sites, all located in or very close to Blaine, Whatcom County, WA. Expanded survey in 2013 detected the species at 25 sites, including detections in Bellingham and outside of Whatcom county. Trap catches indicate that adult flight begins in late June/early July, with a peak in early-mid July. A few moths were still captured into the end of August and early September. This poster presents capture data, known distribution, and basic biological information for this potential cherry pest.

POSTER
Chemical Control/New Products

Activity of Tolfenpyrad on Various Life Stages of Pear Psylla in Laboratory Bioassays

Bruce M. Greenfield and Elizabeth H. Beers
Washington State University, Tree Fruit Research and Extension Center, Wenatchee, WA

Keywords: Pear psylla, *Psylla pyricola*, tolfenpyrad, Bexar, buprofezin, Centaur, endosulfan, Thionex, lambda-cyhalothrin, Warrior, abamectin, Agri-Mek, chemical control

Abstract: Bexar and Warrior+PBO on contact caused 100% mortality of winterform adult female psylla in slide dip bioassays. Thionex caused 100% mortality when the insects were held at warmer temperatures, but only 70% when held at 55 °F. Centaur WP was not toxic to adults. Exposure of winterform adults to residues on shoots caused little mortality (12-29%); only Bexar+oil (with or without PBO) and Agri-Mek were significantly higher than the check. The residues of 11 materials deterred oviposition by female psylla, and killed any nymphs that hatched. Exposure of summerform adults to residues of Bexar and Agri-Mek on potted pear seedlings reduced egg numbers by 64× and 7×, respectively. Bexar and Agri-Mek caused about 100% mortality of younger (instars 1-3) and older (instars 4-5) nymphs, although mortality was a little slower with Agri-Mek on 4th instars. Bexar is a promising new material for control of pear psylla with several possible timings during the growing season.

POSTER
Mating Disruption/SIR

Effects of X-Ray Irradiation on Sterilization and Reproduction of the Navel Orangeworm, *Amyelois transitella* (Lepidoptera: Pyralidae)

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Keywords: Amyelois transitella, navel orangeworm, Lepidoptera: Pyralidae, irradiation, X-ray, sterility, reproduction, fecundity, fertility, inherited sterility

Abstract: An irradiation system using soft x-rays was developed for sterilization of insects for SIT. This system uses a multiple tube design and a rotating target stage that allows for a more uniform dose distribution than has been accomplished using single point sources. The navel orangeworm (NOW), *Amyelois transitella* (Walker) is the key pest of California tree nuts, almonds, pistachios, and walnuts causing both feeding damage on kernels and the vector introduction of Aflatoxin producing *Aspergilli* molds. Because both conventional insecticides and mating disruption have been problematic for control of NOW we have initiated research to assess the possibility of integrating the Sterile Insect Technique into the program. Male adult NOW were irradiated to determine the dose needed to achieve complete egg sterility of mated female moths and inherited egg sterility of F1 generation males and females when mated to with unirradiated normal moths. Female fertility was affected by exposure of males to dose levels of $\geq$50 Gy. Development of eggs to the pre-hatch larval stage was significantly reduced at exposure doses $\geq$100 Gy. Hatching of eggs was significantly decreased at exposure doses $\geq$ 50, with no eggs hatching at $\geq$125 Gy doses. Though fecundity in numbers of unfertilized eggs appeared similar for control and irradiated females, no F2 eggs hatched for the test exposures of >50 Gy.

POSTER
Biology/Phenology

Abiotic Factors Influencing Immature Plum Curculio, *Conotrachelus nenupahr*, Biology in Soil

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Keywords: Biology, Plum curculio, *Conotrachelus Nenuphar*, pupation, burrowing, soil texture, soil moisture, stone fruit, pome fruit, irrigation

Abstract: The current understanding of immature plum curculio biology in soil is primarily based on historical data and observations relying on variable and imprecise methodology. The goal of this research was study the influence of two abiotic soil factors, soil texture and soil moisture, on the depth and pupation of immature plum curculio. Soil treatments consisting of four soil textures and three moisture levels were prepared and added to plastic vials. Plum curculio larvae were introduced individually into vials and were incubated for 10 d, at which point insects were carefully excavated from the vials. Plum curculio depth and lifestage (larvae vs. pupae) were recorded. Analysis revealed that as soil moisture increased, the depth at which plum curculio were recovered increased. Similarly, as soil moisture increased the percent of plum curculio found as pupae increased. Implications from this research are briefly discussed with regards to cultural, mechanical, and microbial control tactics for plum curculio.

POSTER
Thresholds/Monitoring

Field Monitoring of Plum Curculio (*Conotrachelus nenuphar*) Activity with Motion-Sensor Cameras and System Applications in General Entomology

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Keywords: Monitoring, behavior, pyramid trap, plum curculio, *Conotrachelus nenuphar* (Herbst), phenology, circadian rhythm, motion-sensor, camera, stone fruit, pome fruit

Abstract: Wildlife-monitoring cameras were adapted to monitor the entrances to pyramid traps catching plum curculios. Using released curculios, 2 trap designs (v.I and v.II) were field-tested alongside conventional pyramid traps at 1 site in 2010 and at 4 sites in 2012. Traps were evaluated on the basis of battery power, ease-of-maintenance, adaptability, required-user-skills, cost (including labor), and accuracy-of-results. The v.II design fully surpassed expectations except that some trapped curculios were not photographed. In 2012, 13 of the 24 traps recorded every curculio entering the traps during the 18 day study period, and in the traps where some curculios were not photographed, over 90 percent of the omissions could be explained by component failure or external interference with the motion sensor. Significantly more curculios entered the camera traps between 6 pm and 12 am. When compared with conventional pyramid traps, the v.I traps collected a similar number of curculios. Two observed but not significant trends were that the v.I traps collected twice as many plum curculios as the v.II traps while at the same time the v.II traps collected more than twice as many photos per plum curculio as the v.I traps. The research demonstrates that low-cost, precise monitoring of field insect populations is feasible without requiring extensive technical expertise.

POSTER
Biological Control

Amblydromella caudiglans: A New Predatory Mite for Washington Apples

Rebecca A. Schmidt and Elizabeth H. Beers
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Keywords: Predatory mite, spider mite, phytoseiid, Amblydromella caudiglans, Galendromus occidentalis, apple

Abstract: The Washington State integrated mite management program developed in the 1960's was based on conservation of the organophosphate-resistant mite predator *Galendromus occidentalis*. Although grower practices and pest problems have changed, the assumption that this predator is the sole phytoseiid found in Washington apple has never been tested. A preliminary survey found several other species, including *Amblydromella caudiglans*, which was dominant in some orchards. We conducted a more extensive survey that included 110 apple blocks and found that *A. caudiglans* was the dominant predator in almost 25% of samples. Because of its potential as a biological control agent, the basic biology of this predator was investigated. Although it had shorter egg and larval development time (at 89° F) than *G. occidentalis*, it spent more time in nymphal stages, giving *G. occidentalis* an overall shorter life cycle. Survivorship was similar for both species, except during the egg stage, where *A. caudiglans* individuals had lower mortality. Further work will be conducted to investigate the fecundity, pesticide-tolerance, and environmental preferences of this species. This will allow for the determination of its utility as a natural enemy of spider mite pests, with the goal of making recommendations to promote its conservation.

Minutes of the 87th Annual Meeting

Orchard Pest & Disease Management Conference
Hilton Hotel, Portland, Oregon
January 9 - 11, 2013

I. Call to Order

The **87**th Annual Meeting was called to order by the President David Epstein at 9:00 am on January 9, 2013. President Epstein welcomed everyone, asked speakers to not exceed 15 min per presentation to maintain the meeting schedule, asked for each attendee to introduce themselves, and introduced session leaders. They were:

Implementation	- David Epstein
Thresholds/Monitoring	- Alan Knight
Biological Control	- John Wise
Invasive Species	- Peter Shearer
Chemical Control	- Don Thomson and Harvey Reissig
Biology/Phenology	- Jack Jenkins
Mating Disruption/SIR	- Peter McGhee

II. Old Business

A. Approval of 2012 Minutes: Secretary Alston announced that the 2012 minutes are posted on the OPDMC website and printed in the back of the abstract booklet. It was moved, seconded, and voted to approve the 2012 minutes.

President Epstein called for any other old business. There was none.

III. New and Miscellaneous Business

A. Call for New Business

President Epstein called for new business.

- A request to include WiFi in the room rates for next year to avoid an additional charge to use WiFi in the lodging rooms. Don Thomson agreed to speak to the hotel staff about this.
- Betsy Beers introduced "Peter's Tree" as the new logo for OPDMC. The board had previously voted to adopt the new logo. Betty LaDuke Westigard, Peter's wife, created the pear tree after Peter passed.

B. Call for Volunteers for Committee Positions

President Epstein called for volunteers for committee positions. The following committee assignments were made:

Nominations: Larry Gut (Chair), Pete McGhee, and Bob Van Steenwyk
Audit: Rick Hilton (Chair), Ute Chambers, and Keith Granger
Resolutions: Art Agnello (Chair), Peter Shearer, and Andrew Hubbard

C. Meeting Information

General meeting information was presented by Don Thomson.

- The keynote address will be presented by Dr. Camille Parmesan at 3:30 today; her abstract is in the program.
- Social mixer in the foyer today at 5:00 pm.

- Poster session at 10:00 am Thursday in the foyer.
- Concurrent disease session in Broadway 4 Wed and Thurs.

IV. In Memoriam

Tom Unruh presented an in memoriam for Dr. Frank Howell, who passed in 2012. Frank worked for USDA ARS from 1965-95, studied insect biology of loopers and codling moth, conducted early studies with codling moth mating disruption, developed codling moth diet and rearing methods, conducted research in a number of foreign countries, including Tunisia, help found a boy scout camp in the mountains of WA, and will be greatly missed by many.

The opening business meeting was then adjourned until 10:30 am, Friday, January 11, 2013.

V. Closing Business Meeting

The closing business meeting was called to order by President Epstein on January 11.

A. Board Meeting Report

President Epstein called upon Secretary Alston for a report on the 2013 Board of Directors' Meeting which was held on January 9, 2013 at 12:00 pm. The following information items were presented:

- Pre-registration for the conference is highly encouraged. Conference registration fees: 1) pre-registration online cost $40 for registration and $10 for the abstract booklet, and 2) registration on-site cost $50 for registration and $10 for the abstract booklet. The board voted to keep the $10 increase for on-site registration to encourage pre-registration.
- Pre-loading slideshows using AirDropper worked very well and will continue to be used. Encourage everyone to submit their slideshows by the deadline to make it easier for Don and program co-chairs.
- Please submit suggestions for future key-note speakers.
- Request to drop off name tags at registration desk to be re-used next year.

B. Further New Business

President Epstein called for further new business. There was none.

- Don Thomson reported that WiFi service will be provided in the rooms next year and included in the room price.
- Marion Murray asked if a larger meeting room could be reserved for the disease session next year; attendees had to stand in the doorway because the room wasn't large enough.
- Don said that he would send out a map of nearby parking lots before next year's meeting.
- The meeting co-chairs, Betsy Beers and John Dunley, were acknowledged for their excellent service to the conference.

C. Committee Reports

President Epstein called for the committee reports.

1. Nominations

Chair Larry Gut made the following nominations:
President-Elect: Jack Jenkins (Pacific Biocontrol Corp.)
Secretary: Diane Alston (Utah State University)
Treasurer: Nancy Hays (Pacific Biocontrol Corp.)
Executive Director: Donald Thomson (DJS Consulting Services)

Program Co-Chairs: Betsy Beers (Washington State University) and John Dunley (Wilbur Ellis)
Lucia Varela (University of California) will serve as President in 2014
A motion was made and seconded to accept the recommendations of the nominations committee. The motion was passed unanimously.

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

3. Resolutions
Chair DJ Art A (aka Art Agnello) and committee members rapped the proposed resolutions:

1. Be it resolved that this conference extend written appreciation to the management and staff of the Hilton Hotel for the courteous service and fine accommodations provided.
2. Be it resolved that the members of the conference express their appreciation to Executive Director Don Thomson (who served his 14th year as ED and was presented with a bottle of wine by President Epstein), the Past President Tom Unruh, President David Epstein, President-Elect Lucia Varela, Secretary Diane Alston, Treasurer Nancy Hays, and Program Co-Chairs John Dunley and Betsy Beers for their leadership and dedication in organizing the 2013 meeting.
3. Be it resolved that the members of the conference extend their appreciation to the Tree Fruit Research and Extension Center, Washington State University, and in particular, Christina Mayer, for applying for pesticide applicator credits from participating states and preparing the meeting abstracts, Jerry Tangren for maintaining the OPDMC website.
4. Be it resolved that the members of the conference extend their appreciation to the session leaders: David Epstein, Alan Knight, John Wise, Peter Shearer, Don Thomson, Harvey Reissig, Jack Jenkins, and Peter McGhee for ably overseeing the entomology sessions of the 2013 conference.
5. Be it resolved that the members of the conference extend their appreciation to Tamla Blunt, Colorado State University, for ably overseeing the disease management session of the 2013 conference.
6. Be it resolved that the Secretary send a letter of condolence to the family of Frank Howell who passed away during the past year.

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

*It should be noted that the Resolutions Committee is to be acknowledged for a most entertaining rap report, the most interesting committee report in memory.

D. Treasurer Report
Treasurer Hays gave the Treasurer Report

Beginning cash balance	$7,379.29
Income	$1,830.00
Expenses	$7,482.03
Ending cash balance	$1,727.26
Total cash & approx. accounts receivable balance as of 12/31/12	$10,537.26

E. Call for Nominations for the Rubber Chicken Award
President Epstein called for nominations:
1. Larry Gut nominated Don Thomson for delivering the keynote speaker's address in his introduction of Camille before she had a chance to deliver her own presentation. Also, Don temporarily lost the rubber chicken in the foyer, but he did later recover it. Don was the only nominee.

President Epstein called for a vote from the membership by a showing of hands. Don received unanimous support for his first time to receive the rubber chicken award.

President Epstein passed the gavel to the New President Lucia Varela, who adjourned the meeting.

Conference dates for next year are January 8-10, 2014.

Respectfully Submitted,
Diane Alston
Secretary
2013 Orchard Pest and Disease Management Conference

Adult pear psylla

Brown
marmorated stink bug

Woolly apple aphid

Western
cherry fruit fly

Walnut husk fly

Apple maggot

Navel orangeworm

Spotted wing
drosophila

Codling moth