



2010 Orchard Pest & Disease Management Conference

The 84th Conference is pleased to announce our keynote speaker
Dr. Scott Hutchins
Dow AgroSciences/ESA Past President

Keynote Address:
"Next Generation Technologies and Approaches that will Characterize and Enable IPM"



Aphelinus mali parasitizes
woolly apple aphid



Lacewing larva eats
woolly apple aphid

Hilton Portland, Portland, Oregon
January 13-15, 2010

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

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

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

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

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

Rachel Elkins (2001), Univ. of Calif., Clear Lake, for using an overhead projector in a digital age.
Jay Brunner (2002), Wash. St. Univ., Wenatchee, for giving one of the loooooongest talks in the history of the WOPDMC.

Doug Light (2003), USDA, Albany, California, for showing incomprehensible data slides again and again and again.

Stephen Welter (2004), Univ. of Calif., Berkeley, for inappropriate behaviour by leaving the meeting prior to giving his presentation.

Andy Kahn (2007), Wenatchee, Washington, for giving a much too long presentation and refusing to yield the podium - Andy subsequently decapitated our alopeciate friend.

Jim Miller (2008), Mich. St. Univ., for attempting to coerce the entire membership into his cult of the pheromone - and Jim was responsible for the demise of yet another unfeathered friend.

Peter Shearer (2009), Ore. St. Univ., Hood River, for forgetting, like Dorothy, that he was not in Rutgers anymore.

Orchard Pest and Disease Management Conference

Agenda for 2010 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 which that will occur.

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

Wednesday, January 13		
10:00am	Opening Business	Lawrence Lacey, WOPDMC Chair
11:00am	Chemical Control/New Products	Peter Shearer, Moderator
12:00pm	Lunch	
1:30pm	Chemical Control/New Products (cont.)	Peter Shearer, Moderator
3:00pm	Break	
3:30pm	Keynote Address	
5:00pm	Mixer (Lobby)	
Thursday, January 14		
8:00am	Chemical Control/New Products (cont.)	Peter Shearer, Moderator
9:30am	Biology/Phenology	Art Agnello, Moderator
10:00am	Poster Session/Break	
11:00am	Mating Disruption/SIR	Chris Nobbs, Moderator
12:00pm	Lunch	
1:30pm	Mating Disruption/SIR (cont.)	Chris Nobbs, Moderator
3:00pm	Break	
3:30pm	Implementation	Larry Hull, Moderator
4:00pm	Thresholds/Monitoring	Steve Welter, Moderator
Friday, January 15		
8:00am	Biocontrol	Vince Jones, Moderator
9:30am	Resistance Management	John Dunley, Moderator
10:00am	Closing Business	Lawrence Lacey, WOPDMC Chair Peter Shearer, Chair-Elect
11:00am	Adjourn	

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Western Orchard Pest and Disease Management Conference

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**Order of Presentations
FROM THE 84th ANNUAL
ORCHARD PEST AND DISEASE MANAGEMENT CONFERENCE
January 13, 14 & 15, 2010**

Keynote Presentations 3:30 – 5:00pm, Wednesday January 13

Next Generation Technologies and Approaches that will Characterize and Enable IPM - Scott Hutchins, Director, Global Crop Protection R&D, Dow AgroSciences

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CHEMICAL CONTROL/ NEW PRODUCTS—

PETER SHEARER, MODERATOR

Notes

Chemical Control/New Products

Update on Woolly Apple Aphid Control

Elizabeth H. Beers and Randy R. Talley

Washington State University, Tree Fruit Research and Extension Center, Wenatchee, WA

Keywords: diazinon, spirotetramat, Ultor™, Actara®, thiamethoxam, Assail®, acetamiprid, Clutch®, clothianadin, petroleum oil, NNI-0101, woolly apple aphid, *Eriosoma lanigerum*

Abstract: Diazinon provided the best control of woolly apple aphid when applied to an extant population. All other materials tested in 2009 provided varying degrees of suppression. Ultor™, when applied to extant populations, provided suppression in some tests, but in some cases it was not different than the check. Ultor™ applied early in the season (before aphids were visible in the trees) reduced the mid-summer peak in comparison to the untreated check; this mode may prove to be the best use of this material. Assail®, Actara®, and Clutch® applied by airblast sprayer to the canopy provided an intermediate degree of suppression. Clutch® applied to the soil at delayed dormant was not effective, although it provided some suppression of both aerial and root colonies when applied at petal fall.

Woolly Apple Aphid Control In Pennsylvania Apple Orchards and the Impact of Delegate® On *Aphelinus mali*

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²Long Island University, Biology Department, New York, NY

Keywords: Woolly apple aphid, *Eriosoma lanigerum*, *Aphelinus mali*, codling moth, insecticides, apple

Abstract: Increases in woolly apple aphid (WAA), *Eriosoma lanigerum*, populations have been noted in some Pennsylvania apple orchards since the introduction of Delegate® (spinetoram) for codling moth (CM) control in 2008, even in orchards with resistant rootstocks. A series of experiments in research and commercial orchards of apple were conducted during 2008-9 to determine the efficacy of various insecticides on WAA. Pre-bloom applications of chlorpyrifos were found to be very effective in giving seasonal control of WAA as were Movento® and diazinon later in the season. Monitoring of 15 grower orchards over a three year period as part of a USDA-RAMP grant, but with additional funding from Dow AgroSciences found WAA populations to be significantly higher in orchards using Delegate® for first generation codling moth control. Replicated 16 tree research plots also found higher WAA populations as a general trend in plots that used Delegate® for first generation CM control. Evaluation of weekly pan trap samples in the RAMP orchards from 2007-9 (over 7,000 samples) found lower numbers of the parasitoid *Aphelinus mali* to be present in orchards treated with Delegate®, despite higher levels of WAA. Rates of parasitism and predation were also evaluated and will be presented.

Chemical Control/ New Products

Chemical Control/New Products

Positioning of Altacor® and Delegate® in a Reduced Risk Pear Pest Management Strategy

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Keywords: Codling moth, *Cydia pomonella*, pear psylla, *Cacopsylla pyricola*, European mite, *Panonychus ulmi*, twospotted spider mite, *Tetranychus urticae*, Delegate®, spinetoram, Altacor®, rynaxypyr, PureSpray® Green horticultural oil, Imidan®, phosmet, Agri-Mek®, abamectin, Assail®, acetamiprid, Warrior®, lambda-cyhalothrin, pear, chemical control, insecticide

Abstract: A single tree replicated field trial was conducted to evaluate the positioning of Altacor® and Delegate® in a pear pest management program. Delegate® at 4.5 oz/ac and 6.4 oz/ac was applied for the first CM generation and Altacor® at 2.0 oz/ac and 4.0 oz/ac was applied for the second generation and the reverse. This trial was conducted against a moderate CM population with over 31% of the fruit infested at harvest in the untreated check and CM control was excellent with positioning Altacor® for the first generation and Delegate® for the second generation or the reverse. However, pear psylla was significantly reduced when Delegate® was applied for the first generation and Altacor® was applied for the second generation compared to the reverse. Field toxicity and longevity of Altacor® and Delegate® was determined in a single tree replicated field trial by applying Altacor® at 2.0 oz/ac and 4.0 oz/ac and Delegate® at 4.5 oz/ac and 6.4 oz/ac for the second application of the first CM generation and the first application of the second CM generation. Treatments were assessed weekly through the season by infesting 13 pears per replicate each with four neonatal CM larvae. Two larvae were placed in ½ of a pill capsule. Two ½ pill capsules were attached to each pear with hot wax. Mortality was determined after 24 hrs. If one or more of the larvae were alive after 24 hrs, then the capsule was considered alive. This study demonstrated that Delegate® caused significantly greater larval mortality compared to Altacor®. Delegate® at the high rate of application had excellent residuality for 21 DAT. With no difference in CM infestation between Altacor® and Delegate® in the positioning study and with significant greater larval mortality of Delegate® compared to Altacor® in the toxicity study, a replicated laboratory study was conducted to determine the ovicidal effects of Altacor®. Apples were treated by Potter spray tower or dipping with Altacor® at 20 ppm before CM oviposition and 100 ppm after oviposition. There was a minimum of 10 eggs per apple and the apples were discarded if there were less than 10 eggs. Six days after treatment, eggs were counted and mortality rates determined by counting the number of eggs that hatched, the number of eggs that hatched and died, and the number of eggs that did not hatch. Excellent ovicidal activity was observed (over 50%) and maximum efficacy was achieved by applying Altacor® prior to oviposition compared to after oviposition. Similar efficacy was observed when spraying or dipping.

Chemical Control/New Products

Adulticidal and Ovicidal Properties of Rynaxypyr and Spinetoram

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Fruit Research and Extension Center, Biglerville, PA

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

Abstract: The adulticidal and ovicidal properties of rynaxypyr (Altacor®) and spinetoram (Delegate™ WG) were evaluated during laboratory bioassays. All moths used for bioassays were taken from laboratory-reared colonies originated from populations collected from commercial orchards in Pennsylvania. Codling moth and oriental fruit moth males and females were exposed to both compounds through various routes of exposure: ingestion, topically and contact with dry residues for up to 96 hours. Each compound was tested at two concentrations equivalent to field rates per 100 gallons of solution: Delegate™ at 4.5 oz/100 gal (33.7 g/100 liter) and 7.0 oz/100 gal (52.4 g/100 liter); Altacor® at 2.0 oz/100 gal (15 g/100 liter) and 4.0 oz/100 gal (30 g/100 liter). Adult mortalities were evaluated after 24, 48, 72 and 96 hours of exposure. Additionally, the effect of listed treatments on female's fecundity and eggs fertility was also evaluated. Each exposure route for both products appears to directly affect the survival of both sexes of moths. The exposure of moths to spinetoram caused high mortality for both sexes while exposure to rynaxypyr provided higher mortality among exposed male moths. No differences in adult mortality were observed for spinetoram treatments based on the route of exposure or concentration. For rynaxypyr, the topical treatment of adult moths was less lethal than ingestion or contact with dry residue. In addition to this direct adult moths mortality, both compounds also exhibit possible sublethal effects on female's fecundity and eggs fertility. The differences and similarities between effects of spinetoram and rynaxypyr on codling moth and oriental fruit moth adults and eggs will be presented.

Chemical Control/New Products

**Management of Internal Feeding Lepidoptera and Leafrollers
Through Application Method and Rotational Pattern of Various Insecticides**

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Keywords: *Cydia pomonella*, codling moth, *Grapholita molesta*, oriental fruit moth, obliquebanded leafroller, *Choristoneura rosaceana*, tufted apple bud moth, *Platynota idaeusalis*, insecticides, apple

Abstract: A study was conducted in a research apple orchard of Penn State University during 2009 to determine the overall efficacy of Altacor[®], Delegate[®] and Turismo[®] against the codling moth (CM), *Cydia pomonella*, the oriental fruit moth (OFM), *Grapholita molesta*, and two leafrollers; obliquebanded leafroller, *Choristoneura rosaceana*, and tufted apple bud moth, *Platynota idaeusalis*; as affected by the method and frequency of application, use rate, and rotational pattern between pest generations of each product. The various treatments were applied to 12-15 tree plots, each replicated four times, using an airblast sprayer calibrated to deliver 100 gallons per acre. Two methods of application (every row and alternate row middles [ARM]) were used to apply all Altacor[®] and Delegate[®] rotational pattern treatments, while only the every row method was used for the Turismo[®] rotational pattern treatments. Data on pest and natural enemy populations and fruit injury were collected. Two every row or 3-4 ARM applications per CM generation of Altacor[®] and Delegate[®] were equally effective in controlling both CM and OFM and the leafroller complex, while all Altacor[®]/Delegate[®] rotation schemes between CM generations were more effective than the standard insecticide program. Two ARM applications per CM generation of higher rates of Delegate[®]/Altacor[®] were slightly less effective against CM/OFM and the leafrollers than the two and 4-ARM applications per CM generation of this insecticide program. The every row middle program of Turismo[®]/Delegate[®] was as effective as the Altacor[®]/Delegate[®] rotation scheme for CM/OFM control, but was not as effective for leafrollers. The preferred rotation scheme for use of these compounds during the season in Pennsylvania will be presented.

Chemical Control/New Products

**Codling Moth Control Programs and Effects on
European Earwig, Pear Rust Mite and San Jose Scale**

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Keywords: codling moth, *Cydia pomonella*, European earwig, *Forficula auricularia*, pear rust mite, *Epirimerus pyri*, San Jose scale, *Quadrapidiotus perniciosus*, Altacor®, rynaxypyr, Assail®, acetamiprid, Delegate®, spinetoram, Envidor®, spiroadiclofen, Intrepid®, methoxyfenozide, Turismo®, flubendiamide, buprofezin, Ultor™, spirotetramat, apple, pear

Abstract: A variety of codling moth (CM) control programs were evaluated in pear. Materials were alternated by codling moth generation. Delegate®, Altacor®, Intrepid® and Assail® were used for control of first generation codling moth while those same four materials along with Turismo® were used for control of second generation. Control of CM was generally good with the exception of those programs where Intrepid® was used for first generation. Delegate® appeared to suppress the number of European earwigs found in cardboard traps. While pear rust mite levels were fairly high at the Research Center orchard in 2009, the stimulation of rust mite by Delegate® which has been seen in past years was not observed in 2009. However, the level of fruit with San Jose scale was higher in those treatments where Delegate® had been used in first generation. In another trial a program of Delegate® applications also had significantly higher San Jose scale levels on the fruit than the untreated check. This same effect was seen in a trial conducted in Washington State on Fuji apples. In other evaluations conducted at the Southern Oregon Research Center, a number of materials exhibited activity on pear rust mite. Both Envidor® and Ultor™ significantly reduced the level of pear rust mite when tested at various timings.

Chemical Control/New Products

Grape Phylloxera Control with Movento and Systemic Neonicotinoids

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Keywords: Grape phylloxera, *Daktulosphaira vitifoliae* (Fitch), crawler, nymph, Movento™, spirotetramat, Platinum®, thiamethoxam, Admire® Pro, imidacloprid, Venom®, dinotefuran, neonicotinoids, grape, chemical control, insecticide, pesticide, drip irrigation, emergence trap

Abstract: A three-vine replicated field trial was conducted in the Carneros region of Napa, CA to evaluate chemical control of grape phylloxera. *Vitis Vinifera* L. 'Merlot' varieties grafted to 101-14 rootstocks were treated with Movento™, Movento™ with Platinum®, Platinum®, Venom®, and Admire® Pro. Movento™ was applied in October 2008 and June 2009 using an air-blast mist blower. Systemic neonicotinoids were applied in May 2009 through the drip irrigation system using a modified cup method. Each pesticide was applied both early and late during the four hours of irrigation to determine the most effective application timing. Phylloxera infestation was assessed for a two-week period each month from June to September 2009 using a modified crawler emergence trap. Root populations were also assessed in October by removing roots under the drip emitters. Neither Movento™ treatment was effective at controlling phylloxera, especially considering the high infestation found on the roots. All systemic neonicotinoids provided excellent control with respect to the number of nymphs and adults found on the roots. However, based on the number of crawlers found in the traps, only Venom® and Admire® both applied early in the irrigation cycle were effective. Phylloxera populations were monitored in four untreated vines from May to November 2009 using the crawler emergence traps. The number of crawlers caught in the traps peaked for the season in late June then fell sharply. A smaller peak appeared in mid to late August, after which numbers remained low but relatively constant through the beginning of November.

Chemical Control/New Products

Biology and Management of Gill's Mealybug, *Ferrisia gilli*, an Emerging Mealybug Pest of Wine Grapes in California's Sierra Foothills.

Lynn R. Wunderlich and Kent M. Daane
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Keywords: Gill's mealybug, *Ferrisia gilli*, buprofezin, Applaud, acetamiprid, Assail®, spirotetramat, Movento™

Abstract: The seasonal biology of Gill's mealybug, *Ferrisia gilli* (Gullan), a new pest of California wine grapes in the Sierra foothill region, was studied in Sierra foothill vineyards for two seasons. Untreated vines in each vineyard were non-destructively sampled bi-weekly to determine the location of the mealybugs, their age structure and density. In 2009, insecticide trials were conducted to determine efficacy of buprofezin (Applaud), acetamiprid (Assail®), and spirotetramat (Movento™) as compared to an untreated check. Near harvest, mealybug densities within clusters were recorded and cluster damage ratings were made. Mummified mealybugs were collected and parasitoids reared for identification. Results from the biology studies and insecticide trials will be presented.

Chemical Control/New Products

Evaluation of Miticides on Sweet Cherry in California

Michael A. Devencenzi

Devencenzi Ag Pest Management & Research, Woodbridge, CA

Keywords: Omite® 30WS, propargite, Acramite® 50WS, bifenthrin, Envidor® 2SC, spiromdiclofen, Zeal®, etoxazole, Apollo®, clofentezine, Onager®, hexythiazox, Actara®, thiamethoxam, neonicotinoids, Warrior®, lambda-cyhalothrin, pyrethroids, Pacific spider mite, *Tetranychus pacificus*, Twospotted spider mite, *Tetranychus urticae*, Superior oil, chemical control, insecticide, miticide, leafhopper, vector, Cherry Buckskin, sweet cherry

Abstract: Mites have been an increasing challenge due to the disruptive nature of the insecticides that are used for vector management to suppress Cherry Buckskin in San Joaquin County. This trial evaluates the efficacy of some of the available miticides currently registered in California on mites affecting sweet cherry (cherry). There are usually three leafhopper applications of either neonicotinoids such as Actara® or pyrethroids such as Warrior® applied monthly starting after harvest. It is not uncommon to make two applications of miticides during the summer on cherry in San Joaquin County.

This trial was replicated and randomized, 15 trees per replicate, four replicates, with the center tree(s) being used for sampling. All applications were applied at 200 gpa with a Rears air blast sprayer calibrated at 2.5 mph. The orchard site has a history of mite problems; both Twospotted and Pacific mites were very present in this orchard.

Actara® was applied as soon as possible after harvest for leafhopper management. A month later a second leafhopper application was made with Warrior®. Added to it was Acramite®, Apollo®, Zeal® (high and low rate), Envidor®, or Onager®. Superior oil was added to all treatments at a rate of 2 gals / 200 gpa. The oil was included to knock down motiles and adults. The untreated check (UTC) was treated with Warrior® alone, no oil. Mite counts were taken the day prior to the miticide applications for a pre-application count to set population levels prior to treatment. Follow up mite counts were made on a weekly basis up to 27 DAT. "Leaf Collection, Brushing, Pest Counting, and Calculation of Results For Research Samples", (Britt, 2002), was used as the SOP for the collection, brushing, and the counting of mites from the trial.

Control was statistically the same or very similar for all treatments at 7, 15, and 21 DAT; all treatments were better than the UTC. Short of one month after treatment we saw the Acramite®, low dose Zeal®, and Apollo® treatments weaken. The Envidor®, high dose Zeal®, and Onager® held well into the end of the month. A statistical analysis of the overall performance of the treatments resulted in all treatments controlling the mite population better than the UTC. The overall performance of the low dose Zeal®, Acramite®, and Apollo® treatments indicated that they had a harder time managing the mites as compared to the high dose Zeal®, Envidor®, and Onager® which brought down the populations in the beginning and kept them that way into the end of the month.

Chemical Control/New Products

Materials and Methods for Control of Cherry Fruit Fly

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

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

Abstract: Products included in this project during the 2009 trials included imidacloprid (Provado® Pro 192 SC), spinetoram (Delegate®), tolfenpyrad (NAI-2302), Voliam Xpress® (20% Lamnda-cyhalothrin, 20% chlorantraniliprole), Voliam Flexi™ (20% thiamethoxam, 20% chlorantraniliprole), pyriproxifen (Esteem®), and GF-120 NF Bait. All products, rates and timings were tested under pest pressure conditions far in excess of those existing in commercial orchards.

Product in Trials and Rate/A	Years in Trial	Total Trees / Total Sites	Total Fruit Inspected	Total Larvae Found	Larvae Per 1000 Fruit
Untreated Checks, past yrs.	1997-08	24 sites	18,315	8,304	453
Current Untreated Checks	2009	2 trees 2 sites	2,000	1,528	764
Provado® 3 - 6 fl.oz. (imidacloprid)	7 years of trials	72 trees 38 sites	36,600	1	0.027
Provado® Pro 4 fl.oz. (imidacloprid)	2009	5 trees 5 sites	5,000	0	0
NAI-2302 17 fl.oz. (tolfenpyrad) <i>10 day intervals</i>	2009	4 trees 4 sites	4,000	2	0.50
NAI-2302 21 fl.oz. <i>10 day intervals</i>	2009	5 trees 5 sites	5,000	0	0
Delegate® 3 or 4 oz. <i>(10 day interval)</i>	4 years of trials	23 trees 22 sites	23,000	0	0
Delegate® 4.5 oz. <i>14 day intervals</i>	2008	3 trees 3 sites	3,000	0	0
Delegate® 3 oz. <i>14 day intervals</i>	2009	4 trees 4 sites	4,000	19	4.75
Esteem® 5 oz. <i>10 day intervals</i>	2008 2009	6 trees 6 sites	6,000	20	3.33
Voliam Flexi™ 7 oz. <i>10 day intervals</i>	2009	6 trees 6 sites	6,000	21	3.50
Voliam Xpress™ 12 fl.oz. <i>10 day intervals</i>	2009	5 trees 5 sites	5,000	0	0
GF-120NF Bait - 20 fl.oz. (every 7 days)	8 years of trials	134 trees 57 sites	52,400	2	0.038

Summary 2009 results of Cherry Fruit Fly control efficacy trials, with other related data.

Chemical Control/New Products

Chemical Control of Walnut Husk Fly in English Walnuts

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²University of California, Department of ESPM, Berkeley, CA

Keywords: Assail®, acetamiprid, Dyne-Amic®, nonionic organosilicone surfactant, modified vegetable oil, Nu-Lure® Insect Bait, hydrolyzed corn gluten meal, HGW86, Altacor®, chlorantraniliprole, Delegate®, spinetoram, Provado®, imidacloprid, walnut husk fly, *Rhagoletis completa* Cresson, chemical control, insecticide, walnut, *Juglans regia* L.

Abstract: The efficacy of several reduced risk insecticides for the control of walnut husk fly was evaluated in a 'Hartley' walnut orchard near Hollister, CA. Twelve single-tree treatments were replicated four times in a RCB design. Materials were applied with a hand-held orchard sprayer (250 gal/acre) at July 21, August 14 and September 3. Evaluations of walnut husk fly infestation were conducted September 11 and 29. Excellent control was achieved with Assail® (8.0 and 6.4 oz rates) + Dyne-Amic®, Assail® (6.4 and 4.0 oz rates) + Dyne-Amic® + Nu-Lure®, and Provado® + Dyne-Amic® + Nu-Lure®. These treatments were significantly different than the other treatments and the treated check (Dyne-Amic® + Nu-Lure®). HGW86 + Dyne-Amic® + Nu-Lure® was not significantly different than Assail® and Provado® but was numerically higher. HGW-86, HGW86 + Dyne-Amic®, Altacor® + Dyne-Amic®, Altacor® + Nu-Lure® and Delegate® + Dyne-Amic® + Nu-Lure® were not significantly different from the treated check. Thus, Assail® + Dyne-Amic® (all rates with or without Nu-Lure®) and Provado® + Dyne-Amic® + Nu-Lure® provide excellent control of walnut husk fly. HGW86 (except possibly HGW86 + Dyne-Amic® + Nu-Lure®), Altacor® and Delegate® do not provide adequate control of walnut husk fly regardless of the inclusion or absence of Dyne-Amic® or Nu-Lure®. Delegate® is highly toxic to walnut husk flies in the lab but not in field studies conducted in 2008 and 2009 possibly due to the slow insecticidal activity of the product.

BIOLOGY/PHENOLOGY—

ART AGNELLO, MODERATOR

Notes

Biology/Phenology

Developing Monitoring Methods for Spotted Wing *Drosophila* in California Cherries

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Keywords: *Drosophila suzukii*, spotted wing drosophila, cherry, monitoring

Abstract: The larva of the spotted wing drosophila, *Drosophila suzukii*, was first found in California cherries during the 2009 harvest season. This is a new pest to California and little is known about its biology and management. Several different traps types and bait materials were evaluated in cherry orchards in the No. San Joaquin Valley of California to develop a practical field monitoring system for this new pest. A commercial, white-bottomed bucket trap baited with apple cider vinegar was the most promising combination. The addition of yeast increased the catch of *D. suzukii* but also of other non-target species and reduced bait clarity, which made traps difficult to read in the field. Screening the trap entry with 1/8" hardware cloth reduced the catch of some of the larger non-target insects. Additional work is planned in the upcoming season to develop an attractant more specific to this pest and a trap more convenient for field monitoring.

Biology/Phenology

First Report in the United States of European Grapevine Moth, *Lobesia botrana* (Lepidoptera: Tortricidae) in Napa Valley Vineyards

Lucia G. Varela

University of California Cooperative Extension and Statewide IPM Program, Santa Rosa, CA

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

Abstract: *Lobesia botrana* (Denis & Schiffermüller), European grapevine moth, has recently been found for the first time in the United States in vineyards in Napa Valley, California. This moth belongs to the family Tortricidae, sub-family Olethreutinae. Unlike other tortricid moths that are grapevine pests, European grapevine moth larvae do not roll or feed on leaves — they feed on flower parts and inside the berries. *L. botrana* is native to southern Italy; it was first described from Austria and is now found throughout Europe, North and West Africa, the Middle East, and eastern Russia. It was more recently introduced into Japan, and in 2008, it was first reported in Chile.

In mid-September 2009, the first report of the European grapevine moth in North America was confirmed in Napa County, CA. Based on available data at the end of 2009, geographic distribution within the state of California is considered to be limited to Napa County. The original find and the greatest number of confirmed specimens were collected between Oakville and Rutherford, in about a 3 square mile area. An isolated population was also found 10 miles south of the original find, east of the town of Napa. Full delimiting has not taken place. By the time the first determination was made, the majority of the population was in diapause in the pupal stage. Trapping for delimitation will take place in the spring.

Biology/Phenology

**Status of Light Brown Apple Moth,
Epiphyas postvittana (Lepidoptera: Tortricidae) in California**

Lucia G. Varela

University of California Cooperative Extension and Statewide IPM Program, Santa Rosa, CA

Keywords: Light brown apple moth, *Epiphyas postvittana*, exotic pest, grape, apple, tortricid, leafroller

Abstract: Light brown apple moth, native to Australia, was confirmed in California in March of 2007. It is a tortricid leafroller with a broad range of hosts, including herbaceous plants, native plants, ornamental trees, and shrubs and fruit crops. It is now established in New Zealand, New Caledonia, the British Isles, and Hawaii. This leafroller is predominantly a foliage feeder. In Australia and New Zealand, it is a major pest of pome and berry fruit and a minor pest of grapes, citrus, stone and kiwi fruit. In 2007, California and U.S. federal agencies issued quarantine orders restricting intra- and interstate shipments of plant material from infested counties. In California, light brown apple moth has been detected on agricultural lands mostly in production and retail nurseries located near urban areas. Currently the brunt of the economic cost is borne by the nursery industry in the most infested counties. As of December of 2009, light brown apple moth has been detected in 18 counties from Los Angeles in the south, to Sonoma County in the north. The majority of the finds are in coastal counties; however, moths have been trapped in the Central Valley. The highest infestations are in Santa Cruz and San Francisco Counties.

Biology/Phenology

Status of Apple Maggot in Washington State

Michael W. Klaus

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Keywords: Apple maggot, *Rhagoletis pomonella*, mating disruption, pest free areas, organophosphate insecticides, horticultural pest and disease boards

Abstract: The Washington State Department of Agriculture (WSDA) has conducted surveys for various fruit flies since 1980. Based on survey results from 1980 – 2009, all of western Washington is now considered infested with apple maggot (AM). A monitoring and detection program for AM remains necessary for Washington growers to be able to ship fresh apples to various domestic and foreign markets. Changes in IPM practices with emphasis on mating disruption and the loss of several organophosphate insecticides may increase the risk of AM infestation of commercial fruit in areas where AM occurs.

The objectives of the 2009 AM Survey were:

1. To determine which areas of Washington meet the official pest free areas designation, as defined by the North American Plant Protection Organization (NAPPO, 1994).
2. To conduct certification monitoring in or around commercial orchards, as required to determine which growers could meet regulations for shipping fresh apples out of the AM quarantined areas of Washington.
3. Implementation of the Apple Maggot Detection Response Plan – a plan intended to prevent the establishment of AM.

Materials and Methods: WSDA monitored for AM from June 19 through September 30 using standard AM Yellow panel sticky traps baited with ammonium bicarbonate lures. Traps were checked every two to four weeks and were changed at least every four weeks. Trap deployment focused on noncommercial residential host trees in populated areas, abandoned apple orchards and wild, roadside host trees. Major host trees included apple, crabapple, ornamental and native hawthorn.

Results and Discussion: The 2009 AM survey included 9,422 trap sites. Table 1 lists the 2009 survey trap totals and results. There were several significant detections of AM in 2009 including Ellensburg, Yakima and Ephrata. These catches prompted the implementation of the Apple Maggot Detection Response Plan. The AM Detection Response Plan includes high-density trap placement around recent detection sites in cooperation with local Horticultural Pest and Disease Board AM control efforts.

Table 1. 2009 Apple Maggot Trap Placement and Catch Summary

County	# of Trap Sites	# of AM	# of Catch Sites
Adams	27	0	0
Benton	376	1	1
Chelan	607	1	1
Douglas	104	0	0
Franklin	147	1	1
Grant	183	3	2
Kittitas	3,044	85	76
Klickitat	6	0	0
Okanogan	517	0	0
Skagit	137	25	18
Spokane	26	8	6
Walla Walla	395	0	0
Yakima	3,853	19	19
Totals	9,422	143	124

Biology/Phenology

**Chumming for Predators:
A New Method for Measuring Natural Enemy Abundance, Diversity, and Phenology**

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Keywords: apple, attractant, HIPV, lure, monitoring, phenology, diversity, predator, parasitoid, natural enemy, Syrphidae, Hemiptera, Hymenoptera, trap, geraniol, 2-phenylethanol, methyl salicylate

Abstract: Trapping with herbivore-induced plant volatiles (HIPVs) represents an efficient new method for measuring natural enemy diversity, abundance, and phenology. “Cocktails” of HIPVs that attract very high numbers of many insect groups were assembled. When deployed as baits in standard delta traps, thousands of specimens can be captured, identified, and tallied in a given week. In 2009, 160 traps were deployed across four orchards (40/orchard), testing various lure blends from late May through early October. To-date, over 20,000 specimens have been tallied representing at least 80 distinct taxa. Numerically, lacewings and parasitic Hymenoptera dominated trap-catch, though thousands of syrphids and predatory Hemiptera were also caught. These data provide useful assessments of the phenology of some of the most abundant natural enemies. Interestingly, the bulk of the trap-catch derived from two very similar lure blends. To discern whether certain components of the “best blend” were more attractive to particular insect groups, an experiment was designed to assay the independent and interactive effects of the blend’s three components (geraniol, 2-phenylethanol, and methyl salicylate). Findings suggest that sensitivity to these compounds was specific to each insect group—lacewings and parasitic Hymenoptera were interested primarily in the 2-phenylethanol and methyl salicylate blend; syrphids favored the blend of geraniol and 2-phenylethanol; predatory Hemiptera were most attracted to the blend of all three compounds.

Biology/Phenology

Thousand Cankers: An Insect-Vectored Disease of Walnut: Status in California

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Keywords: *Pityophthorus juglandis*, walnut twig beetle, thousand cankers, *Geosmithia* sp., black walnut, English walnut, *Juglans* sp., seedling Paradox hybrid walnut rootstock

Abstract: Many trees of several black walnut species (*Juglans* spp.) have died recently in the western U.S. from an insect-vectored disease called thousand cankers. The disease is spread from attacks by the walnut twig beetle (WTB), *Pityophthorus juglandis* with subsequent canker formation in the phloem. The main fungus associated with the cankers is a species of *Geosmithia*, which develops around beetle galleries. Trees usually die within three years of initial symptoms that include upper crown yellowing and dark bark staining. Thousand cankers disease was first confirmed in California in June 2008 in Yolo County. The beetle-fungus complex has been confirmed in many counties on four black walnut species, English walnut, and/or seedling Paradox hybrid walnut rootstock. English walnut planted for commercial nut production does not appear to be a preferred host for the beetle. WTB is a native bark beetle first collected in 1959 in Los Angeles County, but its association with *Geosmithia* in California has only recently been documented. Yellow Pherocon AM traps were used to monitor WTB flight from April-November, 2009 in Sutter County. WTB was first trapped in mid-April and its flight peaked in July and August. An ambrosia beetle, *Xyleborinus saxeseni*, was also trapped. WTB adults and larvae were found in the trunk of a dying black walnut tree in early April, indicating that they overwintered at this site.

MATING DISRUPTION/SIR—

CHRIS NOBBS, MODERATOR

Notes

Mating Disruption/SIR

**Pheromones and Other Semiochemicals in New Zealand Orchards:
From Discovery to Application**

David Maxwell Suckling¹, Ashraf M. El-Sayed¹, P. Lo², V. Bell² and James T.S. Walker²
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¹Christchurch, New Zealand² Havelock North, New Zealand

Keywords: Pheromones, semiochemicals, IPM, New Zealand, Tortricidae, apple leafcurling midge, mealybugs, thrips, residue-free

Abstract: Pheromone trapping-based thresholds and mating disruption of codling moth, Oriental fruit moth and several leafrollers including lightbrown apple moth, greenheaded and brownheaded leafrollers, are making an increasingly valuable contribution to fruit exports from New Zealand, a process that has been building for some years. Our recent development of a single polyethylene tubing dispenser for disruption of multiple leafroller species was based largely on existing knowledge and is an example of increasing grower adoption by targeting application efficiency and costs. However, it is clear that recent advances in pheromone developments for other pests such as mealybugs, thrips and cecidomyiid midges will require quite different approaches from the Lepidoptera for their development into pheromone-based monitoring and control systems. This talk will examine current efforts in New Zealand to manage these pests in new ways, with the goal of producing residue-free fruit.

Mating Disruption/SIR

**Sixteen-Years of Experience with Codling Moth SIT in British Columbia:
The Experiments Continue**

Gary Judd

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Summerland, British Columbia, Canada

Keywords: codling moth, *Cydia pomonella*, area-wide pest management, sterile insect technique, targeted SIT

Abstract: Over the past fifteen years, area-wide programs to control codling moth (CM), *Cydia pomonella*, have transformed IPM of pome fruits in western North America. Only in Canada was this new paradigm founded on sterile insect technology (SIT). In British Columbia (BC), Canadians have developed the largest area-wide program in horticulture, world-wide, and longest-running, most successful application of area-wide techniques for control of CM, anywhere. In 2009, 37.4% of the total acreage was apparently free of CM and fewer than 10 wild moths were caught per season (1 trap / 2.5 acres) on 84.5% of the acreage. Certifying and sustaining these **Areas of Low Pest Prevalence**, to open, or maintain access to certain markets, has become a key initiative of industry. Originally piloted in 2001-03, the SIR Program is now experimenting with an area-wide program that involves intensive pheromone trapping (1/acre) and targeted release of sterile moths only when and where needed. Results from 2009 trials on over 1200 planted acres of apple and pear in the Similkameen Valley, revealed that 80% of the acreage was free of CM, and targeted wild detections showed no increases across generations. Initial observations suggest the targeted approach is operationally feasible, and more economical, than general application of low-level SIT or MD in this context. If this approach proves biologically successful it may soon provide the program with excess rearing and irradiation capacity that it hopes to use in different ways and potentially market as part of an overall commercialization strategy.

Mating Disruption/SIR

**Understanding Mating Disruption by Aerosol Puffers:
Trap Suppression, Mating Delay and Mating Finding**

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University of California, Berkeley, CA

Keywords: mating disruption, codlemone, sex pheromone, mating success, trap suppression, pear, codling moth, *Cydia pomonella*

Abstract: Mating disruption implementation by means of aerosol dispensers (puffers) is successfully used for the control of a range of pest in different crops. However, little is known about the actual mechanisms underlying the success of this technique. With the aim of improving the understanding of puffer performance, an assay was conducted in summer 2009 in an abandoned pear orchard, ca. 17 acres, at Fremont, CA. Fifty-three codlemone-baited and 40 codling moth-female-baited traps were distributed through the orchard following a fairly regular pattern, and a single puffer of codlemone was placed at the upwind end of the orchard. Traps were checked daily for eight to 11 days, at different times of the season with and without puffer, and the number of codling moth males captured was recorded. The puffer totally suppressed male captures in codlemone-baited traps in a large area, about 250 ft in width and 900 ft in length following the wind transect. This area was larger for the female-baited traps. Moreover, captures in the rest of the orchard were always higher in codlemone than in female-baited traps. Surrounding the capture-free area, there was a transition boundary where captures occurred, but the time to the first capture was delayed and the proportion of nights with captures was lower than in the area out of the puffer plume. Puffers may have not only an effect on mating reduction, but also on reproductive success.

Mating Disruption/SIR

Continued Testing of Meso-emitters for Pheromone Mating Disruption of Codling Moth

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

Abstract: The need to find effective, more cost-effective, alternatives in mating disruption continues to provide the impetus to look at lower number of emitters per acre so as to reduce application costs and ease application in large tree canopies, e.g. walnuts. "Meso-emitters" are defined as dispensers targeting intermediate pheromone emission rates between traditional hand-applied units and aerosol puffer emitters. Two meso emitters currently being evaluated are a modified membrane dispenser by Suterra and a ring of uncut Isomate® dispensers in both pears and walnuts. Treatments were replicated as 20 acre blocks except untreated controls, which were ca. 5 acres. Program efficacy was evaluated by both trap and damage suppression. Traps were suppressed by >95% in all walnut plots while pheromone traps baited with 1X lures in the pear orchards experienced 85% or better suppression despite season totals of >300 moths in traps baited with combination lures (pear ester and pheromone). Damage levels were very low in almost all test plots such that differences were difficult to interpret and not statistically significant. Damage levels were approximately equal in all commercial orchards treated with either the traditional or meso treated plots. Within one pear orchard with two replicates of meso membranes (20 acre reps), two Checkmate plots (20 acres) and two untreated controls, codling moth produced in 1.2, 2.7, and 7.6% damage at harvest, respectively. Finding commercial orchards with sufficient codling moth pressure continues to remain elusive.

Mating Disruption/SIR

**Five Years of Improved Disruption of Female Codling Moth Communication
with the Cidetrak™ CM-DA Combo Dispenser**

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¹USDA, ARS, Wapato, WA, ²Trece, Inc., Adair, OK

Keywords: Mating disruption, *Cydia pomonella*, kairomone

Abstract: Laboratory studies using a piezoelectric sprayer demonstrated that the addition of pear ester improves the orientation of male codling moth to sex pheromone sources. Thus, the use of pear ester plus sex pheromone may increase the importance of competitive attraction as a primary mechanism for mating disruption with this species. A variety of studies over the past five years have examined the effectiveness of a Cidetrak™ dispenser loaded with various blends of sex pheromone and pear ester (Combo) to disrupt virgin female-baited traps. These Combo dispensers have been compared to similar dispensers and to Isomate® dispensers loaded with only sex pheromone. Results from these trials have consistently shown that the Combo dispensers are more effective in reducing male catch in female-baited traps. In contrast, male catch in traps baited with a synthetic sex pheromone lure have not differed between Combo and pheromone dispensers.

Mating Disruption/SIR

Moving Beyond Mating Disruption of Codling Moth: A British Columbia Perspective

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Summerland, British Columbia, Canada

Keywords: mating disruption, codling moth, leafrollers, eye-spotted budmoth, *Archips argyrospilus*, *Archips rosanus*, *Choristoneura rosaceana*, *Cydia pomonella*, *Pandemis limitata*, *Spilonota ocellana*

Abstract: Under area-wide management, populations of codling moth in British Columbia (1994-2009) have been reduced to extremely low levels. In 2009, 37.4% of the acreage was free of codling moth and fewer than 10 wild moths were caught per season (1 trap / 2.5 acres) on 84.5% of the acreage. Maintaining these levels with area-wide mating disruption is relatively straightforward, so the challenge has become adding value to this pheromone treatment by making it applicable to multiple species. In 2009, three 100+acre multi-year pilot projects were established to test and compare the efficacy of Isomate®-CM Flex 80, Isomate®-CM/LR and Isomate®-CM/LR/ESBM as codling moth treatments, but with each targeting increasing numbers of pest species (1, 5, and 6, respectively). In this first-year summary pheromone release-rate characteristics of each dispenser type and levels of disruption achieved in up to six tortricid species are compared. Overall, the CM/LR/ESBM twin-tube dispenser released the highest amounts of pheromone, regardless of the component measured, and resulted in the highest levels of disruption, averaging 92% across all species. All dispensers appeared to perform similarly against codling moth but disruption of secondary species as measured by trap catches ranged from a low of 69% for *Archips rosanus* with CM/LR to a high of 98% for *Spilonota ocellana* with CM/LR/ESBM. Studies were augmented by delivering sterile codling moths to each pheromone-treated plot enabling a unique comparison of sterile:wild ratios, rates of recapture and disruption of equivalent populations of codling moth as dispensers aged. In these controlled comparisons CM Flex 80 appeared to out perform the other dispensers.

Mating Disruption/SIR

**Versatile Application of SPLAT for Mating Disruption
and Attract & Kill Programs in Agricultural and Urban Environments**

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ISCA Technologies, Inc. Riverside California

Keywords: SPLAT, semiochemical, pheromone, attract & kill, mating disruption, application

Abstract: SPLAT (Specialized Pheromone and Lure Application Technology) is a biologically inert matrix for the sustained release of semiochemicals and/or pesticides. The benefits of using SPLAT as a delivery system for attract and kill formulations include the timed release of the pheromone and insecticide from discrete point sources instead of complete coverage applications. SPLAT can be combined with low dose pyrethroids and spinosyns to achieve specific killing action against a variety of pests that are typically targeted with mating disruption programs. Due to its amorphous and flowable quality, SPLAT offers some of the most flexible methods of application of long lasting pheromone formulations; easily accommodating a variety of application methods ranging from manual applicators including the SPLAT Flicker Gun and Metered Dosing Gun for precise applications, to automated ground applicators which allow for rapid coverage of large fields, to aerial application for large scale, region-wide treatment.

Mating Disruption/SIR

**Improve Hand-Applied Dispenser Mating Disruption Systems
for Codling Moth by Determining an Optimized Dispenser Release Rate**

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²Washington State University, Wenatchee WA

Keywords: *Cydia pomonella*, codling moth, mating disruption, pheromone, release rate

Abstract: For mating disruption operating by competitive attraction, improving the efficacy of dispensers might be achieved by increasing: dispenser density, dispenser findability, or disruption time. Findability and disruption time are already high for commercial products as currently used. Current economics do not permit raising dispenser density unless the release rate of pheromone per dispenser could be reduced. This question was investigated using codling moth. Six pheromone dosages (0.1mg, 1.0 mg, 5 mg, 10mg, 20 mg applied to red septa attached to bread clips and Isomate® CM) releasing between 0.015 ug/h and 6 ug/h (E,E)-8, 10-dodecadienol were evaluated in small field plots in Washington and large-cage plots in Michigan. Washington plots (0.08ac) consisted of 20 trees separated by at least 30 m and relied on feral males. Michigan experiments were set up similarly except for use of large-cage plots (19m x 19m x 3.3m) consisting of 12 trees (0.08 ac) and lab-reared CM. In all cases dispenser density was equivalent to 200/acre. Equivalent disruption at about 70% was realized for the two highest septa loads while lower-releasing septa disrupted less well. Although not statistically significant, Isomate® CM disrupted moth catch slightly better than any septum; however, its release rate and its size was greater than any septum. More research is justified to further support our tentative conclusion that the rate of codlemone release per dispenser might be lowered without overall loss in efficacy. Savings from such an adjustment could be used to increase dispenser density or reduce product cost.

Mating Disruption/SIR

Mobile Mating Disruption of Light Brown Apple Moth Using Sterile Medflies

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Keywords: Mating disruption, sex pheromone, *Epiphyas postvittana*, Mediterranean fruit fly, sprayable, E11-tetradecenyl acetate

Abstract: Aerial application of pheromones for mating disruption was forestalled in the \$74.5 million eradication programme targeting light brown apple moth in urban California in 2008. Low social acceptability of interventions using conventional pest management tactics warrants development of new tactics for urban compared with rural environments. The novel concept of insect suppression using cross species or “mobile” mating disruption, with living insects dispensing pheromone of another species, is demonstrated for the first time using sterile male Mediterranean fruit flies (*Ceratitis capitata*) to attract and disrupt mate location by male light brown apple moth (*Epiphyas postvittana*) in the field, by mimicking female moths. We are examining the concept using fly-moth and moth-moth models, targeting the case of light brown apple moth where this concept might be used first, if cost-effective. Field trial results from Christchurch, New Zealand and Perth, Australia will be presented. A sustained twice-weekly release program over a larger area is now needed to evaluate the population reduction potential of this new tactic.

Mating Disruption/SIR

The Need for Appropriate Controls in Evaluating the Efficacy of Mating Disruption

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Michigan State University, East Lansing, MI

Keywords: *Cydia pomonella*, mating disruption, untreated, experimental design

Abstract: The requirement of large areas to evaluate the efficacy of mating disruption is an inherent challenge to the inclusion of control plots. However, the failure to do so limits the conclusions that can be drawn from the results of mating disruption field experiments. Here we examine the unsubstantiated conclusions that can be drawn when an investigator fails to include appropriate controls. The most obvious treatment that must be included is a check that is not treated with pheromone. In the absence of this negative control, the investigator is unjustified in drawing any conclusions as to the level of disruption provided by a pheromone treatment. Capturing few moths and the absence of larval infestation in pheromone treated plots could be due to an effective treatment or to low starting pest densities. A mean seasonal catch of only 2 moths / trap in plots receiving a mating disruption treatment could have resulted from 90, 66 or 0% disruption depending on whether the mean catch in an untreated check, if included, had been 20, 6, or 2 moths / trap. The mode of operation of mating disruption treatments is often multifaceted, and in these cases a positive control is required to attribute treatment effects to one operational factor relative to another. For example, an attract-and-kill formulation operates via the disruptive effect of the pheromone and the killing action of the toxicant. Attributing experimental results to one or the other actions requires including a formulation with only a single operational factor, such as a formulation with the same pheromone release, but excluding the toxicant, as a positive control. Here we examine three additional types of multi-operational disruption treatments that require positive controls for valid interpretation of the results: 1) the auto-confusion approach entailing both direct and indirect disruptive effects, 2) the combined treatment of orchard borders with reservoir dispensers and the interior with low density / high emission devices, and 3) and meso- or very high-emission disruption formulations that attempt to compensate for a low application density by releasing high amounts of pheromone. In order to demonstrate the compensatory effect, field experiments should include a positive control comprised of a standard disruption formulation with a moderate release rate applied at the same low density as the high-release formulation.

Mating Disruption/SIR

**Evaluating Insect Behavior in the Field
with Home Security Recording Systems**

Jay F. Brunner and Mike Doerr

Washington State University, Tree Fruit Research and Extension Center, Wenatchee, WA

Keywords: codling moth, *Cydia pomonella*, behavior, video camera, recording systems

Abstract: Behavior of insects in the laboratory, for instance in wind tunnels, is often used to draw inferences about behavior in the field. This is in part because observing behavior in the field is so challenging. Using inexpensive home security recording systems with night vision technology the behavior of codling moth, *Cydia pomonella* (L.), was evaluated under field conditions. These recording systems cost less than \$500 and include a digital video recorder (DVR), four or more cameras, cabling, and software. The recording systems were made portable by using deep cycle batteries and DC-to-AC power inverters. Video recordings were screened in the laboratory by a trained technician and clips containing activity of interest were saved for detailed assessment of behavior. Data available from recordings include the time of activity, number of approaches over time, duration of approaches, and proportion of approaches resulting in contact with an attractant source. Because multiple cameras can be operated at the same time comparative behavior to different treatments (attractants) can be captured under the same environmental conditions and replicated over time. Some data on the relative attraction of codling moth adults to pheromone sources will be discussed as well as challenges and limitations associated with these recording systems.

Mating Disruption/SIR

**From Tree Cages to Plumes –
Can We Optimize Mating Disruption for Navel Orangeworm?**

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

Keywords: *Amyelois transitella*, navel orangeworm, mating disruption, pheromone, caged tree, almond, plumes

Abstract: Research on the use of mating disruption (MD) for navel orangeworm (NOW), *Amyelois transitella*, control has demonstrated that significant damage reduction can be achieved in both large scale area-wide settings and in smaller 50-150 ac plots, using the major female sex pheromone component, ((Z,Z)-11,13-hexadecadienal)), dispensed from low density, high emission devices (puffers). This technique is now available and used commercially with positive results. With the relatively recent discovery of several minor components, enhancing the impact of MD on NOW control by using a more complete blend is a possibility. The field cage assay developed by Eric Doye and Uwe Koch for comparing MD treatments may provide an efficient and definitive approach to the question of relative levels of disruption attained by the major component vs. a complete blend. Our efforts to adapt this assay to NOW in almonds resulted in unexpected outcomes that led us to investigate the behavior of the moths and plume dynamics in an almond orchard. Our findings and proposed experimental approaches will be discussed.

Mating Disruption/SIR

Implementation of Oriental Fruit Moth Mating Disruption in Canning Peach Orchards in the Northern San Joaquin Valley, California

Marshall W. Johnson, Hannah Nadel, and Walter Bentley
Department of Entomology, University of California, Riverside, CA

Keywords: Oriental fruit moth, mating disruption, cling peach, pheromone, implementation, low risk products, pest management, *Grapholita molesta*, *Macrocentrus ancylivorus*, natural enemy conservation, sunflower, sunflower moth, *Homoeosoma electellum*

Abstract: To reduce reliance on FQPA Priority I insecticides and synthetic pyrethroids in the production of cling peaches used for canning purposes; integrated pest management (IPM) techniques were implemented and demonstrated in late-harvested canning peach orchards in northern San Joaquin Valley, California. The main management tool for Oriental fruit moth (OFM) control was mating disruption via pheromone dispensers hung in orchards. To further reduce reliance on pyrethroids in late-season peaches, biological control of OFM was enhanced through habitat management by plantings of sunflowers along IPM blocks to provide overwintering and breeding habitat for the biological control agent, *Macrocentrus ancylivorus*. The sunflower moth, *Homoeosoma electellum*, provided an overwintering host for *M. ancylivorus*. Pests and beneficial arthropods within the orchards were monitored and compared across experimental blocks. Outreach on IPM and biological control was conducted to broaden awareness and hasten adoption of reduced-risk pest management in both canning- and fresh-market peaches.

Mating Disruption/SIR

Solving the Puzzle of Mating Disruption of Sessiid Borer Pests in Cherry, Peach and Apple Orchards in Michigan

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Department of Entomology, Michigan State University, East Lansing, MI

Keywords: Dogwood Borer (*Synanthedon scitula* [Harr.]), Peachtree Borer (*Synanthedon exitosa* [Say]), Lesser Peachtree Borer (*Synanthedon pictipes* [Grote and Robinson]), mating disruption, attract and remove

Abstract: Lure trials for Dogwood Borer (DWB) indicate moths are attracted to increasing amounts of pheromone, with Isomate[®]-DWB dispensers, 1mg lures without the antagonist, E,Z-3, 13-ODDA, and lures made with pheromone extracted from Isomate[®]-DWB and loaded into septa at 1, 10 and 20mg attracting significantly more males than commercial lures. Traps baited with 10 and 20mg lures and dispensers captured significantly higher moths than any 1mg lures. Video recordings of moth interactions with pheromone sources in disrupted and non-disrupted orchards show DWB, Lesser Peachtree Borer (LPTB) and Peachtree Borer (PTB) approach and contact dispensers and lures. All 3 sessiid species had significantly higher response rates to dispensers and high load lures than to 1 and 0.1mg lures. Dose response trials with Isomate[®]-DWB, Isomate[®]-PTB (ZZA), Isomate[®]-LPTB (EZA) and Isomate[®]-PTB Dual (EZA and ZZA) dispensers showed capture of male PTB, LPTB and DWB followed patterns consistent with competitive attraction. Isomate[®]-PTB Dual provided equal inhibition of male capture as equal numbers of PTB and LPTB dispensers placed individually. Examination of exuviae on trees showed no decrease in LPTB or PTB infestation from 2008 to 2009. DWB exuviae will be quantified in 2010. Preliminary results of attract and remove trials indicate high potential for deployment of this tactic for control of DWB.

Mating Disruption/SIR
POSTER

A Boring Problem for Virginia Vineyards: Mating Disruption for Grape Root Borer

Douglas G. Pfeiffer, Curt A. Laub, Timothy A. Jordan,
Anna K. Wallingford and Meredith Cassell
Virginia Tech, Department of Entomology, Blacksburg VA

Keywords: Mating disruption, pheromone, semiochemical, grape root borer, *Vitacea polistiformis*, Sesiidae, grape, vineyard

Abstract: Grape root borer has a long life cycle, with two years below ground in the larval state, complicating control studies. After an initial 3-year study in southwestern Virginia using 200 dispensers/acre, a second 3-year study using 100 dispensers/acre was carried out in three sites across Virginia. In 2009, pupal counts reflecting emergence of offspring of the first disrupted generation in the current study were made. Mating disruption provided a high level of control.

Mating Disruption / SIR
POSTER

**Analysis of Codling Moth Mating Disruption Dispensers
in a High-Elevation Northern Utah Apple Orchard**

Marion S. Murray and Diane G. Alston
Utah State University, Logan, UT

Keywords: codling moth, mating disruption, dispenser, analysis, Checkmate®, Isomate®-C plus, Isomate®-CTT, Cidetrak®

Abstract: Some apple growers in Utah have expressed concern for the longevity of certain hand-applied brands of mating disruption for codling moth, possibly due to greater UV exposure at higher elevations. The majority of commercial orchards in Utah are at 4500 – 6000 feet elevation. Ideally, dispensers should release enough pheromone consistently over the codling moths' seasonal flights (approximately 140-150 days in Utah) without pheromone depletion or dispenser degradation. The goal of this project was to report on the pheromone content and release rate of three commonly used brands and one new brand to Utah's tree fruit industry. Over a period of 140 days, field-aged dispensers were tested at various times to determine the amount of pheromone remaining (residual analysis) and amount of pheromone being released from each dispenser (volatile testing system). These tests were contracted out to labs at Michigan State University. All dispensers were still releasing pheromone and still contained pheromone by the end of the study; however, there were clear differences among the dispenser types. Isomate®-C plus and Isomate®-CTT dispensers emitted the greatest amount of pheromone over the course of field aging and maintained the most consistent release rate. The Checkmate® dispensers were not very efficient in their release of codlemone. They lost the greatest amount of pheromone over the course of the study, but were among the lowest in release rate, suggesting that pheromone was degrading from the dispensers rather than volatilizing into the air. The Cidetrak® dispensers had the lowest release rates for all testing dates.

IMPLEMENTATION—

LARRY HULL, MODERATOR

Notes

Implementation

Development and Validation of a “Real-Time” Apple IPM Website for New York

Arthur M. Agnello and W. Harvey Reissig
Cornell University, New York State Agricultural Experiment Station, Geneva, NY

Keywords: decision support system, degree-day models, apple maggot, *Rhagoletis pomonella*, oriental fruit moth, *Grapholita molesta*, codling moth, *Cydia pomonella*, plum curculio, *Conotrachelus nenuphar*, obliquebanded leafroller, *Choristoneura rosaceana*, spotted tentiform leafminer, *Phyllonorycter blancardella*

Abstract: A web-based, apple IPM decision support system was developed to facilitate pest management decisions. The system tracks seasonal development of insect pests using degree day (DD) developmental models. DD models and historical records are used to calculate: tree phenological stage, pest stage, status, and management advice. When a spray is recommended, a pesticide filter helps identify appropriate materials according to efficacy and type of management program. Predictions can be refined and adjusted by user-entered information obtained through field monitoring. Hyperlinks provide access to supplemental resources such as pest biology and development, sampling and monitoring methods, pesticide profiles and access to NYS labels of registered products. In 2009 we compared web predictions with population trends observed in the field at 16 NY farms, focusing on events such as first adult capture; start/peak/progress of oviposition or egg hatch; start/peak/end of flight period; first occurrence of adult or larval feeding, foliar or fruit damage, or mines. Main sources of error in the predictions were: 1) traps set out too late for accurate biofix; 2) trap check interval too long to precisely note flight trends; 3) target populations too low to verify predictions' accuracy; 4) some predictions based on limited historical data; 5) insufficient weather station coverage to give representative data.

Implementation

Virtual Weather Stations in DAS – First Analyses Indicate Sufficient Accuracy

Ute Chambers¹, Vincent P. Jones¹ and Gary Grove²

¹Washington State University, Tree Fruit Research and Extension Center, Wenatchee, WA

²Washington State University, Irrigated Agriculture Research and Extension Center, Prosser, WA

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

Abstract: The WSU Decision Aid System (DAS) relies primarily on WSU-AgWeather Net (AWN) data and forecasts for these AWN stations provided by the National Oceanic and Atmospheric Administration (NOAA). While AWN has 132 monitoring sites in Washington, there are still areas with substantial tree fruit production that are underserved based on distance and varied topography between the stations and production areas. The possibility of using “virtual weather stations” in DAS that are based on site-specific forecasts from NOAA (done on a 5 x 5 km grid) to fill in those underserved areas is currently being evaluated. For initial analyses, degree-day (DD) accumulations were calculated from AWN temperature data and from 1-day NOAA forecast data using codling moth (CM) parameters. Comparisons show a strong linear relationship between the DD accumulations from AWN and NOAA. However, slope and intercept varied resulting in considerable differences in projected % CM egg hatch between AWN and NOAA DD (3.2 days on average). Using linear regression, these deviations can be sufficiently corrected for IPM purposes (0.9 days). This suggests that virtual weather stations in DAS are possible. Longer-term validation of this concept (constancy of empirical relationships), especially in areas that are not covered by AWN, and its applicability for all other insect and disease models in DAS is necessary.

Implementation

Site Specific Management of Codling Moth Saves \$\$

Alan Knight ¹, Loys Hawkins ², Matt Borman & Kathleen McNamara ³, and Rick Hilton⁴

¹ USDA, ARS, Wapato, WA, ² Suterra LLC, Bend, OR, ³ Bear Creek Orchards, Inc., Medford, OR, and ⁴ Oregon State University, Medford OR

Keywords: Pear, organic, monitoring, codling moth, *Cydia pomonella*, precision agriculture

Abstract: The use of site specific management of codling moth was continued for a second year in pear orchards treated with a grid of aerosol puffers. The objective of this approach is to reduce total management costs by offsetting an incremental increase in monitoring costs with a significant drop in spray costs. During 2009, studies were conducted in three pear orchards situated in the Rogue Valley in southern Oregon. The density of monitoring traps baited with the combo pear ester and pheromone lure was increased from previous years to create specific management areas surrounding each trap. Action thresholds based on the cumulative captures of males and female moths were employed to recommend the use of supplemental insecticide sprays. Moth catches in traps exceeding these thresholds triggered sprays, which were applied only to the local management area surrounding the trap, or in some situations the area surrounding adjacent traps. Using this approach the codling moth control program costs were reduced 30 to 60%. The management overlap of codling moth and other key pests, i.e. pear psylla will be discussed. An overview of how growers can employ site specific management tools will be presented.

Implementation

**Evaluation of Management Programs for Pacific Spider Mite
in Almonds in the Southern San Joaquin Valley of California**

David R. Haviland¹, Bradley S. Higbee², and Stephanie M. Rill¹
University of California Cooperative Extension Kern Co, Bakersfield, CA
Paramount Farming Company, Bakersfield, CA

Keywords: IPM, integrated pest management, almond, chemical control, miticide, treatment threshold, Agri-Mek[®], abamectin, Zeal[®], etoxazole, Envidor[®], spiroadiclofen, Onager[®], hexythiazox, Fujimite[®], fenpyroximate, Pacific spider mite, *Tetranychus pacificus*

Abstract: Pacific spider mite is a significant pest of almonds in the lower San Joaquin Valley of California. If not managed properly, mite-induced defoliation can reduce both the quality and quantity of the almond crop. Growers have historically tried to prevent these losses through a two-spray program whereby abamectin is sprayed early in the season, often well before mites reach a University of California threshold, and a contact miticide is sprayed at hull split. These timings were primarily based on the need to use abamectin prior to leaf hardening in late May, the lack of effective miticides available in June, and the need to protect trees during harvest. Now, however, several newly registered miticides allow for effective treatments at any time of the year. As such this project was used to compare programs using 'preventative' abamectin treatments to those based on University thresholds. Results showed that both approaches can be very effective for season-long control of spider mites, and that one treatment per season, in combination with biological control organisms, can in certain cases be sufficient to control mites. The project also showed that University of California treatment thresholds can provide an effective measure for when miticide treatments do, and do not, need to be made.

Implementation
POSTER

Providing Individualized IPM Focus in an On-line Graduate Pest Management Course

Douglas G. Pfeiffer
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Keywords: IPM, education, training,

Abstract: The course Managing Arthropod Pests is a part of an online Masters in Agricultural and Life Sciences degree program, in Virginia Tech's College of Agriculture and Life Sciences. In order to allow students to focus work on a commodity of interest, a project is assigned where students adapt a series of general topic lectures to their commodity of choice. These installments are submitted and graded before commodities are covered in the course. Two advantages are provided: (1) students acquire expertise in greater detail than can be provided in this general course, and (2) since students explore IPM concepts, applying to applied situations early in the course, they are better prepared before commodity presentations begin.

Implementation
POSTER

Apple Pest Management Transition Project

Keith Granger, Jay Brunner, Nadine Lehrer, and Ute Chambers
WSU Tree Fruit Research and Extension Center, Wenatchee, WA

Keywords: Apple Pest Management Transition Project, PMTP, OP-alternative, IPM, codling moth, leafroller, Decision Aid System, DAS, pesticide safety, azinphos-methyl, Guthion, EPA phase-out

Abstract: For Washington's tree fruit growers to remain competitive in the global marketplace, they must produce high quality, pest-free fruit. To meet requirements imposed by domestic and international regulatory actions, apple and other tree fruit growers must successfully implement new integrated pest management (IPM) technologies. Since 1996 the U.S. Environmental Protection Agency (EPA) has significantly restricted use of organophosphate (OP) insecticides, the primary pest control technology used in tree fruit production. In 2007, the EPA acted to implement a complete phase-out of azinphosmethyl (AZM), the most important OP used to control the key pest of apple – codling moth, by 2012. In addition, many overseas markets are imposing similar, or even more stringent, regulations on commonly used pesticides, including AZM. IPM research has shown that employing a range of reduced-risk, OP-alternative insecticides can be as effective as older, OP-based, programs. However, a number of significant barriers have slowed the adoption of these new technologies. The reduced-risk chemistries tend to have lower efficacy, require more precise timing and spray coverage, have different modes of activity requiring different use patterns, and are more expensive than products they replace. Dynamic IPM programs based on new technologies require apple growers and crop consultants to have a greater understanding of pest biology, to integrate more information to manage pests, and to continuously upgrade their knowledge base.

The Apple Pest Management Transition Project (PMTP) will address the critical challenges imposed by increased regulatory action restricting or eliminating old pest control technologies by enhancing adoption of new technologies via an industry-wide implementation of biologically intensive IPM. The project will speed the adoption of new IPM technologies through educational programs and communication of research-based knowledge, improve real-time pest management decision-making through increased use of the web-based WSU Decision Aid System, as well as document and communicate changes in practices, attitudes, and perceptions of growers, IPM consultants, and farm workers.

THRESHOLDS/MONITORING—

STEVE WELTER, MODERATOR

Notes

Thresholds / Monitoring

Testing Web-Based Apple IPM Strategies

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

Keywords: Obliquebanded leafroller *Choristoneura rosaceana*, internal lepidoptera *Cydia pomonella* *Grapholitha molesta*, apple, sampling, Insect Development Models, IPM

Abstract: This study tested two different IPM protocols integrating information from the “Real Time” tree fruit IPM website in NY apple orchards. Tests were set up in 14 orchards in major NY apple production regions. Entomology department personnel monitored and sampled plots throughout the season. Growers applied pesticides based on monitoring results and web pest development predictions. In the Fruit Monitoring Protocol, growers applied normal sprays for insect control until plum curculio (PC) activity was over. Starting in late June, 1000 apples were monitored weekly for damage from internal lepidoptera (codling moth or oriental fruit moth) and obliquebanded leafroller (OBLR). Apple maggot (AM) traps were deployed in late July. Control sprays were recommended whenever treatment thresholds were reached (1 fruit damaged by either OBLR or internal lepidoptera; Avg. 5 AM/trap). In the Web-Optimized treatment Protocol, normal control sprays were also applied until PC activity was over. An initial summer spray was recommended based on web predictions of hatch of summer OBLR eggs and 2nd generation internal lepidoptera eggs (Delegate® or Altacor®). A second spray was recommended based on web predictions of AM activity and 2nd generation internal lepidoptera egg hatch (Delegate® or Altacor®). Growers would have applied an average of 2.0 and 1.1 summer sprays, respectively, in the Web-Based and Fruit Monitoring plots if they had followed recommendations. Fewer sprays were recommended in these plots than have been previously applied in NY apple orchards under traditional IPM programs (2-3 Avg. sprays). Harvest insect damage was similar in both protocols (2.9% Web-Based & 3.2% Fruit Monitoring).

Thresholds / Monitoring

**Unequal Trapping Area Challenges Trap Shutdown
as an Intuitive Measure of Mating Disruption**

Larry Gut, Peter McGhee, Matt Grieshop and James Miller
Michigan State University, East Lansing, MI

Keywords: *Cydia pomonella*, codling moth, mating disruption, pheromone, trapping space

Abstract: Experiments were conducted in 2008 and 2009 to determine the trapping area of a codling moth pheromone trap when placed in an apple orchard treated with mating disruption or in an orchard not treated with pheromone. The aim of the study was two-fold: 1) to investigate whether increasing the density of traps in a mating disruption plot improved one's ability to discern treatment effects, and 2) to determine the relative area sampled by traps placed in a disrupted *versus* a non-disrupted plot. The experiments entailed comparing moth catch in traps placed at a range of densities in pheromone and non-pheromone treated plots. The trapping densities were as follows: 1 trap/4.5ac, 9 traps/9ac, 9 traps/4.5 ac, 9 traps/0.5ac which corresponded respectively to: 1 trap/4.5ac, 1 trap/1ac, 1 trap/0.5 ac, 1 trap/ 1/12th ac. A large delta trap baited with an L2 lure was used in all studies. Mating disruption plots were treated with Isomate[®] reservoir dispensers applied at 300-350 per acre. An estimation of trapping area was based on whether traps interfered with catch when deployed at a particular density. The trapping area was found to be at least 10-fold smaller in a pheromone-treated compared to a non-pheromone treated orchard. Traps sampled less than 0.1 acre in a disrupted orchard and greater than 1 acre in the absence of a pheromone treatment. This large differential in trapping area challenges traps shutdown as an intuitive measure of mating disruption. Directly comparing average moth captures in pheromone versus non-pheromone treated plots, if both plots are sampled at the same trap density, is not a valid measure of mating disruption. The large differential in trapping area must be accounted for. If the difference in trapping area is 10-fold, then 10 times as many traps must be placed in plots with the reduced trapping area. Moreover, catches in the suite of traps must be summed rather than averaged.

Thresholds/Monitoring

**Effective Monitoring of Codling Moth without Sex Pheromone Lures
in Sex Pheromone-treated Orchards**

Alan Knight
USDA, ARS, Wapato, WA

Keywords: Apple, *Cydia pomonella*, mating disruption

Abstract: The relative performance of a clear delta trap baited with ethyl (*E,Z*)-2,4-decadienoate (pear ester, PE) and acetic acid (PE+AA) was compared with the standard use of an orange delta trap baited with pear ester and (*E,E*)-8,10-dodecadien-1-ol (codlemone) (PE+PH) for codling moth, *Cydia pomonella* (L.). Season-long studies were conducted in commercial apple *Malus domestica* (Borkhausen) orchards in Washington State treated either with (n = 6) or without (n = 7) sex pheromone dispensers for mating disruption (MD and non-MD). All orchards had resident pest populations. The mean weekly total moth catch was nearly identical for each trap-lure combination across the MD orchards. However, the clear trap baited with PE+AA caught 6.5-fold more females than the orange trap with PE+PH. Moth catch in the clear trap was 45% females compared with 7.0% in the orange trap. Moth catches in the clear trap baited with PE+AA were similar in the MD and non-MD orchards. However, total moth catch was significantly higher (> 2-fold) in the orange compared with the clear traps in the non-MD orchards and only 3.0% of moths were females. These studies suggest that clear delta traps baited with PE+AA lures can be an effective alternative to monitor codling moth in MD orchards that allows female moth populations to be more closely tracked. Further studies are needed to assess the effectiveness of this lure-trap combination in orchards with low pest populations and to assess their use to detect female moth immigration.

Thresholds/Monitoring

Action Thresholds for the DA-Combo Lure in Mating Disrupted Apple Orchards

Diane G. Alston and Marion S. Murray
Utah State University, Logan, UT

Keywords: codlemone, codling moth, mating disruption, monitoring, pear ester, threshold

Abstract: Trap thresholds for the DA and DA-Combo lures were developed based on previous studies conducted in the Northwest (Knight and Light 2005; Knight et al. 2006) and in Utah (2006-08). In 2009, a validation study was conducted in 20 MD apple orchards in Utah County. Two -pairs of DA- and DA-Combo-baited traps were deployed and maintained in each orchard from late April through mid September. When thresholds for lures were met, growers were advised to treat. Fruit injury was assessed for each codling moth generation, shared with growers, and compared to trap capture data to evaluate accuracy of the trap thresholds. The DA-Combo lure trap-capture thresholds provided more accurate predictions of apple fruit injury and the need for a supplemental insecticide treatment than the DA lure thresholds. For the DA-Combo lure, combined use of a total moth threshold of 10 moths with a female moth threshold (0.5 female for first generation and 1 female for second and third generations) resulted in only one false negative prediction for the season and enhanced the accuracy of the thresholds. The DA lure thresholds were too low, and resulted in high numbers of false positive predictions. A revised DA-Combo lure threshold protocol is proposed.

Thresholds / Monitoring
POSTER

Collection of Ambient Almond Orchard Volatiles Toward Identification of Kairomones for Navel Orangeworm Monitoring

John J. Beck, Bradley S. Higbee, Douglas M. Light, Glory B. Merrill, Wai S. Gee, and Klaus Dragull
USDA, ARS, Western Regional Research Center, Albany, CA

Keywords: Navel orangeworm, volatile organic compound, VOC, *in situ* almond emissions, host plant volatiles, kairomones, headspace, GC-MS, electrophysiological responses, electroantennogram, EAG, bioassays, monitoring

Abstract: The navel orangeworm (NOW) continues to be a major insect pest of California tree nuts. There is twofold interest in controlling NOW, namely its direct damage to tree nuts and the associated contamination with toxin-producing fungi resulting from NOW feeding damage. Current efforts to monitor NOW utilize virgin female NOW traps or almond meal, both of which are beneficial but have proven either unavailable commercially or inadequate, respectively. The pheromone blend, while a promising attractant, is hampered by stability problems in the field. Utilizing a unique volatile organic compound (VOC) collection system, ambient and *in situ* almond emissions were collected and have provided a bouquet of plant-derived VOCs that elicit electrophysiological responses from NOW antennae. Studies are underway to determine the ability of the VOC blends to produce both laboratory and field-based behavioral responses from NOW moths.

BIOLOGICAL CONTROL—

VINCE JONES, MODERATOR

Notes

Biological Control

Habitat Modifications on Orchard Borders: Roses and What Else?

Tom Unruh, Eugene Miliczky and Dave Horton
USDA-ARS, Yakima Agricultural Research Laboratory, Wapato WA

Keywords: Wood's Rose, *Colpoclypeus florus*, Tachinid flies, predatory bugs, alternate prey, ecosystem services

Abstract: The ten year history of rose plantings adjacent to Washington apple orchards to enhance parasitism of leafrollers is briefly reviewed. The broader potential to enhance orchard biological control is estimated from North American and European literature and published and unpublished data. We present a shortlist of plants that may be useful for testing by central Washington tree fruits growers. Estimated costs to growers of creating hedges of perennial plants and annual groundcovers on orchard borders and opportunities for support by county conservation districts and the Natural Resources Conservation Service will also be discussed.

Enhancing Biological Control in Orchard Systems: Using HIPV's as Monitoring Tools

Vincent Jones, Shawn Steffan, Callie Baker, and Tawnee Melton
Washington State University Tree Fruit Research and Extension Center, Wenatchee, WA

Keywords: herbivore-induced plant volatiles, biological control, monitoring

Abstract: The use of herbivore-induced plant volatiles (HIPV's) as monitoring tools allows natural enemy phenology to be quantified, effects of management actions to be evaluated, and discovery of which natural enemies are present and abundant in the system. Data will be presented showing how understanding the natural enemy population dynamics can be used and also show why using HIPV's in the whole orchard season-long to increase population levels is likely a very bad idea from the standpoint of population dynamics, biological control, and pest suppression.

Biological Control

Integrated Mite Control: Nontarget Effects on Predator and Prey

Elizabeth H. Beers, Randy R. Talley and Peter Smytheman
Washington State University, Tree Fruit Research & Extension Center, Wenatchee, WA

Keywords: *Galendromus occidentalis*, western predatory mite, twospotted spider mite, *Tetranychus urticae*, spinetoram, Delegate®, chlorantraniliprole, Altacor®, lambda-cyhalothrin, Warrior®, wettable sulfur, Kumulus®, cyazypyr, spirotetramat, Ultor®, Assail®, acetamiprid

Abstract: Microcosm (leaf disk) and mesocosm (whole plant) bioassays were used to examine the effects of orchard pesticides on predator and prey in order to predict their potential for disruption of integrated mite control. Adult *G. occidentalis* mortality (acute, contact) was moderate to high for Delegate®, Warrior®, Assail®, Calypso®, and Rimon®; Altacor®, Saving®, and Guthion® were nontoxic. Surprisingly, larval mortality caused by most of the materials tested was negligible. Several of the materials were moderately repellent, with the exception of Rimon®, which was highly repellent. Warrior® was lethal to *G. occidentalis* even during the course of the 6-h repellency bioassay. Mesocosm studies indicated that while Delegate® was toxic to the predator, it was also toxic to the prey, thus pest mite increases did not occur. Kumulus® disrupted integrated control. Rimon® did not disrupt integrated control in the mesocosm, even though this was predicted from the effects on the leaf disk bioassays. Altacor® had no effect on the predator-prey interaction in the mesocosm study, consistent with its lack of effect in leaf disk bioassays.

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

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

Keywords: cyazypyr, rynaxypyr (Altacor®), spinetoram (Delegate®), novaluron (Rimon®), lambda-cyhalothrin (Warrior®II), *Deraeocoris brevis*, pears, natural enemies

Abstract: This study focused on lethal and sublethal effects of cyazypyr, rynaxypyr, spinetoram, novaluron, lambda-cyhalothrin tested against second - instars and adult males and females of the natural enemy *Deraeocoris brevis* (Hemiptera: Miridae).

Biological Control

An Outside-In Look at Green Lacewing Attraction to HIPV's

John E. Dunley, Bruce M. Greenfield, and Rob Curtiss
Washington State University, Tree Fruit Research and Extension Center, Wenatchee, WA

Keywords: attractant, green lacewing, methyl salicylate, *Chrysopa nigricornis*, *Chrysoperla plorabunda*

Abstract: Field experiments to determine the attraction of lacewings to methyl salicylate (MeSa) and other attractants in apple and pear were conducted in Orondo, Wenatchee, and Peshastin, Washington in 2008 and 2009. At each of the three experimental blocks, sets of yellow sticky traps were established in transects and baited with either a plant extract, or an oil, or methyl salicylate, or a combination of two attractants, or no attractants. Traps were established in May and monitored weekly through August. Attractants were changed and locations were re-randomized weekly.

Methyl salicylate and two other attractants tested were effective attractants in the two crop types. A combination lure including methyl salicylate caught significantly more lacewings than either individual attractant. All attractants were significantly attractive to *Chrysopa nigricornis* Burmeister and *Chrysoperla plorabunda* Fitch in pear and apple, but overall densities captured were much lower in apple.

RESISTANCE MANAGEMENT—

JOHN DUNLEY, MODERATOR

Notes

Resistance Management

Are We Seeing OP-Neonicotinoid-Spinosyn Cross Resistance in Codling Moth?

Alan Knight ¹ and Myriam Siegwart ²
¹ USDA, ARS, Wapato, WA and ² INRA, Avignon, France

Keywords: *Cydia pomonella*, azinphosmethyl, Guthion[®], acetamiprid, Assail[®], spinetoram, Delegate[®]

Abstract: Studies in 2009 focused on the response of codling moth populations collected from a range of managed and unmanaged apple orchards in Washington State. Adult topical assays were conducted with technical acetamiprid, lambda-cyhalothrin, and spinetoram. Larval bioassays were conducted with Assail[®], Altacor[®], and Delegate[®]. The action of detoxifying enzymes (glutathione-S-transferases [GST], mixed-function oxidases [MFO], and esterases [EST]) were again examined in some of these populations. Populations from conventional orchards exhibited higher tolerances to a number of insecticides and also higher MFO and GST activities than populations from unmanaged and organic orchards.

Resistance Management

**Obliquebanded Leafroller (Lepidoptera: Tortricidae) Resistance to Novel Chemistries:
Is it Possible, Stable, and Manageable?**

Ashfaq A. Sial¹, Jay F. Brunner¹, John E. Dunley¹, and Stephen F. Garczynski²

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Keywords: Obliquebanded leafroller, *Choristoneura rosaceana*, Altacor®, chlorantraniliprole, Delegate®, spinetoram, selection, resistance, heritability, reversion, detoxification enzymes

Abstract: Obliquebanded leafroller (OBLR), *Choristoneura rosaceana* (Harris), is one of the major pests of tree fruits in Washington. Use of broad-spectrum insecticides against OBLR for decades has led to the development of insecticide resistance in this pest. Recently registered insecticides, chlorantraniliprole and spinetoram, show promise for controlling OBLR, but resistance evolution is a concern. Risk assessment for resistance to a particular insecticide before its occurrence in the field could be valuable in developing strategies to manage susceptibility. Studies were initiated to screen field-collected populations and select a laboratory population for resistance against chlorantraniliprole and spinetoram using a diet incorporation bioassay. After six generations of selection, 7- and 4-fold increases in LC₅₀ values were observed for chlorantraniliprole and spinetoram, respectively. Realized heritability values were estimated as 0.17 for chlorantraniliprole and 0.18 for spinetoram. Based on the response quotient values, the rate of resistance development in OBLR was slower against spinetoram than that against chlorantraniliprole. In the absence of insecticide selection, the chlorantraniliprole- and spinetoram-resistant populations reverted to susceptibility in five and six generations, respectively. Furthermore, detoxification enzyme assays indicated that the activity of esterases was significantly higher in chlorantraniliprole-selected population whereas levels of oxidases were significantly increased in the spinetoram-selected population. These results indicate that the risk of resistance evolution exists in OBLR against chlorantraniliprole and spinetoram. However, instability of resistance and apparent involvement of different classes of detoxification enzymes in resistance against chlorantraniliprole and spinetoram should make this pest amenable to resistance management strategies involving rotation of these two chemicals.

TREE FRUIT DISEASES—

JANUARY 14, 2010
8:30AM – 12:00PM
BROADWAY IV

Notes

Tree Fruit Diseases

Use of Kocide 3000 and a Tower Sprayer in a Fire Blight Management Program

Chuck Ingels¹, Jim Adaskaveg², Franz Niederholzer³, and Thom Wiseman⁴

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Keywords: Antibiotics, oxy-tetracycline, terramycin, Mycoshield®, copper, russetting, air blast sprayer

Abstract: Three bactericidal programs were compared for fire blight incidence and fruit russetting in a mature Bartlett pear orchard: 1) Season-long use of Mycoshield®, 2) Season-long use of Kocide® 3000 + Manzate® Pro Stick, and 3) Kocide® 3000 + Manzate® Pro Stick up to April 8 and Mycoshield® April 14 through April 21. Each plot was four rows wide by approximately 100 trees long and each was replicated four times. Blight incidence was evaluated on May 7 and July 13. On May 7, relatively little blight was found and there were no significant differences between treatments. In the July 13 evaluation, mostly older shoot strikes were found, and Kocide® + Manzate® alone had significantly fewer strikes (less than half) than the other treatments. Over an inch of rain fell in early May, so the presence of residual copper on the foliage likely enhanced control of the shoot strikes. No significant differences in russetting were found. Also, we compared a standard air blast sprayer (100 gal/acre) with a tower sprayer (80 gal/acre) for coverage of spray cards placed at 5 and 10 ft. in tree canopies. The mean coverage by the tower sprayer was significantly greater than that by the standard sprayer at several points, especially on the upwind adjacent row. Reduced drift is likely with the tower sprayer since the spray is directed laterally and less ends up above the tree canopy.

LUNA Fungicides for Control of Tree Fruit & Grape Diseases

Lorianne Fought

Bayer CropScience, Western Field Technology Station, Fresno, CA

Keywords: Luna Privilege, Luna Sensation, Luna Experience, fluopyram, trifloxystrobin, tebuconazole

Abstract: Bayer CropScience will launch Luna fungicides, representing the newest innovation for control of fungal pathogens in tree fruit and grape crops. The new active ingredient inhibits succinate dehydrogenase in the fungal respiration pathway. Luna products provide outstanding control of leaf and blossom blights, leaf spots, powdery mildew, and other diseases of many high-value agricultural crops, such as apples, stone fruits, tree nuts, and grapes. U.S. registration of the Luna products is anticipated in 2010, with global MRL's anticipated shortly thereafter.