2009 Orchard Pest & Disease Management Conference

The 83rd Conference is pleased to announce our keynote speaker

Dr. Nicholas J. Mills
University of California, Berkeley

Keynote Address
"Biological Control in Western Orchards: Opportunities and Limitations"

Hilton Portland, Portland Oregon
January 14, 15 & 16, 2009

WESTERN ORCHARD PEST AND DISEASE MANAGEMENT CONFERENCE
"The Portland Spray Conference"
(1926 - 2009)

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.

Notables who have received the award include:

1. **Clancy Davis**, Berkeley, California for his quiet, sober, professional demeanor on all occasions;
2. **Stan Hoyt**, Wenatchee, Washington for failing to enliven methods of presentation of papers.
3. **Don Berry**, Medford, Oregon for never having made a single comment over 20 years.
4**. Pete Westigard**, Medford, Oregon for returning from a sabbatical with 400 color slides (all failures) and a new child.
5. **Jay Brunner**, Wenatchee, Washington for giving one of the looooongest talks in the history of WOPDMC
6. **Doug Light**, Albany, California for showing incomprehensible data slides again and again and again.
7. **Stephen Welter**, Berkeley, California for inappropriate behavior by leaving the meeting prior to giving his presentation.

Orchard Pest and Disease Management Conference

Agenda for 2009 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 14	
10:00am	Opening Business	Thomas Larsen, WOPDMC Chair
11:00am	Resistance Management	Carolyn Pickel, Moderator
11:30am	Chemical Control/New Products	Bob Van Steenwyk, Moderator
12:00pm	Lunch	
1:30pm	Chemical Control/New Products (cont.)	Bob Van Steenwyk, Moderator
3:00pm	Coffee	
3:30pm	Keynote Address	
5:00pm	Mixer (Lobby)	
	Thursday, January 15	
8:00am	Chemical Control/New Products (cont.)	Bob Van Steenwyk, Moderator
9:30am	Biology/Phenology	Larry Hull, Moderator
10:00am	Poster Session/Coffee	
10:30am	Biology/Phenology (cont.)	Larry Hull, Moderator
11:00am	Mating Disruption/SIR	Peter Shearer, Moderator
12:00pm	Lunch	
1:30pm	Mating Disruption/SIR (cont.)	Peter Shearer, Moderator
3:00pm	Break	
3:30pm	Implementation	Phil VanBuskirk, Moderator
4:00pm	Thresholds/Monitoring	Gerry Bohmfalk, Moderator
	Friday, January 16	
8:00am	Biological Control	Diane Alston, Moderator
10:00am	Closing Business	Thomas Larsen, WOPDMC Chair Lawrence Lacey, WOPDMC Chair-Elect
11:00am	Adjourn	

Washington State University
Tree Fruit Research and Extension Center
1100 N. Western Avenue
Wenatchee, WA 98801
Phone: 509-663-8181

Content queries to Dr. John Dunley
dunleyj@wsu.edu

Western Orchard Pest and Disease Management Conference

Officers for the 2009 Conference

Chair
Thomas Larsen
Suterra, LLC
213 SW Columbia St.
Bend, OR 97702
Phone: 541-317-2242
Fax: 541-388-3705
Email: larsen@suterra.com

Chair-Elect
Lawrence Lacey
USDA-ARS
5230 Konnowac Pass Road
Wapato, WA 98951
Phone: 509-454-4463
Fax: 509-454-5646
Email: lerry.lacey@ars.usda.gov

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

Program Chair
John Dunley
Washington State University
Tree Fruit Research and Extension Center
Wenatchee, WA 98801
Phone: 509-663-8181, ext 236
Fax: 509-662-8714
Email: dunleyj@wsu.edu

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

Proceedings
Christina Mayer
Washington State University
Tree Fruit Research and Extension Center
Wenatchee, WA 98801
Phone: 509-663-8181, ext 0
Fax: 509-662-8714
Email: wopdmc@wsu.edu

For information, see: http://entomology.tfrec.wsu.edu/wopdmc/index.html

Order of Presentations
FROM THE 83rd ANNUAL
ORCHARD PEST AND DISEASE MANAGEMENT CONFERENCE
January 14, 15 & 16, 2009

Resistance Management

Carolyn Pickel, moderator

Notes

Resistance Management

A Survey of Adult Codling Moth in Washington State: Correlating Metabolic Enzyme Activity with Responses to Acetamiprid and Novaluron

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

Keywords: Cydia pomonella, resistance, novaluron, Assail, Rimon, monitoring, apple

Abstract: The action of detoxifying enzymes (glutathione-S-transferases [GST], mixed-function oxidases [MFO], and esterases [EST]); and the presence of insensitive variants of target proteins (kdr) were examined in French studies with individual male and female codling moth, *Cydia pomonella* L., collected from managed and unmanaged overwintering 2007 sites in Washington State apple. Adult topical bioassays using acetamiprid were conducted with these and several additional populations from 2006 to 2008. Results from these two studies will be presented. In addition, data collected from 2006 to 2008 examining these population's responses to novaluron will also be presented.

Insecticide Resistance Monitoring of Codling Moth in North Carolina

J.F. Walgenbach, L. C. Magalhaes, V. M. Barlow, R.M. Roe.
Dept. Entomology, MHCREC, NC State University, Mills River, NC

Keywords: Codling moth, *Cydia pomonella*, resistance, apple

Abstract: In recent years the codling moth, *Cydia pomonella* (L.), has developed into the most important arthropod pest of apples in North Carolina. Insecticide resistance was suspected of being a key contributing factor to the elevated importance of this pest. A novel 16-well platicware bioassay dish containing lyophilized codling moth diet was used to screen field-collected codling moth larval populations for resistance to a diversity of insecticides. Resistance was detected to all major insecticides used in recent years, although different populations varied in their resistance status to specific insecticides. Resistance was most widespread to the insect growth regulators methoxyfenozide and novaluron, followed by acetamiprid. Studies that assessed the impact of larval age on codling moth resistance screening will also be presented.

Resistance Management

Resistance risk assessment for novel reduced-risk insecticides in obliquebanded leafroller, C*horistoneura rosaceana* (Lepidoptera: Tortricidae)

Ashfaq A. Sial, Jay F. Brunner, John E. Dunley, and Michael D. Doerr
Washington State University, Tree Fruit Research and Extension Center, Wenatchee, WA

Keywords: Obliquebanded leafroller, C*horistoneura rosaceana*, reduced-risk insecticides, Altacor, chlorantraniliprole, Delegate, spinetoram, selection, resistance, heritability

Abstract: The obliquebanded leafroller (OBLR), *Choristoneura rosaceana* (Harris), is one of the most destructive pests of tree fruits in Washington. The use of broad-spectrum insecticides against OBLR over decades has led to the development of insecticide resistance in this pest. In this situation the recently developed chemicals with novel modes of action, including rynaxypyr and spinetoram, show promise for controlling OBLR, but resistance remains a threat. The risk assessment for resistance to a particular insecticide before its occurrence in the field could be valuable in developing strategies to manage susceptibility. The rate of resistance development is proportional to the population's narrow-sense heritability of resistance (h^2). An important factor in evaluating the sustainability of an insecticide on a particular pest population is the proportion of total phenotypic variation attributable to additive genetic variation. Studies were initiated to select OBLR for resistance against rynaxypyr and spinetoram to determine the risk of resistance evolution. We treated 2000 neonates from laboratory population at LC_{70}-LC_{90} for 96 hours using diet-incorporation bioassay at each generation. After four generations of selection, 2.5- and 3.5-fold increases in LC_{50} values were observed for rynaxypyr and spinetoram, respectively. The realized heritability values were estimated as 0.21 for rynaxypyr and 0.23 for spinetoram. The response quotient (Q) was used to compare the risk of resistance development in OBLR against these insecticides. The Q values were 0.138 and 0.086 for rynaxypyr and spinetoram, respectively. These results indicate that the rate of resistance development in OBLR would be slower against spinetoram than that against rynaxypyr.

Resistance Management

The IRAC Codling Moth Working Group: Aims & Scope

James Dripps[1], Enrique Ariso[2], Andrea Bassi (chair)[3], Daniel Camus[2], Matthias Haas[4], Eric Harrestrup Andersen[5], Werner Heck[6], and Robert Senn[7].
[1]Dow AgroSciences, [2]Makhteshim Agan, [3]DuPont, [4]Bayer CropScience, [5]Cheminova, [6]BASF, and [7]Syngenta (*www.irac-online.org*)

Keywords: IRAC, codling moth, *Cydia pomonella*, insecticide resistance, resistance management, IRM, bioassay, resistance monitoring

Abstract: IRAC (Insecticide Resistance Action Committee) coordinates industry response to resistance development. The Codling Moth (CM) Working Group facilitates information sharing and networking between industry and the scientific community, supports research to improve and standardize bioassay methods, and contributes to local Insect Resistance Management (IRM) strategies. Alternating modes of action (MOAs) between consecutive CM generations combined with semiochemical, biotechnical, and cultural tools remains the best IRM practice. Metabolic cross-resistance is the most relevant type of resistance for CM and analysis of enzymatic activity in populations is a key element of resistance evaluation. Recent studies show topical application to diapausing larvae is valid for detecting resistance to IGRs but may not be for some neurotoxins. Bioassays should preferably be done on the target instar. For larvicides, ingestion bioassays on F_1 or F_2 neonate larvae provide a more reliable indication of field resistance. Major factors affecting the current status of CM resistance are: increased use of semiochemicals for mating disruption, fewer insecticides due to regulatory and food-chain pressure, and improved tools for resistance detection and confirmation. The current toolbox has 10 different MOAs. Efficacy varies among these MOAs, but all are relevant to ensure sustainable CM control.

Chemical Control
New Products

Bob Van Steenwyk, moderator

Notes

Chemical Control/New Products

Nontarget Effects of Pesticides on *Typhlodromus occidentalis*

Elizabeth H. Beers, Randy R. Talley, Luis Martinez-Rocha & John E. Dunley
Washington State University, Tree Fruit Research & Extension Center, Wenatchee, WA

Keywords: *Typhlodromus occidentalis*, western predatory mite, lime-sulfur, calcium polysulfide, ammonium thiosulfate, ATS, wettable sulfur, Kumulus, spinosad, Success, spinetoram, Delegate, carbaryl, Sevin, chlorantraniliprole, Altacor

Abstract: The nontarget effects of pesticides and ATS were explored in a series of bioassays of *T. occidentalis*. Altacor had no measurable effect on mortality, fecundity or prey consumption. Sevin had no measurable effect on mortality, prey consumption, fecundity, or egg sterility. Delegate was toxic to *T. occidentalis* on contact, causing 48-56% mortality after 48 h. Fecundity was reduced by the 1x (maximum label) rate; prey consumption was not affected. Fresh residues of Delegate were toxic to adults to about the same degree as contact with sprays, as well as causing reductions in fecundity. Success was toxic to adult *T. occidentalis* on contact, causing 60-70% mortality (48 h) at the 1x and 2x rates, while the 0.1x rate was not different than the check. In addition to the insecticides, three sulfur products were tested (lime-sulfur, ATS and Kumulus). Lime-sulfur and ATS were toxic on contact to adult *T. occidentalis*, whereas Kumulus was not. However, all three products were toxic to larvae exposed to 3-d-old residues, and repellant to adults exposed to fresh residues. Higher temperatures (32 v 18°C) did not increase the toxicity of Kumulus. Prey consumption (treated twospotted spider mite eggs) was reduced by lime-sulfur and ATS. Lime-sulfur was applied with an airblast sprayer to mature apple trees at 20 and 80% bloom, and leaves with residues collected at intervals post-treatment. Lime-sulfur residues were toxic to larvae 11, 20 and 26 d after the 2nd application, causing 89, 50, and 17% mortality, respectively (all significantly higher than the check).

Chemical Control/New Products

A Fixed Spray System for Applying Pesticides to High-Density Apple Plantings

Arthur M. Agnello and Andrew J. Landers
Cornell University, New York State Agricultural Experiment Station, Geneva, NY

Keywords: pesticide application technology, apple, high-density plantings, solid-set delivery system

Abstract: Pesticide application to tree fruits using airblast sprayers can be inefficient and inaccurate, resulting in spray drift, off-target contamination, and ineffective pest control. A spray system fixed into the tree canopy was used to apply all seasonal sprays to a commercial planting and was compared with a conventional sprayer. A high-density Gala planting received all pesticide and thinning sprays through a system of microsprinkler nozzles attached to polyethylene tubing running along the rows and supplied by a central tank and pumping station. Insect and disease control, thinning results, and spray deposition data were compared with a section of the orchard treated using a tractor and airblast sprayer. Sprays were applied quickly and efficiently, each taking only a few minutes to completely cover all the trees in the fixed-spray section of orchard. In-season sampling sessions revealed identical zero-damage levels in both spray treatments from leaf- or fruit-infesting insects. Fruit harvest evaluation showed comparable levels of clean fruit (96-97%) in the two halves of the block. Spray deposition in different canopy sectors, as measured by a dye tracer, was comparable using either method. This type of arrangement could offer benefits in pesticide application efficiency and accuracy while maintaining crop protection efficacy and production quality in modern apple plantings.

Chemical Control/New Products

Internal Feeding Lepidoptera and Leafroller Management with Altacor™, Belt™ and Delegate™ on Apples

L. Hull, N. Joshi, F. Zaman
Penn State University, Fruit Research and Extension Center, Biglerville, PA

Keywords: *Cydia pomonella*, codling moth, *Grapholitha 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 during 2008 to determine the overall efficacy of Altacor and Delegate against the codling moth (CM), *Cydia pomonella*, the oriental fruit moth (OFM), *Grapholitha 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 generations of each product. In addition, the efficacy of Belt was investigated, with and without the addition of various adjuvants, for CM/OFM and leafroller control. Also, the relative toxicity of these compounds against various natural enemy populations was measured. 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) were used to apply all Altacor and Delegate treatments while only the every row middle method was used for the Belt treatments. Data on pest and natural enemy populations and fruit injury were collected. Alternate row middle applications of Altacor and Delegate were very effective in controlling both CM and OFM and the leafroller complex and all Altacor/Delegate rotation schemes between generations were more effective than the standard insecticide program. There was no difference in the control of these four pests regardless of the rotational scheme between generations for Altacor and Delegate. The Belt program was slightly less effective than Altacor/Delegate against the CM/OFM complex, but it was very effective against the leafroller complex. Delegate showed some toxicity to the mite predator, *Typhlodromus pyri*.

Chemical Control/New Products

Characterization of DA-MEC, the Microencapsulated Pear Ester Spray Adjuvant, and Behavioral Activity Evoked in Codling Moth Neonate Larvae

Douglas M. Light, John J. Beck, James L. Baker and Janet Haworth
USDA-ARS, Western Regional Research Center, Albany, CA

Keywords: Cydia pomonella, codling moth, neonate larvae, spray adjuvant, microencapsules, pear ester, Cidetrak DA-MEC, SPME, GC-MS, orientation, insecticides

Abstract: A microencapsulated formulation of codling moth (CM) larval-attractant kairomone, ethyl (2*E*,4*Z*)-2,4-decadienoate, the "pear ester" (DA-MEC; Cidetrak, Trécé Inc. Adair, OK), enhances control efficacy of various insecticides when tank-mixed as a spray-adjuvant. DA-MEC formulation is characterized, including microcapsule size, concentrations, emission rate, and laboratory dual-choice pedestrian bioassays on neonate CM larvae. Diameter size of the thin-walled microcapsules ranged from 2 to 14+ mm, with 68.6% of capsules being 2–3 mm wide. At the field application dilution of DA-MEC formulation in spray water (12 ml in 100 gal water or 1:3200 dilution), the concentration of microcapsules averaged 264.6 x 10^3 capsules per mL spray solution. SPME headspace collections and GC-MS analysis showed the evaporative emission of pear ester over 21 days varied by concentration of microcapsules applied to filter paper substrates and followed power trendline (R^2 = 0.8902) and exponential trendline decay curves (R^2 = 0.9490). Extrapolations of the trendlines suggest picogram emissions of pear ester would extend to 2.5 weeks. Newly hatched CM larvae spent significantly more time (64.0 $\pm$ 0.7%) crawling within filter paper zones treated with dilute field rate DA-MEC than untreated zones for up to 14 days during evaporative aging. Observed strong orientation preferences, extended crawling time, and frequent turning by CM larvae support that PE kairomone evokes increases in "larval wandering." Applications of DA-MEC spray adjuvant with insecticides may evoke an increase in neonate wandering upon foliage, thereby disrupting host fruit/nut finding, as well as enhancing mortality by increasing the exposure to insecticides.

Chemical Control/New Products

Larvicidal and Ovicidal Properties of Rynaxypyr, Spinetoram and Novaluron Observed During Field/Laboratory Residual Bioassays

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

Keywords: codling moth, Oriental fruit moth, tufted apple budmoth, pesticide residual activity

Abstract: The residual activities of rynaxypyr, spinetoram and novaluron were evaluated during field/laboratory bioassays conducted during the 2008 season. Young, four-year old apple trees were treated with the evaluated compounds at the concentrations equivalent to the spray-tank concentration of the products applied at the recommended field rate in 100 gallons of solution per acre. All applications were done using Accu-Power Solo 416 battery powered backpack sprayer at the pressure of about 35 psi to the point of drip. The larvicidal and ovicidal properties of field aged pesticide residues were evaluated on fruit using codling moth and oriental fruit moth neonates. The larvicidal activities of foliar residues were evaluated using tufted apple budmoth neonates. The fruit and foliage samples were collected for up to 34 days after the application. All tested products provided excellent control of internal fruit feeders and leafroller neonates for up to 17 days but only larval control provided by residues of rynaxypyr continued longer. The ovicidal properties of the compounds were variable with only residues of novaluron providing acceptable level of ovicidal control.

Chemical Control/New Products

Voliam Flexi™: A New Broad Spectrum Insecticide from Syngenta Crop Protection

Christopher Clemens[1] and Caydee Savinelli[2]
Syngenta Crop Protection, [1]Richland, WA, [2]Greensboro, NC

Keywords: Voliam Flexi™, chlorantraniliprole, thiamethoxam, peach twig borer, *Anarsia lineatella* (L.), navel orangeworm, *Amyelois transitella* (Walker), oriental fruit moth, *Grapholitha molesta* (Busck), codling moth, *Cydia pomonella* (L.), Spotted tentiform leafminer, *Phyllonorycter blancardella* (Fabr.), pear psylla, *Cacopsylla pyricola* (Foerster), plum curculio, *Conotrachelus nenuphar* (Herbst), Japanese beetle, *Popillia japonica* Newman, potato leafhoppers, *Empoasca fabae*, San Jose scale, *Quadraspidiotus perniciosus* (Comstock), *Hoplocampa testudinea* (Klugs), green fruitworm, *Orthosia hibisci*, tufted apple budworm, *Platynota idaeusalis*, green apple aphid, *Aphis pomi* (De Geer), rosy apple aphid, *Dysaphis plantaginea* (Passerini), green peach aphid, *Myzus persicae* (Sulzer), pome fruit, stone fruit, chemical control, insecticide

Abstract: Voliam Flexi™ is a new broad-spectrum, systemic, foliar applied insecticide developed for use for key lepidopteran, sucking and chewing insect pests in vegetables, grapes, pome fruit, stone fruit and potatoes. Voliam Flexi™ received US EPA registration during August, 2008, and is now registered in many tree fruit producing states including WA, OR, ID, and MI. Field studies in tree fruits conducted during the 2007 and 2008 growing seasons in California, Washington, Oregon, New York, Virginia, North Carolina, and Michigan demonstrated effective control of key pests such as: peach twig borer, *Anarsia lineatella* (L.), navel orangeworm, *Amyelois transitella* (Walker), oriental fruit moth, *Grapholitha molesta* (Busck), codling moth, *Cydia pomonella* (L.), Spotted tentiform leafminer, *Phyllonorycter blancardella* (Fabr.), pear psylla, *Cacopsylla pyricola* (Foerster), plum curculio, *Conotrachelus nenuphar* (Herbst), Japanese beetle, *Popillia japonica* Newman, potato leafhoppers, *Empoasca fabae*, San Jose scale, *Quadraspidiotus perniciosus* (Comstock), *Hoplocampa testudinea* (Klugs), green fruitworm, *Orthosia hibisci*, tufted apple budworm, *Platynota idaeusalis*, green apple aphid, *Aphis pomi* (De Geer), rosy apple aphid, *Dysaphis plantaginea* (Passerini), green peach aphid, *Myzus persicae* (Sulzer), as well as other insect pests. Voliam Flexi™ is formulated as a 40% water dispersible granule in a 1:1 ratio of thiamethoxam and chlorantraniliprole. Effective use rates range from 4 to 7 oz/acre (112-196 gai/ha) for most lepidopteran and sucking pests. Research trials in 2008 in the Pacific Northwest showed that Voliam Flexi™ WG provided excellent control of codling moth in apples. Voliam Flexi™ is an effective broad-spectrum control option for lepidopteran, sucking and chewing insect pests in tree crop integrated management programs.

Chemical Control/New Products

ULTOR®, a new broad-spectrum insecticide for sucking insect pest control from Bayer CropScience

R. Warner, J Bell, S Krueger, R Steffens
Bayer CropScience, Research Triangle Park, NC

Keywords: Ultor®, spirotetramat, systemic

Abstract: ULTOR® (spirotetramat) is a novel active ingredient from the new chemical class of tetramic acids. The product's new mode of action, known as a lipid biosynthesis inhibitor, shows no cross-resistance to currently available chemical classes in the market. When applied to the foliage, this highly systemic insecticide is translocated in an acropetal and basipetal manner within the plant, resulting in effective pest control on roots and shoots. ULTOR® provides excellent initial and long-lasting residual control of a broad range of economically important sucking pests infesting annual and perennial crops, including aphids, whiteflies, scales, mealybugs, psylla, and *Phylloxera*. Studies have shown minimal risk to both predators and parasitoids, making ULTOR® an excellent fit in IPM programs. Due to the new mode of action that shows no cross-resistance to currently available chemical classes, as well as the product's excellent performance against target pests with minimal risk to beneficial arthropods, ULTOR® will serve as a powerful tool in both resistance management and IPM programs.

Chemical Control/New Products

Insecticide Evaluation for Codling Moth Control in Apples

C.A. Evers[1], R.A. Van Steenwyk[1] & W.W. Coates[2]
[1]Dept. of E.S.P.M., University of California, Berkeley, CA
[2]University of California Cooperative Extension, Hollister, CA

Keywords: Codling moth, *Cydia pomonella*, twospotted spider mite, *Tetranychus urticae*, western predatory mite, *Glandromus occidentalis*, apples, chemical control, insecticide, Altacor 35WDG, Delegate 25WG, Rimon 0.83 EC, DPX-HGW86 0.088SE, Voliam Xpress 1.25SC, Voliam Flexi 40WG, Pygamic 1.4EC, B5028, Entrust 80WP, Battalion 0.2EC, Imidan 70W, Warrior II, Agri-Mek 0.15EC, Assail 30WG, Latron B-1956, Purespray Green horticultural oil

Abstract: The efficacy of reduced risk insecticides for the control of codling moth (CM), twospotted spider mite (TSSM) and western predatory mite (WPM) were evaluated in an apple orchard near Hollister, CA. Fifteen treatments were replicated four times in a RCB design. Materials were applied with a handgun sprayer (150 gal/acre). Applications were scheduled based on day-degrees (DD). DD were calculated using biofix dates of 3/22, 6/19, and 8/13. Treatments were targeted to 250 DD and 650 DD for each flight. CM damage was evaluated by examining 500 fruit per treatment at the end of the first generation (7/19). At commercial harvest (9/17) 1000 fruit per treatment were removed and examined in the lab. TSSM and WPM control was evaluated on 8/4, 8/11 and 8/18 by leaf brushing 20 leaves from each replicate onto plates. The plates were counted under magnification in the lab. The orchard had high CM pressure that resulted in 58% infested fruit in the untreated check at harvest. Excellent control was observed with Voliam Express, and Voliam Express followed by Voliam Flexi; however the later resulted in a TSSM flare-up. Excellent CM control was observed with various treatments of Altacor and Delegate with no significant TSSM flare-up. The organic treatments of Entrust and Pyganic were not enhanced by B5028, but had significantly lower CM infestation compared to the untreated control.

Chemical Control/New Products

Insecticide Evaluation for Codling Moth Control in Pears

C.A. Evers & R.A. Van Steenwyk
Dept. of E.S.P.M., University of California, Berkeley, CA

Keywords: Codling moth, *Cydia pomonella*, pear psylla, *Cacopsylla pyricola*, twospotted spider mite, *Tetranychus urticae*, western flower thrips, *Frankliniella occidentalis*, European red mite, *Panonychus ulmi*, pears, chemical control, insecticide, Belt 4SC, Leverage 2.7SE, Imidan 70W, Guthion 50WP, Actara 25WDG, Voliam Targo, Delegate 25WG, Voliam Flexi 40WG, Proclaim 5SG, Assail 30WG, Warrior II, Agri-Mek 0.15EC, Dyne-Amic, Latron B-1956, Purespray Green horticultural oil

Abstract: The efficacy of reduced risk insecticides for the control of codling moth (CM), pear psylla (PP), twospotted spider mite (TSSM), western flower thrips (WFT) and European red mite (ERM) were evaluated in a pear orchard near Fairfield, CA. Thirteen treatments were replicated four times in a RCB design. Materials were applied with a handgun sprayer (200 gal/acre). Applications were scheduled based on day-degrees (DD). DD were calculated using biofix dates of 3/24 and 6/12 for each generation. Treatments were targeted to 250 DD and 650 DD for each flight. CM damage was evaluated by examining 400 fruit per treatment at the end of the first generation (6/10). At commercial harvest (8/5) 1000 fruit per treatment were removed and examined in the laboratory. PP, TSSM, WFT and ERM control was evaluated weekly from 6/2 to 7/28 by leaf brushing 20 leaves from each replicate onto plates. The plates were counted under 20X magnification in the laboratory. The orchard had high CM pressure that resulted in 46% infested fruit in the untreated check at harvest. Leverage provided excellent CM control but had significant increase in TSSM. Belt provided effective CM control but is not as effective as Voliam Targo or Voliam Flexi rotated with Delegate. The higher rate of Voliam Targo or Voliam Flexi in rotation with Delegate looks very promising when the total insect and mite complex is considered.

Chemical Control/New Products

Control of Codling Moth by Postharvest Application of Ethephon 2SL and Insecticide

Chuck A. Ingels[1], Robert A. Van Steenwyk, Lucia G. Varela, and Rachel B. Elkins
[1]UC Cooperative Extension, 4145 Branch Center Rd., Sacramento, CA 95827

Keywords: Codling moth, *Cydia pomonella*, chemical control, ethephon, plant growth regulator, insecticide, postharvest, pear

Abstract: Application of ethephon shortly after harvest results in rapid maturation and drop of unharvested fruit, preventing codling moth (CM) larvae in unharvested fruit from completing larval development and decreasing CM populations the next spring. Trials were initiated in five pear orchards in Sacramento and Mendocino Counties of California following the 2007 harvest. Ethephon 2SL at 4 pt/ac + 2 pt/ac of Lorsban 4E was applied to 10-20 acres shortly after harvest. In Aug. 2008, these and five other orchards were treated, but other insecticides were used instead of Lorsban. In-season CM control was the same for treated and untreated blocks and was at the discretion of the grower. Fruit pressures of normal and rat tail fruit were significantly reduced in most Sacramento orchards but not in the North Coast orchards. In treated orchards, there was a substantial (38-55%) reduction in moth counts of both pheromone and bait pan traps in 2008. Based on harvest evaluations, there is no clear indication that Ethephon affects yield or fruit size the following season.

Field Performance and Sub-lethal Activity of Novaluron for Codling Moth Control

John C. Wise, Ayhan Gökce, Soo-Hoon Kim, Larry Gut and Mark E. Whalon
Michigan State University, Trevor Nichols Research Complex, Fennville, MI

Keywords: novaluron, *Cydia pomonella*, sub-lethal effect, egg viability, fecundity

Abstract: Field efficacy trials and laboratory bioassays were used to evaluate the field performance and sub-lethal effects of the benzoylurea chitin synthesis inhibitor insecticide, novaluron, on codling moth, *Cydia pomonella* (L.). Field efficacy trials were based on two-tree plots sprayed with an airblast sprayer, followed by apple fruit damage assessments. Three different adult exposures to novaluron were assessed for sub-lethal effects on codling moth fecundity and egg viability under laboratory conditions. The topical, contact and ingestion exposures all induced sub-lethal effects, and persisted to various degrees throughout codling moth oviposition. A more complete understanding of novaluron's lethal and sub-lethal activities will help IPM practitioners optimize field timing for management of the codling moth.

Chemical Control/New Products

Chemical Control of Woolly Apple Aphid

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

Keywords: woolly apple aphid, *Eriosoma lanigerum*, spirotetramat, Movento, tolfenpyrad, NNI-2302, NNI-0101, flonicamid, BeLeaf, diazinon, endosulfan, Thionex, Cyazypyr, SucraSheild, sucrose octoanate esters

Abstract: Seven field and greenhouse experiments were performed to investigate various materials and timings for control of woolly apple aphid. Early season (June) applications of Movento were tested in three commercial orchards with a history of woolly apple aphid problems; only one orchard developed a usable population. Movento suppressed colony expansion in late summer, but the degree of suppression was much less for the buildup that occurred in October. In a small plot experimental orchard, BeLeaf, some rates of NAI 0101 and NAI 2302 provided some suppression of woolly apple aphid, but not as good as diazinon. In a second small plot trial, diazinon and Thionex provided the best control, with Movento, Saf-T-Side, and Cyazypyr providing a lower, but still useful, level of control. In a third trial (larger plots), diazinon provided the best control, followed closely by Thionex, and less closely by Movento. Cyazypyr with or without oil failed to provide control of woolly apple aphid in a greenhouse test on potted trees.

Fall Actara or Asana Application Control Prune Aphid the Following Season

Franz Niederholzer, Carolyn Pickel, Rich Buchner, and Bill Krueger
University of California Cooperative Extension, Yuba City, CA

Keywords: Prune, Actara, thiamethoxam, Asana, esfenvalerate, chemical, control, aphid, leaf curl plum aphid, *Brachycaudus helichrysi*, mealy plum aphid, *Hyalopterus pruni*

Abstract: Prune aphids (mealy plum and leaf curl plum aphid) are key pests in prune production. Effective control has traditionally been provided by a dormant spray of pyrethroid or organo-phosphate pesticide. Potential regulatory elimination of the dormant spray prompted studies of alternative timings for prune aphid control. Single, mature prune trees (*Prunus domestica)* were treated using air-assisted backpack sprayers in October or November, 2005 with Actara or Asana. All timings of Asana provided excellent control in spring, 2006. Actara provided excellent aphid control when applied in October, before the start of leaf drop. Ineffective control resulted from Actara application in November – after leaf fall had begun. A larger scale study applied with an air-blast sprayer was conducted in October, 2007 with the same materials. Excellent control, equal to a dormant spray, was measured in May, 2008.

Chemical Control/New Products

Insecticide Evaluations for Grape Phylloxera with Foliar Applications of Movento

R. A. Van Steenwyk[1], L. G. Varela[2] & M. Ehlhardt[3]
[1]Dept. of E.S.P.M., University of California, Berkeley, CA
[2]UCCE, Santa Rosa, CA, [3]Bayer CropScience, Chico, CA

Keywords: Grape phylloxera, *Daktulosphaira vitifoliae*, Movento, spirotetramat, grapes, chemical control, insecticide

Abstract: This trial was designed to test the control of grape phylloxera on grapes by a foliar application of Movento. Four treatments were replicated four times in a RCB design. Foliar applications were applied on 18 Sep & 19 Oct with an air-blast mist blower with a finished spray volume of 75 gal/acre. A pre-application sample was taken on 18 Sep, 2007 immediately preceding the application. The samples were taken from the top one foot of soil and about one foot from the trunk beneath drip emitter. All phylloxera nymphs and adults were counted in the laboratory at UCB under magnification (20X). This procedure was repeated one year later on 15 Sep, 2008. In the pre-application sample of 18 Sep, 2007, there was no significant difference in the total number of phylloxera or the number of phylloxera per gram of root. In the post-application sample of 15 Sep 2008, the total number of phylloxera was significantly lower in the 12 and 16 oz/ac rates of Movento compared to the untreated control. However, there was no significant difference in the total number of phylloxera among the 6 oz/ac rate applied twice, 8 oz/ac rate applied once and the untreated control. When root mass was considered, there were significantly fewer phylloxera/gram of root in the 8, 12 and 16 oz/ac rates of Movento applied once compared to the untreated control. However there was no difference between the 6.0 oz/ac Movento applied twice compared to the untreated control.

Chemical Control/ New Products

Insecticide Evaluations for Codling Moth in Walnuts

R. A. Van Steenwyk & C.A. Evers
Dept. of E.S.P.M., University of California, Berkeley, CA

Keywords: Codling moth *Cydia pomonella*, walnut aphid, *Chromaphis juglandicola*, twospotted spider mite, *Tetranychus urticae*, Western predatory mite, *Galendromus occidentalis*, European red mite, *anonychus ulmi*, walnut aphid parasitoid, *Trioxys pallidus,* Delegate, Voliam Targo, Voliam Xpress, Proclaim, Lorsban, Warrior II, Brigade, Intrepid, walnuts, chemical control, insecticide

Abstract: This trial was designed to evaluate the control of CM in walnuts by reduced risk insecticides. Seventeen treatments were replicated four times in a RCB design. Foliar applications were applied with a handgun sprayer (250 gal/acre) on 5 May, 26 Jun and 7 Jul. Control of CM was evaluated at harvest on 1 Oct by inspecting 125 nuts per tree (500 nuts per treatment) for CM and NOW infestation. WA and WAP were counted weekly from 3 Jul to 20 Aug on 10 terminal leaflets per replicate. Control of motile TSSM, ERM and WPM were evaluated by brushing 10 terminal leaflets per replicate weekly from 3 Jul to 20 Aug. The plates with the contents from the brushed leaves were counted under magnification (20X) in the laboratory. All experimental treatments had a significantly lower percent of CM infested nuts at harvest compared to the untreated check. Voliam Targo, Warrior II combined with Proclaim, Intrepid and the grower standard had no CM infestation and were significantly lower than Lorsban plus Agri-Mek and the untreated control. All other experimental treatments did not differ significantly and ranged from 0.2% to 1.0% CM. WA was held under control by the WAP and there was no significant flare-up in WA by any experimental treatment. TSSM were reduced with Volaim Targo and Proclaim but elevated with the grower standard, Warrior II and Delegate treatments.

Chemical Control/New Products

Control of Walnut Husk Fly in English Walnuts

William W. Coates[1], Robert A. Van Steenwyk[2] and Chad A. Evers[2]
[1]University of California Cooperative Extension, Hollister, CA
[2]University of California, Dept. of ESPM, Berkeley, CA

Keywords: Assail™, acetamiprid, Dyne-Amic®, nonionic organosilicone surfactant, modified vegetable oil, Delegate™, spinetoram, Nu-Lure®, hydrolyzed corn gluten meal, Provado®, imidacloprid, Baythroid®, beta-cyfluthrin, Altacor™, chlorantraniliprole, Rynaxypyr™, Leverage®, cyfluthrin, walnut husk fly, *Rhagoletis completa*, chemical control, insecticide, walnut

Abstract: The efficacy of a number of reduced risk insecticides for the control of walnut husk fly was evaluated in a 'Hartley' walnut orchard near Hollister, CA. Nine single-tree treatments were replicated four times in a RCB design. Materials were applied with a handgun sprayer (250 gal/acre) at three timings (July 2, July 22 and August 12). Evaluations of walnut husk fly infestation were conducted three times (September 2, 18 and 27). Excellent control was achieved with Assail™ + Dyne-Amic®, Delegate™ + Nu-Lure®, Provado® + Dyne-Amic®, Baythroid® + Nu-Lure®, Leverage® + Dyne-Amic® + Nu-Lure®, Provado® + Delegate™ + Nu-Lure® + Dyne-Amic®, and Assail™ + Delegate™ + Nu-Lure® + Dyne-Amic®. All the materials provided significantly lower infestation compared to the untreated control and there was no significant difference among the treatments. Although not significantly different, damage in the Delegate™ + Nu-Lure® treatment was numerically higher than other treatments possibly due to slower toxicity. Only Altacor™ + Nu-Lure® had significantly higher walnut husk fly infestation compared to the untreated control.

Chemical Control/New Products

Baseline Susceptibility of Oriental Fruit Moth Larvae to Chlorantraniliprole, Spinetoram, Acetamiprid, and Novaluron

Moneen M. Jones
University of Illinois, Natural Resources & Environmental Sciences, Urbana, IL

Keywords: bioassays, insecticide resistance, chlorantraniliprole, spinetoram, acetamiprid, novaluron, *Grapholitha molesta*

Abstract: To determine baseline susceptibility of oriental fruit moth (OFM) to chlorantraniliprole, spinetoram, acetamiprid, and novaluron, neonates were placed on diet blocks containing a range of concentrations of the candidate insecticides. Mortality was assessed after 96 hours. Two populations were tested, a long-term lab colony from Rutgers University and a colony established from a southwestern Illinois field population (Calhoun County), in the summer of 2007. Environmental conditions for bioassays were 16:8 L:D photoperiod, 60%RH, and 26.8C. Data were analyzed by probit and/or logit models, and LC50 and LC90 values were estimated using POLO (LeOra Software, 2007). The LC50s for the insecticides ppm in diet for chlorantraniliprole were [0.077 Rutgers; 0.078 Calhoun], spinetoram [0.040 Rutgers; 0.057 Calhoun], and acetamiprid [0.302 Rutgers; 0.403 Calhoun], and LC90s for chlorantraniliprole were [0.281 Rutgers; 0.382 Calhoun], spinetoram [0.136 Rutgers; 0.207 Calhoun] and acetamiprid [0.462 Rutgers; 0.666 Calhoun]. Bioassays with Rimon are still ongoing at the present time.

Chemical Control/New Products

Navel Orangeworm Control at Hull Split in Almond, 2008

Brent A. Holtz, Tomé Martin-Duvall, David Haviland and Dee Haanen
University of California, Division of Agriculture and Natural Resources, Bakersfield, CA

Keywords: Altacor, Assail, BAS 320001, Belt, Brigade, Clutch, Danitol, Delegate, Dimilin, Dipel, Guthion, GWN-2117, Imidan, Intrepid, Lorsban, Mustang Max, NNI-.077, Proclaim, Rimon, Voliam Xpress, 415 oil, almond, NOW, *Amyelois transitella*, nonpareil, almond

Abstract: Insecticides were tested in a heavily infested Nonpariel mature almond orchard in Madera where the grower infestation level was 12 percent. Single tree plots were divided into six replications of 32 treatments in a RCBD. Treatments were applied once at 20% hull split on 24 July with a handgun sprayer delivering 150 gallons of spray solution through a 90 disc tip at 200 psi. Samples were taken from the crop destruct trees on 14 August and from harvestable treatments on 21 August. All samples were oven dried to kill the existing NOW larvae and stop damage at that point. 200 nuts were randomly selected from each sample and surveyed for NOW damage. Mean separations was based on Fisher's lsd at the 5% level.

The least infestation was exhibited by Voliam Xpress 8 fl oz tank-mixed with DyneAmic. This treatment while numerically the best was not significantly different from the following treatments Oil at 1.5 gal, Belt at 4 fl oz with R11, Assail 70WP at 2.6 or Assail 30SG at 6 oz with Silwet, NNI 0772 at 10.3 or 13.3 fl oz with Induce, Intrepid with Induce, Voliam Xpress at 9 fl oz, Danitol with R-11, Imidan, Altacor at 3.02 or 4 oz with Induce, Mustang Max with Oil, BAS320001 at 12.56 -16 fl oz with Induce, Lorsban Advanced, Clutch with R-11, Guthion, Proclaim with DyneAmic or GWN-2117. The least control was exhibited by the Untreated Control (UTC) and was not significantly different from the following treatments: Dipel mixed with R-11 or mixed with Intrepid and R-11, Rimon with Sylgard, Delegate with Induce, Imidan mixed with GWN-1986, Brigade, Lorsban 4E or Dimilin mixed with Sylgard. Due to late application timing and storage time prior to drying, there may be some anomalies in the data. Normally, oil alone will not perform at the level indicated in this study and with proper timing it is expected that materials such as Dipel and Delegate will provide better control than indicated in this year's study.

Biology
Phenology

Larry Hull, moderator

Notes

Biology/Phenology

2008 Apple Clearwing Moth Survey in Washington State and Northwestern Washington Detections

Eric LaGasa
Washington State Department of Agriculture, Olympia, WA

Keywords: apple clearwing moth, *Synanthedon myopaeformis*, Lepidoptera, Sesiidae, apple, bark-boring, exotic, introduced pest

Abstract: Pheromone-trap surveys to detect and delimit populations of the apple clearwing moth (ACM), *Synanthedon myopaeformis* Borkhausen (Lepidoptera: Sesiidae), were conducted in 2008. ACM is a bark-feeding European apple pest new to North America, discovered in British Columbia, Canada, in 2005. Selected northern counties and commercial nurseries importing foreign apple stock in recent years (under USDA post-entry requirements) were surveyed. ACM distribution was delimited in northern Whatcom County but ACM was not detected in any other county or at nursery sites surveyed. A small scale comparison test of new pheromone lures available was also conducted with promising results.

Biology/Phenology

Apple Clearwing Moth in the Pacific Northwest Apple Pest Complex: Updates on its Biology and Management in Canada

Gary Judd, Marius Aurelian, Karen Bedford and Chelsea Eby
Agriculture and Agri-Food Canada, Pacific Agri-Food Research Centre,
Summerland, British Columbia, Canada

Keywords: *Synanthedon myopaeformis*, Sesiidae, invasive species, monitoring, mating disruption, mass trapping

Abstract: Surveys in 2006 and 2007 discovered populations of apple clearwing moth (ACM), *Synanthedon myopaeformis*, in apple growing areas of the Fraser, Okanagan and Similkameen Valleys of British Columbia that border Washington. More recently, this invasive European species was discovered on backyard trees in Whatcom County, WA, just south of the Fraser Valley infestation. Based on current information, natural movement of the pest seems low and transport by humans on infested firewood or intact uprooted trees is the single greatest cause of spread. Currently, the ACM infestation is most severe in the Similkameen where 97% of the apple acreage surveyed in 2008 was infested and one third of that had a 100% infestation rate. All trees older than three years are being infested, but damage is having its greatest impact on five to eight year old high-density plantings of Ambrosia and Gala on M9, M26 and Ottawa 3 dwarfing rootstocks. Like dogwood borer, ACM primarily infests burr knots at the rootstock-scion graft union, but damage throughout the canopy on pruning scars and other wounds is increasing. Foliar growth of heavily infested, dwarfing trees is sparse, and trees are often stunted, with some signs of early death. Phenology studies have shown the insect has a two-year life cycle with a predictable, 8-10 week adult flight period each year arising from trees infested with mixed, overlapping cohorts of larvae. Management is multi-tactical combining degree-day-timed trunk sprays applied before, during and after the fruiting season, followed by pheromone-based mating disruption and mass trapping. Preliminary pesticide trials look promising, but there are few control products available to organic producers other than multiple applications of Entrust® or oil during the season, and nematodes applied pre- and post-season. Mating disruption with Isomate-P, which contains the major pheromone component, has been much less effective than initial expectations, probably because population densities are extreme. Swarms of these day-flying moths are often seen feeding on flowering weeds and various damaged fruits. Catches of moths in juice-baited traps often exceeds that of pheromone traps. Research on monitoring and mass-trapping female moths using fruit and floral volatiles to supplement male mating disruption has yielded some promising results and development of combined behavioral control tactics is the focus of research for the near future.

Biology/Phenology

Identification of Physiological Targets in Control of Codling Moth and Other Orchard Pests

Stephen F. Garczynski
USDA-ARS, Yakima Agricultural Research Laboratory, Wapato, WA

Keywords: Codling moth, *Cydia pomonella*, Oblique-banded leafroller, Light brown apple moth, chemosensory system, endocrine system, signal transduction

Abstract: Larvae of insect species from the Order Lepidoptera are among the most destructive pests of agriculture. Control of these pests is primarily achieved through the use of chemical insecticides, however, concerns about the hazards of chemical insecticides to the environment and consumer and worker safety calls for alternative technologies and strategies. Identification of targets for use in control of lepidopteran insect pests of orchards include those present in the chemosensory system, endocrine system and nervous system. Strategies and recent molecular work will be discussed.

Update on WSU-Decision Aid System and Results of a User Survey

Vincent P. Jones, Brad Petit, Jay F. Brunner, Jerry Tangren
Washington State University, Tree Fruit Research and Extension Center, Wenatchee, WA

Keywords: Decision support system, Decision Aids System (DAS), user survey, phenology

Abstract: Version 3.0 of our WSU–Decision Aid System (WSU–DAS) for tree fruit is being readied for release. This version has a completely redesigned interface that simplifies and enriches the user experience while reducing maintenance issues. A user survey was performed this past year and results of that survey indicate that WSU-DAS is covering nearly the entire Washington industry in terms of number of orchards and acreage. Respondents also indicated that 77% felt that WSU–DAS had improved their IPM programs, particularly in the areas of improved timing (80%), clarification of scheduling (65%) and assisting with multiple pests (39%). Users were also asked to estimate the value of WSU–DAS on a per acre basis and the average value of $75/acre suggests that the value to the industry is ≈$17M per year.

Biology/Phenology

Influence of Cherry Phenology on Reproductive Maturity of Cherry Fruit Fly in Northern Michigan

Diane G. Alston[1], Luis A. F. Teixeira[2], and Larry J. Gut[2]
[1]Utah State University, Department of Biology, Logan, UT
[2]Michigan State University, Department of Entomology, East Lansing, MI

Keywords: *Rhagoletis cingulata*, black cherry, *Prunus serotina*, sweet cherry, *Prunus avium*, tart cherry, *Prunus cerasus*, host adaptation, fruit maturity, ovary maturity

Abstract: Cherry fruit fly is a key economic pest of sweet and tart cherries in eastern North America. Black cherry is its most important native host. Ecologically-based management strategies should consider the cherry fruit fly's activity period, dispersal, and potential for egg-laying in cultivated and wild hosts. In northern Michigan, there is a greater gap between maturation of cultivated and wild host fruits than in warmer, southern locations. The study objective was to determine if separation in phenology among hosts differentially influences timing of reproductive maturity in cherry fruit fly populations, and thus, the timing of risk for fruit infestation. In sweet, tart, and black cherry trees in northwestern Michigan, the timing of cherry fruit fly ovarian maturity was aligned with host fruit maturity of the immediate habitat, and wasn't influenced by the presence of nearby trees of other cherry species. In general, female flies matured earliest in sweet, then in tart, and lastly in black cherry trees. Host quality (e.g., nutrition of leaves and fruit) and environment (e.g., no insecticides were applied to study trees) likely influenced timing of cherry fruit fly reproductive maturity; however, the lack of dispersal of mature females from adjacent "early" to "late" hosts also lends support to genetic-based host adaptation.

Biology/Phenology

Seasonal Flight Activity of Filbertworm and Nut Infestation Patterns in Hazelnut Orchards in Oregon

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

Keywords: Filbertworm, *Cydia latiferreana*, hazelnut, pheromone traps, flight activity, infestation, oviposition

Abstract: The filbertworm, *Cydia latiferreana* (FBW), is a key pest of hazelnuts in Oregon. If untreated, FBW can infest up to 54% of nuts. Temporal and spatial patterns of adult FBW flight and damage need to be better understood in order to optimize control. FBW flight was monitored using pheromone-baited traps in an abandoned hazelnut orchard and two commercial hazelnut orchards as well as in oak trees adjacent to the commercial orchards from June to October 2008. Traps within orchards were placed in the center and border rows and moth flight recorded twice a week in all locations. The timing of nut infestation was determined in an abandoned orchard by enclosing 100 nut-bearing hazelnut branches in gauze bags from May 21 to Oct 1, 2008. Per sample date, 10 bags were opened to expose the nuts to FBW for a period of two weeks. Nut infestation in the abandoned orchard occurred from beginning of June until October with a peak in mid-July. FBW were found in pheromone traps in abandoned and commercial orchards from June to October. The majority of FBW was caught in oak trees and at orchard borders. This data suggests that FBW damage occurs during a longer period than previously believed, and that FBW mainly migrate into commercial orchards from the surrounding host plants such as oak trees. Data indicate that orchard sanitation is essential for FBW control.

Biology/Phenology

Conservation Biology of Syrphids, Predators of Woolly Apple Aphid in Central Washington

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

Keywords: marigold, *Calendula officinalis,* buckwheat, *Fagopyrum esculentum,* cosmos, *Cosmos sulphureus,* mustard, *Brassica juncea,*, zinnia, *Zinnia hybrida,* and sweet alyssum, *Lobularia maritima,* woolly apple aphid, *Eriosoma lanigerum*, biological control, conservation biology, cover crop

Abstract: This test is part of an ongoing effort to enhance biological control of woolly apple aphid in the central fruit-growing districts of Washington. This experiment was a preliminary test to determine if adult syrphids would be attracted to flowering plants. For this first step, six species of flowering annuals were grown in pulp pots in the greenhouse, and then moved to an empty field surrounded by orchards and native habitat. Syrphids were observed for 2-min periods at ca. 6-day intervals. All of the flowering annuals in the test attracted some adult syrphids; however, alyssum was significantly more attractive to adults than the other plants tested. Mustard and buckwheat were the next most attractive, with marigold intermediate, and zinnia and cosmos the least attractive. Alyssum, in addition to being highly attractive, possesses growth characteristics that will likely make it easy to manage in commercial orchards. Mustard, though moderately attractive to syrphids, was highly attractive to honeybees. This may be a negative management factor; in addition, it is possible that honeybees compete with syrphids for nectar resources on mustard. Further data are needed to determine if the appropriate species of syrphids were attracted to the various plant species, and if planting flowers in an orchard enhances biological control.

Mating Disruption
SIR

Peter Shearer, moderator

Notes

Mating Disruption/SIR

Kinetics of moth attraction to traps and pheromone dispensers

Jim Miller, Peter McGhee, Piera Siegert, Matt Grieshop and Larry Gut
Michigan State University, Department of Entomology, East Lansing, MI

Keywords: Cydia pomonella, codling moth, mating disruption, monitoring

Abstract: Algebraic modeling of the probabilities that male codling moths complete progressive steps leading to capture in a monitoring trap baited with sex attractant pheromone yielded a simple but novel equation for insect attraction. Catch per trap per male reproductive lifespan = male density * p male responsiveness * p of male-plumeT contact * p male-plumeT connectivity * p trap-male connectivity * duration of the trap male complex measured in units of male reproductive lifespan. Since ensnarement in a trap lasts a lifetime (=1.0), this parameter can be ignored for traps. The above equation is also useful in describing the kinetics of male moth interactions with attractive pheromone dispensers used in mating disruption; this involves substituting dispenser for trap and disruption for capture. Results from large field cages document that codling moth behaviors follow the above predictions and that probabilities for each of these steps approaches 1.0 over a male's reproductive lifespan. The parameter of "retentiveness" of the attractive source markedly influences its overall effect in removing males from the reproductive pool. Cage results across two field seasons suggest that actual CM male density = 1.1 – 2 * capture in a monitoring trap baited with 0.1 mg codlemone on a red rubber septum. The above equations set the stage for equation expansion to describe competitive attraction.

Mating Disruption/SIR

Male Sequestration: A Key to Understanding the Effectiveness of Mating Disruption

Peter McGhee, Larry Gut, James Miller, and Piera Siegert
Michigan State University, Tree Fruit Entomology East Lansing, MI

Keywords: Cydia pomonella, mating disruption, competitive attraction

Abstract: Pheromone mating disruption experiments historically rely on direct comparisons of male moth captures in pheromone treated vs. non-pheromone treated orchards. Among the greatest challenges in conducting experiments in open orchards is accounting for the substantial variation in pest densities. To minimize this factor, a series of pheromone dispenser, dosage-response experiments was conducted in large 12-tree field cages with known population densities, i.e., moths were released in otherwise codling moth-free plots. Dosage-response profiles were directly compared using various densities of 0.1mg baited, Pherocon VI traps with sticky liners and without sticky liners as mating disruption dispensers and a central linered trap to measure disruption. CM behavior conformed well to the predictions of competitive attraction; dosage-response profiles that were smoothly concave for untransformed data and linear for transformed data. Thus, the initial response of CM males to both dispenser types was attraction. However, attraction alone was insufficient for achieving a high level of disruption. The weakest impact was recorded when the central monitoring trap and dispensers were equivalent. Only a maximum of 60-70% suppression was recorded when monitoring traps were baited with optimally-tuned 0.1mg lures and competing pheromone "dispenser" treatments were: 0, 1, 2, 4, 8, and 17 equivalently baited traps lacking sticky liners. Transforming the data allowed direct comparison of the potency of dispensers. In plots in which the x-axis is catch vs. catch*dispenser density, the slope provides a measure of dispenser activity (effect of the dispenser relative to the monitoring trap) and the x-intercept predicts the effective male density. If the x-intercept is greater than the known numbers of males in the plot, it reveals that males were making multiple visits to pheromones sources and can be used to calculate the number of visits males made over the course of the experiment. Directly comparing dispenser performance using these measures of activity revealed that the addition of liners to the same dispenser treatments greatly enhanced the level of disruption achieved. Indeed, the linerless dispensers were only $1/14^{th}$ as disruptive as linered dispensers. Thus, the desired outcome was greatest when males were prevented from making multiple orientations to pheromone sources.

Mating Disruption/SIR

Toward optimization of hand-applied and attracticidal mating disruption formulations

Larry Gut, Juan Huang, Peter McGhee, Piera Siegert and James Miller
Michigan State University, Tree Fruit Entomology, East Lansing, MI

Keywords: Cydia pomonella, mating disruption, competitive attraction, Isomate, attract-and-kill

Abstract: Recent efforts to develop more effective and economical disruption formulations for codling moth have been guided by a series of experiments conducted in replicated plots consisting of large field cages constructed over 12 apple trees. Dosage-response profiles for Isomate dispensers generated in cage experiments revealed that competition between pheromone dispensers and females initiates communicational disruption in the field. However, additional disruption mechanisms come into play subsequent to initial attraction. Disruption profiles indicated that one exposure to an Isomate dispenser rendered codling moth males incapable of normal sexual response for the remainder of a diel cycle, but males recovered and oriented to pheromone sources the following evening. Very similar profiles and impacts were generated using dispensers that released pheromone at much lower rates than the standard Isomate dispenser. Superior disruption was achieved when the initial attraction to a dispenser resulted in the complete elimination of subsequent male orientations, i.e., males were killed following attraction. Disruption profiles generated for an attract-and-kill dispenser revealed that this approach provided disruption 4-5 times greater than that achieved using hand-applied dispensers. The high cost of mating disruption is often cited as a major impediment to broader adoption of the tactic. The economics of point-source dispensers could be improved through more efficient use of the precious active ingredient. Attract-and-kill technologies offer the possibility of an especially cost-effective option for codling moth disruption.

Mating Disruption/SIR

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

Stephen Welter and Frances Cave
University of California, Department of Environmental Science, Policy and Management, Berkeley, CA

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

Abstract: Two types of meso-dispensers, which are loosely defined as units dispensing codlemone at 10-30 mg ai per day, were evaluated in 2008 in replicated five-acre blocs of walnuts and pears for control of codling moth. Meso-emitters included a membrane dispenser develop by Suterra using a larger release area and different release membrane and an uncut chain of 10 Isomate twin tubes hung in a loop. The meso-emitters are hand-applied dispensers which use fewer units per acre so as to cut labor costs and increases speed of application in pears. For walnut orchards, the fewer number of dispensers per acre provides a logistical advantage over traditional hand-applied dispensers given the large canopy sizes of mature walnut trees. In pears, replicated plots using meso-emitters applied at 18 (Suterra) or 20 (Isomate) units per acre were contrasted against standard pheromone plots with 200 Isomate twin-tube dispensers per acre. All plots within an orchard received the same insecticide applications. Applications were determined by the grower or pest consultant based on the conventional pheromone program. Codling moth pressures ranged from <10 moths for the season to >600 moths within one organic pear orchard. No clear differences in trap suppression were observed between the pheromone treatments for traps bated with traditional pheromone lures or combination lures of pear ester and pheromone. Codling moth damage was very low in all plots (0.3% or less) such that no statistical differences were detectable between treatments. Because of the lack of untreated controls, no real conclusion can be drawn about the efficacy of the two pheromone treatments. Conversely, the fear that lowering the number of point sources to 20 units per acre would result in outbreaks of codling moth was not supported. Replicated contrasts in walnuts were not productive in 2008 given the low damage levels in all plots, including those that did not have any pheromone treatment. Whereas no problems were observed in any of the test plots, a more rigorous testing of the meso-emitters in 2009 will require a reduction in insecticide applications and inclusion of untreated controls.

Mating Disruption/SIR

Rynaxypyr (Altacor) Reduces Mating of Codling Moth

Alan Knight
USDA, ARS, Wapato, WA

Keywords: Mating disruption, insecticide, sublethal, *Cydia pomonella*

Abstract: Management of codling moth in apple, pear, and walnut usually requires a combination of sex pheromones for mating disruption and several insecticide applications. The problems with managing this pest is that there is very little tolerance for this direct fruit feeder, sex pheromones alone are at best moderately effective, and it has developed resistance to many of the most important classes of insecticides. A new class of insecticides, anthranilamides, has been discovered and Rynaxypyr (Altacor) was evaluated against adult moths. Unexpectedly, this compound was shown to interfere with mating of moths. A series of laboratory and field tests demonstrated this effect. Under a seasonal spray program in apple a greater proportion of female moths were virgin in orchards treated with this material than in similar orchards treated with sex pheromone alone. The combination of this compound's insecticidal toxicity and its interference with mating may allow this new material to be integrated with sex pheromones to improve control of codling moth. For example, linking its reproductive and ovo-larvicidal activity for codling moth with its control of leafrollers promotes its use during first generation.

Mating Disruption of Lesser Peachtree Borer *Synanthedon pictipes* and Peachtree Borer *S. exitiosa* (Lepidoptera: Sesiidae) in Peach and Cherry Orchards

Luís A. Teixeira, Matthew J. Grieshop and Larry J. Gut
Michigan State University, Department of Entomology, East Lansing, MI

Keywords: mating disruption, dispenser rate, behavior

Abstract: Trap disruption efficacy of pheromone dispensers targeting lesser peachtree borer and peachtree borer separately and dispensers targeting both species were compared. Deployment of single or dual species dispensers at 150 dispensers/acre, in 3-6 acre plots, resulted in 99-100% trap disruption in treated blocks. Visual exam of marked trees showed no differences in background infestation among plots in terms of the number of borer exuviae. Larval infestation of the same trees will be determined in 2009. The effect of varying number of dispensers per acre on capture of male moths in pheromone-baited traps was also investigated. It was found that moth capture was disrupted using relatively low rates of point sources of pheromone (<150 dispensers/acre). The behavioral response of wild lesser peachtree borer moths to a lure and a dispenser placed in control and mating disruption plots was characterized using field-deployed cameras. A large number of approaches to the lure were recorded and dispenser placed in the control plot. Under mating disruption, there were few approaches to the dispenser and no moths approached the lure. The significance of moth approaches to the dispensers with respect to the mechanisms underlying mating disruption of clearwing moths will be discussed.

Mating Disruption/SIR

Practical Aspects of Maintaining Low Populations of Navel Orangeworm in Almonds with Mating Disruption

Bradley S. Higbee
Paramount Farming Company, Bakersfield, CA

Keywords: Amyelois transitella, navel orangeworm, mating disruption, pheromone, monitoring, almond

Abstract: Research on mating disruption (MD) for navel orangeworm (NOW) over the past 7 years, in both large scale area-wide settings and in smaller 50-150 ac plots, has demonstrated that MD can serve as the foundation of a pest management program for NOW. In the 2500 ac Santa Fe area-wide project, a combination of MD and insecticides resulted in reducing average historical damage levels from 5-10+ % to under 1 % in the first year of MD use (2007). In the second year, the intent was to base the NOW control program on MD and apply supplemental insecticides where needed as indicated by monitoring information. In 2008, MD alone was able to maintain damage levels under 1% in 90% of the acreage, while the remaining 10% received one application of methoxyfenozide (Intrepid).

Monitoring techniques for NOW are few, and the development of reliable decision making tools for MD systems has lagged behind the technology development to some degree. Good correlation has been shown between virgin-baited (pheromone) traps and damage in almonds that are not under MD, but this type of trap has not been as useful under MD, and there is no commercial pheromone lure. A combination of existing approaches has been developed, including oviposition attractants and pre-harvest nut examinations, which show promise in providing information that reflects the relative damage risk of a given orchard.

Implementation

Phil VanBuskirk, moderator

Notes

Implementation

Integrated Areawide Codling Moth Management in the Hood River Valley, Oregon

Steven Castagnoli, Allison Walston, Helmut Riedl, and Jean Godfrey
Oregon State University,
Mid-Columbia Agricultural Research & Extension Center, Hood River, OR

Keywords: integrated pest management, pear, organophosphate, codling moth, *Cydia pomonella*, mating disruption, monitoring

Abstract: In 2007 an integrated areawide program for codling moth management was initiated in Dee Flat, Oregon. Eleven growers comprising 614 acres of pear and apple orchards participated in the project. A monitoring program for key pests and beneficials was conducted with results transmitted to participants and PCAs in weekly email reports. Monthly meetings provided additional opportunities to review monitoring results and treatment options. Rigorous codling moth control programs were implemented consisting of pheromone mating disruption at full label rates and supplemental insecticides when thresholds were exceeded. Growers were encouraged to avoid using azinphos-methyl and phosmet but choice of registered products was their own. Total phosmet use in 2007 increased from 2006 but there was a substantial decrease in total azinphos-methyl use over the same time period. No azinphos-methyl or phosmet sprays were used in 2008. The total number of codling moths caught in 2007 was 2,726 vs. 1,056 in 2008 with average trap catch at peak flight in 2007 of 4.8 moths/trap/week vs. 2.8 moths/trap/week in 2008. Fruit damage from codling moth was reduced by 95% from 2007 to 2008. End of season surveys indicated that threshold based decision making for codling moth management was widely adopted although not absolute. All growers indicated they used monitoring information on secondary pests in their pest management decisions. Sixty percent of the growers indicated they used monitoring information on beneficial arthropods in their pest management decisions, and all chose specific pesticide products with the intention of conserving beneficials.

Implementation

Organic Materials and Other OP Alternatives for Control of Codling Moth: Implementing Programs for Large-scale and Small-scale Orchards

Richard Hilton, Alan Knight and Philip VanBuskirk
Oregon State University, Southern Oregon Research & Extension Center, Central Point, OR

Keywords: codling moth, *Cydia pomonella*, European earwig, *Forficula auricularia*, Altacor, rynaxypyr, Delegate, spinetoram, Entrust, spinosad, Cyd-X, granulosis virus, *Steinernema carpocapsae*, organophosphates, apple, pear

Abstract: OP alternatives have been implemented on a large-scale in southern Oregon pear orchards. With the use of mating disruption, codling moth granulosis virus, and new materials such as Delegate and Altacor, the need for organophosphates in pear production can be reduced or eliminated. Evaluations of various codling moth control programs continue to indicate that both Altacor and Delegate are very active on codling moth and can provide a high level of codling moth control in pear. Altacor shows minimal effect on European earwig populations as compared to either Delegate or Entrust. Due to the fact that extra-orchard sources of codling moth can pose a threat to IPM and organic programs, a multi-tactic approach utilizing only biological and behavioral methods for controlling codling moth was designed for small-scale and home orchards. This program which uses applications of the codling moth granulosis virus, entomopathogenic nematodes (*Steinernema carpocapsae*), and trapping for female codling moth was evaluated in sites throughout the Rogue Valley. A high level of codling moth control was achieved in the treated sites, in the check sites the number of successful codling moth entries in apples averaged 0.58 per fruit while in the treated sites the number of successful entries averaged 0.06 per fruit. Factors affecting the success of this program will be discussed.

Implementation

Using Aerosol Pheromone Puffers for Area-wide Suppression of Codling Moth in Walnuts

Joseph Grant[1], Carolyn Pickel[2], and Stephen C. Welter[3]
[1]University of California Cooperative Extension, Stockton, CA
[2]UC Cooperative Extension, Yuba City, CA
[3]Department of ESPM, University of California, Berkeley, CA

Keywords: codling moth, *Cydia pomonella*, pheromone mating disruption, area-wide management, IPM, walnut

Abstract: Successful use of pheromone mating disruption (PMD) for reducing codling moth damage in apples and pears, along with pressure coming from various sources to find alternatives to conventional insecticides, has led to intensive efforts to adapt PMD technology in California walnuts. Recent work has focused aerosol "puffers" because they are cost competitive with other available dispensing technologies and conventional insecticide programs currently used by many walnut growers. Two long-term area-wide projects using aerosol pheromone puffers were initiated in 2005; several additional large-scale trials were added in subsequent years. Putative benefits of using PMD over a large area for several years include reduced crop damage and codling moth populations with fewer insecticide sprays. Fourth-year results of the longest-running trials confirm these benefits and provide useful information on practical aspects of puffer deployment in walnuts.

Implementation

Pest Management Transition Project

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

Keywords: Pest management, transition, organophosphate, new insecticides, education

Abstract: The Pest Management Transition Project (PMTP) was funded by the Washington State Legislature for two years ($550,000 for 07-09 biennium) to accomplish three objectives:

1. To enhance understanding of new IPM technologies through educational programs and communication of research-based knowledge.
2. To increase adoption of new IPM technologies through sharing information on successes and failures and communicating with all stakeholders on project progress.
3. To document changes in practices, attitudes, and perceptions of growers, farm workers, and stakeholders.

The three objectives were addressed in 2008 through educational efforts conducted through Implementation Unit (IU) meetings, printed materials, and web-based products. Fourteen IUs, distributed geographically across the principal apple production regions of Washington State, were established. The IUs involved 192 participants representing over 42,600 Washington apple acres. A PMTP handbook was developed to provide reference and support at the educational and informational events and IU meetings. Three field days were held to share the PMTP knowledge and experiences with a broader audience of the tree fruit industry. Ten newsletters addressing seasonal IPM topics were distributed via mail and email. More information about the PMTP, archived additions of the newsletters, and the PMTP handbook can be found by visiting the PMTP web site (http://pmtp.wsu.edu).

Implementation

Spray Drift Management in Pear and Cherry Orchards: New Technology, Vegetative Buffers, and Efficacy

Kelly Wallis, Helmut Riedl and Jeffrey Jenkins
Oregon State University,
Mid-Columbia Agricultural Research and Extension Center, Hood River, Oregon

Keywords: spray drift reduction technology, spray drift, efficacy of spray drift reduction technology, vegetative buffer, air induction nozzle, tower sprayer, airblast sprayer, organophosphate, salmon, pear, cherry

Abstract: This project examines the role vegetative buffers may play in intercepting pesticide spray drift in pear and cherry orchards, thus reducing the amount of organophosphates reaching salmon bearing streams. Trials were conducted at three sites in The Dalles, Oregon. Sprayers evaluated were the Accutech 6-Head Orchard Sprayer, a restrictive air flow plywood doughnut attached to an airblast sprayer, traditional airblast sprayer, and an aerial applicator. Levels of pesticide interception were tested in sites with a barrier strip of native riparian vegetation and compared to sites with little or no vegetation. Trials showed that in many cases having a vegetative barrier decreases the amount of product that would potentially enter a stream.

In addition, efficacy trials of drift reduction technologies were conducted at MCAREC. For each treatment, two blocks of Anjou pears were divided in half so that one half was treated with the traditional airblast sprayer and the other half was sprayed with either air induction nozzles (1.08 and 0.35 acres) or the plywood doughnut (0.44 and 0.42 acres). Insect populations were monitored over two growing seasons via beating trays and spur, terminal, leaf and fruit evaluations. Overall, the drift reduction technology performed statistically no different than the traditional airblast sprayer.

Implementation

Evolution of the Pest Complex and Related Treatments Incurred from 1996 to 2008 in the Lake County Areawide Codling Moth Puffer Program

Rachel Elkins, Broc Zoller, Bill Oldham, and Paul Morse
University of California Cooperative Extension, Lakeport, CA

Keywords: Codling moth, mating disruption, puffers, pheromone confusion, spider mites, pear psylla, pears, areawide management

Abstract: The Lake County Areawide Codling Moth Puffer Project was initiated in 1996 under direction of the late Dr. Harry Shorey of UC Riverside. The project was variously funded by the Pear Pest Management Research Fund, California Department of Pesticide Regulation Pest Management Alliance and IPM Demonstration Grants, and the USDA Codling Moth Areawide Management Program. One hundred sixty acres participated from 1996-1998, 500 acres in 1999, 820 acres in 2000 and 1300 acres in 2001, the final year of formal University of California Cooperative Extension coordination and field data collection. Pest control advisers and growers continue to manage the program. Acreage was 1,133 in 2002, 1072 in 2003, 1039 in 2004, 993 in 2005 and remains stable at around 900 acres today. There are also approximately 900 acres using puffers in neighboring Mendocino County. Acreage decline is due to 1) orchard removal for economic reasons unrelated to puffer efficacy and 2) puffer removal from organic orchards. Initial modified bathroom deodorizer dispensers created by Dr. Shorey were replaced by solenoid controlled dispensers sold by Paramount Farming Co. (Bakersfield, CA) and eventually to the currently used mechanically-controlled dispensers manufactured from Suterra LLC (Bend, OR). Efficacy and labor savings motivate sustained program participation, despite product cost increases, and the program has served as model for others in California (walnuts) and Oregon (pears). A detailed cost and return study published in 2003 showed significant cost savings, mainly due to reduced labor costs and pear psylla and spider mite treatments. Evolution of the pest complex and related treatments from 1996 through 2008 will be discussed.

Implementation

Implementation of an IPM Program in Pears: Continued Reduction in OPs and Increased Use of Organically Approved Pest Control Methods

Philip VanBuskirk and Richard Hilton
OSU-Southern Oregon Research & Extension Center, Central Point, OR

Keywords: codling moth, *Cydia pomonella*, mating disruption, puffers, granulosis virus, Surround, kaolin, organophosphates, pear

Abstract: The use of codling moth mating disruption in southern Oregon pear production increased significantly in 2008 after a number of years with little or no growth. Most of the increase in mating disruption is due to increased use of puffers for dispensing pheromone along with greater grower cooperation. A 2008 comparison of an IPM program to a conventional program where mating disruption was not used showed synthetic insecticide use could be reduced by almost 75% while organophosphates were eliminated in the IPM program. In addition to the use of mating disruption in the IPM program, codling moth granulosis virus was used as well as multiple applications of Surround, i.e. kaolin. In this comparison the use of inorganic materials measured in total pounds applied was over four times higher in the IPM program than in the conventional program. An organic program used even higher amounts of inorganic materials, mainly Surround, as that material was the primary control for pear rust mite. While the amount of organic pear production has increased during the last two to three years, the amount of certified or transitional organic acreage remains less than 5% of the total pear production in southern Oregon. A survey of growers in 2008 when compared to a similar survey conducted in 2002 confirmed the increased adoption of mating disruption and continued movement away from organophosphates.

Substituting CM Traps for Sprays Saves Growers Money

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

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

Abstract: Two pear orchards treated with a grid of aerosol puffers situated in the Rogue Valley, OR were used to evaluate the potential value of adopting precision farming to reduce the cost of codling moth management. 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 by 55% and no fruit injury occurred.

Thresholds
Monitoring

Gerry Bohmfalk, moderator

Notes

Thresholds/Monitoring

Codling Moth Monitoring in Mating Disrupted Apple Orchards: Development of Trap Thresholds and Prediction of Fruit Injury in Utah

Diane Alston and Marion Murray
Utah State University, Logan UT

Keywords: threshold, monitoring, codling moth (*Cydia pomonella*), mating disruption, fruit, injury, apple, Utah, 10x, DA, DA-Combo, lure, trapping

Abstract: For the past three growing seasons, (2006, 2007, 2008), we evaluated codling moth lures were evaluated for use in mating disrupted orchards. The most commonly used lure in Utah is the 10x lure, which releases ten times the rate of codlemone. Two newer lure types, DA (composed of a pear ester) and DA-Combo (pear ester plus codlemone), are not widely used because the efficacy of the lures and a trap threshold had not yet been determined under Utah conditions. The 10x, DA, and DA-Combo lures were tested in 15 different orchard blocks in northern Utah (10x and DA-Combo tested in all three years, and DA in two years only) to evaluate lures for capture of codling moth and to develop trap thresholds based on predictions of fruit injury. Traps were placed in mating disrupted orchards starting at biofix. Moths were collected once per week, and gender and mating status were identified in the lab. At the end of the first and second generations, 400 apples from each study site were evaluated for injury. The DA-Combo traps caught the most moths, and both the DA-Combo and the DA lures attracted more males than females. The number of females and mated females the DA-Combo and DA lures attracted were similar. Regression analysis found a strong relationship between fruit injury and each of the DA-Combo and DA lures, and a weak relationship between fruit injury and the 10x lure. For growers to maintain 0.5% injury, a one moth threshold is recommended for the DA trap, and a 10 moth threshold for the DA-Combo trap. These thresholds represent total moths regardless of gender. Results will be field-tested in the 2009 season.

Thresholds

Evaluation of a New Fruit Damage Sampling Protocol for Making Control Decisions for the Summer Generation of OBLR Larvae

Harvey Reissig, Art Agnello, and Jan Nyrop
Entomology Department, NYSAES, Geneva, NY

Keywords: Obliquebanded leafroller, *Choristoneura rosaceana*, sampling. chemical control

Abstract: A new fruit damage monitoring system to determine when and if control of the summer generation of the obliquebanded leafroller, *Choristoneura rosaceana* is necessary was tested in large plots set up in commercial apple orchards in western NY. Proclaim was applied to all plots at petal fall to control the overwintering generation of larvae. Then, the growers agreed to apply normal control sprays during the summer in all of the plot except for two small subplots set up in each block. In these subplots, growers were advised to apply an initial control spray against the summer generation of larvae whenever the first damaged fruit was detected. No subsequent control sprays were recommended in these research plots unless subsequent fruit damage exceeded 1.5% injury. Starting in early July 1000 apples were sampled for OBLR damage in each plot. Two hundred growing terminals were sampled weekly for OBLR larvae in each of the plots so that terminal infestations of larvae and fruit damage could be compared throughout the season. Sampling continued until the last week in August. Damage levels were low in most of the subplots plots throughout the season and no control sprays were recommended in most of the orchards although several plots were treated once. At harvest, OBLR fruit damage was comparable in the subplots treated according to fruit damage sampling recommendations and the grower's standard plots. Therefore, it appears that the fruit damage sampling protocol could be used to make treatment decisions for control of the summer generation of OBLR larvae although more work should be done to optimize the timing and numbers of fruit to be monitored.

Thresholds and Monitoring

Monitoring Oriental Fruit Moth In Mating Disruption Orchards

Walter Bentley and Andrew Molinar
UC Integrated Pest Management Program, Kearney Agricultural Center, Parlier, CA

Key Words: Oriental fruit moth, *Grapholitha molesta*, monitoring, thresholds, bait attractants, peach, population dynamics,

Abstract: Oriental fruit moth, *Grapholitha molesta*, was monitored in mating disruption and non mating disruption orchards. Trapping was done in commercial peach orchards. The use of the bait mixture consisting of water, terpinyl acetate, brown sugar, and B1956 surfactant tracked the dynamics of OFM flight equal to that in the traditional pheromone sticky traps. The initial moth catches in each of four generation were identical for both the bait trapping and the pheromone trapping. Oriental fruit moth catch was greater in bait traps than that in pheromone sticky traps. Where mating disruption was in use, no moths were trapped in OFM pheromone sticky traps but moths were found in bait traps. Preliminary results indicate that bait trapping can serve as a valid indicator of OFM abundance, mating status, and as a method of establishing biofix for supplemental sprays.

Materials and Methods

The information presented here was developed for commercial peach orchards. Some used mating disruption and three were not treated with sprays or with mating disruption products. Orchard size ranged from 3 to 10 acres. Placed in each orchard were two Oriental fruit moth pheromone sticky traps and one, 2-quart terpinyl acetate bucket. These were monitored each week throughout the season. The terpinyl acetate bait was replenished on a weekly basis and the pheromone cap and sticky bottoms changed as per manufacture's recommendation. The moths trapped in the bait bucket were sexed and mating status was determined.

Results

Initiation of OFM flight in each of four generations was identical between the two monitoring methods in non-mating disruption orchards. The abundance of OFM moths in bait traps was statistically ($P<0.05$, FPLSD) greater than those in pheromone traps. In all mating disruption orchards, clear delineation of each generation was found at each site. Based on this information, it appears that OFM activity in bait traps can be used interchangeably with pheromone trap data for timing sprays in mating disruption orchards during the season.

Biological Control

Diane Alston, moderator

Notes

Biological Control

Reduced-risk Insecticides and Natural Enemies in North Carolina Apple Orchards

Vonny Barlow and Jim Walgenbach
North Carolina State University, Mountain HCREC, Mills River, NC

Keywords: Trichogramma minutum, phytoseiid, stigmaeid, predatory mites, egg parasitoid reduced risk insecticides, biological control, apple, chemical control, insecticide

Abstract: Starting in 2007, the impact of reduced-risk and conventional insecticides on important natural enemies found in North Carolina apple orchards including phytoseiid and stigmaeid predatory mites and the egg parasitoid, *Trichogramma minutum,* has been evaluated. Apple orchards using reduced-risk insecticides had greater parasitization of codling moth egg-clusters by *Trichogramma minutum* as well as greater presence of both phytoseiid and stigmaeid predatory mites. This demonstrates that the use of reduced-risk insecticides is less harmful to natural enemy populations. Natural enemy populations are generally more robust in orchards relying on reduced-risk versus older broad-spectrum insecticides, and potentially offer greater opportunities for biological control of certain pests.

Attractants for Green Lacewings in Apple and Pear Orchards

John E. Dunley 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: A field experiment to determine the attraction of lacewings to methyl salicylate (MeSa) and another attractant in apple and pear was conducted in Orondo, Wenatchee, and Peshastin, Washington in 2008. At each of the three experimental blocks, sets of yellow sticky traps were established in transects and baited with either methyl salicylate, another compound (Chem X), both attractants, or no attractants. Traps were established in June and monitored weekly through August. Attractants were changed and locations were re-randomized weekly.

Methyl salicylate and Chem X were both effective attractants in the two crop types tested. Chem X had significantly higher trap catch than methyl salicylate, and the combination lure caught significantly more lacewings than either individual attractant. Both 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.

Biological Control

Survey of Predacious Mites in North Coast Pear Orchards

Rachel B. Elkins[1], Lucia Varela[2], and Beth Grafton-Cardwell[3], Yuling Ouyang[3]
[1]University of California Cooperative Extension, Lakeport, CA
[2]University of California Cooperative Extension, Santa Rosa, CA
[3]Department of Entomology, UC Riverside

Keywords: biological control, predacious mites, phytophagous mites, predatory mites, pears

Abstract: The western predatory mite (*Galendromus occidentalis*) has been largely credited for spider mite control in California due to fairly high host specificity and resistance to organophosphate (OP) insecticides. Use of softer insecticides such as insect growth regulators and fermentation products, as well as changing cropping patterns, have allowed the number and diversity of phytoseiid mites to increase. A reassessment of the presence and abundance of various phytoseiid mite species on multiple tree fruit and nut crops was undertaken from 2005-2007 to improve current and future spider mite pest management. Three pear orchards in Lake and three in Mendocino County were sampled every 2-4 weeks from May through October. Specimens were placed in 70% alcohol and preserved until permanently mounted in Hoyers solution. Date, location and neighboring crops were recorded, and variety, sample date, presence of pest populations, and pesticide history for each block noted. 144 individual mites comprising seven species were collected from all orchards. Another 32 individuals were collected in one of the same orchards in Lake County in 2008. Identified species (and number collected) were *G. occidentalis* (34*), Neoseiulus californicus* (4), *Typhlodromus caudiaglans* (76), *Metaseiulus citri* (49), *Amblyseius anderson* (1), *Euseius tularensis* (1), and *Euseius quetzal* (11). Seventy one percent of the individuals from 2005-07 were from one abandoned orchard. Number of species per site ranged from none in one orchard to six (the abandoned orchard had four). Survey results suggest bio-control from multiple species rather than one or two. Species number and distribution will doubtless evolve with changing pesticide use and crop patterns.

Biological Control

Suppression of Plum Curculio by Entomopathogenic Nematodes in Residential Fruit Trees of Northern Utah

Diane G. Alston and Hong Geun Kim
Utah State University, Department of Biology, Logan, UT

Keywords: *Conotrachelus nenuphar*, *Heterorhabditis bacteriophora*, *Steinernema feltiae*, Coleoptera, Curculionidae, biological control, field applications, population suppression, apple, sweet cherry

Abstract: A localized infestation of plum curculio, *Conotrachelus nenuphar*, in northern Utah is the only known occurrence of this economically damaging fruit pest in western North America. To determine if entomopathogenic nematodes could provide a low toxicity and sustainable option for suppression of plum curculio in residential fruit trees where it poses a threat for spread to commercial orchards, *Heterorhabditis bacteriophora* and *Steinernema feltiae*, were applied to the soil beneath infested trees of 11 residential sites from mid June through July or early August in 2004-2006 (45 plots across treatments and years). Two and three successive years of nematode applications (0.5 to 2.0 mill infective juveniles per m^2 per season) reduced plum curculio adult trap captures as compared to one year of applications. Densities of summer generation (reproductively immature) females were less in nematode-treated as compared to untreated plots in two of the three study years. Both nematode species became established in plots based on soil-baiting with *Galleria mellonella* last instars, and were detected one and two months after applications. Low to moderate levels of *Heterorhabditis* spp. were detected in untreated plots indicating that this nematode is endemic and widespread in Brigham City, UT.

Biological Control

Microbial Control of Apple Clearwing Moth

Lawrence Lacey[1] and Joan Cossentine[2]
[1]USDA-ARS, Yakima Agricultural Research Laboratory, Wapato, WA
[2]Agriculture and Agri-food Canada, Summerland, Canada

Keywords: apple clearwing moth**,** *Synanthedon myopaeformis*, invasive species, apple

Abstract: The apple clearwing moth (ACWM)**,** *Synanthedon myopaeformis*, is established in commercial apple orchards in southern British Columbia. This invasive pest presents a control challenge for orchardists due its biology, two year life cycle and protection of larvae by extensive tunnels in the cambium. Heavy infestations have the capability of causing significant debility or death in young trees. In Europe native natural enemies (parasites, predators, pathogens) of ACWM exert significant control. ACWM larval tunnels are not plugged with frass tubes and therefore may present potential channels for delivering microbial control agents such as insect-specific nematodes and fungi. Preliminary laboratory and field trials in 2008 indicated that two nematode species successfully killed larvae within a wide range of temperatures. Also several field-collected larvae became infected with fungi. ACWM larvae are also susceptible to the commercially-produced fungus *Beauveria bassiana*.

The Potential of a Biofumigant Fungus for Post-Harvest Control of Codling Moth

Lawrence A. Lacey and Clive Kaiser
Yakima Agricultural Research Laboratory, USDA-ARS, Wapato, WA
Oregon State University Extension Service, Milton-Freewater, OR

Keywords: codling moth, biofumigant, *Muscodor albus*, post-harvest, apple, *Cydia pomonella*

Abstract: Codling moth is a serious pest of pre-harvest apple and pear and a threat to exportation of apples because of the possibility of shipping infested fruit. The need for alternatives to fumigants such as methyl bromide for quarantine security of exported fruit has encouraged the development of effective fumigants with reduced side effects. The symbiotic fungus, *Muscodor albus*, produces volatile compounds that are biocidal for bacteria and fungi that cause rot in stored apples and other fruit, plant parasitic nematodes and insects. We studied the effects volatile organic compounds (VOCs) produced by *M. albus* on codling moth adults, neonate larvae, larvae in infested apples, and diapausing cocooned larvae in simulated storage conditions. Our data on treatment of several stages of codling moth with *M. albus* VOCs indicate that the fungus could provide an alternative to broad spectrum chemical fumigants for codling moth control in storage and contribute to the systems approach to achieve quarantine security of exported apples. An additional benefit of this biofumigant is protection of stored apples from rot organisms.

Minutes of the 82nd Annual Meeting
Orchard Pest and Disease Management Conference
Hilton Hotel, Portland, Oregon
January 9 -11, 2008

I. Call to Order

The **82**nd Annual Meeting was called to order by the President Harvey Reissig at 10:00 AM. President Reissig extended an official welcome to everyone. President Reissig then called for the participants to introduce themselves. President Reissig introduced section leaders. They were:

Biological Control	- Lerry Lacey
Resistance Management	- Alan Knight
Chemical Control/New Products	- Elizabeth Beers
Biology/Phenology	- David Epstein
Mating Disruption/SIR	- Larry Gut
Thresholds/monitoring	- Art Agnello
Implementation	- Loys Hawkins

II. Old Business

A. Issues Arising from the Meeting of the Board of Directors

President Reissig announced that the Board of Directors held their annual meeting at 7 AM on Wednesday, January 9. The Board consisted of Past President Walt Bentley, President Harvey Reissig, President Elect Tom Larsen, Executive Director, Donald Thomson, Program Chair John Dunley and Secretary/Treasurer Nancy Hays.

B. Reading of 2007 Minutes: It was moved and seconded that the reading of the minutes be dispensed with and that the minutes be approved as written. Secretary Hays indicated that the minutes would be posted at the registration desk and that members could also review them in the appendix to the abstracts or on the organization's web site.

C. Miscellaneous

Peter Witzgal was unable to make the meeting. Patrick Guerin took his place as a keynote speaker.

Thursday a poster session was held from 10-10:30 AM. The presenters were asked to be available for questions.

Speakers were asked to stay on point and keep to the time allocated.

President Reissig called for a report of the officers. There were no reports.

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

III. New Business

A. Committee Assignments

The following committee assignments were made:

Nominations: Rachel Elkins, Phil Van Buskirk, and Rick Hilton
Audit: Timothy J. Smith, Broc Zoller, and Dave Epstein
Resolutions: Mike Willett, Peter Shearer and Larry Hull

B. PCA Sign Up Sheets

Sign up sheets will be available at the registration desk by afternoon coffee.

C. Call for Further New Business

There was no further new business. The business meeting was then adjourned until 11:00 AM, Friday, January 11.

IV. Closing Business Meeting

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

President Reissig called for further new business.

President Reissig then called for the committee reports.

A. Committee Reports:

1. Nominations:

The nominating committee nominated Lerry Lacey, USDA, ARS, 230 Konnowac Pass Road, Wapato, WA 98951 as President Elect, Nancy Hays, Pacific Biocontrol Corporation, 14615 NE 13th Court, Suite A, Vancouver, WA 98685 as Secretary/Treasurer, Helmut Riedl, Oregon State University, 3005 Experiment Station Drive, Hood River, OR 97031 as Executive Director and John Dunley, Washington State University, Wenatchee, WA as Program Chair for the 2009 meeting. A motion was made and seconded to accept the recommendations of the nominations committee. The motion passed unanimously. Harvey Reissig, Cornell University, Geneva, New York will be the Past-President for the 2009 meeting and Tom Larsen, Suterra LLC, 213 SW Columbia, Bend, OR 97702 will be the President for the 2009 meeting.

2. Audit

The Audit Committee reported that they have examined the Report of the Treasurer and recommended that the membership accept the report of the Treasurer. It was moved, seconded and approved.

Nancy Hays gave the Treasurers report. She reported that the balance forward from December 31, 2006 was $2,214.01. The 2007 meeting took in $8,579.00. Expenses in 2007 were $6,525.55. The balance as of December 31, 2007 was $4,267.46. For the 2008 meeting we have taken in dues of approximately $8,400.

3. Resolutions

a. Be it resolved that this conference extend written appreciation to the management and staff of the Hilton Hotel for the courteous service and the fine accommodations provided.

b. Be it resolved that the members of the conference express their appreciation to Past President Walt Bentley, President Harvey Reissig, Secretary/Treasurer Nancy Hays, Executive Director Don Thomson and Program Chair John Dunley for their leadership and dedication in organizing the 2008 meeting.

c. Be it resolved that the members of the conference extend their appreciation to the Tree Fruit Research and Extension Center, Washington State University and in particular Christina Mayer for applying for pesticide applicator credits from the various states.

d. Be it resolved that the members of the conference extend their appreciation to the Tree Fruit Research and Extension Center, Washington State University, Wenatchee, and in particular Christina Mayer and John Dunley, for preparing the abstracts.

e. Be it resolved that the members of the conference extend their appreciation to the Tree Fruit Research and Extension Center, Washington State University, Wenatchee and in particular Jerry Tangren, Christina Mayer and John Dunley, for organizing and maintaining the WOPDMC web site.

e. Be it resolved that the members of the conference extend their appreciation to the Tree Fruit Research and Extension Center, Washington State University, Wenatchee for the Poster Boards.

f. Be it resolved that the members of the conference extend their appreciation to the section leaders: Lerry Lacey, Alan Knight, Elizabeth Beers, David Epstein, Larry Gut, Art Agnello, and Loys Hawkins.

g. Be it resolved that the Secretary write letters of condolences to family of members Bill Hudson, Martin Barnes and Don Berry who passed away last year.

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

John Dunley asked to have a discussion about the idea to limit the number of talks. The membership decided not to limit the number of talks and instead leave it up to the Program Chair to work with presenters to ensure that the number of presentations is suitable and that the subject matter is appropriate.

Jim Miller was awarded the Rubber chicken award.

It was announced that the meeting for the 2009 meeting would take place the 2nd full week of January.

President Reissig thanked those who had attended and helped in various capacities to make the 82nd Pest and Disease Management Conference a success. President Reissig turned over the proceedings to President Elect Tom Larsen. He adjourned the meeting.

Respectfully Submitted,

Nancy J. Hays
Secretary/Treasurer
Orchard Pest and Disease Management Conference

Notes