Western Orchard Pest and Disease Management Conference

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For information, see: http://entomology.tfrec.wsu.edu/wopdmc/format.html
Agenda for 2004 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 at which that will occur.

Talks within a session will be in the order in which they are listed in the Conference Abstracts, which will be picked up when you pay your registration fee at the beginning of the conference, or can be viewed at http://entomology.tfrec.wsu.edu/wopdmc/index.html.

See the section on "Information for Presenters/Report format" for more information.

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PEST AND DISEASE MANAGEMENT CONFERENCE
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<td>Cherry Fruit Fly Management at the Agricultural-Urban Interface in the B.C. Interior (Thistlewood &amp; DeLury)</td>
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Abstract: The U.S. tree fruit industry has based its success on production efficiency, product quality and worldwide marketing of its fresh and processed apple, pear and cherry crops. To sustain its success in domestic and international markets, this industry must rapidly adjust to the dynamics of globalized trade and technology. A world marketplace that requires high quality fruit and fruit products at globally competitive prices demands that the U.S. tree fruit industry reinvigorate itself. Decisions about how and where technology can be implemented are critical. The entire industry and its research community must be involved in this initiative. We have developed and documented a roadmap for technological innovation. This Technology Roadmap (full text available on line at http://www.treefruitresearch.com) comprises three major components: the status of the industry, key barriers to future success and R & D priorities to overcome these barriers. The document was originally developed by the Pacific Northwest tree fruit industry but has now expanded into a broad national effort. It recognizes that technology is, at least in part, an answer to globalization and competition. Our effort addresses the fundamental question: How can science and technology be used to advance efficiency and quality in tree fruit production and processing sector while maintaining the integrity of the environment and enriching the opportunities of its people? In 2004, we will be mobilizing a focused effort involving the tree fruit production and processing sectors, with their research partners, to push for increased investment in selected priority areas. While the immediate beneficiaries of this effort are the producers, work force and communities of the U.S. tree fruit industry, its ultimate success will be the continued supply of the highest quality fruit to consumers worldwide. Our industry and our communities are enduring unprecedented and devastating economic conditions. This Roadmap is unique because it matches the magnitude of the solution to the magnitude of the problem.
Mating Disruption/SIR

Jeff Olsen, moderator
Mating Disruption/SIR

Response of Four Tortricid Species to High-Dose Pheromone Sources

Lukasz Stelinski, Larry Gut and James Miller
Michigan State University, East Lansing, MI

Keywords: Cydia pomonella, codling moth, Grapholitha molesta, oriental fruit moth, Choristoneura rosaceana, obliquebanded leafroller, Argyrotaenia velutinana, redbanded leafroller, mating disruption, pheromone

Abstract: The responses of male codling moth (CM), oriental fruit moth (OFM), obliquebanded leafroller (OBLR) and redbanded leafroller (RBLR) were compared using electrophysiological analyses, wind tunnel assays and behavioral observations in the field. In a series of wind tunnel assays, brief exposures of male OBLR and RBLR to the plumes generated by lures releasing pheromone blends specifically tuned for each species or by commercially distributed Isomate OBLR/PLR Plus pheromone 'rope' dispensers induced different subsequent behavioral responses to pheromone. Pre-exposure of RBLR to pheromone resulted in decreased attraction to a lure and increased attraction to a rope. For OBLR, pre-exposure increased responsiveness to its tuned blend. Orientational responses of the four tortricids in the field to high-release pheromone rope dispensers were directly observed in apple plots treated or untreated with pheromone ropes. Attraction of male moths to rope dispensers proved to be more of the rule than an exception. Numerous OBLR, RBLR and OFM were attracted within 100 cm of their respective pheromone ropes in a plot not treated with pheromone. OBLR and OFM also came within 100 cm of their respective rope dispensers in a fully pheromone-treated orchard plot. No CM males were observed orienting to or landing near their respective rope dispensers in either the untreated or pheromone-treated plots.

Mating Disruption/SIR

Relationship of Point Source Distribution to Mating Disruption Success

David Epstein, Larry Gut and James Miller
Michigan State University, East Lansing, MI

Keywords: Cydia pomonella, codling moth, Grapholitha molesta, oriental fruit moth, mating disruption, pheromone

Abstract: Using small and large plot field trials, we examined the relationship between point source distributions and mating disruption success. One set of experiments entailed varying the numbers of point sources per area while maintaining a constant amount of pheromone applied per area. The experimental design was a randomized complete block replicated at four locations. Treatments were randomly assigned to 1-acre plots within each block. Treatments included an untreated check and at least five point source densities. Levels of trap shutdown within the center and on the edges of plots increased with increasing numbers of point sources. Very high levels of at least 97% inhibition of catches were recorded only at the high point source densities. Substantially better disruption of orientation to traps was achieved in the center compared to the plot edges at all point source densities. A second experiment involved a direct comparison of Isomate C Plus and CTT dispensers deployed at full and half rates in 10-acre commercial blocks at four locations. All pheromone treatments provided mean levels of trap shutdown of at least 95%. Despite high levels of trap shutdown, some fruit injury occurred in all treatments. However, most of the damage was detected on the edge of plots, especially those treatments with half rates of pheromone.
Mating Disruption/SIR

Virgin Female Trapping with Leafrollers and Codling Moth in the Field

Nik G. Wiman, Vincent P. Jones and Jay F. Brunner
Washington State University Tree Fruit Research and Extension Center, Wenatchee, WA

Keywords: Mating tables, mating disruption, obliquebanded leafroller, codling moth, Cydia pomonella, Choristoneura rosaceana

Abstract: Mating tables are an invaluable tool for researching mating behavior of codling moth (CM) and leafrollers (LR) in the field because they allow adult females to be used as sentinels to determine when and where mating occurs. We are using a simple design consisting of a clear tube with inverted screen funnels at each end. Each tube is housed in a standard LPD trap for shelter. Photo-conditioned virgin adult female CM or LR are contained in the tube by the funnels, and they call readily at dusk. Males enter through the funnels and become trapped, allowing the night of mating to be determined with daily monitoring. The design has proven effective where populations of CM and LR are extremely high but requires improvement to effectively measure CM mating under MD conditions. Our findings in conventional orchards demonstrate that approximately 40 and 38% of CM females mate on the first and second night of adult life, respectively. With OBLR, between 63 and 68% of females mated on the first night of adult life in both conventional and MD orchards. The remaining females tended to mate within a few days with both CM and OBLR. Efficacy of current OBLR MD technology appears questionable because females readily trapped wild males despite their location in close proximity to active pheromone dispensers. Mate selection and/or multiple matings were relatively common, as individual LR and CM females frequently attracted multiple males per night.

Mating Disruption/SIR

Alternative Mating Disruption Choices for Codling Moth and Leafroller

Betsy Stutzman and Jay F. Brunner
Washington State University Tree Fruit Research and Extension Center, Wenatchee, WA

Keywords: codling moth, Cydia pomonella, leafroller, Choristoneura rosaceana, mating disruption

Abstract: Alternatives to hand-applied mating disruption technology for codling moth and leafrollers continue to be evaluated. Scentry Biologicals NoMate CM and OBLR Fibers were evaluated in large 15-acre sites at rates of 100, 200 or 200 grams of fiber plus pesticide compared with untreated (no pheromone), Checkmate XL-1000 or Isomate C+ hand-applied dispensers. Most sites showed a reduction in trap catch compared to an untreated control but this was not always directly correlated with fruit injury or larval densities. IPM Technologies LastCall OBLR/PLR Attract and Kill formulations were evaluated in large 15-acre and smaller 1-acre sites replicated 2-4 times. Rates of 300, 600 or 1200 drops per acre were compared to untreated (no pheromone) controls. There was no rate effect observed in drops per acre but all rates significantly reduced trap catch compared to the untreated control. Evaluations of overwintering populations will be conducted in early spring 2004 to determine effects of 2nd generation applications of Scentry Biologicals NoMate CM and OBLR Fibers and IPM Technologies LastCall OBLR/PLR formulations on populations of 2003.
Abstracts of the 78th Annual Western Orchard Pest & Disease Management Conference

Mating Disruption/SIR

Advances in Use and Augmentation of Lower Rates of Sprayable Pheromone for Mating Disruption of Codling Moths in Walnuts

Douglas Light, Kathy Reynolds, Robert Fritts and Bill Lingren
USDA-ARS, Western Regional Research Center, Albany, CA

Keywords: mating disruption, sprayable pheromone, kairomone, DA, microencapsulated, codling moth, Cydia pomonella

Abstract: The efficacy of applying lower rates (both 5 and 10 grams/acre) of microencapsulated sprayable pheromone (Ph-MEC, Certis, Inc.) was tested in mating disruption (MD) trials on codling moth (CM) in California walnut orchards. These tests also investigated the novel use of a microencapsulated sprayable formulation of the pear-ester kairomone (ethyl (2E, 4Z)-2,4-decadienoate) (DA-MEC, Trécé, Inc.) as an adjuvant to augment the disruption efficacy of Ph-MEC in walnut orchards. The ability of the kairomone DA-MEC to augment and enhance the MD activity of the Ph-MEC was conducted in two studies in 17 walnut orchards/blocks. The design was to test whether the DA-MEC will 1) perform similarly to sprayable pheromone in “shutting-down” or decreasing CM capture in kairomone-baited monitoring traps (6 traps/treatment block), 2) affect the pheromone control efficacy and 3) influence the degree and number of female matings. The first or “fixed-rate” study was replicated in six walnut orchards (Vina, Serr, Hartley and Chandler var.). The second or “variable-rate” study was replicated in 11 blocks in two walnut orchards (Hartley var.). Impact of these two studies shows that reduced rates of Ph-MEC will control CM in low to moderate CM population orchards and that the DA-MEC adjuvant might improve the efficacy of these more affordable lower rates of pheromone MEC in MD.

Mating Disruption/SIR

How We Can Make Codling Moth Mating Disruption Work

Alan Knight
USDA, ARS, Yakima Agricultural Research Laboratory, Wapato, WA

Keywords: Codling moth, Cydia pomonella, sex pheromone, apple, mating disruption, microencapsulated sprayable, puffers, Pheromone Mops, attract and kill, Last Call, Isomate C+, Isomate C-tt

Abstract: The efficacy of several approaches that use the sex pheromone of codling moth to manage this important pest in apple has been investigated over the past 14 years. These tactics include the use of hand-applied dispensers, microencapsulated sprayables, widely spaced high emission sources such as puffers and the Pheromone Mop, attract and kill paste drops and the application of chopped capillary fibers. It has been difficult to demonstrate that the use of hand-applied dispensers can adequately prevent mating by codling moth. Nor does increasing the density of dispensers noticeably increase the disruption of mating. A delay in egg hatch (= delay in mating) was demonstrated in three orchards treated with a full rate of Isomate C+. Whether a similar delay occurs in orchards treated with reduced rates of dispensers is unknown. The current use of microencapsulated sprayable formulations applied with air blast can be improved by increasing the number of capsules deposited in the canopy and especially by increasing the density of leaves with a high number of capsules, >20. This can be accomplished by reducing the amount of water applied, reducing the spray pressure of the application and with the addition of an effective sticker. The use of widely spaced high emission dispensers such as puffers and Pheromone Mops appear to be more effective in disrupting mating than the use of hand-applied dispensers. In addition, their use has also been shown to be effective in ensuring low levels of codling moth fruit injury. The sex pheromone-based attracticide approach can be effective if the appropriate number of drops is applied to compete successfully with the density of calling females. The Last Call paste formulation was found to form a larger oil-based halo around each drop that is effective in killing moths. We also found that the attractiveness of Last Call droplets is significantly reduced in orchards treated with Isomate dispensers the previous season or when used as a supplemental border application. The successful deposition and retention of the chopped fibers mixed with an adhesive remain serious limitations with this approach. An alternative approach using a paintbrush was much more effective in depositing fibers in the canopy.

Mating Disruption/SIR

Low Rate-Frequent Applications of Sprayable Pheromones for Oriental Fruit Moth and Codling Moth Management in Pennsylvania

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Penn State University, Fruit Research and Extension Center, Biglerville, PA

Keywords: Codling moth, Cydia pomonella, oriental fruit moth, Grapholitha molesta, mating disruption, sprayable pheromones

Abstract: The effect of low rate-frequent applications of sprayable pheromones (3M Canada and Suterra, Inc.) was evaluated for both oriental fruit moth and codling moth management in various commercial apple orchards during 2003. For the oriental fruit moth, alternate row middle applications of sprayable pheromones from both companies were applied at rates varying from 2.5-5.2 g AI per acre per side of the tree and were compared with a non-pheromone treated area. For the codling moth, alternate row middle applications of sprayable pheromones from both companies were applied at rates varying from 2.5-7.5 g AI per acre per side of the tree and were compared with hand-applied dispensers (Isomate CM/OFM TT and Isomate CM TT at 200 dispensers per acre, CBC America) and a non-pheromone treated area. Insecticides continued to be applied at varying rates and frequency depending upon the perceived need for both OFM and CM and other pests present in all pheromone and non-pheromone treated blocks. All treated blocks were monitored for each species with large delta traps baited with standard lures and a high-load (10X) pheromone lure for CM. In addition, “DA” lures were used for monitoring both male and female CM activity. Fruit injury was evaluated at mid-season and at harvest in all treated blocks. Shutdown of OFM trap capture ranged from 95-100% in all sprayable pheromone treated blocks with as little as 15 g AI per acre for the season. In addition, similar or reduced levels of fruit injury attributable to OFM were also found in the pheromone treated blocks in comparison to the conventionally treated blocks. Shutdown of CM trap capture was much lower and ranged from 60-90% in all sprayable pheromone treated blocks despite the application of 45 g AI per acre. No reduction in CM-related fruit injury was found in any of the sprayable pheromone treated blocks.

Mating Disruption/SIR

Lessons Learnt in Three Seasons of Managing Codling Moth at Very Low Densities by SIR

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Keywords: codling moth, Cydia pomonella, sterile insect release, semiochemical suppression, mating disruption, management, chemical alternatives, flight, radiation, reinfestation

Abstract: By 2006, the Okanagan-Kootenay Sterile Insect Release Program must provide an areawide management program for codling moth in key fruit-growing areas of the BC interior at significantly lower cost than today. We present results from research into minimal and sustainable service using semiochemical suppression and sterile insect release. From May 2001 to July 2003, we managed a test area in the Similkameen Valley comprising 326 acres of apple orchards and 24 acres of pear blocks, in 39 properties worked by 25 growers, set in 2,211 acres of mixed land use. The moth population was monitored annually at up to 211 trap locations, with codlemone or DA2123 lures, and was investigated annually by fruit checks, using cardboard tree bands and interviews with growers when moths or damage were found. Releases of sterile moths irradiated at different Gy were studied in cool spring weather and warm summer conditions when released from various locations. In 2003, we trapped a total of 7 unmarked moths between May 28 and June 30 and found trace damage in one location, as compared with 18 unmarked moths season-long with nearby light damage in three orchards in 2002, and with two unmarked moths season-long and no codling moth damage in 2001. From the patterns observed, we conclude that the primary risk of repopulation of the study area arose from movement of moths on bins or bin parts.
Mating Disruption/SIR

Mating Disruption for Control of Navel Orangeworm in Almonds and Pistachios

Bradley S. Higbee¹ and Charles S. Burks²
¹Paramount Farming Company, Bakersfield, CA, ²USDA-ARS, Parlier, CA

Keywords: Amyelois transitella, navel orangeworm, mating disruption, pheromone, puffer, almond, pistachio, membrane dispenser

Abstract: Puffers and membrane dispensers (Suterra) containing (ZZ) 11,13-hexadecadienal, a major (and the only identified) component of the navel orangeworm (NOW) sex pheromone, were evaluated for disruption of mating and damage reduction in almonds and pistachios. Puffers deployed in grids and perimeters around 40 acre test plots (2 per acre), membrane dispensers (almond only, 150/acre) and conventional insecticide programs were compared to untreated control plots. Each section was monitored with NOW virgin baited delta-type flight traps (25 per section), mating assays, blank traps and NOW egg bait traps. We found that NOW adults were present and highly prevalent in all four pistachio sections from early March until December, in contrast to the almonds in which few NOW were captured prior to July 28. The mating disruption technologies had pronounced biological impact in both crops, reducing males captured in female-baited flight by 94-99% and the number of females mated in assays by ~80-90%. However, in all pistachio sections the proportion of nuts damaged by NOW was not significantly different in blocks receiving mating disruption treatments compared to untreated control plot damage. This was a distinct contrast with almonds, in which the range of damage was much greater, and the mating disruption treatments had significantly less damage than untreated controls.

Mating Disruption/SIR

Effect of Temperature, Season and Population Density on Likelihood of Success in Mating Assays with Female Navel Orangeworm

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Keywords: Mating disruption, mating assay, navel orangeworm, Amyelois transitella, almond, pistachio

Abstract: We performed mating assays with unmated female navel orangeworm, Amyelois transitella Walker, as part of a study of biological and economic impact of mating disruption. We found a wide range of mating rates in the absence of mating disruption and therefore also performed a series of mating assays under more closely monitored field conditions to characterize the performance of this assay. We examined the effect of temperature and day length, the prevalence of males in the test area, the presence or absence of wood perches in the arena and time spent in a cooler prior to field placement on the proportion of females mated. We conclude that the mating assay protocol that we used is influenced most strongly by the temperature and local population density of males and that the assay provided useful information about the efficacy of mating disruption in situations where the mating was well under 100% among females not exposed to mating disruption treatments.
Mating Disruption/SIR

Mating Disruption in a System Where the Trees are the ‘Fruit’

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Keywords: Western poplar clearwing moth, *Paranthrene robiniae*, poplar, mating disruption

Abstract: The Western Poplar Clearwing Moth (WPCM), *Paranthrene robiniae* (Sesiidae), is the most economically important pest of hybrid poplar in Washington and Oregon. WPCM larvae burrow into poplar, causing galleries that discolor the heartwood and weaken limbs and trunks to the point of breakage. Historically poplars have been used only for high quality paper pulp but, with pulp value dropping, Potlatch® has switched its target product to quality veneer logs and WPCM galleries cannot be tolerated. Chlorpyrifos (44,000 pounds) failed to control WPCM in 2002. Potlatch® is restricted by guidelines of the Forest Stewardship Council, which prohibits the use of broad-spectrum pesticides. Boise® is not as restricted in its choice of insecticides but is still very enthusiastic toward a ‘soft’ management strategy. We received a Section 18 and implemented a pheromone-based mating disruption strategy in 2003 that targeted 8,000 acres of newly planted and 1-year-old trees. Here we will report our season-long trap catch data, effects of the pheromone treatments and results of our damage survey. Membrane dispensers were more effective but expensive to apply, and flowable formulations of 0.5 g/acre/season effectively suppressed trap capture. Monitoring traps in non-treated blocks were influenced even at one mile from any application of pheromone.

Mating Disruption/SIR

Effect of Low Temperature on the Relative Release of Codlemone from Various Commercial Mating Disruption Products

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Suterra LLC, Bend, OR

Keywords: codling moth, *Cydia pomonella*, mating disruption, codlemone, temperature effect

Abstract: Laboratory tests were performed to evaluate how low temperature affects the release rates of several codling moth (CM) mating disruption products. The relative release of codlemone was determined for six commercial CM products. The samples were exposed in an environmental chamber at 59°F (15°C) and an air turnover rate of once every 1.5 minutes. Results indicate that all mating disruption products tested release codlemone at 59°F.
Implementation Programs

Carolyn Pickel, moderator
Implementation

Mating Disruption in Organic Orchards in Arizona: A Brief 10-year History

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InterMountain Ag Inc. and Briggs and Eggers Orchards, Willcox, AZ

Keywords: apple production, organic, mating disruption, codling moth, *Cydia pomonella*, thrip, pheromone, alternative control methods

Abstract: Briggs and Eggers Orchards have been using mating disruption in organic apple and pear production for 10 years. The Arizona high desert production area and the pest complex faced there present a rather simple ecosystem into which organic production can be done. The current strategy and the evolution of past tactics and strategies have enabled successful certified organic apple and pear marketing.

Implementation

Areawide II and Best Management Practices for Orchard Spraying: Projects Aim to Reduce Grower Reliance on OP Insecticides and Protect Water Quality

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Oregon State University, Mid-Columbia Agricultural Research and Extension Center, Hood River, OR

Keywords: pear, areawide, best management practices, extension, outreach, water quality

Abstract: Implementation of the Areawide II Project in Oregon has focused on pear production in the Hood River and Medford growing districts. Information generated from the research components of the project has been disseminated using traditional Extension methods including newsletters, newspapers, trade magazines, field days and workshops. Additionally, the Oregon Fruit Crop Pest Alert System, an Internet-based system for delivering near real time notification of critical events in pest development, has been developed. Technical support materials developed include a Spanish language guide for pest monitoring programs in pears. In both districts, unmanaged trees have been the target of outreach programs to the general public to reduce potential threats to commercial orchards. As new information is generated from the research components of the Areawide II project, it will be integrated into these ongoing Extension programs. Projects that complement the goals of the Areawide II Project have been carried out in both districts. In Hood River, the Hood River Grower-Shipper Association Best Management Practices (BMP) Project supports grower adoption of orchard pest management practices that protect water quality. Information on BMPs for pesticide use and alternatives to organophosphate insecticides has been integrated into a grower handbook and website and disseminated through an intensive outreach program.
Implementation

Michigan Organic Apple Production

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East Lansing, MI

Keywords: organic apple production, functional diversity, ground cover management, disease management, insect and disease damage

Abstract: A 5-yr-old Michigan State University Experiment Station apple orchard at Clarksville was certified organic by OCIA in 2003. The three varieties and replicated plot design provided data on organic apple yield, pest control practices, rootstock by scion interaction and ground cover/diversity strips. Insect and disease control strategies included a range of practices including pheromone disruption, codling moth virus, kaolin clay, Bt, pyrethrum, neem treatments, sulfur, oil and lime sulfur. Three ground cover strategies were also compared including the Swiss Sandwich, Michigan Compost and blown inter-row compost with propane flaming. Plant diversity strips designed to provide pollen and nectar reward to predators and parasites were also incorporated into the system in 2003. Overall damage from insects was below 20% at harvest. The yield and damage data were compared across the replicates and with other organic apple sites throughout the state. Disease management included several strategies for fire blight and scab. Fire blight conditions at this site were not severe in 2003 and very low damage was observed. Scab injury was significant in some varieties and the variety by disease-management-strategy interaction was significant (P<0.05). Ground cover systems were evaluated for weed growth and density within the drive row and under the trees. The Michigan Compost System was most effective and economical compared to the Swiss Sandwich System and the blown drive row clipping compost together with flaming system.

Implementation

Can You Survive Without Organophosphate Insecticides? After 3 Years and at 15 Locations, the Answer is Yes!

Jay Brunner, Mike Doerr, Elizabeth Beers, John Dunley and Vince Jones
Washington State University Tree Fruit Research and Extension Center, Wenatchee, WA

Keywords: Apple, pest control, organophosphate, selective insecticide, growth regulator, Guthion, Lorsban, Intrepid, Esteem, Success, Assail, codling moth, Cydia pomonella, leafroller, lacanobia fruitworm, Lacanobia subjuncta, secondary pests

Abstract: We compared three years of pest control at several sites using codling moth (CM) mating disruption as a base program supplemented with either “conventional” insecticides (OP) or newly registered selective insecticides (NON-OP). In apple orchards that started with moderate to high CM pressure, populations declined in both OP and NON-OP blocks over the 3-year duration of the project. In apple orchards that started with low to moderate CM pressure, populations did not increase over the duration of the project. The average insect control cost of the NON-OP program was slightly higher than the OP program in Year 1 of the project but was lower or the same in the last two years. Removing OP insecticides (essentially chlorpyrifos [Lorsban 4E]) from the pre-bloom control program did not result in increased problems with scale, aphids, mites or sucking bugs in the 15 apple orchards in our study. There were NO unexpected increases in pest problems from “secondary” insects in either the OP or NON-OP blocks at any location. Secondary pest populations were low in all orchards as was the level of injury to fruit at harvest. Monitoring of codling moth, leafrollers and lacanobia fruitworm provided growers with information needed to respond with well-timed control measures where needed. Management of lacanobia fruitworm became easy in both OP and NON-OP blocks with the introduction of newly registered insecticides.
Implementation

Organic and IPM Programs for Areawide Pest Management of Pear

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

Keywords: organic, organophosphate, areawide, pear, pear psylla, Cacopsylla pyricola, codling moth, Cydia pomonella, biocontrol

Abstract: In 2002, an Areawide Organic Management Program was established on 310 acres of contiguous pear in a small valley near Peshastin, WA. Organic pest management practices were implemented for insect and mite control throughout the project. Approximately 50% of the acreage was Certified Organic; however, other organic practices were not required in the remaining acreage (e.g., nutrient, rodent, and weed control were conventional). Over two years, there was a reduction in pesticide use and an associated reduction in insecticide costs. However, there have been no correlated increases in overall natural enemy densities. Fruit yield and quality have been maintained, and alternative marketing programs have been explored.

In 2003, pear psylla densities were much lower across the entire project area than 2002, and densities remained below economic threshold levels. Spider mite pressure was generally low, although an outbreak of pear rust mite occurred in one orchard. Codling moth pressure was surprisingly high in 2003, but management programs proved very effective at controlling fruit damage. Despite 1st generation trap catches of over 100 moths in several locations (up to 315), pre-harvest damage was at or below 0.5% in all locations that followed control recommendations. Low predatory insect densities were found in all programs, with increases in late season correlated with increasing pear psylla. This suggests that damage thresholds for pear psylla may be too low to sustain higher densities of natural enemies. Nevertheless, predators appear to be more numerous in orchards under organic pest management.

Implementation

Doubling-Times and Half-Lives: Considerations for IPM Programs under Heavy Codling Moth Pressure

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Keywords: apple, chemical control, codling moth, Cydia pomonella, degree-day, insecticide half-life, IPM, spray coverage, surface area

Abstract: The concentration of insecticide residual on the surface of an apple tends to decrease over time as the insecticide degrades and the fruit expands. The most pronounced change (% increase) in apple surface area occurs early in the season, which is also when the eggs of codling moth, Cydia pomonella, begin hatching. Rapidly increasing surface area during this critical period has implications for codling moth management, especially in areas with severe infestations. Season-long codling moth trap counts in northern Utah averaged 229 moths/trap in 2003, and there were substantial economic losses in various locations. General fruit growth patterns (based on estimates of ‘Red Delicious’ diameters from 1996-1999) and codling moth development (based on degree-day accumulations) are presented. The half-lives of commonly used insecticides are presented as well, with an emphasis on the relationship between residual concentration and codling moth development. To accommodate seasonal surface area dynamics and the natural breakdown of insecticides, the Utah State University Extension IPM program advises on the importance of mating disruption, adequate spray coverage and the use of degree-day accumulations in management decisions.
Implementation

Cooperative Field Demonstrations of Fiber Technology for Mating Disruption in Codling Moth in Washington

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Scentry Biologicals Inc., Billings, MT

Keywords: NoMate fibers, mating disruption, codling moth, *Cydia pomonella*, pheromone

Abstract: Several medium to large scale field development trials were done in the Columbia Basin of Washington. Various cooperators utilized fiber technology being developed by Scentry Biologicals Inc. Attempts were made to make the trials as grower practical as possible and efforts were made to implement the strategy in a way that would supplement current codling moth management practices.

Implementation

Reducing Pesticide Use in California Walnuts: The San Joaquin Walnut BIOS Project

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Keywords: codling moth, *Cydia pomonella*, pheromone mating disruption, walnut aphid, *Chromaphis jundicola*, webspinning spider mites, *Tetranychus urticae*

Abstract: This study compared the effectiveness of Biologically Integrated Orchard Systems (BIOS) with conventionally managed walnut orchards in the northern San Joaquin Valley from 1999 to 2001. We found no significant differences between BIOS and conventional blocks in nut quality or yields. Codling moth was effectively controlled by pheromone mating disruption. Substantially fewer conventional insecticide applications were made in BIOS blocks, mainly as a result of replacing codling moth sprays with mating disruption. Webspinning mite and walnut aphid were similar in BIOS and conventional blocks. Key generalist predator species were more abundant in BIOS blocks.
Implementation

Eastern RAMP 2003 Results, NJ Peaches

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Keywords: Mating disruption, oriental fruit moth, tarnished plant bug, plum curculio, reduced-risk, leafrollers, San Jose scale, Grapholitha molesta, Lygus lineolaris, Conotrachelus nenuphar, Quadraspidiotus perniciosus

Abstract: Eight peach orchard blocks were divided approximately in half and each half was assigned one of two treatments. Treatments were designated as RAMP (a reduced risk products and non-OP/non-carbamate program) or conventional (the growers’ traditional program). RAMP growers used Avaunt (an EUP was granted for this use) for early season plum curculio and oriental fruit moth control, mating disruption for oriental fruit moth and peach tree borer and lesser peach tree borer control, in addition to non-OP and non-carbamate insecticides for control of other arthropod pests. RAMP orchards were compared with the conventional sites throughout the season. The RAMP program provided control that was equivalent to or better than the conventional programs albeit at a higher cost per acre.

Implementation

Sampling Leafrollers in Apple Orchards: Effect of Sample Frequency and Number of Samples

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

Keywords: Geostatistics, sampling, obliquebanded leafroller, Pandemis leafroller, Choristoneura rosaceana, Pandemis pyrusana

Abstract: During 3 consecutive field seasons, Pandemis and obliquebanded leafroller (PLR and OBLR) larvae were collected at regular intervals from two orchards. Samples were taken using a grid system and GPS units were used to document exact locations of samples. Geostatistical analysis of the data showed that population level spatial structure was present in 80% of the orchards sampled. The analysis suggested that samples be spaced more than 50 meters apart, which was confirmed by sampling simulations run on the data. We also found that if the orchard block is divided into 1 acre “zones,” collecting multiple samples from within a zone was inefficient compared to collecting a single sample in each zone. Using larval density maps generated from data taken in small plots at 2-week intervals showed that we need to standardize the time of sampling because the variation from sample to sample caused by larval phenology is excessive and may compromise IPM decision making.
Implementation

Areawide II Pear Project: All IGRs All the Time

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Keywords: areawide, selective, soft, organophosphate, IGR, pear, pear psylla, Cacopsylla pyricola, codling moth, Cydia pomonella, spider mites, biocontrol

Abstract: In 2002, an areawide implementation program was initiated in pear to examine the effects of pest management using selective insecticides on crop protection and biological control. The program was arbitrarily limited to insect growth regulators, with the exception of kaolin (Surround) for prebloom pear psylla control, and endosulfan (Thiodan) for prebloom pear rust mite control. Pear orchards at six locations, three in the Wenatchee Valley and three in the Yakima Valley, were split into conventional and soft (All-IGR) blocks. Comparisons were made between pest and natural enemy densities throughout the season and overall costs.

Insect pest control in pear was maintained in soft management programs, arbitrarily limited to insect growth regulators, relative to conventional programs over the two-year period. Pear psylla and codling moth control was not significantly different either year. Grape mealybug and pear rust mite control remain problematic, as there are no soft materials available. Densities of natural enemies were expected to be higher in soft programs but were not found to be significantly different between programs. In both years of the project, numbers of applications as well as costs of the soft program were higher, though not significantly so. Thus, it appears that pest management is feasible when limiting pest management tactics to the more environmentally benign materials, although costs may increase. Further study is necessary to determine if long-term implementation can increase biological control and reduce overall costs.
Thresholds/Monitoring

Stephen Cockfield, moderator
Abstracts of the 78th Annual Western Orchard Pest & Disease Management Conference

Thresholds/Monitoring

Developing an Automated Trapping System for Precision IPM in Washington Apples

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2Washington State University Center for Precision Agricultural Systems, Prosser, WA

Keywords: Automated traps, obliquebanded leafroller, Choristoneura rosaceana

Abstract: Automated traps are a key component of web-based orchard monitoring systems that will ultimately provide users with pest flight data from remote trapping stations. These data will reduce the labor required to physically monitor traps and will increase pest management precision. We are currently testing a modified multi-pher trap equipped with a sensor and data logger. This trap uses pheromone lures to attract adult lepidoptera to a vertical funnel that collects them into a chamber with insecticide. The sensor is located in the apex of the funnel and is intended to provide an account of each insect that enters the kill chamber. The data logger stores this information with the date and time when each insect passed the sensor. The trap was tested in the field with OBLR and to a lesser extent with CM. The automated traps caught approximately 52% fewer adult male OBLR than standard multi-pher traps. This was likely due to slight differences in design of the automated versus the standard multi-pher traps. The sensor and logger technologies provided an inconsistent account of the actual number of captured adults. New technology is currently being evaluated to improve the efficacy of the sensor and logger components and improved trap designs will be evaluated next field season.

Thresholds/Monitoring

Improvements in Monitoring Coding Moth

Alan Knight

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Keywords: Codling moth, Cydia pomonella, monitoring, apple, pear, Biolure, Superlure, Bubble lure

Three types of experiments were conducted this year that relate to improving the monitoring of coding moth in apple and pear orchards. The Biolure 10X lure was found to catch more moths than the Superlure (Bubble lure) in orchards treated with either 200 or 400 Isomate C+ dispensers or 100 or 200 Isomate C-tt dispensers per acre. The Pherocon DA (pear ester) lure was found to catch more moths than sex pheromone lures in Anjou and Comice orchards under mating disruption. The DA lure caught an equivalent number of moths as the pheromone lure in Bosc blocks and caught significantly fewer moths than the pheromone lure in Bartlett. The use of non-white delta traps eliminates the incidental capture of honeybees that often occurs in orchards early in the season. However, color traps (orange, red and green) caught more muscid flies than white traps. Painting traps with these three bright colors (glossy paint) significantly increased the capture of codling moth, possibly due to an elevated UV reflectance.
Thresholds/Monitoring

An Evaluation of Lure Technologies for Monitoring Codling Moth in a Variety of Pheromone Environments

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Keywords: Codling moth, Cydia pomonella, monitoring, lure, pheromone, kairomone, DA lure, MegaLure, SuperLure, BioLure, NoMate Fiber Lure, red septum

Abstract: Pheromone-baited traps are routinely used to determine the time of emergence of codling moth (CM), track seasonal phenology and time insecticide applications. The application of synthetic pheromone in a mating disruption (MD) program changes the relative attractancy of pheromone lures. High load lures (10X), DA Lure and a combination DA/Pheromone Lure represent an improvement to 1X septum in MD orchards, especially at high rates (i.e., 400 dispensers/acre). CM monitoring in MD orchards is not precise due to many sources of variation. Lure types, each with a different level of attractiveness, are being used to monitor CM. Reduced rates and alternative delivery systems (Scentry NoMate Fibers, Sprayable CM pheromone) can change the relative attractancy of pheromone lures. Lure comparisons under these conditions have been limited. As we move toward greater reliance on narrow-spectrum materials, a more precise understanding of trapping systems will be required to achieve control. We will summarize our most recent work with optimizing the CM monitoring system under various commercial applications of synthetic CM pheromone.

Thresholds/Monitoring

Development and Testing of a New Female-based Phenology Model for Codling Moth

Alan Knight
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Keywords: Codling moth, Cydia pomonella, monitoring, timing, model, phenology

Abstract: The use of the DA lure to establish a female moth Biofix followed by 155 degree-days was found for a third year to be roughly equivalent to the current use of male catch in pheromone traps plus 250 degree-days to predict the beginning of codling moth egg hatch. A color-coded Biofix system based on three-day periods of maximum daily temperatures was successful in assigning the Biofix dates for males and females in all eight sites plus in a similar study conducted in Medford. This approach, on average, did not improve the standard Biofix selection protocol that is based on weekly counts of moth catches in traps. Moth flight and egg hatch were found to continue throughout the summer in unmanaged orchards. A decline in activity (no cessation) occurred between 900-1,000 degree-days after Biofix. Unhatched codling moth eggs were found in these orchards every week during the season. A new predictive phenology model was developed for codling moth that includes the nonlinear effects of daily degree-day accumulations to control the rate of female mating and the number of eggs laid. These curves were generated from a series of laboratory tests conducted under fluctuating temperatures in environmental chambers. The new model improved the prediction of cumulative fruit injury during the first generation in four of the five sites fully evaluated. The model delays the accumulation of fruit injury compared with the WSU model due to the restraining influence of cool spring temperatures. The accumulation of 20% of the total fruit injury was approximately 110-150 DD later than that predicted by the WSU model. In addition the distribution of injury over the entire generation was shifted later with 80% of the cumulative injury occurring 190-230 DD later than predicted by the WSU model. The current WSU model was more accurate than the new model for one site that can be characterized by three important factors: establishment of a rather late Biofix (13 May), the orchard was neither sprayed with insecticides nor treated with sex pheromones, and the moth population was highly susceptible to Guthion (population originally derived from field-releases of the USDA laboratory colony). A significant delay in the occurrence of fruit injury was found in three orchards treated with a full rate of Isomate-C+ dispensers (400/acre). The first detection of fruit injury in these sites was 4-8 d later than predicted by the male Biofix. Similarly, the distribution of fruit injury was delayed in an orchard with a Guthion-tolerant population.

Biased Sampling for Consperse Stink Bug Using a Cut Fruit Technique in Bartlett Pears

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

Keywords: Consperse stink bug, Euschistus conspersus, pears, monitoring, cut fruit

Abstract: A cut fruit technique used to monitor codling moth and oriental fruit moth oviposition in mating disrupted pear orchards has been found to be helpful in monitoring levels of consperse stink bug (CSB). Infestation in a 12.7 ha Bartlett orchard in the Upper Sacramento Valley of California was followed on orchard interior and perimeter cut fruit clusters at 55-16 days before harvest (DBH) in 2002. Adult CSB infestation in the cut fruit clusters was up to 3.3% at 41-13 DBH with treatment at 28 DBH. Levels of CSB were monitored at 58-9 DBH in 2003. In addition, adult and/or injury presence in cut fruit vs random uncut fruit clusters in one sample area were compared during the 30-9 DBH period. CSB was found only in the cut fruit clusters, and combined injury + adult presence was about four times higher in cut fruit than in uncut fruit clusters. Adult CSB infestation reached 10% in the cut fruit clusters at 30-9 DBH, with the highest numbers in the perimeter samples. This knowledge, and the lateness of the infestation, resulted in a perimeter spot treatment for CSB at 22 DBH in 2003.

Management and Migration of Western Flower Thrips in Apple

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Keywords: Western flower thrips, Frankliniella occidentalis, Entrust, spinosad, Assail, acetamiprid, oil, detergent, migration, dandelion, weed

Abstract: A variety of insecticides was tested in blossom cluster assays for activity against thrips. Entrust at a high rate was very effective, at a low label rate was slightly less effective, but at below label rate it had no significant effect. A low concentration of oil did not improve the performance of Entrust. Assail at the maximum label rate had useful activity against thrips. Neither detergent tested killed thrips. Seven orchards were sampled for thrips at bloom on the border with natural vegetation and along a transect into the orchard. Populations decreased in the orchard interior with distance from natural vegetation, with most of the decrease occurring within 100 feet of the border. In the first year of a weed management trial in four orchards, dandelions were greatly reduced on the orchard floor, thus the total internal orchard thrips population was reduced; however, similar populations of thrips occurred in the tree canopy in weedy and low-weed blocks.

Thresholds/Monitoring

Effect of *Campylomma verbasci* on ‘Gala’ and Other Apple Cultivars

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*Abstract:* Caged blossom clusters on field-grown trees of seven apple cultivars were artificially infested with *C. verbasci* nymphs. The nymph density per cage was one (2002) or two (2003), which contained a single king blossom. ‘Braeburn’ fruit was not damaged in either trial. Percentage damage of ‘Gala’, ‘Fuji’ and ‘Granny Smith’ fruit was similar to that of ‘Delicious’, thus the economic injury level for ‘Delicious’ (5 nymphs/tap) can be used for these cultivars. Percentage damage of ‘Cameo’ fruit was similar to that of ‘Delicious’ in 2002 and to ‘Golden Delicious’ in 2003, thus the economic injury level for ‘Golden Delicious’ (1 nymph/tap) would be an appropriate conservative level for ‘Cameo’. The economic injury level for ‘Gala’ was investigated in an additional experiment in 2003. Caged branches were infested with different densities of nymphs at bloom and symptoms of feeding injury were tracked throughout the season. Although all damage appeared similar at petal fall, most marks remained minute as the apple grew and were not classified as economic injury. Some marks, however, grew in size along with the fruit and either appeared as russet or dark scabs surrounded by a depression on the apple surface. A regression analysis revealed 3 nymphs/tap at bloom corresponded to 3% damaged fruit at harvest.
Biological Control

Diane Alston, moderator
Biological Control

Codling Moth Granulovirus: Its History and Mode of Action

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Keywords: Cydia pomonella, codling moth, granulovirus

Abstract: The granulovirus of codling moth (CpGV) was first isolated from infected larvae in Mexico and described by Tanada in 1964. CpGV is one of the most virulent baculoviruses (insect-specific viruses). The LD₅₀ for neonate codling moth larvae was determined by Huber to be less than 2 virus granules/larva. Following ingestion by neonate larvae, the proteinaceous coat or granule is dissolved in the alkaline pH of the gut. The virions first infect the gut epithelial cells prior to attacking a wide range of host tissues including, and most importantly, the fat body. Virus replication or virogenesis takes place within 48 hours following infection. Symptoms of the disease develop slowly. There are no obvious symptoms of the disease until day 4 when the larvae start to swell and become glossy and moribund. The larvae stop feeding around day 7 as they begin to die. In the terminal phase of the disease (day 10), the larvae become milky and liquefy.

CpGV was first mass cultured and field tested in California from 1965 to 1972. Sandoz Corporation developed the first commercial formulation (SAN 406) and granted an experimental use permit by the EPA in 1981. SAN 406 was tested worldwide between 1981 and 1984. Sandoz terminated all work on insect viruses in 1984 and the commercial development of CpGV products in the USA was largely terminated until recently. Currently, there are 3 formulations registered in the USA. They include Cyd-X (1995), Certis USA, Virossoft (2000), Biotopp and Carpovirusine (2001), Sumitomo Corporation. CpGV was used on an estimated 10,000 to 12,000 acres in 2003. In Europe, the first field tests on CpGV were conducted in 1970. In 1979, the Commission of European Communities (CEC) initiated the "Biological Control in Apple Orchards" program. The CEC supported research on the use of CpGV in orchards throughout Europe. After Sandoz terminated work on SAN 406, European government agencies, working in conjunction with companies, developed and commercialized CpGV products. This collaborative effort led to the registration of 3 products including Madex (1988), Andermatt Biocontrol, Switzerland, Granupom (1991) Hoezter, Germany and Carpovirusine (1993), Calliope, France. In 2003, CpGV was used on an estimated 200,000 acres in Europe.

The specificity of CpGV for codling moth and safety to nontarget organisms has been very thoroughly documented. Its use will contribute significantly to the conservation of other natural enemies in the orchard agroecosystem. Given its virulence and specificity to codling moth, CpGV is an important technology for inclusion in pest management programs in pome fruits and walnuts.

Biological Control

Control of Codling Moth (Cydia pomonella L.) with CARPOVIRUS Plus, Granulosis Virus Product, in Pome Orchards in Argentina: Three Years of Field Trials

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Keywords: Baculovirus, granulosis virus, bioinsecticide, codling moth, Cydia pomonella, biological control, field trials, pome orchards

Abstract: The CARPOVIRUS Plus, granulosis virus insecticide (CpGV), was registered (2000) for codling moth (CM) control in Argentina. The aim of this study was to monitor and the control of CM with this formulation on the main growing area for pomes of Argentina at the Rio Negro Valley. Field trials were carried out for 3 years (2000-2003) under 2 different management conditions: Integrated Fruit Production (IFP) and Organic Production (OP). IFP assays were conducted in blocks traditionally treated with regular organophosphate sprays. Virus applications sprayed at 8-, 10- and 12-day intervals from October to early March were compared to unsprayed treatment. On OP plots the assays were performed with combined treatments of pheromone (mating disruption technique, MD) plus CpGV insecticide. Plots with 1000 dispensers/ha (Isomate C) were sprayed with virus at 14-day intervals and compared to plots with MD treatments. This 3-year experiment indicated that under IFP management on 8-day treatment the results were similar to conventional sprays with chemical insecticides, since records of fruit damage at harvest were lower to 2%. According to the results of these assays, the combination of CARPOVIRUS plus pheromone treatments was very promising.

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Biological Control

Field Evaluation of Commercial Formulations of the Codling Moth Granulovirus

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Keywords: Cydia pomonella, codling moth, granulovirus

Abstract: Among the biological control options available for codling moth, the granulovirus of C. pomonella (CpGV) offers potential for effective and selective control. In 2003 we assessed the persistence and efficacy of three CpGV products—Cyd-X (Certis), Virosoft (Biotep), Car povirusine (Sumitomo)—and monitored the season-long performance of Cyd-X used by several commercial organic growers. For the persistence study the products were applied according to label rates (3 oz/acre for Cyd-X and Virosoft and 13.7 oz/acre for Carpovirusine). All three products were also compared at 6 oz/acre. Fruits were exposed to neonate larvae using a standardized laboratory bioassay immediately after spraying and at 1-, 3-, 7-, 10- and 14-day intervals. Ten days after exposure, apples were destructively sampled to quantify fruit damage and larval mortality. Residual activity of all products remained highly effective (>80% larval mortality relative to controls) for 24 hours following application and moderately effective (>70%) after 72 hours. Significant activity in all treatments remained after 14 days, suggesting prolonged survival of the virus in UV-protected locations, such as the calyx of fruit. Fruit damage was also reduced; while overall >97% control larvae formed deep entries, <35% of CpGV-killed larvae stings were >3mm. The results of grower applications of virus provide strong evidence for the effectiveness of well-timed CpGV applications against codling moth outbreaks. In all cases where 1st generation larvae were targeted, fruit damage was reduced or eliminated in the 2nd generation.

Biological Control

Acute Toxicity and Sublethal Effects of Abamectin, Acetamiprid, Methoxyfenozide and Spinosad on the Predaceous Plant Bug Deraeocoris brevis (Hemiptera: Miridae) in the Laboratory

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Keywords: Assail, Intrepid, Success, AgriMek, development, reproduction, pesticide impact, natural enemies, biological control, apple, pear, predaceous plant bug, Deraeocoris brevis

Abstract: This is a part of a regional cooperative project (Areawide II) to assess the impact of pesticides on key natural enemies of apple and pear pests. The work conducted at the Mid-Columbia Agricultural Research and Extension Center focuses on the predaceous plant bug, D. brevis Knight, a widely distributed natural enemy in Pacific Northwest apple and pear orchards. Deraeocoris brevis life stages were reared in the laboratory and were treated in a Potter spray tower to assess acute toxicity and chronic sublethal effects of pesticides commonly used in tree fruits. Methoxyfenozide and spinosad had no acute toxicity to nymphs and adults at the 10% and full field rate and had no effect on egg hatch and nymph survival just after hatch. Acetamiprid and abamectin at the full field rate did not affect egg hatch but had moderate to high toxicity to hatched nymphs. Also, topically applied acetamiprid and abamectin had moderate to high acute toxicity to nymphs and adults at full field rate but moderate toxicity at the 10% rate. In sublethal bioassays, acetamiprid applied to nymphs or adults had no effect on development or reproduction. Spinosad had sublethal effects when applied to adults but not to nymphs. Spinosad-treated (full field rate) adults laid fewer and less viable eggs. Also, egg hatch in the subsequent generation was lower. Abamectin-treated adults (10% field rate) laid fewer and less viable eggs compared with the untreated control. Methoxyfenozide had no sublethal effects on adults, but treating nymphs at the full rate increased development time of 4th instars and lowered fecundity in the subsequent generation. The impacts of additional pesticides on D. brevis are being investigated.
Biological Control

Ecology and Potential for Biological Control of Lygus Bug in Apples and Stone Fruits

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Keywords: Lygus bugs, *Peristenus* spp., apple, stone fruits, alfalfa, biological control, host plants

Abstract: Lygus bugs are listed as pests of several fruits, including apples, pears, prunes, apricots and plums. A wasp parasite, *Peristenus* spp., attacks the nympha stages of lygus and keeps individuals from reaching sexual maturity by emerging in the late instar nymph or early adult stage. Extensive surveys were conducted in 2002 and 2003 to determine the presence of lygus parasitism by *Peristenus* spp. in several important fruit growing regions in Washington State. Common hosts for lygus included volunteer alfalfa, mustard and perennial pepperweed. Parasitism of lygus by *Peristenus* spp. was greatest in areas that were less disturbed by human activity. However, the results of the survey were disappointing in that levels of parasitism were low or not detected in major apple production areas.

Biological Control

Leafroller Biocontrol Enhanced Near Rose and Strawberry Gardens: An Update

Tom Unruh
USDA-ARS, Wapato, WA

Keywords: Biological control, habitat modification, wild rose, strawberry, *Colpoclypeus florus*, parasitoids, leafrollers, Strawberry leafroller, *Ancylos comptana*, Pandemis leafroller, *Pandemis pyrusana*, obliquebanded leafroller, *Choristoneura rosaceana*

Abstract: Mixed multifloral rose and strawberry gardens planted adjacent to pome fruit orchards continue to support the non-pest strawberry leafroller, *Ancylos comptana*, which acts as an overwintering host for the leafroller parasitoid *Colpoclypeus florus*. As gardens matured they had more foliage, hosted more of the beneficial complex, and parasitism of pest leafrollers in the adjacent orchards increased in both spring and summer generations. OBLR and *Pandemis pyrusana* were equally susceptible to parasitism by *C. florus* in orchards adjacent to rose gardens.
Biological Control

Natural Enemy Complexes in Pear Orchards and Adjacent Habitats in Oregon’s Hood River Valley

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Keywords: pear, natural enemies, organic, selective, conventional, host plants, perimeter habitat

Abstract: Natural enemy populations build up on host plants along the perimeter of orchards. When food sources become depleted they disperse into the orchard. Spray programs determine whether natural enemies successfully establish in an orchard. Nine orchards with three different spray programs (conventional, selective and organic) as well as adjacent perimeter habitats were monitored to determine how different pest management programs affect establishment and survival of natural enemies. Study sites were located in the lower, mid and upper Hood River Valley. Orchards and arboreal vegetation along orchard perimeters were monitored every three weeks from May through September with beating trays and by sampling leaves. Leaves were scanned under a microscope and brushed to record phytophagous arthropods and natural enemies. Host plants in the orchard perimeter were mapped and identified. The analysis indicated that there was natural enemy dispersal into orchards when prey, primarily pear psylla, built up in the orchards. When sufficient prey (primarily aphids and mites) was available in the perimeter habitat, predator dispersal into the orchard was low. Principal component analysis (PCA) showed that the species composition of natural enemy populations in orchard perimeters was similar at upper valley locations and distinct from other locations in the valley. This was likely due to the makeup of the perimeter habitat in the upper valley which supports unique predator/prey complexes. PCA also showed that natural enemy complexes on certain arboreal hosts such as oak and ocean-spray were unique and distinct from those on other host species. Natural enemy complexes were similar on conifers, cottonwood, dogwood, elderberry, hazelnuts, maple, snowberry, vine maple, wild cherry and wild rose.

Biological Control

European Earwig (Dermaptera: Forficulidae) Populations in Pear Orchards Treated with and without Organophosphate Insecticides

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Keywords: Earwigs, Forficula auricularia, biological control, monitoring, sampling, organophosphates, pesticide disruption, natural enemies, pear, indicator species

Abstract: European earwigs, Forficula auricularia Linnaeus, are commonly found in Oregon pear orchards where they contribute to the biological control of various pear pests. Earwigs can be monitored easily with rolls of corrugated cardboard attached to tree limbs. This study tested the hypothesis that earwigs can serve as an indicator species for pesticide disruption of natural enemies. Two insecticide programs were compared, one with organophosphates (OP) and one without. Earwigs were sampled by two different sampling programs: one where cardboard rolls were replaced biweekly and the other where cardboard rolls were installed at the beginning of the season and then a certain number removed at two-week intervals (cumulative sampling). Biweekly sampling indicated higher earwig populations in the non-OP than in the OP sections, suggesting disruption. Pesticide disruption of earwigs was less evident with the cumulative sampling. Other natural enemies (spiders, lacewings and snakeflies) were also found in the corrugated cardboard and were consistently lower in the OP section of the orchard.
Biological Control

Entomopathic Nematodes for Managing the Cherry Bark Tortrix, *Enarmonia formosana* Scopoli (Lepidoptera: Tortricidae)

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**Keywords:** cherry bark tortrix, *Enarmonia formosana*, entomopathic nematodes, *Steinernema carpocapsae*, *S. feltiae*, *Prunus*, biological control

**Abstract:** The cherry bark tortrix (CBT) (*Enarmonia formosana* Scopoli) is an exotic pest of rosaceous woody trees and shrubs, including *Prunus* and *Malus*. Current management practices include a well-timed broad-spectrum insecticide application; however no treatments are available to complement conservation biological efforts. This study investigates the potential of using entomopathic nematodes as control agents for CBT. Street cherry trees (*Prunus serrulata* ‘Kwanzan’) were treated with nematodes using different application methods under field conditions. Trees were evaluated for CBT activity two days posttreatment. All nematode treatments reduced CBT activity. Field trials were replicated in controlled conditions using CBT-infested *P. avium* logs. Recoveries of nematode-infested CBT larvae were made two days after treatments. In all preliminary trials, both species of entomopathic nematodes caused over 70% CBT mortality.

Biological Control

Biological Control in Areawide Organic Pest Management

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**Keywords:** Biological control, pear psylla, *Cacopsylla pyricola*, predator monitoring, spatial distribution, edge effects

**Abstract:** Predator densities were examined in pear orchards under organic, soft and conventional pest management. Nine transects were established at orchard/vegetation edges, extending into each habitat. Beat tray sampling was used to monitor baseline densities of predatory insects along transects; exclusion cages were used to directly measure levels of predation on sentinel pear psylla nymphs. Preliminary results show low predator densities in all programs. Increases in late season predator densities were correlated with an increase in pear psylla densities, suggesting damage thresholds for pear psylla may be too low to sustain higher densities of natural enemies. Nevertheless, predators appear to be more numerous in orchards under organic pest management. Soft programs also appear to positively influence predator densities. An edge effect is also seen in all programs. The study will be continued in 2004.
Pesticide Resistance

Lyla Lampson, moderator
Resistance Management

A 40-Year Experiment: Codling Moth’s Responses to Guthion and Other Insecticides

Alan Knight
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Keywords: Resistance, codling moth, Cydia pomonella, organophosphate, Guthion, azinphosmethyl, neonicotinoid, Assail, acetamiprid, benzylhydrazine, Intrepid, methoxyfenozide, Naturalyte, Success, spinosid

Abstract: The response of adult male codling moth to Guthion was surveyed in 20 orchards using a discriminating concentration (0.3 µg/moth) during 2003. A wide range of responses was found with 17 of the populations being statistically categorized as tolerant to Guthion versus our laboratory population. The post-diapause emergence of six populations was measured and a strong correlation was found between a population’s tolerance to Guthion and a delay in their emergence. Laboratory studies found that these populations did not differ in their rate of larval and pupal development. However, the more tolerant populations also exhibited some reduction in mating success and a strong reduction in fecundity. Bioassays of these populations to field-collected residues showed that a 1.0 lb rate of Guthion 50W provided <14 d control and a 2.0 lb rate provided <21 d of control of the most tolerant strains of codling moth. Assail 70WP applied at a 3.4 oz rate provided poor control of Guthion-tolerant populations. Field populations were also tested at two discriminating concentrations selected from studies of the larval responses of our lab population to Guthion, Intrepid, Assail and Success. In these tests, the most tolerant strain to Guthion also exhibited a significantly more tolerant response to Success, Intrepid and Assail.

Resistance Management

Insecticide Resistance in Codling Moth to Azinphosmethyl, Fenpropathrin and Acetamiprid

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University of California, Berkeley, CA

Keywords: Guthion, azinphosmethyl, Danitol!, fenpropathrin, acetamiprid, Assail, insecticide resistance, topical bioassay

Abstract: Resistance levels in populations of codling moth were determined from pear and apple orchards in California for 2002 and 2003. Three insecticides were screened for patterns of resistance including azinphosmethyl in 2002 and 2003 (Guthion), fenpropathrin in 2003 (Danitol) and acetamiprid in 2003 (Assail) using pheromone-assisted topical bioassays of field populations collected in pheromone traps. The number of moths used to develop the probit lines ranged from 80 to 605 moths per line in 2002 and from 111 to 340 moths in 2003. Specific concentrations of insecticides were applied topically to adult moths in pheromone traps at 1 µl per moth. The most susceptible orchard to azinphosmethyl in 2002 was an organic apple orchard in Sacramento which has been used as a reference orchard since the early 1990s, whereas the most susceptible orchard in 2003 with sufficient numbers to monitor was in the Anderson Valley.
Update on Organophosphate Resistance in Codling Moth

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Keywords: organophosphate, resistance, codling moth, Cydia pomonella, apple

Abstract: In 2003, organophosphate (Guthion) resistance was surveyed in codling moth from populations throughout Washington State. Populations were collected using pheromone traps during first and second flights from apple and pear and sampled for Guthion resistance using the standard adult topical bioassay. Select populations were also sampled for pyrethroid and chloronicotinyl resistance.

All orchards sampled during the first flight were Guthion susceptible, despite some extremely high trap catches (both from trap counts provided by referring fieldmen and from bioassay trap yield). Thus, Lorsban and esfenvalerate (Asana) were tested only in orchards with susceptible populations, and data regarding cross-resistance was not found. Assail bioassays were also conducted against Guthion-susceptible populations during the first flight. However, during the second flight, a Guthion-resistant population was identified near Manson, WA. This allowed testing of Assail to determine potential levels of cross-resistance. Fenpropathrin (Danitol) and thiacloprid (Calypso) were not tested against any populations (trap nights were limited in the Guthion-resistant orchard, as the grower treated immediately after samples were collected).

Guthion resistance was found to be low to moderate in orchards sampled throughout the state. The lack of significant resistance in many orchards with high trap catch and unacceptably high infestation point toward operational factors as a likely cause. These factors include possibilities such as inadequate pest control measures leading to higher populations, failure to respond to higher populations with increased rates and decreased spray intervals, and low levels of resistance reducing residual activity of Guthion. Nevertheless, it appears that a rapid shift to Guthion resistance is not the cause of increased codling moth damage in many orchards.

The adult bioassay for Assail appears to be adequate; however, adjustments to the method should be examined in the future (such as increasing the exposure time, altering the moth holding temperature, etc.). Bioassay results for Assail were quite variable in this study. Unfortunately, the results for the Manson Guthion-resistant population were not precise enough to determine statistical confidence of cross-resistance with Assail. Thus, it cannot be concluded from this study that cross-resistance exists between the compounds. However, with the inference of cross-resistance between Guthion and Assail, additional studies should be conducted of field efficacy of Assail in Guthion-resistant orchards.
Chemical Control/

New Products

Bruce Greenfield, moderator
Abstracts of the 78th Annual Western Orchard Pest & Disease Management Conference

Chemical Control/New Products

Areawide II Demonstration Project: 2003 Update for Oregon’s Hood River Valley

Allison T. Walston, Deborah J. Brooks, Steve P. Castagnoli and Helmut Riedl
Oregon State University, Mid-Columbia Agricultural Research and Extension Center, Hood River, OR

Keywords: phosmet, methoxyfenozide, natural enemies, codling moth, Cydia pomonella, apple, pear, organophosphate alternatives, Areawide II

Abstract: Areawide II is a collaborative project to evaluate selective alternatives to organophosphate (OP) insecticides for control of codling moth and to enhance biological control in pear and apple orchards. The study has been ongoing since 2001 and is being conducted in three commercial Hood River Valley orchards (two pear, one apple). Orchard blocks treated with OPs (phosmet) or with OP alternatives (methoxyfenozide) had similar codling moth control. Codling moth damage levels have gradually decreased since 2001, which is also indicated by pheromone trap catches. Trap catches with the DA food lure remained low through the season at both pear sites and were not indicative of actual population levels. Pheromone traps baited with the high load (10X) Suterra Biolure caught on average four to 16 times more moths than traps baited with the DA lure. In general, OP-treated blocks had more serious secondary pest problems and fewer natural enemies compared with blocks treated with OP alternatives. Pear psylla levels were generally higher where OPs were applied, except in blocks where Agri-Mek was used. Natural enemies consisted primarily of spiders, earwigs and Deraeocoris brevis, a mirid predator, and were more plentiful in orchard sections where no OPs were used. Any insecticide applications after late June had a tendency to reduce natural enemy populations.

Chemical Control/New Products

Arthropod Efficacy Test Results, NJ Peaches: 2003

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Keywords: Damoil, Esteem, Lorsban, Diazinon, Applaud, Assail, Actara, Avaunt, Provado, Danitol, Imidan, Calypso, Intrepid, Guthion

Abstract: Results from efficacy studies against peach and nectarine insect pests indicate several compounds show promise against key pests. All tests were applied with an airblast sprayer delivering 100 GPA at 2.5 MPH. A prebloom application of Esteem plus oil provided good control of overwintering white peach scale (WPS). Esteem, Applaud and diazinon provided good control when targeted against WPS crawlers. Avaunt and Actara provided control of plum curculio that was comparable to Imidan. In a season-long test against oriental fruit moth, the untreated control had 73% wormy fruit at harvest. The standards Imidan and Guthion had 9 and 11% wormy fruit, respectively. Percent wormy fruit from trees treated with Intrepid, Assail and Avaunt was 12, 20 and 21%, respectively.
Abstracts of the 78th Annual Western Orchard Pest & Disease Management Conference

Chemical Control/New Products

New Materials and Methods for Control of Cherry Fruit Fly

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Keywords: cherry fruit fly, Rhagoletis indifferens, azinphosmethyl, carbaryl, Food Quality Protection Act

Abstract: The advent of the USA Federal Food Quality Protection Act has caused special concern to sweet cherry growers, as the two products most commonly used to control cherry fruit fly, azinphosmethyl and carbaryl, are receiving special regulatory attention during their re-registration process. The recent ESA/waterway buffer zones ruling potentially affects application of these two products, as well as malathion, malathion ULV, diazinon and dimethoate. Few choices remain. Organic growers have reported great difficulties in controlling cherry fruit fly (CFF), and both adults caught on traps and larvae found during fruit inspections have been increasing in their orchards for the past three seasons. Six candidate products were screened for their effect on CFF during summer 2003. Replicated plots were set up in two small infested orchards. Also, 61 highly infested trees on 16 separate sites were treated to assess effect of various product rates and/or application intervals. Two commercial organic orchards were treated with bait to test application equipment and practicality of this treatment method.

Chemical Control/New Products

Attract and Kill Technology to Control New World Fruit Flies

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IPM Tech, Inc., Portland, OR

Keywords: Anastrepha, Rhagoletis, tephritid fruit flies, Mexican fruit fly, apple maggot, cherry fruit fly, walnut husk fly, killing stations, control, lure

Abstract: Anastrepha and Rhagoletis fruit flies are the most damaging tephritid pests indigenous to North and South America. IPM Tech, Inc. in cooperation with ARS developed effective lure technologies for these species that provide the basis for development of killing stations. Killing stations combine an attractant with an effective killing agent that is delivered at the surface of a visually attractive target upon which the flies alight and are killed.

A new multi-component lure for Mexican fruit fly (MFF) was developed cooperatively by IPMT and Dr. David Robacker, USDA-ARS, and described in a 2002 ESA poster and recent ARS magazine article. Also a newly formulated lure that we developed for apple maggot fly (AMF), cherry fruit fly (CFF) and walnut husk fly (WHF) has been shown to be superior to existing lures for CFF and WHF.
Chemical Control/New Products

Introduction of Two New Products for Use in Pome Fruit: CLUTCH™ Insecticide and
KANEMITE™ Miticide

Hiro Arakawa, Kevin Forney and Charles T. Schiller
Arvesta Corporation, San Francisco, CA

Keywords: Insecticide, CLUTCH™, miticide, KANEMITE™, pome fruit

Abstract: Arvesta plans to introduce a new insecticide and a new miticide in 2004. CLUTCH is
the trade name of a new neonicotinoid insecticide, and KANEMITE is the trade name of a new,
unique mode of action miticide for use on pome fruit. Both products have very favorable
toxicological and ecological profiles. EPA has granted CLUTCH an OP replacement status and
KANEMITE has been approved as a reduced risk compound.

Chemical Control/New Products

New Materials for Control of Pear Psylla, 2003

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

Keywords: novaluron (Diamond), clothianidin (Clutch), pyriproxifen (Esteem), diflubenzuron
(Dimilin), pear psylla, Cacopsylla pyricola

Abstract: Several insect growth regulators were examined in various field trials to determine
their efficacy in the control of pear psylla. Materials included in these trials were pyriproxifen
(Esteem, Valent), diflubenzuron (Dimilin, Crompton Chemical) and novaluron (Diamond,
Crompton Chemical) as well as a new chloronicotinyl, clothianidin (Clutch, Arvesta). All trials
were single tree, replicated four times in randomized complete block design.

Overall comparisons, the insect growth regulators performed best against the first
generation of pear psylla when applied at either clusterbud or petal fall. However, these materials
provided control for only the first generation. The new chloronicotinyl, Clutch, appeared to
compare well with existing materials of the same class. Overall however, the effects seen in this
trial were likely reduced because pressure was very high in these blocks, and the small size
allowed for migration from the surrounding untreated trees.
Chemical Control/New Products
Rate and Timing of Assail (acetamiprid), Actara (thiamethoxam), Calypso (thiacloprid) and Applaud (buprofezin) on Pear Psylla, 2003
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Keywords: Assail (acetamiprid), Actara (thiamethoxam), Calypso (thiacloprid), Applaud (buprofezin), pear psylla, Cacopsylla pyricola

Abstract: Assail was applied at four different timings and two different rates—April 7 for Clusterbud, May 1 for Petalfall, June 20 for Summer 1, and July 31 for Summer 2 application. Actara, Calypso and Applaud were sprayed April 7 for Clusterbud, June 20 for Summer 1 and July 31 for Summer 2. Oil was added to all treatments at a rate of 0.25% v/v. All trees were treated by handgun to simulate a rate of 400 gpa and sprayed until drip. The trial was single tree replicated four times in a complete random block design.

A pre-treatment count was performed on all treatments on March 13. The plots were sampled weekly thereafter. Adult pear psylla were sampled with 4 beating trays per tree. Pear psylla eggs and nymphs were initially counted by collecting 5 spurs per tree and then examining them under a binocular microscope. From May 13 through June 9, 25 leaves were collected from lower scaffold branches (1.5-2 m height). Pear psylla, spider mites and rust mites were then removed from the leaves onto glass plates using a standard leaf brushing machine. The numbers of insects were then determined by examining one-half of the plate using a binocular microscope. From June 16 through the end of the season, 25 leaves were taken from lower scaffold branches and another 25 were collected from shoots in the upper canopy. These samples were then also brushed and examined using a binocular microscope.

From the data collected this year it would appear that timing applications at clusterbud rather than petalfall would be a more effective approach for controlling pear psylla nymphs. The one petalfall application of Assail paralleled the generational decline observed in the untreated check, preventing conclusions about the efficacy at this time. This may have been due to a delay in the development of the pear trees this season, causing them to be out of sync with the target pest. Later observations showed no significant difference between treatments.

Chemical Control/New Products
Control of Codling Moth in Large Plot Apple Trials with Diamond™ 7.5 WG
Ron Britt¹ and Don Joy²
¹Ron Britt and Associates and ²Uniroyal Chemical/Crompton Corporation, Yakima, WA

Keywords: Diamond, novaluron, codling moth, Cydia pomonella, apple

Abstract: Trials were conducted in the lower Yakima Valley of Washington to evaluate Diamond 7.5 WG for control of codling moth in apple. Large plots, 0.75 acre, were used and sub-sampled four times. The first trial was an evaluation of Diamond 7.5 WG at 0.125, 0.1875 and 0.25 lb a.i./A compared to Imidan 70W at 3.15 lb a.i./A for season-long codling moth control. Damage was assessed after first generation and at harvest with the harvest data presented here. Diamond at 0.125, 0.1875 lb a.i./A and 0.25 lb a.i./A provided 78, 94 and 96% control, respectively. Imidan gave 88% control and the check had 85% codling moth damaged fruit. The two highest rates of Diamond and Imidan provided significantly better codling moth control than did the low rate of Diamond when compared to the untreated check. Codling moth pressure was very high in this trial.

In a separate trial, Diamond 7.5 WG was used with and without Imidan for second generation codling moth control. Codling moth damage was assessed at harvest. Diamond at 0.125 and 0.25 lb a.i./A provided 90 and 95% control, respectively. Diamond at 0.125 lb a.i./A plus Imidan at 3.5 lb a.i./A and Diamond at 0.25 lb a.i./A plus Imidan at 3.75 lb a.i./A as a tank mix gave 98.5% and 98.2% control, respectively. Imidan alone gave 97.2% control and the check had 28.5% codling moth infested fruit. All treatments provided significantly better codling moth control when used alone or in combination with Imidan, compared to the untreated check. The low rate of Diamond had significantly less codling moth control compared to all other chemical treatments.
Abstracts of the 78th Annual Western Orchard Pest & Disease Management Conference

Chemical Control/New Products

Control of Codling Moth in Large Plot Apple Trials with Diamond™ 7.5 WG

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Keywords: Diamond, novaluron, codling moth, Cydia pomonella, apple

Abstract: Trials were conducted in the Mid-Columbia area of Oregon to evaluate Diamond 7.5 WG for codling moth control in apple. Large plots, 0.1 acre, were utilized and replicated four times. The first trial was an evaluation of Diamond 7.5 WG at 3 rates compared to Guthion for season-long codling moth control. Damage was assessed after the first generation and at harvest. Diamond at 0.1875 lb a.i./A and 0.25 lb a.i./A and Guthion provided excellent codling moth control for the entire season. Codling moth damage observed in the Diamond 0.125 lb a.i./A treatment was not significantly different from the higher rates of Diamond. However, more deep entries were observed in this treatment.

In a separate trial, Diamond 7.5 WG was used with and without Imidan for second generation codling moth control. Codling moth damage was assessed at harvest. Diamond at 0.125 lb a.i./A and 0.25 lb a.i./A alone and Diamond, at the same rates, plus Imidan at 3.75 lb a.i./A as a tank mix provided excellent codling moth control. Diamond provided significantly better codling moth control when used alone or in combination with Imidan, compared to Imidan used alone and the untreated.

Chemical Control/New Products

Studies for Control of Codling Moth in Pear

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Keywords: codling moth, Cydia pomonella, chloronicotinyls, acetamiprid, Assail, thiacloprid, Calypso, novaluron, Diamond, azinphosmethyl, Guthion, fenpropathrin, Danitol, abamectin, Agri-Mek, lambdacyhalothrin, Warrior, spinosad, Success, emamectin benzoate, Proclaim, esfenvalerate, Asana

Abstract: In 2003, several trials were conducted to examine the effects of many insecticides for codling moth control in pear. In general, codling moth pressure was moderate (relative to typical untreated control treatments), and all materials performed well. Two chloronicotinyl insecticides, Assail and Calypso, were examined, and both performed well relative to the Guthion standard. Several pyrethroid insecticides were tested, including Asana, Danitol and Warrior, and all controlled codling moth. Two insect growth regulators, Danitol and Diamond, also controlled codling moth relative to the Guthion standard treatment. Success was successful in managing codling moth. Codling moth management programs alternating Agri-Mek with Warrior also managed to give control.

Observations were also made of codling moth mating behavior. Codling moth were marked with fluorescent dye, released into the field, then followed through the scotophase using a portable black light. Several unique observations were made of female calling behavior, male movement and predation by spiders.
Chemical Control/New Products

Insecticide Evaluations for Codling Moth Control in Pears

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Keywords: Codling moth, Cydia pomonella, pear psylla, Cacopsylla pyricola, European red mite, Panonychus ulmi, twospotted spider mite, Tetranychus urticae, Agri-Mek, abamectin, Imidan, Guthion, azinphosmethyl, Milbemectin, milbemectin Imidan, phosmet, Dimilin, diflubenzuron, Seize, pyriproxifen, Diamond, Novaluron, Calypso, thiacloprid, pear, chemical control, insecticide

Abstract: A trial was conducted in Fairfield, CA, to evaluate the efficacy of reduced risk insecticides for control of codling moth (CM) in pears. Each experimental treatment was replicated four times in a RCB. The CM infestation in all experimental treatments was significantly lower than in the untreated control. The grower standard of Agri-Mek followed by Imidan and then two applications of Guthion had significantly less CM infestation compared to Imidan followed by two applications of Guthion and Seize followed by Imidan and then two applications of Guthion or four applications of Dimilin. Diamond treatments provided excellent CM control. The highest rate (0.25 lb (a.i.)/acre) of Diamond plus Omni Supreme oil had significantly less CM infestation compared to grower standard. The two applications of a high rate (0.25 lb (a.i.)/acre) of Calypso followed by an application of Intrepid showed good CM control compared to all other treatments. A flare-up of pear psylla nymph populations was observed in treatments containing Imidan and Guthion except for the grower standard. A flare-up of twospotted spider mite populations was observed in the Seize followed by Imidan and then Guthion treatment while a flare-up of European red mite was observed in the Imidan and Guthion, Seize followed by Imidan and then Guthion and Calypso followed by Intrepid treatments.

Chemical Control/New Products

Codling Moth Trials and Treatment Programs in Southern Oregon Pear Orchards

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Keywords: Calypso, thiacloprid, Diamond, novaluron, Assail, acetamiprid, Danitol, fenpropathrin, Cyd-X, Carpovirusine, granulosis virus, codling moth, Cydia pomonella, pear

Abstract: Control of codling moth was assessed in various field trials conducted at the Research Center. In the four replicated comparisons, organophosphate materials generally provided the best control. However, Diamond (novaluron) also gave excellent control of codling moth. Assail and Danitol significantly reduced codling moth damage but not to the same degree as an organophosphate when tested under high pressure. However, in another test conducted in a lower pressure situation, no significant difference between Assail and a standard organophosphate was seen. In one study where Calypso and Assail were compared, little difference between the two products was observed. Two formulations of codling moth granulosis virus, Carpovirusine and Cyd-X, were applied on a 10-day schedule in an unreplicated trial. A total of nine applications was made over the season and both products reduced successful codling moth entries, although a high number of non-downgrading stings was observed. Research conducted in grower blocks continues to show that IPM programs using mating disruption can reliably achieve high levels of codling moth control, particularly in winter pear cultivars such as Bosc and Comice. The Suterra 10X Biolure was used for monitoring codling moth and performed well; comparisons with other lures will be discussed.

14-16 January 2004, Hilton Hotel, Portland, OR
Chemical Control/New Products

Strategies for Using Imidan (phosmet) in a Seasonal Codling Moth Control Program

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Keywords: Imidan, phosmet, codling moth, *Cydia pomonella*, organophosphate, apple, pear, bioassay

Abstract: Imidan (phosmet) is an 'old' organophosphate insecticide which has been available for codling moth control for many years. However, because of cost and a perception of being less effective, Imidan use on apple and pear has been relatively low compared with Guthion. Use of Imidan for codling moth control has increased some after the recent label changes for Guthion. Research on Imidan for codling moth control conducted over the last ten years at the Mid-Columbia Agricultural Research and Extension Center has focused on optimizing rates; alternating Imidan with non-OP insecticides, i.e., Intrepid (methoxyfenozide), Assail (acetamiprid); assessing the potential for inducing secondary pests; evaluating Imidan's selectivity to natural enemies, especially on pear; and monitoring for resistance. A more basic question arose in recent years about the appropriate timing and frequency of sprays in a seasonal codling moth control program due to changing emergence patterns and a spring flight, which now seems to extend into July. In 2003, we compared two control programs with Imidan. The standard program consisted of two sprays against each generation (total of four sprays per season) where sprays were applied at the beginning of egg hatch and three weeks later. This program leaves a large gap between the second spray against the spring generation and the first spray against the summer generation. The second program consisted of three sprays against each generation (total of six sprays per season) where the first spray (full rate) in each generation was also applied at the beginning of egg hatch but subsequent sprays (half rate) followed at two-week intervals. The total amount of Imidan applied per season was the same in both programs. The effectiveness of the two control programs was evaluated in the laboratory by caging neonate larvae on fruit and checking for survival and damage seven days later and in the field by checking for infested fruit during the season and at harvest.

Chemical Control/New Products

Codling Moth Control with Old and New Insecticides: The Continuing Search for the Next Guthion

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Keywords: Codling moth, *Cydia pomonella*, Guthion, azinphosmethyl

Abstract: For the last 50 years the organophosphate insecticide Guthion (azinphosmethyl) has been the principal control tool against codling moth and has provided unprecedented control. Although resistance development has reduced its usefulness for codling moth control in some fruit-growing regions, Guthion has remained an important insecticide for codling moth control worldwide. However, in recent years concerns about worker exposure and regulatory restrictions have become a more serious threat than resistance development to the continued use of Guthion in tree fruits. Efforts to develop alternatives to Guthion for codling moth control have been under way for the last 20 years beginning with pyrethroid insecticides, various insect growth regulators (IGRs) such as Dimilin (diflubenzuron) and Intrepid (methoxyfenozide), and more recently neonicotinyl insecticides such as Assail (acetamiprid) and Calypso (thiacloprid) and codling moth virus formulations. Research on Guthion alternatives conducted at the Mid-Columbia Agricultural Research and Extension Center over the last 20 years will be reviewed in terms of effectiveness against codling moth, spectrum of activity against other pests, IPM compatibility, impact on beneficials and potential threat to water quality and fish.
Chemical Control/New Products

Integrating Assail™ into Sierra Foothill Apple Pest Management Programs for Codling Moth and Leafhopper Control

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Abstract: Assail, acetamiprid, was compared to azinphosmethyl when applied for control of the 1b codling moth flight in two commercial apple orchards. One orchard was under mating disruption and had a relatively low codling moth population. The other orchard was without mating disruption, had been treated with azinphosmethyl for the 1a flight but still had a high codling moth population as well as a rose and white apple leafhopper infestation. Codling moth populations in each orchard were monitored using traps loaded with the L2 pheromone lure and with the DA kairomone lure, and the sex of the moths in the DA traps was identified. Assail was applied at 3.4 oz. in 100 gal/acre with 0.5% oil using the grower's airblast sprayer onto four 1-acre replicated plots in each orchard and compared to the grower standard of 2-3 lb. azinphosmethyl in 100 gal/acre. Codling moth damage on fruit and presence/absence of leafhoppers on leaves were assessed before and after treatment. In both orchards, the codling moth damage observed on fruit was not different in those plots treated with Assail compared to those treated with azinphosmethyl. The percent of leaves infested with leafhoppers was lower in the plots treated with the Assail as compared to those treated with azinphosmethyl.

Chemical Control/New Products

Managing Codling Moth with Spinosad and Granulovirus

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Abstract: Research trials with Entrust in 2003 tested efficacy against codling moth in comparison to Success and Guthion when used for season-long codling moth control. The organic formulation (Entrust) performed similar to the conventional formulation (Success) in the reduction of CM fruit injury. Trials conducted with granulosis virus in 2003 included dose-response and field-aged bioassays of three commercial formulations (Carpovirusine, Cyd-X and Virosoft) as well as a small-plot field trial comparing efficacy of the products when applied at recommended rates and frequency intervals for season-long CM control. The products look promising as a means to reduce CM populations but may not reduce fruit injury caused by the generation treated.
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Chemical Control/New Products

Control of Codling Moth Using Organically Acceptable Granulosis Virus and Spinosad Products

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Keywords: Granulosis virus, Cyd-X, Carpovirusine, spinosad, Entrust, oil, mating disruption, codling moth, Cydia pomonella, pear

Abstract: The efficacy of two granulosis virus (GV) products and an organically acceptable formulation of spinosad were tested versus oil and mating disruption (MD) alone to control codling moth in Bartlett pears. There were three replicated grower-treated sites and one single-tree trial. Treatments in the large-scale plots were applied in conjunction with MD. Untreated controls were included at two sites. Control using the GV products (Carpovirusine and Cyd-X), spinosad (Entrust) and oil gave significantly greater control versus MD alone by harvest.
Biology/Phenology

Lucia Varela, moderator
Abstracts of the 78th Annual Western Orchard Pest & Disease Management Conference

Biology/Phenology

It's All in the Timing for Sampling Leafroller Parasitoids

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Keywords: sampling, phenology, obliquebanded leafroller, *Choristoneura rosaceana*, Pandemis leafroller, *Pandemis pyrusana*, parasitoids

Abstract: Between 2001-2003 13 orchards were monitored for OBLR and PLR parasitoid activity. The dominant parasitoids found in each orchard varied depending on whether OBLR or PLR was the dominant (or only) leafroller present, the location of the orchard and the treatments used for management. OBLR parasitoids were dominated by two species of tachinid flies, *Nemorilla* and *Nilea*, both of which have their greatest impact late in the summer and which occurred at virtually all the locations. Overall, these two tachinids account for an average of 50% of all the parasitoids collected from OBLR. At other locations, we also collected *Macrocentrus* (a braconid wasp dominant at 4 locations), *Sympiesis* (a eulophid wasp, summer generation only, 2 locations), and *Tranosema* (an ichneumonid wasp, spring generation only). *Colpoclypeus florus* (eulophid wasp) was rarely collected at any of our OBLR sites. PLR parasitism was dominated by *Apanteles* (a braconid wasp at 5 locations), *C. florus* (2 locations) and *Tranosema* (3 locations, first generation only). *Nemorilla* and *Nilea* were dominant at two sites but overall had a lower importance for PLR than for OBLR. The timing of sampling was crucial in determining the importance of each species. Our recommendation is to restrict sampling to specific times for each species.

Biology/Phenology

Effect of Sublethal Doses of Bt and Intrepid™ on OBLR: Implications for Model Timing

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Keywords: sublethal effects, *Bacillus thuringiensis* (Bt), Intrepid™, obliquebanded leafroller, *Choristoneura rosaceana*, Pandemis leafroller, *Pandemis pyrusana*, phenology model, developmental delay, flight curve

Abstract: Lab and field studies were conducted to determine how phenology of OBLR and PLR larvae is affected by the use of Bt and Intrepid™. In the lab, 3rd and 4th instar OBLR larvae were fed Bt or Intrepid™ spiked diet at rates low enough to achieve sublethal effects. The larvae were monitored until death or adult emergence, and the time of each molt was recorded. Results show that the increase in time needed to reach adult stage caused by the ingestion of Bt was 6-20% and the delay associated with Intrepid™ was 10-15% when compared with control individuals. Field studies consisted of monitoring orchards that were treated with Bt or Intrepid™ and untreated orchards. Adult trap data were used in conjunction with larvae samples, which were taken weekly throughout the season. Flight curves were generated for treated and untreated orchards and compared to the WSU flight model as well as to the flight models generated by our previous data. In orchards treated with either Bt or Intrepid™ there was a developmental delay of approximately 105 LR degree-days compared to control orchards.

Biology/Phenology

Deciduous Tree Fruit Arthropod Pests of North America: An Annotated Checklist

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Keywords: tree fruit pests, checklist

Abstract: The change in tree fruit pest management programs over the past decade provides a good opportunity to examine our current pest complex in the context of the known pool of tree fruit pests in North America. Tree fruit pests occur in eleven orders of Arthropoda, including Lepidoptera, Coleoptera, Diptera, Hymenoptera, Heteroptera, Homoptera, Thysanoptera, Orthoptera, Dermaptera, Plecoptera and Acari. The Lepidoptera contain the greatest number of species and are overall the most important pest group. The most important families include the Tortricidae, Sesiidae, Noctuidae and Gracillariidae. Of the Coleoptera, the Curculionidae have the most members, although several of the Scolytidae are widespread and persistent pests. The importance of the Diptera as tree fruit pests rests almost solely with a few species of Tephritidae and, for the Hymenoptera, the Tenthredinidae. The Homoptera are represented by several historically problematic pests in the Diaspididae and, to a lesser extent, in the Coccidae and Pseudococcidae. The Aphididae are widespread although rarely key pests (except perhaps in stone fruits), and the Psyllidae contain one of the key pests of pear. Of the seven families of Heteroptera affecting tree fruits, only the Miridae and Pentatomidae contain important pests. The Orthoptera (Acrididae, Gryllidae), Thysanoptera (Thripidae), Dermaptera (Forficulidae) and Plecoptera (Taeniopterygidae) each contain a few pest species. The Arachnida order Acari contains a number of important pest families, most notably the Tetranychidae and Eriophyidae.

Biology/Phenology

DNA-Based Diagnostics for Lepidopteran Pests of Pome Fruits

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Keywords: DNA diagnostics, real time PCR, mitochondrial DNA, pome fruit, quarantine insects, Mexico, Cydia pomonella, Grapholitha molesta, G. packardi, G. prunivora

Abstract: CO-I mitochondrial DNA from the 4 tortricids which feed internally in apples and pears in the USA was sequenced and compared. Primer sets were designed that selectively amplify each species and protocols were developed for a real-time PCR instrument and for traditional PCR followed by agarose electrophoresis. Cydia pomonella and the 3 Grapholitha species (G. molesta, G. packardi, G. prunivora) are readily separated. The technique is robust for geographically disparate populations of each species. Mexico is now using the method to confirm identifications of larvae found in intercepted fruit. A possible new species of Grapholitha, near packardi, was seen attacking rose hips in Washington.
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Biology/Phenology

Effect of Cover Crop Control on Plant Bug Damage in Pears

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Keywords: Lygus bug, Lygus hesperus, pear, biology, herbicide, 2,4-D, Orchard Master

Abstract: A study was conducted on the effect of plant bug damage due to broadleaf weeds in the ground cover. The ground cover, which was mowed every other week and sprayed with two broadleaf herbicides, was compared to the untreated control (neither mowed nor sprayed) for the type of vegetation cover, number of plant bugs and percent pear damage. Significantly higher numbers of plant bugs were caught in the untreated control, while pear damage was numerically higher in the mowed-herbicide treatment. The numerically higher damage present in the mowed and herbicide treatment could be attributed to the absence of broadleaf weeds, the plant bugs' preferred food source. If broadleaf weeds can be sustained throughout the season, plant bug damage may be reduced.

Biology/Phenology

The Growth and Development of the Consperse stink bug, Euschistus conspersus, on Selected Potential Host Plants Present in Orchard Ground Cover

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Keywords: consperse stink bug, Euschistus conspersus, phenology, hosts, orchard, apple, border, weeds, damage distribution

Abstract: The consperse stink bug, Euschistus conspersus Uhler, has emerged as an important pest of pome fruit production in northcentral Washington in the past decade. Fruit damage is primarily caused by the feeding of adult E. conspersus in late summer and early fall, often within a few days of harvest. Crop losses of greater than 10% have been reported from many orchards. While some fruit packing facilities have rated stink bug damage as being a more serious problem than codling moth, relatively little is known about the habits of this insect and, as a result, management has been difficult. In previous years, we have developed information on host plants used by E. conspersus outside the orchard; however, there is little information on the role that plants present in the orchard ground cover might play in supporting populations that could contribute to damage of apple. We conducted a study to compare the development of E. conspersus from the egg stage to adult on the most common plants found in the cover crop of Washington orchards. This information is presented in conjunction with data documenting patterns of fruit damage within orchards, and the significance of these findings to grower practices such as insecticide and herbicide treatment regimes is discussed.
Biology/Phenology

Biology and Management of Bark Beetles (Shothole Borer) in Stone and Pome Fruits

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Keywords: Scolytidae, bark beetle, Scolytus rugulosus, shothole borer, ambrosia beetle, Xyleborus dispar, cherry, insecticide, control

Abstract: We will report results from a one-year project that focused on biology and management of bark beetles in Washington state. The dominant bark beetle found throughout the state was the shothole borer (SHB), Scolytus rugulosus Müller. An ambrosia beetle, the European shothole borer (AB) (Xyleborus dispar Fabricius) and/or the lesser shothole borer (Xyleborinus saxeseni Ratzburg) were present in high numbers at only one location, a cherry orchard abandoned for several years. At many locations more than one species of scolytids were detected. The life histories as determined in 2003 indicated one prominent flight that peaked in June and a probable but less prominent second flight of SHB and possibly two flights of ambrosia beetle. These data were inconsistent with some of the reported literature. Beetles appeared to live a long time or emerge from various hosts over a long time. Wood piles of apple and cherry are the main sources of high beetle densities that cause injury to commercial orchards. Cherry trees were most heavily attacked and in some cases severe injury resulted to trees adjacent to wood piles. Injury accumulation continued well after peak flight, with damage occurring through September. Traps were useful in identifying peak activity periods but it was not clear whether they would be useful in setting thresholds for treatments. Available attractants enhanced trap captures but it seemed likely that with some effort better attractants could be found. A preliminary protocol was developed for screening insecticides against SHB adults. The method seemed to work well when tested against older adults but needs to be validated against adults of a known age distribution.

Biology/Phenology

Cherry Fruit Fly Management at the Agricultural-Urban Interface in the B.C. Interior

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Keywords: western cherry fruit fly, black cherry fruit fly, Rhagoletis indifferent, Rhagoletis fausta, trap, lure, phenology, movement, flight, chemical control, insecticide

Abstract: Managing the cherry fruit fly (CFF) complex (Rhagoletis species) has become a serious challenge in B.C. since 1999, but little research has occurred in Canada since the 1970s. Results are presented from two years of research into basic information necessary for an area wide program in orchards, private gardens and the mixed urban-rural landscape of the B.C. interior. At 35 sites from the border to Salmon Arm, from June-September 2002 and May-October 2003, eight species of CFF-like flies were collected on traps throughout the study area: R. indifferent, R. fausta, R. basiola, R. berberis, R. zephyria, R. completa, R. ribicola, and one unknown species, near R. suavis, the eastern walnut fly. Trapping of CFF for spray timing by consultants and extension staff occurs using a wide variety of materials of various shapes, sizes, configurations, colors, with and without various odor lures. Captures of flies on typical and newer traps were highly variable and one trap in general use was almost ineffective: the “Rebell” trap caught significantly more R. indifferent than an existing standard trap. Apparent emergence of flies from wild hosts seems to occur later than apparent emergence in orchards. Measurements of CFF flight and movement were made in three orchards in 2002 or 2003.
Biology/Phenology

Development of a phenology model for predicting western cherry fruit fly, *Rhagoletis indifferens* Curran (Diptera: Tephritidae), emergence and oviposition in the Mid-Columbia Area of Oregon

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Keywords: Trapping, distributed time-delay model, prediction, egg-laying, cherry, western cherry fruit fly, *Rhagoletis indifferens*

Abstract: The western cherry fruit fly (CFF) is a major pest of cherries. Because of a zero tolerance for damage, detecting CFF emergence is critical for successful control. Due to low CFF populations in the major cherry-growing districts in the Mid-Columbia, emergence cannot be detected reliably with traps. Phenology models developed elsewhere have not proven accurate enough for predicting emergence and oviposition. To improve predictions of CFF emergence, historical observations on first emergence, rainfall and temperature were analyzed. A phenology model of CFF emergence and oviposition was developed using the distributed time-delay concept. The model was validated with trap catch records from several years.

Biology/Phenology

Temperature-dependent Development and Fecundity of the Predaceous Plant Bug *Deraeocoris brevis* (Hemiptera: Miridae) Reared on Eggs of *Ephestia kuehniella* (Lepidoptera: Pyralidae)

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Abstract: The development and reproduction of the predaceous mirid *Deraeocoris brevis* Knight were studied using eggs of *Ephestia kuehniella* as food. The biological parameters of temperature-dependent development and reproduction were estimated for the purpose of constructing a *D. brevis* population model that describes its seasonal occurrence and development. Also, basic life history data were needed for the design and standardization of bioassays. The incubation periods for eggs were 13.0 d and 10.2 d at 21 and 24°C, respectively. Nymph development times averaged 19.7 d and 16.2 d at those temperatures. Adult longevities were 52.9 d at 21.0°C and 49.8 d at 24°C. Females produced on average 401.2 eggs at 21°C and 471 eggs at 24°C. Additional experiments will be conducted to determine development and fecundity over a broader temperature range.

Appendix
Minutes of the 77th Annual Meeting
Western Orchard Pest and Disease Management Conference
Hilton Hotel, Portland, Oregon
January 15-17, 2003

I. Call to Order: The 77th Annual Meeting was called to order by the Chair John Dunley at 10:00 AM. Chair Dunley extended an official welcome to everyone. Chair Dunley introduced section leaders. They were:

- Chemical Control/New Products - Christian Krupke
- Biology/Phenology - Maciej Pszczolkowski
- Matting Disruption/SIR - Jay Brunner
- Implementation - Peter McGhee
- Thresholds/monitoring - Mike Omeg
- Biological Control - Tom Unruh
- Pesticide Resistance - Roger Willemsen
- Tree Fruit Diseases

II. Old Business

Reading of 2002 Minutes: It was moved and seconded that the reading of the minutes be dispensed with and that the minutes be approved as written. Secretary Thomson indicated that the minutes would be posted at the registration desk.

Chair Dunley called for any other old business. There was none.

III. New Business

A. Committee Assignments: The following committee assignments were made:
   - Nominations: Mike Willett, Helmut Riedl, Brad Higbee
   - Audit: Tim Smith, Mike Omeg, Fred Smith
   - Resolutions: Chris Nobbs, Greg Rains, Glenn Thayer

B. Venue 2004: It was agreed that the WOPDMC would meet again at the Hilton Hotel. It was agreed that Secretary Thomson would make the arrangements with Hilton Hotel to secure arrangements for all future meetings.

C. Structure of the WOPDMC: Secretary Thomson reported on the incorporation of the WOPDMC as a nonprofit organization in the State of Oregon.

IV. Closing Business Meeting:

The closing business meeting was called to order by Chair Dunley at 11:30 AM on January 17.

A. Committee Reports:
   1. Nominations: The nominating committee nominated Phil VanBuskirk as chair elect for the 2004 meeting and Don Thomson as Secretary/Treasurer for the 2004 meeting. A motion was made and seconded to accept the recommendations of the nominations committee. The motion passed unanimously. Broc Zoller will be the Chair for the 2004 meeting.

   2. Audit: Chair Dunley asked for the report of the auditing committee. The committee audited the report from Treasurer Thomson. They reported it to be in good order. A motion was made and seconded to accept the treasurer's report. The motion passed. Don Thomson then read the Treasurer's Report.
3. Resolutions: The report of the resolution committee was requested by Chair Dunley. The committee proposed the following:

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. The membership would like to especially thank the Hilton Hotel for the organization of the reception on Wednesday, January 15.

b. Be it resolved that the members of the conference express their appreciation to Chair Dunley, and Secretary/Treasurer Don Thomson for their leadership and dedication in organizing the 2003 meeting.

c. Be it resolved that the members of the conference extend their appreciation to Bette Brattain for preparing the research report abstracts as well as to the section leaders: Maciej Pszechalkowski, Jay Brunner, Peter McGhee, Mike Omeg, Tom Unruh, Roger Willemsen and Christian Krupke.

d. Be it resolved that the Secretary write letters of condolences to the family members of those who passed away during the past year.

e. Be it resolved that the members of this conference recognize the long-term benefits the organization will receive from the development of the web-based communication made possible through the efforts of Betsy Beers, Bette Brattain, John Dunley, and Jerry Tangren, WSU-TFREC, Wenatchee, Washington.

A motion was made and seconded to accept the resolutions as read. The motion passed.

It was announced that the meeting dates for the 2004 meeting will be January 14, 15 and 16. The meeting will start at 10:00 AM on Wednesday, January 14, 2004.

Chair Dunley thanked those who had attended and helped in various capacities to make the 77th Pest and Disease Management Conference a success. Chair Dunley turned over the proceedings to Chair Elect Broc Zoller. He adjourned the meeting.

Respectfully Submitted,

Donald R. Thomson
Secretary/Treasurer
Notes
78\textsuperscript{th} Annual Conference

Hilton Portland, Portland, Oregon

January 14-16, 2004