2013 Orchard Pest and Disease Management Conference

The 87th Conference is pleased to announce our keynote speaker:

Camille Parmesan

Marine Institute, Plymouth University, England; University of Texas, Austin

Keynote Address:

Insects and Climate Change: What's Happening and Where Are We Going?

Hilton Portland, Portland, Oregon
January 9-11, 2013

Dr. Camille Parmesan

Camille grew up in Houston, Texas the grandchild of Sicilian and Scandinavian immigrants. Camille's mother was a geologist with a minor in botany. Camille spent her summers hiking with her Mother and sisters learning about rocks and plants. Camille attained her undergraduate degree in animal behaviour and her PhD from the University of Texas. She completed a postdoc at the National Center for Ecological Analysis and Synthesis at UC Santa Barbara. In 2000, she joined the faculty at the University of Texas Austin where she is now a Professor in Integrative Biology. In 2011, Camille was appointed Professor, N.M.A. Chair in Public Understanding of Oceans and Human Health at the Marine Institute, Plymouth University, UK.

In 1983, just before the start of her senior year, Camille began research on the Edith's checkerspot *Euphydryas editha* butterfly under the direction of Mike Singer (now her husband) an evolutionary ecologist at the University of Texas. Camille continued her work on *editha* for her graduate research.

In 1992, Camille received a grant from NASA's Global Change Program, Mission to Planet Earth program to study if *editha* was being affected by climate change. Camille spent 4.5 years living in a tent while she gathered data on *editha* over its range on the Pacific Coast including from Baja California to southern British Columbia and up along the Continental Divide to the species' northernmost populations, near Jasper and Banff National Parks. Camille's research showed that the species had moved, on average, two degrees of latitude northward, and 300 feet upward, from where it was historically recorded. Camille suspected that it wasn't an isolated case but part of a general trend affecting flora and fauna. She went to Europe where there were records on butterfly movement and phenology in the northern countries going back to 1760. Working with European colleagues, they compiled data for 57 species. In a 1999 Nature publication, they provided the first large-scale evidence of poleward shifts in entire species' ranges.

In 2003, Camille co-authored a landmark publication in Nature with Wesleyan University economist Gary Yohe entitled "A globally coherent fingerprint of climate change impacts across natural systems". Using global meta-analyses, they documented the impact of climate change on over 1,700 species of flora and fauna. Thomson Reuters ISI Web of Science ranked Camille the second most highly cited author in the field of Climate Change from 1999 to 2009. In 2007, Camille shared in the Nobel Peace Prize for her work as a Lead Author in assessment reports of the Intergovernmental Panel on Climate Change. Camille's research and communications have helped support arguments in policy sectors for reduction of greenhouse gas emissions. Camille works actively with governmental agencies and NGOs to help develop conservation assessment and planning tools aimed at preserving biodiversity in the face of climate change. She was awarded the Conservation Achievement Award in Science by the National Wildlife Federation, named "Outstanding Woman Working on Climate Change," by IUCN, and named as a "Who's Who of Women and the Environment" by the United Nations Environment Program (UNEP).

Orchard Pest and Disease Management Conference
Agenda for 2013 Conference

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

	Wednesday, January 9
9:00am	Opening Business—David Epstein, OPDMC Chair
10:00am	**Implementation—David Epstein**
11:00 am	**Thresholds/Monitoring—Alan Knight**
12:00pm	*Lunch*
1:30pm	**Biocontrol—John Wise**
3:00pm	*Coffee*
3:30pm	*Keynote Address:* **Insects and Climate Change: What's Happening and Where Are We Going?** Camille Parmesan, National Marine Aquarium Chair in the Public Understanding of Oceans and Human Health, Marine Institute, Plymouth University; Professor, Section of Integrative Biology, University of Texas, Austin
5:00pm	*Mixer (Lobby)*
	Thursday, January 10
8:00am	**Invasive Species—Pete Shearer**
10:00am	*Poster Session/Coffee (Lobby)*
11:00am	**Chemical Control—Don Thomson**
12:00pm	*Lunch*
1:30pm	**Chemical Control (cont'd)—Harvey Reissig**
3:30pm	*Break*
4:00pm	**Biology/Phenology—Jack Jenkins**
	Friday, January 11
8:00am	**Mating Disruption/SIR—Peter McGhee**
10:30 am	Closing Business—David Epstein, OPDMC Chair, Lucia Varela, Chair-elect
11:30 am	*Adjourn*

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

Orchard Pest and Disease Management Conference
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Order of Presentations
FROM THE 87th ANNUAL
ORCHARD PEST AND DISEASE MANAGEMENT CONFERENCE

January 9, 10 & 11, 2013

Keynote Presentation, Wednesday, January 9, 2013, 3:30pm – 5:00pm

Insects and Climate Change: What's Happening and Where Are We Going?

Camille Parmesan, National Marine Aquarium Chair in the Public Understanding of Oceans and Human Health, Marine Institute, Plymouth University; Professor, Section of Integrative Biology, University of Texas

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IMPLEMENTATION—

Moderator: David Epstein

Notes:

Implementation

Federal Pesticide Update

David Epstein
USDA Office of Pest Management Policy, 1400 Independence Avenue, SW, Room 3871-South Bldg., Mail Stop 0314, Washington, DC 20250-0314

Keywords: National Pollution Discharge Elimination System (NPDES), Pesticides General Permit, Endangered Species Act (ESA), USEPA Registration Review

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

Principles and Recent Applications of Area-Wide-IPM with an SIT Component

Marc J.B. Vreysen
Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture
Insect Pest Control Laboratory, Vienna, Austria

Keywords: integrated pest management, insecticide use, sterile males, SIT, area-wide IPM, localized IPM, eradication, suppression, containment, prevention.

Abstract: E.F. Knipling, on the occasion of receiving the World Food Prize in 1992, stated that "major advances in coping with most of the major arthropod pest problems will require a change in the tactics and the strategies to manage those pests. They must change for the currently used limited scale, reactive, broad-spectrum measures to preventive approaches that are target specific and applied on an area-wide basis". Since then, practices to manage these pests have hardly changed and pesticide use is still on the rise every year to the detriment of the environment, human health and the ecosystem. The need for more target specific, sustainable, environmentally-friendly and cost-effective control tactics and pest management strategies remains to date more pertinent than ever.

Integrated pest management (IPM) aims at the careful integration of several control tactics which are the most opportune for the particular ecosystem, while safeguarding human health and the environment. It has remained the dominant paradigm of pest control over the last half century. IPM can be applied on a field-by-field basis (localised IPM), or against an entire pest population within a delimited geographic area (area-wide (AW-IPM)). AW-IPM seeks to treat all habitats, also those that are of no economic interest to the farmer, so that none produces migrants to re-establish significant infestations in areas of concern. This is in contrast to the field-by-field approach that focuses narrowly on defending the valued entity (crop, livestock, people, building, etc.). In most cases, AW-IPM leads to more effective and sustainable management of the insect pest.

The sterile insect technique (SIT) is a species-specific autocidal control tactic that interferes with the reproductive potential of the target insect pest. It is a very powerful tool that is most effective when insect populations are low and when applied on an area-wide basis. The SIT within an AW-IPM context can be applied for the suppression, eradication, containment or prevention of insect pest populations. There are numerous AW-IPM programmes where the SIT has been used successfully, especially against dipteran and lepidopteran pests, and examples will be given to illustrate this. On economic, environmental and biological grounds, the case for SIT is compelling.

Implementation

Assessment of a New Precision Pest Management System Using SIR Codling Moth

Dr. Michael Gilbert and Chelsea Eby
SemiosBIO Technologies Inc., 320-887 Great Northern Way, Vancouver, BC

Keywords: Codling moth, *Cydia pomonella*, apple, mating disruption, pheromone, automated aerosol puffers, camera traps, wireless mesh network, precision pest management

Abstract: Preliminary trials of SemiosBio's Precision Pest Management System were conducted in the Okanagan and Similkameen Valleys of British Columbia, Canada during the summer of 2012. Wireless communication between weather stations, aerosol puffers and camera traps was proven. A 35 acre apple orchard had puffer units deployed at one puffer per acre. The efficacy of number of puffer units deploying pheromone and a variety of dispensing schedules was assessed using sterile codling moths (*Cydia pomonella*) from the Okanagan SIR program. Trap catches were reduced in all treatments.

Solid Set Canopy Delivery System

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

Keywords: Solid Set Canopy Delivery System, SSCDS

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

Water sensitive cards showed a weakness for coverage of the underside of leaves in the initial SSCDS design in apples that was tested at the Sunrise Research Orchard located near Wenatchee, Washington. Compared to the airblast application method, it was clear that the distribution of spray deposits with the SSCDS was strongly weighted to the upper surface of foliage. Tartrazine dye, used to measure spray distribution, showed that the SSCDS design had the highest levels of dye within the canopy. Both of the application methods (SSCDS and airblast) provided less coverage in the lower portion of the tree canopy. Leafroller bioassays supported the spray distribution data shown by the water sensitive cards. There was higher mortality in the airblast treatment, which provided better coverage of the lower leaf surface where first instar leafrollers feed. Future work will focus on optimizing the use of micro sprinklers or micro sprayers to improve spray coverage on both top and bottom surfaces of leaves and on fruit. The Washington State SSCDS Team includes: Jay Brunner, Keith Granger (WSU-TFREC, Wenatchee); Gwen Hoheisel (WSU Extension); Matt Whiting, Gary Grove, Ajay Sharda, Manoj Karkee and Qin Zhang (WSU-IAREC, Prosser); Tory Schmidt and Ines Hanrahan (Washington Tree Fruit Research Commission).

Implementation

Progress in the Development of an In-Canopy Fixed Spraying System for High-Density Apple Orchards

Arthur Agnello and Andrew Landers
Department of Entomology, Cornell University, NYS Agric. Expt. Station, Geneva, NY 14456

Keywords: apple, pesticide application, microsprinklers, solid-set

Abstract: A spray system fixed into the tree canopy is being developed to apply pesticide sprays to a commercial high-density planting. All pesticide sprays will be applied through a system of microsprinkler nozzles attached to polyethylene tubing running along the tops of tree canopies and supplied by a central tank and pumping station. Spray nozzles supplied by tubing are attached to a support wire above the trees; single or double microsprayer nozzles are suspended on 8" or 28" lengths of tubing reservoirs alternating every 3 ft along the lateral tubing, and are fitted with anti-drip devices. Trials were conducted to test system operation and time requirements to fill and empty the tubing. Water was pumped from a tanker through an input manifold, filling all the tubing reservoirs (45 sec), and then compressed air at 15 psi was used to push the excess liquid through return lines and back into the tank (4.5 min). Finally, compressed air at 40 psi was used to open the check valves and spray out the liquid (9-12 sec). Without use of a reservoir system in the microsprayer assemblies, ~3 times as much water (150 vs. 50 gal) would have been needed to fill and spray out the 0.38A of tubing used in these tests. As this would have taken considerably longer, it can be concluded that the reservoir design can effect a considerable time reduction in spray operation. Field efficacy trials will begin in 2013.

Implementation

Effect of Horticultural Practices on Environmental Data Used for IPM Models

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

Keywords: IPM, Decision Aid System, temperature, degree-day accumulation, codling moth, oblique-banded leafroller, insect models, overhead cooling, orchard density

Abstract: The quality of temperature input data compared to the temperature an organism actually experiences greatly affects the accuracy of model predictions. The WSU Decision Aid System (DAS) uses WSU-AgWeatherNet (AWN) data and forecasts for these AWN stations provided by the National Digital Forecast Database (NDFD) to run insect and disease models. Typically, AWN stations are placed outside orchards to avoid the effects of agricultural practices on environmental measurements. Thus, using extra-orchard temperature data to estimate the temperature an insect experiences within an orchard might introduce significant error in model predictions. Our study was designed to evaluate how the differences in environmental parameters depending on sensor placement and horticultural practices affect model accuracy. We compared data from AWN stations vs. orchard interior, high-density vs. low-density orchards, as well as the impact of overhead cooling.

For the analysis, we calculated degree-day (DD) accumulations with data from all different scenarios using parameters for codling moth (CM) and six other insect models. Degree-day accumulations using data from the orchard interior vs. AWN differed, but were strongly correlated, and this relationship remained fairly constant between 2010 and 2012. Typically, AWN temperatures were lower than orchard temperatures before June causing key insect events to be predicted later. However, during June-August AWN temperatures exceeded orchard temperatures and this resulted in predictions being early. These late seasonal differences could exceed the three-day threshold we considered to be the maximum error tolerable for IPM purposes. Wind speed within an orchard was reduced to favorable conditions for CM adult flight compared to measurements taken outside the orchard. The difference in model predictions between adjacent high- and low-density orchards was below three days for most sites and models. Only later in the season did these differences exceed three days and key insect events were predicted to occur later in low-density plantings than in the neighboring high-density plots. Outside orchard conditions better predicted environmental conditions in high-density orchards than in low-density orchards. Overhead cooling in late summer at temperatures of 85°F and above reduced the daily maximum ambient temperature by up to 5.4 ± 1.6°F. However, this temperature reduction had no significant effect on CM and oblique-banded leafroller model predictions or longevity (difference ≤ 1d).

THRESHOLDS/MONITORING—

Moderator: Alan Knight

Notes:

Thresholds/Monitoring

Estimating Population Density by Calculating Trap Interception Radius from the Single-Trap, Multiple-Release Configuration

Peter McGhee, Larry Gut, Chris Adams, Jim Miller,
Michigan State University East Lansing, MI

Keywords: Trapping, population sampling, monitoring, pheromone plume

Abstract: Accurate and efficient measurement of the population density of insects in cropping systems is important. Various methods have been developed to estimate densities, including mark-release-recapture techniques such as the Lincoln index, removal-trapping, and statistically-based sampling. However, extrapolation of trap data into actual animal densities remains elusive. Here we report a new and more robust empirical method for estimating density of local populations of any agent capable of being attracted to or arrested at a site where responders can be detected. In simple form, this method utilizes a single trap with responders being released outwardly at varying distances. The equation of the resultant straight line provides valuable data and new methods for determining the area where 95% of catch results, the trap "reach" or pheromone plume length, the contribution of insect meander, and finally an estimate of absolute animal density. Data from our experiments using codling moth, *Cydia pomonella*, closely match established action thresholds used by the fruit industry. The single-trap, multiple-release configuration has long been used, but the resultant computations have been complex and less accurate, and often not transferable to other species. We present a simpler and general method that accurately measures populations of random movers like insects. The application of these methods can be used to establish the mean distance an insect moves over time, help determine action thresholds for emergent and invasive species, and estimate pheromone plume reach from traps and mating disruption products.

Monitoring Oriental Fruit Moth with the Ajar Trap

Alan Knight[1], Esteban Basoalto[2], and Rick Hilton[2]
[1]USDA, ARS, Wapato, WA; [2]SOREC, Oregon State University, Medford, OR

Keywords: Cydia molesta, peach, apple

Abstract: The Ajar trap has been developed and tested in North and South America and Europe over the past two years to monitor both sexes of oriental fruit moth. The Ajar trap is a standard orange delta trap with a 250 ml plastic jar attached to the bottom in which the cap is inside the trap. A standard sticky liner is used with a hole cut out to fit around the lid of the jar. The terpinyl acetate plus sugar bait is replaced every two weeks. Studies during 2012 developed the use of exclusion grids to prevent large moths, yellow jackets, and some flies from fouling the liner of the trap. Also, studies were conducted with several new pheromone and kairomone lures added to the Ajar trap. The trap has proved to be a new effective tool to monitor OFM within sex pheromone-treated orchards and is now commercially available from Marginal Designs in Oakland, CA.

Thresholds/Monitoring

Captures of Western Cherry Fruit Fly on Red Spheres versus Yellow Traps

W. L. Yee
United States Department of Agriculture, Agricultural Research Service, Yakima Agricultural Research Laboratory, Wapato, WA, USA

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

Abstract: Sticky red spheres and spheres and panels of various yellow colors were used to capture western cherry fruit fly. Traps were hung in randomized block designs in wild and unmanaged cherry trees in Washington. In general, yellow spheres and panels were more effective than red spheres, with Saffron Thread, Marigold, Sunny Summer, and Yam yellows more effective than other yellows. Results suggest bright yellow traps should be used instead of red spheres for detecting low populations of this fly.

Monitoring Spotted Wing Drosophila in Sweet Cherries

Caroline R. Wise, Robert A. Van Steenwyk and Lauren M. Novotny
Department of E.S.P.M., 130 Mulford Hall, University of California, Berkeley, CA 94720

Keywords: Spotted wing drosophila, *Drosophila suzukii*, monitoring, baits, trapping, apple cider vinegar, ethephon, Monterey Insect Bait, GF-120, yeast, sugar, merlot, rosewater, raspberry extract, Bird Shield, methyl anthranilate.

Abstract: Three trap and bait trials were conducted in a citrus grove in early spring 2012 in Northern California. One trial examined trap design efficacy while the other trials examined bait attractiveness. In all trials, each treatment was replicated six times in an RCB design, with a minimum of one buffer tree between each trap. Baits were changed and traps rotated weekly. In the trap trial, size of trap opening and distance from bait to opening (headspace) were examined. In the trap type trial large trap openings and smaller headspace caught more SWD than small openings and larger headspace. Trap opening size had a greater impact on SWD catch than headspace. In the first bait trial, Monterey Insect Bait (MIB), apple cider vinegar (ACV), sugar/yeast and GF-120 +ACV were evaluated. MIB showed significant promise as an attractant and caught significantly more SWD than other baits. GF-120 + ACV caught the fewest SWD. In the second bait trial ACV, ACV + wine and ACV with various additives were evaluated. A 3:2 mixture of merlot and ACV caught significantly more SWD than all ACV based baits.

Thresholds/Monitoring

Using Volatile Chemicals from Wine and Vinegar to Attract Spotted Wing Drosophila, *Drosophila suzukii*

Todd B. Adams[1] , Peter J. Landolt[2], Dong Cha[2] and Helmuth Rogg[1]
[1]Oregon Department of Agriculture, Salem, OR
[2]USDA Yakima Agricultural Research Lab, Wapato, WA

Keywords: spotted wing drosophila, Trapping, Bait, Lure

Abstract: Field experiments were conducted to determine the attractiveness of volatile chemicals that were isolated from the headspace of Merlot wine and rice vinegar, and found to be EAD active. Each of these chemicals was tested alone and in combination with a mixture of acetic acid and ethanol, as a trap bait for spotted wing drosophila (SWD). The objectives of the study were to determine if each compound is attractive by itself, and if it is co-attractive with acetic acid and ethanol. A small number of these chemicals were attractive when used alone as trap baits, and a larger subset of the chemicals showed co-attractiveness with acetic acid and ethanol. Generally, these results are consistent with prior evaluations of the chemicals in a laboratory bioassay. Further evaluations of more complex combinations of the chemicals that were attractive or co-attractive may provide superior chemical lures for SWD.

Walnut Husk Fly Trap Optimization

Lauren M. Novotny, Robert A. Van Steenwyk, Caroline R. Wise,
William W. Coates and Janine K. Hasey
Department of E.S.P.M., 130 Mulford Hall, University of California, Berkeley, CA 94720

Keywords: Walnut husk fly, *Rhagoletis completa*, ammonium carbonate, ammonium bicarbonate, green leaf alcohols, caryophyllene, Trécé, Alpha Scents, walnut, monitoring, trapping

Abstract: Potential improvements to commercially available WHF traps were investigated in three commercial walnut orchards in Sutter/Yuba, San Joaquin and San Benito counties. Two traps and six lures were used in 10 trap-lure combinations. The trap types included the Trécé Pherocon® AM/NB trap and the Alpha Scents back-folded yellow sticky trap. Lures included ammonium carbonate, ammonium bicarbonate, green leaf (GL) alcohol blend, caryophyllene and commercially available lures from Trécé and Alpha Scents. Treatments were replicated four times in a RCB design in each orchard. Each replicate consisted of two traps placed at about 6 ft above the ground and in the top 5 ft of the canopy of adjacent trees. There were 3 to 5 trees between replicates. Traps were monitored and positions rotated weekly from 19 June through 7 September. Panel traps were changed once a month or when panel surface lost stickiness. Ammonium carbonate and bicarbonate lures were changed weekly; all others were replaced once a month. There was no significant difference in trap catch between the two trap types, nor was there a significant difference in trap catch between ammonium carbonate and ammonium bicarbonate Super Charger lures. The Alpha Scents commercial lure performed comparably to the Super Charger lures and all three captured significantly more flies than the Trécé lure. GL alcohols and caryophyllene alone and in combination with ammonium carbonate suppressed trap catch. Further study is warranted to determine the impact of lure release rate on trap catch and the conditions under which traps placed high in the tree (requiring more labor to check) are necessary to accurately monitor WHF populations.

BIOCONTROL—

Moderator: John Wise

Notes:

Biological Control

Enhancing Biological Control in Western Orchards: A Summary of New Information and Directions for Future Research

Angela N. Gadino[1], Vince P. Jones[1], Jay F. Brunner1, Elizabeth H. Beers[1], Karina Gallardo[1], Jessica Goldberger[1], Nick Mills[2], Peter W. Shearer[3], Steve Castagnoli[3], David R. Horton[4], Thomas R. Unruh[4], Ute Chambers[1], Wendy Jones[1], and Nadine Lehrer[1]
[1]Washington State University, Tree Fruit Research and Extension Center, Wenatchee, WA
[2]University of California Berkeley, Berkeley CA
[3]Oregon State University, Mid-Columbia Research and Extension Center, Hood River, OR
[4]USDA-Agricultural Research Service, Wapato, WA

Keywords: natural enemies, monitoring, phenology, pesticide effects, codling moth, secondary pests, stakeholder surveys, educational resources

Abstract: Over the last four years a regional project, including a team of ten scientists from Washington, Oregon and California, has been focused on efforts to enhance biological control in apple, pear and walnut orchards. Pest management programs in these orchard crops have been changing due to the loss of organo-phosphate (OP) insecticides and the introduction of 23 new pesticides. These shifts, in addition to the increased use of mating disruption, have created an opportunity to expand the use of biological control in these systems through the conservation and enhancement of natural enemies. The project has focused on several aspects to better understand natural enemies in these orchards. Our team has (1) evaluated pesticide effects on eight common natural enemies, (2) developed new monitoring tools for natural enemies which also enabled us to generate phenology models for some key species, and (3) investigated the predators most responsible for consuming codling moth using gut content analysis. We will present a synthesis of our results and discuss how this new information can benefit pest management decision makers in orchards. A large component of this project is our outreach education efforts to successfully transfer the new knowledge to the industry. This effort has been guided through the use of either formal or informal surveys of stakeholder groups, and we will present key results from these surveys and what this information means for our outreach approach. In conclusion, we will discuss new ideas and directions for future research that have arisen from knowledge gained in this project.

Biological Control

Impact of New Insecticides on Predacious Mites of Apples

John Wise, Raja Zalinda and Mark Whalon
Michigan State University, Trevor Nichols Research Center, Fennville, MI

Keywords: *Neoseiulus fallacis*, Panonychus ulmi, mite flaring, insecticide toxicity

Abstract: European Red Mite (Koch), *Panonychus ulmi* (Acari: Tetranychidae), is the principal phytophagous mite pest in Michigan apples. The predatory mite, *Neoseiulus fallacis* (Acarina: Phytoseiidae) plays an important role in biological control of European red mite in Michigan apple orchards. This semi-field study examined the impact of insecticides on the population dynamics of *P. ulmi* and the predator, *N. fallacis* at the Michigan State University Trevor Nichols Research Center, in Fennville, Michigan. The toxicity of insecticides from the pyrethroid, neonicotinoid, carbamate, spinosyn, diamide and insect growth regulator (CSI) classes on *N. fallacis* was measured based on topical and foliar residual exposure (1, 7, 14, 21 days) bioassays. The mite-flaring response of European Red Mite egg and motile populations was also measured throughout the growing season after two post-petal fall applications of the treatment insecticides, based on labeled field rates for codling moth control.

Comparing Effects of Newer Insecticides on *Chrysoperla johnsoni* and *Chrysoperla carnea* (Neuroptera: Chrysopidae)

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

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

Abstract: This study compared lethal and sublethal effects of five insecticides, rynaxypyr, cyazypyr, spinetoram, novaluron and lambda-cyhalothrin, on adult and second instars of two green lacewing species, *Chrysoperla johnsoni* Henry, Wells and Pupedis and *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) in the laboratory. Formulated pesticides were tested using concentrations equivalent to the high label rate dissolved in 378.5 L of water. Novaluron and lambda-cyholothrin were toxic to larvae and no treated larvae survived to the adult stage. Larva to adult survival was reduced in rynaxypyr, cyazypyr and spinetoram treatments. Larva to adult developmental time and sex ratio were not different among the treatments within a species. Rynaxypyr, cyazypyr, spinetoram and lambda-cyhalothrin treatments were highly toxic to adults of both species. *Chrysoperla johnsoni* females had lower fecundity than *C. carnea* females in the control. Fecundity of females was similar in the control and novaluron treatment within each species. However, fertility and egg viability were negatively impacted for both species when females were treated with novaluron. *Chrysoperla carnea* females had higher fertility and egg viability than *C. johnsoni* females in the control. Adults of both species had similar longevity in the control and novaluron treatment and adult longevity was not gender specific. All insecticides tested were toxic to *C. johnsoni* and *C. carnea* either at the immature or adult stage or both. Results of this study demonstrate a similarity between *C. johnsoni* and *C. carnea* for pesticide toxicity irrespective of their varied geographical distributions.

Biological Control

Evaluating the Effects of HIPV lures on Natural Enemy Populations in Western Orchards

Andrea Bixby-Brosi & Vincent Jones
Washington State University, Tree Fruit Research and Extension Center, Wenatchee, WA

Keywords: Herbivore induced plant volatiles, natural enemies, green lacewings, *Chrysopa nigricornis*, *Chrysoperla plorabunda*, aphids, apples, biological control

Abstract: Lures made with herbivore induced plant volatiles (HIPVs) have the potential to enhance biological control in orchards by increasing numbers of natural enemies, which subsequently decrease pest populations. By utilizing an egg white marking system in combination with HIPV lures, we found that green lacewings, *Chrysopa nigricornis* and *Chrysoperla plorabunda,* move up to 60 m, suggesting an approximate distance around HIPV lures where an increase in natural enemy activity is expected to occur. We demonstrated that lures contribute to pest suppression by monitoring small aphid colonies and observing natural enemies on small trees with and without the presence of HIPV lures. The information gained in this study leads to more appropriate use of HIPV lures in orchards to manipulate natural enemy populations in ways that enhance biological control.

Aureobasidium pullulans Based Biological Control Products for Fruit, Nuts, and Berries: Their Mode of Action and Proper Use

Robert A. Hudson, Ph.D.
Westbridge Agricultural Products

Keywords: Aureobasidium pullulans, Botector, Blossom Protect, Aureo Shield, yeast, ascomycete, competitive exclusion, fire blight, *Botrytis cinerea*, gray mold, *Monilinia fruticola*, *Monilinia laxa*, brown rot, blossom blight, twig blight, *Phomopsis obscurans*, phomopsis fruit rot, *Colletotrichum acutatum*, anthracnose, stone fruit, grapes, pome

Abstract: Aureobasidium pullulans is an yeast that serves as the active ingredient for three effective biological control products; Blossom Protect™, Aureo Shield™, and Botector®. These products are labeled for the control of both bacterial and fungal pathogens, depending on the particular product. Blossom Protect is labeled for the control of fire blight (*Erwinia amylovora*) on pome fruit including, but not limited to, apple, pear, and quince. Aureo Shield and Botector are labeled for the control of various fungal pathogens on stone fruit, grapes, and strawberries; especially those diseases that have blossoms as a primary infection court. Included in this group are gray mold (*Botrytis cinerea*) and brown rot blossom and twig blight (*Monilinia fruticola*), as well as phomopsis (*Phomopsis obscurans*) and anthracnose (*Colletotrichum acutatum*) fruit rot diseases. The mode of action for all three products is competitive exclusion, in which pathogenesis is inhibited through the lack of space and/or nutrients for the pathogenic species. Since all these products rely on yeast-pathogen population interactions for effective control, timing of the applications is critical. In addition, it is important to be aware of orchard production issues that may adversely impact the yeast population. Efficacy data and suggestions for these product's effective use will be presented and discussed.

INVASIVE SPECIES—

Moderator: Pete Shearer

Notes:

Invasive Species

Spotted Wing Drosophila: Year 3 in Eastern Washington

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

Keywords: spotted wing drosophila, *Drosophila suzukii*, monitoring, trapping, lures, chemical control

Abstract: The regional trapping program for spotted wing drosophila (SWD) indicated that populations rebounded in 2012 from the low levels found in 2011; this year's trap counts were similar to 2010, the first year of trapping. The most obvious reason for the low populations is the Thanksgiving freeze of 2010; the 2010 and 2012 levels are likely what we will experience in eastern Washington. However, it should be noted that different traps and sometimes different locations were used in the three years of the monitoring program. Tests of trap design indicate no effect of color (red, yellow, black, white, clear). Other trap design factors show distinct trends: higher catches are associated with larger bait surface area, greater bait volume, and increasing points of entry/diffusion. A commercial insect bait (Monterey Ag Bait) caught about 3x as many SWD as the standard, apple cider vinegar. Field trials of pesticides for control of SWD were unsuccessful in that no field infestation developed despite repeated releases of lab-reared flies; however bioassays of residues provided a relative indication of efficacy. When pesticides were used at their labeled PHI/retreatment intervals, Warrior residues (single application, 14 days before harvest [DBH]) provided high levels of control initially, but dropped off by harvest. Spinosad (Entrust 80W or 2SC; 3 applications at 17, 10, and 3 DBH) gave higher levels of control. However, in a handgun residue longevity trial, Warrior and Diazinon provided the longest residual control. In an unreplicated large-block test, spinosad+Monterey Ag Bait (3 applications, ATV sprayer at 4.2 gpa) provided similar levels of control as an airblast applications of spinosad (Entrust 2SC) in residual bioassays; however, these results should not be interpreted as field-level control without further testing.

Invasive Species

Spotted Wing Drosophila in Mid-Columbia Sweet Cherry: 2012 Update

Peter W. Shearer, Preston H. Brown and Steven P. Castagnoli
Oregon State University, Mid-Columbia Agricultural Research and Extension Center, Hood River, OR

Keywords: Spotted Wing Drosophila, *Drosophila suzukii*, invasive, apple cider vinegar, trap, bait, overwintering survival, bioassay, insecticide, airblast sprayer, Warrior II, lambda-cyhalothrin, Danitol, fenpropathrin, malathion, Delegate, spinetoram, Entrust, spinosad, Belay, clothianidin, carbaryl

Abstract: Adult female spotted wing drosophila (SWD) were used to evaluate the effectiveness and residual activity of various insecticides applied with an airblast sprayer to cherry trees in the field. SWD were then exposed to leaves or fruit at various intervals in the laboratory. The response of SWD varied depending upon substrate (treated leaves versus fruit), insecticide and post-treatment interval. Pyrethroids were the most efficacious and long lasting products tested. Delegate and Entrust were slower acting. Malathion provided quick knockdown but had extremely short residual activity. High rates of carbaryl looked effective while Belay had limited activity.

SWD caused damage to some cherries in the Mid-Columbia district in 2012. Intensive trapping generally detected adult SWD before eggs were observed in cherry fruit. First flies captured in traps were just as likely to be from orchard borders as from interior trees. It is quite possible that with a better trap, use of more traps and fruit sampling, growers and fieldmen may be able to use other products for western cherry fruit fly when is not at risk from SWD. Further research is needed to substantiate this.

Insecticide Efficacy for Spotted Wing Drosophila in Sweet Cherries

Caroline R. Wise, Robert A. Van Steenwyk and Lauren M. Novotny
Department of E.S.P.M., 130 Mulford Hall, University of California, Berkeley, CA 94720

Keywords: Spotted wing drosophila, *Drosophila suzukii*, Danitol 2.4EC, fenpropathrin, Belay 2.13SC, clothianidin, Lambda-Cy EC, lambda-cyhalothrin, Assail 30SG, acetamiprid, Malathion 57%, malathion, Exirel 10SE, cyantraniliprole, Success 2SC, spinosad, CHA-3189, sweet cherry, *Prunus avium,* chemical control, insecticide, invasive species

Abstract: Spotted wing drosophila (SWD) was first found in California in 2008, and caused significant economic damage to the California sweet cherry crop in 2009. Studies were conducted in 2012 to assess the efficacy of various insecticides in controlling SWD in sweet cherries. Three trials were conducted sequentially in order to include a greater number of materials. In each trial treatments were replicated 6 times in a RCB and treated with a hand-held orchard sprayer operating at 250 PSI with a finished spray volume of 200 gpa. Ten female SWD were exposed to treated foliage at 1, 3, 7, and 15 DAT. Mortality was determined at 24 hrs. The high rate of Malathion 57%, the mid and high rate of CHA-3189 and Success 2SC provided excellent knockdown effect. The mid and high rate of both CHA-3189 and Malathion 57% provided moderate to excellent control at 3 DAT. Exirel 10SE provided little knockdown effect but moderate control at 7 DAT. Danitol 2.4EC and Lambda-Cy + Assail 30SG provided adequate control at 7 DAT and Danitol 2.4EC + Belay 2.13SC and Lambda-Cy + Assail 30SG provided some measure of control out to 15 DAT.

Invasive Species

Enhancing GF-120 to Control Spotted Wing Drosophila

Janet Caprile and R.A. Van Steenwyk
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Keywords: GF-120, spinosad, spotted wing drosophila, *Drosophila suzukii*, cherry

Abstract: Field trials were conducted in the No. San Joaquin Valley to identify potential additives that would enhance the attraction of GF-120 to spotted wing drosophila (SWD) and to test the field efficacy of the most attractive, enhanced GF-120 formulation. Five GF-120 treatments enhanced with apple cider vinegar, yeast and sugar, Monterey Insect Bait, or a combination, were compared to a standard 1:4 dilution of a 20 oz/acre rate of GF-120. Treatments were placed in traps in a high pressure orchard and replicated five times with treatments changed and traps rotated twice a week. The GF-120 standard control was not very attractive. The apple cider vinegar enhancement increased in attraction as the fruit got riper. The combination treatment was significantly more attractive than all others. This combination treatment was applied to ¼ acre block of cherries in an unreplicated, demonstration trial. Treatment began at straw and the entire block was sprayed twice a week through harvest. Bing damage was 15-20% at harvest which was a 50% reduction over the previous two years when the block was unsprayed. Earlier application may have improved control.

Invasive Species

Post-Harvest Control of Spotted Wing Drosophila in Cherry

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Keywords: Lambda-Cy, lambda-cyhalothrin, Danitol, fenpropanate, Baythroid, cyfluthrin, spotted wing drosophila, *Drosophila suzukii*, chemical control, insecticide, cherry

Abstract: The study was conducted in five commercial 'Bing' cherry orchards in Santa Clara, San Joaquin, Sacramento and Stanislaus counties in California. Two treatments were replicated five times in a matched pair design. The five orchards were divided approximately in half. One half of each orchard was treated with a maximum rate of pyrethroid insecticides at monthly intervals starting in August and the other half of the orchard was an untreated check. Danitol was applied from 27 July to 4 August, Lambda-Cy was applied from 21 August to 30 August and Baythroid was applied from 23 September to 3 October. Spotted wing drosophila (SWD), *Drosophila suzukii*, populations were monitored weekly in each half of each orchard with four standard ACV traps. The traps were placed on 11 July 2011 and monitored weekly through 9 April 2012. All SWD were counted and sexed and all other drosophila were counted, but not sexed, under magnification in the laboratory. Due to variation among application dates between orchards, all SWD counts were organized in relation to material applications as well as calendar date. Additionally, because of the wide variation in SWD populations between the orchards, the SWD data was reported both as the percentage of the total population and number of total flies captured. Data were analyzed using Student "T" Test at $P \leq 0.05$. The post-harvest applications of Danitol 2.4EC, Lambda-Cy 1E and Baythroid XL resulted in the suppression of the SWD population. These applications were timed to simulate a treatment regime for Western X-disease control. The post-harvest pyrethroid program suppressed the SWD population through the fall and winter months. This suppression continued into the following spring. However, the numbers of SWD were very low. Thus, it is recommended that if growers are going to conduct a post-harvest Western X-disease control program then they use pyrethroid insecticides. However, if growers are not going to conduct a post-harvest Western X-disease control program then because of the marginal suppression of the SWD population the following spring post-harvest control of SWD is not recommended.

Invasive Species

SWD and MRLs: Controlling One While Complying with the Other

David R. Haviland[1] and Elizabeth H. Beers[2]
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[2]Washington State University, Tree Fruit Research and Extension Center, Wenatchee, WA

Keywords: spotted wing drosophila, *Drosophila suzukii*, malathion, Warrior II, lambda-cyhalothrin, spinosad, Success, spinetoram, Delegate, zeta cypermethrin, Mustang Max, fenpropathrin, Danitol

Abstract: The recent introduction of spotted wing drosophila (SWD) into the major cherry-producing regions of the western US has elevated concerns regarding Maximum Residue Levels (MRLs) on exported sweet cherries. Pesticide labels granted by the US-EPA are designed to meet US tolerances, but each country has the ability to set its own tolerance for any given pesticide, some of which are considerably lower than that of the US. This has created a void in our knowledge of how to apply these materials so that they will produce fruit that meet export requirements. Residue degradation curves were developed for six of the most likely candidate pesticides to be used for SWD control. Of the six insecticides tested, three had a favorable profile for use on fruit destined for export, viz., spinosad, lambda-cyhalothrin, and malathion. With the exception of malathion on fruit destined for the EU, all could be used according to the US label with little projected concern about MRLs. Insecticides with similar tolerances between the US and other countries were more likely to be favorable; those with markedly dissimilar tolerances (e.g., 500- fold higher in the US) were deemed more likely lead to problems.

EGVM Control: Chemical Efficacy and Agronomic Practices

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Keywords: European grapevine moth, *Lobesia botrana*, Intrepid 2F, methoxyfenozide, Entrust 80WP, spinosad, DiPel DF, *Bacillus thuringiensis*, subsp. *kurstaki*, Altacor 35WDG, chlorantraniliprole, Belt 4SC, flubendiamide, insecticide, chemical control, canopy management, generation timing

Abstract: Timing and efficacy of pesticides for control of European grapevine moth (EGVM) were assessed by comparing Intrepid 2F, Entrust 80WP, DiPel DF, Altacor 35WDG, Belt 4SC and an untreated check in two vineyards. Treatments were replicated four times in each vineyard in a RCB design. The two vineyards practiced different canopy management, one with minimal pruning on a quadrilateral trellising system, the other with manicured pruning on a Smart-Henry trellising system. Treatments were applied in the field on 21 May and 25 June, for first and second generation larval hatch. Grape clusters were collected from the field at 1, 4, 7 and 14 DAT and transported to the Contained Research Facility (CRF) at UC Davis. Ten neonate larvae (<12 hours old) obtained from a colony maintained in the CRF were placed on each cluster. Clusters were examined after four days of exposure and larvae scored for mortality. Excellent control of EGVM was achieved with Entrust 80WP, Altacor 35WDG and Belt 4SC and adequate control was achieved with Intrepid 2F and DiPel DF. Training system and EVGM generation influenced control. Better control was achieved in the first generation compared to the second. Canopy management had little impact on control in the first generation. In the second generation, better control can be achieved with a more open and highly manicured trellising system compared to the minimally pruned quadrilateral trellising system.

Invasive Species

Why Western Cherry Fruit Fly Can't Establish in Commercial Cherry-Growing Areas of California

Lisa G. Neven, Sunil Kumar, Wee Yee
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Keywords: Western cherry fruit fly, *Rhagoletis indifferens*, ecological niche models, Maxent, invasive species, sweet cherry

Abstract: Ecological niche modeling was used to assess the risk of establishment of western cherry fruit fly, *Rhagoletis indifferens* Curran (Diptera: *Tephritidae*), in sweet cherry, *Prunus avium* (L.) L., in the commercial cherry-growing areas of California. We integrated species occurrence records and spatial environmental variables using the Maxent (i.e., maximum entropy) niche modeling algorithm to assess the potential risk of establishment of R. *indifferens*. Maxent model performance was high, with a mean test area under the ROC (receiver operating characteristic) curve value (AUC) of 0.92 and a highly significant correlation between observed presence-(pseudo) absence and predicted probability of presence. The model predicted a very low risk for R. *indifferens* establishment in the San Joaquin Valley around the areas where sweet cherries are produced. Most of the high to very high risk areas for R. *indifferens* were predicted in northern parts of California and the Sierra Nevada Mountains, where the fly exists in association with its native host, bitter cherry [*Prunus emarginata* (Douglas) Eaton]. Human footprint index (a surrogate for irrigation-supported cherry orchards), minimum temperature of coldest month, temperature annual range, and precipitation seasonality were the top predictors of R. *indifferens* distribution. Overall results suggest that R. *indifferens* is unlikely to establish in the commercial cherry-growing areas in the San Joaquin Valley of California, largely because chilling requirements in those areas are not met.

Documenting an Invasion: Brown Marmorated Stink Bug in Oregon

Nik Wiman[1,2] Silvia Rondon[1], Vaughn Walton[2], and Peter Shearer[3]
[1]Hermiston Agricultural Research and Extension Center, [2]Department of Horticulture,
[3]Mid-Columbia Agricultural Research and Extension Center, Oregon State University

Keywords: Halyomorpha halys, beat samples

Abstract: The brown marmorated stink bug (BMSB) has been established in Oregon since 2004. This pest has been confined to urban areas where it is a nuisance pest, and distribution maps have been dependent on homeowner reports. In 2012, we did beat sampling at 240 sites, covering more than 244 km of ground on foot across Oregon in our search for BMSB. Surveys resulted in new detections of BMSB and improved understanding of host plant use. Established populations of BMSB were found in three new Willamette Valley Counties (Benton, Linn, and Lane), and in Hood River. Smaller numbers of BMSB were also detected in Jackson, Wasco and Union Counties. These survey results suggest that BMSB is now present throughout the Willamette Valley, is spreading east through the Columbia Gorge, and may be establishing in Southern Oregon. Other significant findings from 2012 are the detection of BMSB in commercial crops for the first time in Oregon. There were 11 farms in the Willamette Valley where BMSB was found. The crops produced on these farms included hazelnuts, tree fruits, caneberries, winegrapes, vegetables and ornamentals. Generally, on-farm populations of BMSB were low, but in select cases numerous BMSB were detected in or proximate to crops by beat samples, visual sampling or pheromone traps.

Invasive Species

Flight Capacity of Brown Marmorated Stink Bug in Oregon and Implications for its Dispersal and Spread

Nik Wiman[1,3], Peter Shearer[2], Vaughn Walton[3], and Silvia Rondon[1]
[1]Hermiston Agricultural Research and Extension Center, [2]Mid-Columbia Agricultural Research and Extension Center, [3]Department of Horticulture, Oregon State University

Keywords: Halyomorpha halys, flight mill

Abstract: We used flight mills to evaluate the flight capacity of field-collected brown marmorated stink bug (BMSB). Adult BMSB, primarily collected from the northern Willamette Valley, were flown at least two times per week (when available) over the course of the 2012 field season (May – October). Our goal was to determine potential sexual or phenological differences in flight capacity, to determine flight-associated life-history costs, and to improve general understanding of flight behavior. We evaluated more than 600 BMSB and found that most flew less than 10 km, but a minority went considerably further in our trial period of 24 hours. There were no differences in total flight distance according to sex, or in adults classified as being from the overwintered or summer generation. However, there were periods from each generation where flight activity peaked, and the longest flight distances came from summer generation adults. These results may corroborate findings from the field, where small numbers of adults sometimes appeared in sites far from known infestations late in the season. Those females that flew the farthest tended to produce fewer subsequent egg masses, but this reduction is not expected to result in substantial reductions in population growth. While BMSB is famous for being an excellent hitchhiker, it is clear that this pest can spread quite effectively by its own means.

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

Christopher Hedstrom, Vaughn Walton, Peter Shearer, Jeffrey Miller and Jeff Olsen.
Oregon State University, Department of Horticulture, Corvallis, OR

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

Abstract: Brown marmorated stink bug (*Halyomorpha halys*, Hemiptera:Pentatomidae) is a potential pest of many crops in the Willamette Valley of Oregon, including hazelnuts. The objectives of this study are to characterize the damage caused on hazelnut kernels by feeding stink bugs and to determine how the timing of feeding during kernel development could influence the types of damage observed. A preliminary trial was done in 2011 using mesh exclusion bags to expose feeding stink bugs to developing hazelnuts for discrete two-week periods. Trends observed suggested that stink bug feeding on young kernels would result in aborted kernel development, and the appearance of necrotic kernel tissue when insects fed on mature kernels. A field trial was done in 2012 based on the preliminary results. Adult male brown marmorated stink bugs were allowed to feed on kernels for one-week periods, from initial hazelnut kernel development until harvest. Trends were observed during the 2012 trial that were similar to the 2011 preliminary trial. The timing of the damage will be compared to physiological kernel development, with the intent to determine the best timing to implement management strategies to avoid damage or yield loss. A second field trial will be completed in summer 2013.

CHEMICAL CONTROL/NEW PRODUCTS—

Moderators: Don Thomson 11am-12pm;
Harvey Reissig 1:30pm-4pm

Notes:

Chemical Control/New Products

Field Characterization of Closer™ SC[1], A New Insecticide for Control of Key Sap-feeding Pests in Tree Fruits

Harvey Yoshida, Barat Bisabri, Brian Olson and James Thomas
Dow AgroSciences, LLC, Indianapolis, IN

Keywords: rosy apple aphid, *Dysaphis plantaginea*, apple aphid, *Aphis pomi*, woolly apple aphid, *Eriosoma lanigerum*, white apple leafhopper, *Typhlocyba pomaria*, black cherry aphid, *Myzus cerasi*, citricola scale, *Coccus pseudomagnoliarum*, Closer SC, sulfoxaflor, sulfoximine, chemical control, insecticide

Abstract: Closer™ SC is a new sap-feeding insecticide under development by Dow AgroSciences, LLC. The active ingredient in Closer™ SC insecticide is sulfoxaflor. Sulfoxaflor belongs to a class of insecticides known as the sulfoximines which has a unique mode of action. Field trials were conducted to evaluate the performance of Closer™ SC against key pests of tree fruit crops including rosy apple aphid, *Dysaphis plantaginea*, apple aphid, *Aphis pomi*, woolly apple aphid, *Eriosoma lanigerum*, white apple leafhopper, *Typhlocyba pomaria*, black cherry aphid, *Myzus cerasi*, and citricola scale, *Coccus pseudomagnoliarum*. Performance of Closer™ SC insecticide was compared to commercial standards such as acetamiprid, imidacloprid, and spirotetramat. Results of these field trials indicate that Closer™ SC insecticide is effective in controlling key pests of tree fruits and offers an alternative tool for use in integrated management programs.

Chemical Control/New Products

Chemical Control of Codling Moth in Pear

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Keywords: Codling moth, *Cydia pomonella*, pear psylla*, Cacopsylla pyricola,* Pear rust mite, *Epitrimerus pyri,* Twospotted spider mite, *Tetranychus urticae*, Closer, Silvanto, flupyradifurone, sulfoxaflor, Danitol, fenpropanate, Belt, flubendiamide, Athena, bifenthrin and avermectin combined, Brigade, bifenthrin, Exirel, cyantraniliprole, Altacor, chlorantraniliprole, Bexar, tolfenpyrad, Agri-Mek, abamectin, Fujimite, fenpyromimate, Centaur, buprofezin, Imidan, phosmet, PureSpray Green horticultural oil, Dyne-Amic, pear, chemical control, insecticide

Abstract: A study was conducted in a commercial 'Bartlett' pear orchard in Fairfield, CA. Closer, Silvanto, Centaur, Bexar, Fujimite and Agri-Mek were evaluated for control of pear psylla (PP) and Belt, Exirel, Altacor and Athena were evaluated for control of codling moth (CM). A total of 15 treatments were replicated four times in an RCB design. Each replicate was an individual tree. Treatments were applied with a handgun operating at 200 psi with a finished spray volume of approximately 100 gal/acre for the cluster bud and petal fall sprays, 150 gal/acre for the first CM treatment and 200 gal/acre for all remaining CM sprays. Control of the CM, pear rust mites (PRM), mealybug (MB) and piercing/sucking insects was evaluated at harvest on 2 Aug by inspecting 250 fruit per replicate. Control of PP nymphs, motile twospotted spider mites and PRM was evaluated by sampling 10 exterior and 10 interior leaves per replicate weekly from 21 Jun through 30 Jul. Sivanto provided control of PP, MB and PRM and was as efficacious as Agri-Mek. Closer provided control of MB and PRM and was as efficacious as Agri-Mek but only suppressed PP. Excellent PP control was achieved with Fujimite followed by Bexar and Centaur followed by Fujimite, Bexar and Altacor**.** Agri-Mek followed by Altacor and Agri-Mek followed by Exirel provided excellent CM control and Athena followed by Brigade also provided excellent CM control. Agri-Mek followed by Belt and Fujimite followed by Bexar did not provide similar CM control compared to the other experimental treatments. Danitol followed by Imidan with and without Agri-Mek provided excellent CM control but Danitol followed by Imidan without Agri-Mek resulted in increased damage and numbers of PRM.

Chemical Control/New Products

Navel Orangeworm Control in Almonds – Impact of Insecticides, Coverage and Mating Disruption

Bradley S. Higbee
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Keywords: Amyelois transitella, navel orangeworm, insecticides, spray coverage, almond, reduced risk, mating disruption

Abstract: Pyrethroids in the 3rd and 4th generation classes have been very effective against Navel Orangeworm (NOW) and other pests in almonds since they have become registered, starting in 2007. Increasing LD_{50} values and regulatory scrutiny combine to jeopardize the long-term sustainability of this class of insecticides in almonds. Mating disruption has been in use since 2006 and has also effectively reduced damage from NOW in both small scale trials and areawide demonstrations along with reducing insecticides directed at NOW by 50-100%. Mating disruption has not been adopted by a majority of the industry, primarily due to the cost relative to the inexpensive pyrethroid options. Similarly, the use of reduced risk products (methoxyfenozide, flubendiamide, chlorantraniliprole and others), have been throttled to some degree by the same cost differential. Over this same time period, NOW damage thresholds have decreased and returns to growers have increased in almonds. Our progress toward maintaining low damage levels without the use of pyrethroids will be summarized and discussed.

Chemical Control/New Products

Effects of Newer Insecticides against Apple Maggot Oviposition and Survival in Laboratory Bioassays

Harvey Reissig, David Combs, and Cindy Smith
Entomology Department, Cornell University, Geneva, NY 14456

Keywords: apple maggot, *Rhagoletis pomonella*, Laboratory Bioassays, Insecticides, Assail, Calypso, Apta, Exirel, Altacor

Abstract: In 2012 newer insecticides, Apta, Calypso, Assail, Exirel, and Altacor were tested in the field against the apple maggot (AM), *Rhagoletis pomonella*. These materials were applied with a handgun sprayer to single-tree plots of 'Jonagold' and 'Cortland' apple trees along the edge of a commercial apple orchard in Wayne Co., NY. Plots were separated with untreated buffer trees and replicated four times in an RCB design. These trees were located next to an abandoned apple orchard that had been removed and the ground was cultivated in the spring. Four sprays of each insecticide were applied at the estimated first date of AM oviposition on 23 Jul, and repeated on 6 Aug, 20 Aug, and 4 Sept. Prior to the start of AM emergence, 20 fruit were covered in each plot with brown paper bags to protect them from insecticide sprays. Five apples were uncovered just before each spray was applied on each application date. Fruit was marked and allowed to dry, and brought into the laboratory for bioassays against AM flies. Two gravid AM females were confined within a clear plastic cup that was placed over each apple. After 24 hours, fly mortality and numbers of oviposition punctures were counted. Then the apples were incubated individually on a hardware cloth rack over water in clear plastic cups and larvae emerging from each apple were collected. Unfortunately, AM pressure was very light in the treated orchard and no infested apples were observed at harvest. AM mortality was 26 and 44%, respectively, in the Calypso and Assail laboratory bioassays, and the mortality in all of the other treatments was lower and not significantly different than that in the check treatments. The average number of larvae emerging in the laboratory from apples in the check, Calypso, and Assail treatments was 4.2, 0.1, and 0.2, respectively. The average larval emergence from apples in all other treatments was similar to that in the check treatments. Because there were fewer punctures in the apples treated with Calypso and Assail than in the check treatments, we estimated the average number of larvae emerging from 100 punctures in these three treatments. The average numbers of larvae emerging/100 punctures from the three treatments were 4.2, 12.5, and 38.6 respectively in the Calypso, Assail and check. In summary, these laboratory bioassays showed that the most effective compounds, Assail and Calypso, were only moderately toxic to AM adults, but they significantly reduced oviposition, compared to that in check untreated apples. Fewer AM larvae emerged from apples treated with these two materials, even after oviposition was standardized to account for differences in puncture density. Therefore, Calypso and Assail not only kill some adults, but also reduce oviposition punctures and larval survival in treated apples. Additional studies need to be done to determine whether reduced survival of larvae in these treatments is due to ovicidal activity, larval toxicity, or toxicity to both eggs and larvae. Currently, apples are cut to determine the presence of internal brown tunnels caused by AM larvae penetrating the interior of the fruit when apples are inspected for AM damage. Depending upon whether eggs or larvae are killed in apples sprayed with these two materials, these standard methods for assessing AM infestation in apples treated with these materials may have to be revised.

Chemical Control/New Products

Control of Woolly Apple Aphid in Apples

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Keywords: Woolly apple aphid, *Eriosoma lanigerum,* Closer 2SC, sulfoxaflor, Movento 2SC, spirotetromet, apple, chemical control, insecticide

Abstract: Woolly apple aphid (WAA) control can be problematic since infestation occurs both in subterranean and aerial colonies in apple orchards. A field trial was conducted to evaluate the efficacy of a new material (Closer 2SC) as compared to the grower standard of Movento 2SC and an untreated check in control of an aerial population of WAA. Five treatments were replicated four times in an RCB design. Treatments were applied on 8 June and 31 July using a with a hand-held orchard sprayer operating at 250 PSI with a finished spray volume of 200 gal/acre. Aerial WAA colony densities were visually assessed weekly from 6 June (pre-treatment) through 7 September. All treatments had significantly lower WAA population ratings as compared to the untreated check. The high rate (8.50 oz/ac) of Closer 2SC had significantly lower WAA ratings compared to the middle rate (5.70 oz/ac) and low rate (2.50 oz/ac) of Closer 2SC and Movento 2SC. The middle and low rates of Closer 2SC and Movento 2SC did not differ significantly.

Evaluation of New and Existing Insecticides for the Control of Walnut Husk Fly—2012

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Keywords: Danitol, Belay, Brigadier, Triple Crown, Assail, Exirel, Warrior II, Malathion, Nu-Lure, Dyne-Amic, fenpropathrin, clothianidin, bifenthrin, imidacloprid, zeta-cypermethrin, lamda-cyhalothrin, cyazypyr, anthranilic diamide, pyrethroid, neonicotinoids, organophosphate, walnut husk fly, Rhagoletis completa, walnut, chemical control, insecticide

Abstract: Dilute, full coverage treatments of pyrethroid and neonicotinoid insecticides combined with Nu-Lure Insect Bait and Dyne-Amic provided excellent (Danitol + Belay, Brigadier) or good (Triple Crown) control of walnut husk fly (WHF). Neonicotinoids plus Nu-Lure Insect Bait and Dyne-Amic also provided excellent (Assail) or good (Belay) control of walnut husk fly. A pyrethroid (Warrior II) or organophosphate (malathion) treatment combined with Nu-Lure Insect Bait and Dyne-Amic each provided good WHF control. Exirel 10SE (cyazypyr), an anthranilic diamide, did not reduce WHF damage and does not appear to be an effective WHF control material.

Chemical Control/New Products

Developing a Sublethal Bioassay for Spotted Wing Drosophila, *Drosophila suzukii*

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

Keywords: Spotted wing drosophila, *Drosophila suzukii*, Cyazypyr, cyantraniliprole, bioassay, sublethal, oviposition

Abstract: This research was conducted to develop a method to measure sublethal insecticide effects on spotted wing drosophila (SWD) oviposition. The methodology evolved from observations of a field-laboratory bioassay using treated leaves as a substrate to test residual adult mortality. We observed SWD females ovipositing through assay leaves. This led to using parafilm as an oviposition substrate. Cyazypyr™ (cyantraniliprole) was selected for preliminary testing because its mode of action causes impairment of muscle function and previous studies indicated it was slow acting. Therefore, the basis of the assay was to measure differences in oviposition when little to no mortality was observed. The bioassays were conducted by exposing female SWD to cyazypyr through three routes of exposure: direct spray or ingestion of treated diet or treated sugar water solutions. Females were treated and then transferred to petri dishes with a parafilm substrate for egg laying. Results indicated that females exposed to cyazypyr laid fewer eggs than untreated females. However, only very low concentrations of cyazypyr (1.25 and 2.5 PPM) produced apparent sub-lethal effects. At those concentrations, fewer eggs were laid compared with the control despite high survivorship of treated females. Compared with the effect of mortality observed at the experimental rates, sublethal effects appear to be minimal.

BIOLOGY/PHENOLOGY—

Moderator: Jack Jenkins

Notes:

Biology/Phenology

Identification of Resistance in *Malus* to Obliquebanded Leafroller, *Choristoneura rosaceana*

Joseph Schwarz, Kate Evans, Cameron Peace, and Jay Brunner
Washington State University, Tree Fruit Research and Extension Center, Wenatchee, WA

Keywords: Obliquebanded leafroller, *Choristoneura rosaceana*, apple, natural plant resistance.

Abstract: Apple represents nearly 70 percent of Washington State's tree fruit industry. Following codling moth (CM; *Cydia pomonella*), the obliquebanded leafroller (OBLR; *Choristoneura rosaceana*) is the next most destructive insect pest of apple in Washington State, causing damage by feeding on leaves and fruit. The majority of insecticides applied to apple is for control of OBLR and CM. Pesticide usage defeats biological control efforts of secondary insect pests, and has led to the development of insecticide resistance and cross-resistance throughout North America.

A whole-leaf bioassay method was developed that provided high apple-leaf quality over time. Development rates and mortality of OBLR larvae reared on artificial diet provided the data and a timeline against which larval performance on different apple (*Malus*) genotypes are evaluated. OBLR larvae feeding on different *Malus* genotypes showed variation in development time, pupal weight, fecundity, and mortality. For some genotypes, resistance disrupted normal hormone development and physiological processes; and was expressed as a function of the plants' phenology.

This project will provide key information to the Washington Apple Breeding Program for selecting parents and seedlings with resistance against OBLR, and eventually CM. The long-term impact will be a reduction in the use of insecticides and the enhancement of biocontrol.

Differential Scanning Calorimetry Applications for Entomologists

Lisa G. Neven
USDA-ARS, Yakima Agricultural Research Laboratory, Wapato, WA

Keywords: Differential scanning calorimetry, metabolic heat rate, physiology, phenology

Abstract: Changes in metabolic heat rates can indicate the response of an organism to various stresses, such as temperature extremes and pesticide exposure. Differential scanning calorimetry (DSC) measures the rate of heat produced by an organism over a wide range of temperatures, both static (isothermal) or changing (scanning). DSC can be used to determine the upper and lower thermal limits for growth and development of an insect which can be used to refine phenology models. DSC can be used in combination with fiber optic oxygen sensors to record oxygen uptake in relation to temperature and pesticide treatment. DSC can be used to determine cold hardiness of plants and insects as well as identifying the biomolecules, such as carbohydrates, lipids, or proteins, used by an organism to support metabolism. In many cases, DSC is non-destructive, and can yield insight into insect metabolism and physiology while preserving the test subject for other testing. The current and future applications of DSC for entomologists are discussed.

Biology/Phenology

European Earwig Biology in Peach Orchards

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Utah State University, Logan, UT

Keywords: European earwig, *Forficula auricularia*, peach, population biology, phenology, crop injury, trap capture, predation, green peach aphid, *Myzus persicae*

Abstract: The European earwig, *Forficula auricularia*, is a non-native insect pest of fruit and other crops. In peach, earwigs primarily damage fruit, and can cause significant yield loss through reduced quality and increased cullage. Corrugated cardboard traps were placed at the base of tree trunks and on scaffold limbs to monitor populations. Overwintered adults and summer nymphs were caught in higher number on trunk traps, while trap catch of summer adults was similar between the tree canopy and trunk. Two summer generations of earwig was observed (bivoltine). When caged in no-choice tests on peach shoots, adults and nymphs fed on both leaves and fruits. The majority of fruit-feeding occurred in August and September when fruits softened as they neared maturity. Overwintered adults were caged on peach shoots infested by green peach aphid. Aphid densities were significantly decreased on shoots with pairs of female, male, and mixed gender earwigs as compared to shoots without earwigs.

MATING DISRUPTION/SIR—

Moderator: Peter McGhee

Notes:

Mating Disruption/SIR

Twenty-year Anniversary of Codling Moth SIT in British Columbia: What Have We Learned?

Hugh Philip and Cara McCurrach
Okanagan Kootenay Sterile Insect Release (OKSIR) Program, Kelowna, British Columbia, Canada

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

Abstract: Entering the 20th year of operation, the Okanagan-Kootenay Sterile Insect Release (OKSIR) Program in British Columbia, continues as the longest-running, most successful area-wide program for control of codling moth (CM) in North America and the only one founded on sterile insect technology (SIT). The program remains a partnership between pome fruit tree owners (commercial and urban) and local government, representatives of which make up the governing Board of Directors. The governance and management of the area-wide Program and the area-wide application of SIT and MD has presented not only many challenges but also has created real and potential opportunities for improving the value of the Program to growers. Originally implemented as an eradication program, OKSIR has transitioned into an area-wide suppression program that incorporates use of chemical and non-chemical practices when necessary to supplement SIT, supported by CM monitoring, compliance enforcement and education. In order to evaluate the cost-effectiveness of other area-wide control tactics, the Program applied mating disruption (Isomate CM/LR TT) in 2011 throughout the northern half of the Program area as part of a 3-year project. This has presented the Program participants with a unique opportunity to compare these area-wide technologies side-by-side in the same production region. The Pacific Agri-Food Research Centre (Summerland) continues to assist the program through research aimed at improving the cost-effectiveness of the Program. For example, recent field studies indicate that targeted release of sterile moths only when and where needed based on intensive pheromone trapping (1/acre) is operationally feasible, and more economical, than general application of low-level SIT or MD. Information is presented on the status of CM after 2 years of a planned 3-year project to evaluate the effectiveness of area-wide mating disruption. Because of the threats posed by new invasive pests, growers are looking to the OKSIR Program to expand its mandate to include other pests and tree fruit crops. Since 1992, the OKSIR Program has removed at least 250,000 feral or abandoned pome fruit trees. This translates into 250,000 fewer sites that new invasive species could become established undetected. Overall, CM populations levels remain on average well below the recommended action thresholds throughout the Program area which has helped to reduce pesticide applications to protect against CM damage.

Mating Disruption/SIR

Evaluation of an Aerosol Dispenser at Different Loading Rates

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[1]Washington State University, Wenatchee, WA
[2]Pacific Biocontrol Corp., Vancouver, WA.

Keywords: sex pheromones, mating disruption, Cydia pomonella, aerosol dispensers

Abstract: Pheromones have been a key component of apple IPM programs but are even more important as growers transition to organophosphate (OP) alternatives and move towards softer programs that conserve biological control agents. While new insecticides have been shown to be effective against CM, they are more difficult to use, cost more and are likely more vulnerable to resistance development. In addition, some of the reduced risk OP alternatives have been shown to disrupt biological control of spider mites and likely interfere with biological control of other pests like woolly apple aphid. Improvements that make behavioral-modifying control tactics more effective will reduce the reliance on OP alternatives, stabilize apple IPM and most likely result in reduced pest management costs over time.

Following years of research, hand-applied pheromone technology remains the industry standard. The observed efficacy and longevity of the hand-applied pheromone technology has resulted in many new products reaching the market place. Pheromone companies continue to develop dispensers that improve the ease of application relative to older technologies and have modified dispenser release rates and built flexibility into labels to address point source density issues. Companies have also developed meso-type dispensers that release high levels of pheromone from reduced numbers of point sources per acre as well as aerosol emitters that are deployed at one to two units per acre. This presentation discusses an experiment that evaluated the performance of an aerosol emitter at three loading rates compared to a standard hand-applied treatment as a positive control at three locations in Washington.

Treatments were evaluated using trap captures of sterile moths. Fifty sterile CM were released at 16 predetermined sites in each treatment block (approximately 800 moths per week per block). There were four release sites in each of four rows and each separated by 100 feet. Release sites were equidistant from nine monitoring traps. All traps were baited with Trécé L2 CM pheromone lures. Aerosol pheromone emitters are known to cause damage to foliage and fruit due to the aerosol emission of pheromone. Five sites in each aerosol treatment were sampled at each location (total of 15 sites per treatment). The distance to the furthest damage was measured and the number of fruit damaged out of the 100 fruit closest to each aerosol unit was counted.

All pheromone treatments provided roughly the same suppression of sterile CM moth captures per trap over the entire season. However, there was more trap captures in blocks with the 25% load. With respect to phytotoxicity, the aerosol units emitting a lower amount of pheromone (25%) per spray had the furthest fruit injury closer, 2.5-2.7 feet, compared to the aerosol units emitting higher amounts of pheromone per spray, 8.9 feet (50%) and 18 feet (100%).

Mating Disruption/SIR

Evaluation of an Aerosol Dispenser Cycling between On & Off Compared to One On all the Time

Jay Brunner[1], Larry Gut[2], Bonnie Ohler[1] and Don Thomson[3]
[1]Washington State University, Wenatchee, WA
[2]Michigan State University, East Lansing, MI
[3]Pacific Biocontrol Corp., Vancouver, WA.

Keywords: sex pheromones, mating disruption, Cydia pomonella, aerosol dispensers

Abstract: Pheromones have been a key component of apple IPM programs but are even more important as growers transition to use of organophosphate (OP) alternatives and move towards softer programs that conserve biological control agents. Improvements that make behavioral-modifying control tactics more effective will reduce the reliance on OP alternatives, stabilize apple IPM and most likely result in reduced pest management costs over time.

Following years of research, hand-applied pheromone technology remains the industry standard. Companies have also developed aerosol emitters that are deployed at one to two units per acre. This presentation discusses an experiment that evaluated the performance of an aerosol emitter utilizing a temperature sensor to shut down emission below 10 °C. The experiment addressed the impact of an aerosol treatment turned off for five days then on for two days following a release of sterile CM compared to aerosol treatment that was on for seven days. The goal was to simulate an aerosol unit not operating due to a low temperature cut off for a period of time then turning on when temperatures rise with a concurrent flight of moths. The aerosol treatment was compared to a hand applied dispenser.

The aerosol treatments were applied at one per acre and the hand-applied treatment at 400 dispensers per acre. The aerosol "ON" treatment had units turned on during the entire study. The aerosol "ON/OFF" treatment had units turned on for two days following the release of sterile CM, Wednesday through Friday. These units were then turned off on Friday when traps were monitored. This cycle was repeated every week through the summer. Treatments were evaluated using trap captures of sterile moths. Fifty sterile CM were released at sixteen predetermined sites in each treatment block (approximately 800 moths per week per block). There were four release sites in each of four rows and each separated by 100 feet. Release sites were equidistant from nine monitoring traps. All traps were baited with Trécé L2 CM pheromone lures.

The aerosol ON treatment provided consistent suppression of sterile CM moth captures per trap per day over the entire season. The aerosol ON/OFF treatment showed higher CM captures whether the aerosol unit was turned on or off. The hand applied treatment had moth captures similar to the aerosol ON treatment when the aerosol units in the aerosol ON/OFF treatments were turned on but high CM captures when the aerosol units in the aerosol ON/OFF treatment was turned off. These data indicate that when the aerosol units are turned off for a period of time there is little suppression of CM activity, and when the aerosol units are turned on for two days following a CM release there was not sufficient time to impact CM captures in monitoring traps, at least relative to the treatment where aerosol units that were always on.

Mating Disruption/SIR

Optimizing Pheromone Release Rates for Aerosol Emitters to Manage Codling Moth in Walnuts

Stephen Welter, Joe Grant, Carolyn Pickel, Frances Cave, Sara Goldman Smith, and Jeannine Grohe
San Diego State University, San Diego, CA

Keywords: Pheromone mating disruption, aerosol emitters, Puffers, Mist, codling moth

Abstract: Previous research has shown little difference between plume size and efficacy in trap suppression from aerosol emitters using 100% or 50% emission rates. In eight orchards, the value of mating disruption treatments using 100% or 50% emission rates in addition to traditional insecticide applications was contrasted. No significant differences were detected between the two treatments relative to trap suppression, whereas both treatments were significantly different from the non-disrupted control. Given low damage levels in all treatments, no significant differences were detected. Within a second experiment, the impact of period of reduced duration of emission per night at 7 hours was compared suppression in the full 12 hour emission. Trap suppression in the 7 hour emission cycle was not significantly different from suppression levels plots treated over 12 hours per night, but both were different from the controls.

How Codling Moth Disruption Is Achieved Using Aerosol Emitters Remains a Mystery

Peter McGhee, Jim Miller, Larry Gut
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Keywords: codling moth, mating disruption, pheromone

Abstract: Mating disruption of codling moth in apple is primarily achieved using hand applied, high-point source dispensers via competitive attraction. Mechanical aerosol emitters (Checkmate CM Puffer – Suterra, Isomate MIST CM – Pacific Biocontrol) deployed at low point sources, (0.5 – 2 units/ac) emit high quantities of pheromone to disrupt insect mating. The prevailing assumption, based on grid trapping, is that pheromone plumes created by aerosol emitters are vast and highly concentrated compared to hand applied dispensers so that traps are camouflaged and thus so are calling female moths. Furthermore, male moth exposure to high doses of pheromone has previously been shown to reduce male response to pheromone indicating sensory adaptation.

A direct comparison of male CM response to pheromone baited traps after direct or indirect exposure to different pheromone sources (Isomate CM FLEX, Isomate CM MIST and NO MD) was conducted in Michigan apple orchards. The experiment was replicated on three farms near Grant, MI. Treatments were applied to 10 ac apple blocks at a rate of 400/ac for Flex dispensers and 1 unit/ac for aerosol emitters. Groups of 400 sterile male moths were exposed to each of 5 pheromone treatments for 24 hours. Moths in MIST orchards were caged on foliage directly treated with 5 MIST bursts or NOT directly treated; moths in FLEX orchards were caged on foliage treated with 2 FLEX CM dispensers or NOT treated with FLEX dispensers; and moths in a NO MD orchard were caged on foliage not treated with pheromone. Following 24 hours of pheromone treatment, one complete set of the 5 pheromone treated moths was released into a MIST, FLEX or NO MD orchard. Male response to four pheromone-baited (Trécé L2) traps oriented in the cardinal directions 10 m and 90 m from the release location was measured the following day. Square root transformed catch analyzed by ANOVA revealed that capture of moths was significantly greater following direct exposure to pheromone-treated foliage than when moths were not exposed to treated foliage. Volatile capture analysis revealed that MIST treated leaves released pheromone at an average rate of 4µg/hr. These results indicate that high concentrations of codlemone do not inhibit male CM's ability to find lower concentration sources such as pheromone-baited traps.

Mating Disruption/SIR

Pheromone Concentration Measurement in the Field Using Volatile Trapping System

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Keywords: pheromone concentration, volatile trapping system, aerosol emitter

Abstract: Mating disruption (MD) is a pest control method by preventing male moths from finding mates. Since the effectiveness of MD depends on the aerial concentration of synthetic sex pheromone, measurement of the concentration in the field is important for us to develop new product. Recently, we found that (*E,E*)-8,10-dodecadienol and (*Z*)-8-dodecenyl acetate, as sex pheromone components of *Cydia pomonella* and *Cydia mollesta* respectively, were gradually degradated on activated charcoal fibers, which had been generally used as absorbents of volatilized pheromone. Therefore, we chose polyurethane-forms as the absorbents for our volatilized pheromone trapping system. We confirmed that the system can also be utilized for (*E,Z*)-7,9-dodecadienyl acetate and (*Z*)-11-hexadecenal as sex pheromone components of *Lobesia botrana* and *Helicoverpa armigera,* respectively.

By using above technique, we carried out the pheromone concentration measurement in the field treated by a high dose aerosol pheromone emitter. Measurement points were placed in eight directions at 25, 50 and 100 m away from the emitter in a concentric pattern and the pheromone concentration was quantified during two consecutive days. Simultaneously, the concentration in another field treated by hand-applied polyethylene ropes of Shin-Etsu was quantified as a control. During the measurements climatic data including temperature, wind speed and wind direction were recorded.

In the field treated by the aerosol emitter, the pheromone concentration varied according to measuring point. When there was south wind constantly, the pheromone emitted from the aerosol emitter was detected mainly in north area. On the other hand, under no wind condition, the pheromone was detected mainly at the points along nozzle direction. It is suggested that volatilized pheromone is mainly diffused to downwind direction, but not to upwind direction. Our data suggest that pheromone concentration might be insufficient for MD in the area upwind or behind the emitter.

Mating Disruption/SIR

Pheromone Tectonics: Meso Dispensers Are the Newest Tools to Manage Codling Moth

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Keywords: Mating disruption, pear ester, sex pheromone, Cydia pomonella,

Abstract: The marketplace in the United States for semiochemical-based products used to manage codling moth continues to shift and groan with new products and approaches. Twelve years ago I (A.K.) reported to WOPDMC how aerosol puffers (1 per 2.5 acres) and Pheromone Mops (3-5 per acre) could be used to reduce the application costs of mating disruption technology for growers and maintain effective control. Today puffers have a solid place in the market at a somewhat higher density and the Pheromone Mop lids are housed in a few museums. But, the Meso dispensers (initially spearheaded by Dr. Welter) are finally posed to enter the market. Meso dispensers are applied at 1/10th the standard rate (32 – 40 per acre) and thus have much lower application costs than the use of high-density hand-applied dispensers. Also, Meso dispensers do not require machines or batteries. Last year Dr. Light reported on the use of Meso Cidetrak dispensers loaded with pheromone and/or pear ester in walnut. Our continued studies in apple in 2012 again demonstrated their successful application in 12 commercial orchard blocks. No significant differences were found in the level of female virginity or fruit injury among blocks treated with high-density codlemone or combo dispensers and Meso dispensers. Justifications to continue to use standard high-density dispensers to manage codling moth with an integrated program are waning.

Use of Sex Pheromone to Monitor Invasion and Manage the Spread of Codling Moth in China

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Keywords: Codling moth, *Cydia pomonella*, China, mating disruption, codlemone

Abstract: The codling moth, an important invasive quarantine pest in China, was first detected in Xinjiang Province in 1953. After almost six decades of spread, its infested distribution range has expanded to 75°49′E-106°48′E and 127°11′E-132°57′E, covering over 71,550 hectares within 120 counties of 6 provinces. We identified two routes of its spread. One is from the northwest eastwards to central China, and the other is from the northeast to East China. This spread poses a serious threat to the two largest apple producing areas in China, Northwest Plateau and Bohai Bay. We used mating disruption to control codling moth in infested locations. In 2009, there was an average 60.5% decline of cocoons and pupae found in the trunks in mating disrupted orchards as compared to untreated control orchards. Between 2010 and 2011, the rates of damaged fruits in mating disruption treated orchards decreased, as compared to control areas, were 32.7% and 91.0%, respectively. After indoor and outdoor trials, the longest duration of the rubber septa used in sex pheromone traps for monitoring and controlling lasted for 15 weeks with the most effective duration of 4 weeks.

Mating Disruption/SIR

Monitoring, Abundance, and Mating Disruption for Navel Orangeworm in California Walnuts

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Keywords: navel orangeworm, *Amyelois transitella*, walnut, pheromone trap, egg trap, mating disruption

Abstract: The navel orangeworm is considered the principle insect pest of almonds and pistachios in California, but generally of secondary importance in walnuts. In the former nut crops, however, there is a gradient of navel orangeworm abundance and damage, with less damage in the north and more to the south. Efficacy of mating disruption for navel orangeworm has been demonstrated in almonds, but separate examination of mating disruption in walnuts is important due to a very different canopy structure. In the present study we examined abundance of navel orangeworm in walnuts the southern portion of the California growing area, and the impact of mating disruption on navel orangeworm in this crop. Traps with unmated females as a pheromone source found cohort structures of male abundance similar to those observed in almonds and pistachios. Egg traps captured many eggs during first flight, but few during subsequent flights. Mating disruption completely prevented males from being captured in female-baited traps and reduced eggs captured in egg traps, demonstrating both disruption of sexual communication and impact on fertility. Comparison of seasonal abundance of navel orangeworm and codling moth suggests that insecticides targeting codling moth flight 2A would also impact the second navel orangeworm flight, but that the first navel orangeworm flight would be less affected by insecticides timed against the 1B codling moth flight.

Mating Disruption/SIR

Side-by-Side Performance Comparison of Puffer® and Dispensers for Mating Disruption of Oriental Fruit Moth in Peach and Nectarine

Kevin R. Day[1], Walter Bentley[2], Christeen Abbott[3], Sheila West[3] and Daniel Casado[3]
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[3] Suterra® LLC. 20950 NE Talus Pl., Bend, OR (97701)

Keywords: mating disruption, Puffer®, dispenser, peach, oriental fruit moth, *Grapholita molesta*.

Abstract: The use of Puffer®-OFM for the implementation of mating disruption of the Oriental Fruit Moth (OFM) has increased during the last few years. In 2012 ca. 6,300 acres of stone fruits were under mating disruption by Puffer®-OFM in California. However, their performance is still sometimes questioned in the sector. In 2012, a side-by-side comparison of Puffer® and a hand-applied dispenser (CheckMate® OFM-SL+) was made in five sites near Traver and Parlier (CA) using late-ripening varieties of peach and nectarine. The comparison of both technologies included evaluation of trap captures in pheromone and food-bait traps, sexing of individuals and assessment of mating status of females in the food-bait traps, and damage assessments both in shoots and fruits. Due to a serious hail storm in April, one of the trials was lost, but the results in the others support the equivalency of both technologies. Populations were always similar between plots from the two treatments. Pheromone traps tended to catch more moths in Puffer® plots, especially early-season, but that did not result in increased fruit damage. To the contrary, only in one site did differences in fruit damage occur, and the Puffer® outperformed the dispensers. Similarly, differences in mating status of females in food traps were found only in one site with a lower proportion of mated in the Puffer® plot.

Development of an Attract and Kill Tactic for Oriental Fruit Moth

Juan Huang, Matthew Grieshop, Larry Gut
Michigan State University

Keywords: deltamethrin, pheromone, wind tunnel, attract-and-kill

Abstract: Current attract-and-kill techniques for controlling Lepidopteran moths often contain an attractant—such as a sex pheromone—with a contact insecticide in a paste or a gel form. A major problem with these formulations is that moths have to contact a very small surface long enough to pick up a lethal dose while contacting their sex pheromone at the same time. However, exposure to their pheromone by direct contact increases the risk of moths overloading their sensory system and not touching the formulation. In this study, an attract-and-kill device was developed for OFM, consisting of a sex pheromone attractant and deltamethrin as a toxin presented separately. In a contact bioassay, the number of moths knocked down increased as their contact time with a deltamethrin-treated surface increased. In a flight tunnel bioassay, OFM males exhibited similar behaviors when exposed to a control or deltamethrin treated device, indicating no repellency to deltamethrin. Among moths that contacted the treated device, nearly all were knocked down 1 hour after voluntary contact. This attract-and-kill device shows considerable promise for OFM control.

POSTER SESSION

Notes:

POSTER
Implementation

First Year Progress in the Development of Tree Fruit Solid Set Canopy Delivery Systems (SSCDS) at Michigan State University

MSU SSCD TEAM:
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Department of Entomology, Michigan State University

Keywords: Canopy delivery, apples, sweet cherries, chemical pest management, pesticides, plant growth regulators, engineering, irrigation

Abstract: The development of Solid Set Canopy Delivery Systems (SSCDS) is expected to help growers increase the efficiency and timing of pesticide, nutrient, and plant growth regulators applications. This novel approach towards input delivery relies on microsprayers distributed throughout the tree canopy with inputs delivered via a system of irrigation pumps and air compressors. Our first year activities centered on the establishment of two apple test plots and a sweet cherry test plot at MSU research farms. The apple plots consisted of a replicated plot set up for season long comparisons of insecticides and fungicides and a smaller test plot designed to test spray coverage on super slender spindle, tall spindle and vertical axe trained trees. The cherry plot was established on four sweet cherry training systems both within and outside of a four season high tunnel. Preliminary results on apple coverage were extremely favorable with SSCD outperforming air blast applications throughout the canopy. However, coverage in cherries was not nearly as good. Season long comparisons were unable to be made due to statewide crop failures.

POSTER
Thresholds/Monitoring

Ambient Orchard Volatiles as Attractants for Navel Orangeworm Monitoring

John Beck, Brad Higbee, Doug Light, and Wai Gee
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Keywords: navel orangeworm, *Amyelois transitella,* kairomones, attractants, monitoring, volatile organic compounds, almonds

Abstract: Navel orangeworm (NOW), *Amyelois transitella,* is the chief moth pest associated with the introduction of *Aspergillus* mold and occurrence of aflatoxin in almonds, pistachios, and walnuts. Currently, a season-long dependable monitoring lure is lacking for NOW. A pheromone-based lure is unavailable due to its instability and monitoring with egg-traps baited with almond meal is only seasonally effective from winter through spring but ineffective/unreliable at the crucial summer "hull-split" pre-harvest period of highest vulnerability of nuts to NOW attack. A blend of volatiles derived from the emissions of almonds at hull split and mechanically damaged almonds was compared to almond meal in trapping studies. The blend comprised racemic 1-octen-3-ol, ethyl benzoate, methyl salicylate, acetophenone, and racemic (*E*)-conophthorin, with ethyl acetate as a solvent. The blend attracted both sexes of NOW when tested over the summer flights of 2011 and 2012 in commercial almond orchards in the southern Central Valley of California. The blend demonstrated consistently higher capture rates for female NOW throughout the evaluation period, but unlike almond meal significantly attracted males. The results of this test blend

highlight progress toward a host plant-based attractant for NOW, a major insect pest of California tree nuts which presently lacks an adequate monitoring lure.

POSTER
Thresholds/Monitoring

Development of a Long Lasting Pheromone Lure for the Major Pest of Almonds and Pistachios, Navel Orangeworm, *Amyelois transitella*

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[2]Suterra, LLC, Bend, Ore

Keywords: navel orangeworm, *Amyelois transitella,* sex pheromone lure, monitoring, almonds

Abstract: The navel orangeworm, *Amyelois transitella* (Walker) (Lepidoptera: Pyralidae) (NOW), sex pheromone has posed particular problems for chemical ecologists in terms of identification of minor components, and subsequently, stabilization in a lure for monitoring purposes. Although the main pheromone component is used successfully to disrupt mating in almonds, it is not sufficiently attractive for use as a monitoring tool. The relatively recent discovery of the minor components (2005) and subsequent characterization and demonstration of required components and relative ratios (2010), was followed by unsuccessful efforts to formulate a lure that lasted more than a few days. The lack of available monitoring tools has been a limiting factor in the ability to effectively identify phenological time points, compare relative NOW populations and effectively manage NOW in almonds and pistachios. The purpose of this study was to evaluate the longevity and relative attractiveness of 3 and 4 component lures, loaded with 1 or 2 mg of the respective blends. This poster presents findings from trials conducted in 2012.

POSTER
Mating Disruption/SIR

Development of SPLAT MAT Controlled Release Semiochemical Bait Formulations for Long Lasting Fruit Fly Management

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Key words: SPLAT, Spinosad, Attract-and-kill, Attractant, Mortality

Abstract: The insecticide landscape is changing rapidly in orchard crop production in the US and abroad. This is particularly true for nursery, greenhouse, fruit, olive and nut production where conventional insecticide products that form the foundation of current management programs are being lost. Small growers in particular, suffer with this increasing lack of available control tools and from pressure of suburban neighbors to reduce use of conventional insecticides. Current Male Annihilation Techniques (MAT) combine male-specific attractants with insecticide in traps and devices that, while effective, require routine service that is costly and labor intensive. ISCA Technologies' Specialized Pheromone and Lure Application Technology (SPLAT) was initially developed for the mechanical deployment of small doses of Lepidopteran pheromones for long lasting mating disruption. Here we report further development of this biologically inert matrix to create Tephritid management formulations that are hand or mechanically applied, rain-fast, and provide long-term controlled release of a variety of semiochemicals and pesticides at biologically relevant levels.

POSTER
Mating Disruption/SIR

Tangler Technology, Advanced Mating Disruption that Provides for Rapid & Cost Effective Application

Brett E. Bunker and Chandra L. Maleckas-Bunker
Ridge Quest Inc., Kent City, Michigan

Keywords: Mechanized Delivery System, Mating Disruption, Codling Moth, Labor Saving, Biopesticide, *Cydia pomonella*, Apple, Walnuts, Almonds, Pears, Insecticide

Abstract: The major aim in developing the Tangler technology is to greatly improve the mating disruption application process, and substantially reduce its cost, especially the application cost, thereby increasing adoption. The Tangler system consists of a module loaded with pheromone and a launcher that enables the grower to rapidly apply numerous modules to the upper tree canopy. The module consists of a cap and a base made of biodegradable plastic. The cap is attached to the base by a length of cotton string. During construction the string is coiled and placed inside the base and top attached, assembling it into the capsule. Capsules are clipped together in a fashion that allows them to be fed into a mechanical launcher operated by compressed gas. As a result of the bola design, the propelled modules readily become tangled in the tree branches. A single applicator can treat a 1 ha orchard with 1000 dispensers in 30-45 minutes. The greatly improved efficiency provided by Tangler will mean that growers no longer will need to skimp on the number of mating disruption dispensers applied because it is time consuming and labor intensive. Moreover, their dependence on labor to use mating disruption and the expense associated with the application will be substantially reduced.

POSTER
Mating Disruption/SIR

Evaluation of Puffer Mating Disruption in Utah

Marion Murray and Diane Alston
Utah State University, Logan, UT

Keywords: mating disruption, Checkmate Puffer CM-O, codling moth

Abstract: This project tested the efficacy of Checkmate Puffer CM-O (Suterra LLC) for codling moth control as a labor-saving alternative to hand-applied dispensers. Puffers (1/acre) were deployed on two different orchards located in Utah County, UT, in 2011 and 2012. Orchard A had a historically low codling moth population, and Orchard B had a historically high population. Both orchards had been using hand-applied dispensers for at least three years. Trap catch and injury results in each orchard's Puffer-treated block (35-40 acres in size) were compared to a neighboring block (10-15 acres in size) using Isomate CM-Flex (Pacific Biocontrol Corp.). Average cumulative trap catch (using CM-DA Combo lure) for the Puffer and hand-applied blocks on both orchards was not statistically different in 2011. In 2012, trap catch was higher in the hand-applied block than the Puffer block in the high population orchard (B), and was not statistically different in the low population orchard (A). Injury (successful entries) was similar in the Puffer and the hand-applied blocks for both orchards in both years.

MINUTES OF THE 86TH ANNUAL MEETING

Orchard Pest & Disease Management Conference
Hilton Hotel, Portland, Oregon
January 11 -13, 2012

I. Call to Order

The **86**th Annual Meeting was called to order by the President Tom Unruh at 9:00 am on January 11, 2012. President Unruh welcomed everyone, asked speakers to not exceed 15 min per presentation to maintain the meeting schedule, asked for each attendee to introduce themselves, and introduced session leaders. They were:

Mating Disruption/SIR	- Alan Knight
Implementation	- Rick Hilton
Thresholds/Monitoring	- Don Thomson
Biological Control	- Tom Unruh
Invasive Species	- Angela Gadino
Chemical Control	- Ron Britt

II. Old Business

A. Reading of 2011 Minutes: Secretary Alston announced that the 2011 minutes are posted on the OPDMC website and printed in the back of the abstract booklet. It was moved, seconded, and voted to approve the 2011 minutes.

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

III. New and Miscellaneous Business

A. Call for New Business
President Unruh called for new business. There was none.

B. Call for Volunteers for Committee Positions
President Unruh called for volunteers for committee positions. The following committee assignments were made:

Nominations: Larry Gut (Chair), Walt Bentley, and Peter Shearer
Audit: David Epstein (Chair), Peter McGhee, and Bob Van Steenwyk
Resolutions: Elizabeth Beers (Chair), Rick Hilton, and Tom Unruh

C. Pesticide License Credit Sign Up Sheets

Sign up sheets will be available at the registration desk.

The business meeting was then adjourned until 11:00 am, Friday, January 13.

IV. In Memoriam

Two prominent members died in the past year and memoriam presentations on their lives and contributions to tree fruit entomology were given.

1. Peter Westigard – presentation by Rick Hilton
2. Dick Rice – presentation by Walt Bentley

3. Sympathy cards to the families are on the registration desk and members were asked to leave a note.
4. A moment of silence for Peter and Dick was observed

V. Closing Business Meeting

The closing business meeting was called to order by President Unruh on January 13.

A. Board Meeting Report

President Unruh called upon Secretary Alston for a report on the 2012 Board of Directors' Meeting which was held on January 11, 2012 at 7:00 am. The following information items were presented:

- The board revisited the conference name and confirmed that they would follow their previous vote to retain "Disease" in the conference name, but drop "Western" to reflect the national and international scope of the meeting. The website manager will be contacted and a request submitted to revise the conference name on the website.
- Conference registration fees: 1) pre-registration online cost $40 for registration and $10 for the abstract booklet, and 2) registration on-site cost $50 for registration and $10 for the abstract booklet. The board voted to keep the $10 increase for on-site registration to encourage pre-registration.
- Pre-loading slideshows using AirDropper worked very well; only four talks were not submitted by the deadline.
- There has been a concern expressed about the workload for Christina Mayer, WSU employee, who graciously manages the meeting abstracts and prepares the abstract booklet. This has been done gratis in the past because the conference is unable to compensate Christina because she is a WSU employee. The board is exploring the option of identifying someone else to prepare the abstracts and to compensate them for their time.
- Please submit suggestions for future conference key-note speakers; Camille Parmesan, Texas A&M, has been contacted to be the 2013 key-note speaker; she isn't confirmed yet; her topic would be on the effect of climate change on insects and agriculture.
- Two announcements were made:
  - Reminder to drop off name tags at registration desk to be re-used next year
  - Requested a copy of the three committee reports from the committee chairs

B. Further New Business

President Unruh called for further new business including comments about the hotel, conference format, etc.

- WiFi in the hotel rooms cost $10 per day; it was requested to negotiate free WiFi in the meeting contract.
- Request for screen to be placed higher to make it more visible from the back of the room.
- Request to keep meeting room more open for the Friday morning session; closing the side walls crowded the seating area.
- Request for 2 cordless mics to facilitate hearing questions from the audience.
- Request for a more user-friendly laser pointer
- Don Thomson commented that we need to balance the wishes with costs.
- Scott Ockey suggested that the conference could seek industry support to cover some meeting costs; Don responded that the board has felt that corporate sponsorship was not appropriate and that we want all attendees to be equal and pay the same fees.
- Request for a larger meeting room for the disease session; it was very crowded this year.
- Chris Nobbs asked about interest in hosting a photo salon during the conference, perhaps during the Wed evening mixer; he offered to organize it. There was some interest expressed by the members.

- Request to avoid concurrent tree fruit entomology and disease sessions; it was mentioned that this may be difficult to do because the tree fruit disease session would have to be placed before the vegetable and field crop disease session and so it might have to be on Tues or Wed morning.

C. Committee Reports
President Unruh called for the committee reports.

1. Nominations
Chair Larry Gut made the following recommendations:
President-Elect: Lucia Varela (University of California)
Secretary: Diane Alston (Utah State University)
Treasurer: Nancy Hays (Pacific Biocontrol Corp.)
Executive Director: Donald Thomson (DJS Consulting Services)
Program Co-Chairs: Betsy Beers (Washington State University) and John Dunley (Wilbur Ellis)
David Esptein will serve as President in 2013
A motion was made and seconded to accept the recommendations of the nominations committee. The motion was passed unanimously.

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

3. Resolutions
Chair Betsy Beers read the proposed resolutions:

1. Be it resolved that this conference extend written appreciation to the management and staff of the Hilton Hotel for the courteous service and fine accommodations provided.
2. Be it resolved that the members of the conference express their appreciation to Executive Director Don Thomson (who served his 13th year as ED and was presented with a bottle of wine by President Unruh), the Past President Peter Shearer, President Tom Unruh, President-Elect David Epstein, Secretary Diane Alston, Treasurer Nancy Hays, and Program Co-Chairs John Dunley and Betsy Beers for their leadership and dedication in organizing the 2012 meeting.
3. Be it resolved that the members of the conference extend their appreciation to the Tree Fruit Research and Extension Center, Washington State University, and in particular, Christina Mayer, for applying for pesticide applicator credits from participating states and preparing the meeting abstracts, Jerry Tangren for maintaining the OPDMC website, and Bruce Greenfield for transporting the poster boards.
4. Be it resolved that the members of the conference extend their appreciation to the session leaders: Alan Knight, Rick Hilton, Don Thomson, Tom Unruh, Angela Gadino, and Ron Britt for ably overseeing the entomology sessions of the 2012 conference.
5. Be it resolved that the members of the conference extend their appreciation to Tamala Blunt, Colorado State University, and Jay Pscheidt, Oregon State University, for ably overseeing the disease management session of the 2012 conference.
6. Be it resolved that the Secretary send the signed sympathy cards to the families of Dick Rice and Peter Westigard, recently deceased members.

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

D. Treasurer Report

Treasurer Hays gave the Treasurer Report
Beginning balance $4,875.65

Income	$10,442.59
Expenses	$7,938.95
Net cash inflow	$2,503.64
Ending balance	$7,379.29

E. Call for Nominations for the Rubber Chicken Award

President Unruh called for nominations:

1. Brad Higbee nominated Tom Unruh for taking phone calls while presiding over the meeting.
2. Dave Epstein nominated Doug Light for the busiest title slide ever.
3. Larry Gut nominated Walt Bentley for answering a question that suggested a toilet paper roll as the solution.
4. Harvey Reissig nominated Larry Gut for now researching Puffers after pooh-poohing them for many years.
5. Tom Unruh nominated Harvey Reissig for saying "you just have to believe me" two times during his presentation without backing it up with data.

President Unruh called for a vote from the membership based on loudness of applause for each name. There was tie between Tom Unruh and Larry Gut. A vote by a show of hands was taken for the two finalists. Larry received 23 votes to Tom's 21 votes. President Unruh awarded Larry Gut the rubber chicken. Larry commented that this was his 34th year to attend this conference and in 33 years he had never received the rubber chicken, but he wasn't so lucky in his 34th year.

President Unruh passed the gavel to the New President, Dave Epstein who adjourned the meeting.

Respectfully Submitted,

Diane Alston
Secretary
2012 Orchard Pest and Disease Management Conference


Adult pear psylla


Brown marmorated stink bug


Walnut husk fly


Woolly apple aphid


Navel orangeworm


Apple maggot


Western cherry fruit fly


Spotted wing drosophila


Codling moth