94th Annual
Orchard Pest & Disease Management Conference

Keynote Address: "Ridding Apples of their Worms:
30 Years of Semiochemical and Sterile Insect Research"
Gary Judd, AAFC, Summerland, BC, Canada

Hilton Portland, Portland, Oregon
January 8-10, 2020

Keynote Speaker: Gary Judd

Dr. Gary Judd completed his entire post-secondary education at Simon Fraser University, in Burnaby, BC, Canada, receiving an Honors B.Sc. in Marine Biology - 1979, MSc Pest Management Program - 1982, and PhD in 1987. In 1989, Gary began working at the Summerland Research and Development Centre (Agriculture and Agri-Food Canada), where he continues to work in tree fruit Entomology and extension.

At Summerland, Gary met pheromone enthusiast Don Thomson. As scientist and technician, Gary and Don's initial collaboration led to the first successful codling moth mating disruption project in Canada, and kick-started a career in tree fruit entomology. Early research demonstrated the power of complementary technologies in managing a key pest, and for an emerging organic apple industry, it ensured successful implementation of a codling moth sterile insect program (OK-SIR) in 1994. Dealt a semiochemical career inevitably entwined with SIT, Gary has endeavored to understand and improve this technology through many basic studies of codling moth behavior.

Collaborations have allowed Gary to author and co-author over 100 peer-reviewed journal articles, 175 extension articles and 7 Book Chapters. His Adjunct Professorship and role as Head Instructor of the Tree Fruit Pest Management course at SFU, since 1992, have allowed him to contribute to the mentorship of over 30 students and post-docs. He recently received a Lifetime Achievement Award from the Professional Pest Management Association of B.C. and was awarded an Honorary, Lifetime Membership in the Similkameen-Okanagan Organic Producers' Association.

When not working, which is rare, Gary spends time tinkering with and driving his '65 Austin Healey, enjoying time in his garden, especially that in shared exploration with his six grandchildren. In the near future Gary hopes to rekindle a passion for fly fishing between times spent traveling the world with his wife and life friend, Linda.

About the cover: "*Still Life with Fruit and Nuts*" - Artist unknown. (Modernist French Oil).

94th Annual Orchard Pest and Disease Management Conference

Orchard Pest and Disease Management Conference
2020 Agenda

Below is the order in which the sessions will be given and the projected time slot in which they will occur. 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.

Talks within each session are listed in order in the Table of Contents.

Wednesday, January 8th	
8:00 AM	**Registration/Name Tag Pickup**
8:45 AM	**Opening Business—***Rodney Cooper, OPDMC Chair*
9:30 AM	Implementation – *Moderator: Karol Krey (USDA-ARS)*
10:45 AM	Thresholds/Monitoring – *Moderator: Lynn Wunderlich, (UC Extension)*
12:00 PM	**Lunch (on your own)**
1:15 PM	Biological Control – *Moderator: Kacie Athey (WSU)*
2:45 PM	Pathology/Diseases – *Moderator: Tobin Northfield (WSU)*
3:00 PM	**Coffee Break**
3:30 PM	Pathology/Diseases *(cont'd)*
4:00 PM	*Keynote Address:* **Ridding Apples of their Worms: Reflecting on 30 Years of Semiochemical Collaboration to Support a Codling Moth Sterile Insect Program** Gary Judd (Agriculture and Agri-Food Canada)
5:00 PM	**Adjourn**
5:00 – 7:00 PM	**No Host Mixer (Hilton Lobby)**
Thursday, January 9th	
8:00 AM	Pathology/Diseases *(cont'd)*
9:45 AM	Invasive Species – *Moderator: Greg Krawczyk (PSU)*
10:00 AM	**Coffee Break**
10:30 AM	Invasive Species (cont'd)
12:00 PM	**Lunch (on your own)**
1:00 PM	Chemical Control/New Products – *Moderator: Louis Nottingham (WSU)*
3:00 PM	**Coffee Break**
3:30 PM	Chemical Control/New Products (cont'd)
4:00 PM	Biology/Phenology – *Moderator: Houston Wilson (UC Riverside)*
5:00 PM	**Adjourn**
Friday, January 10th	
8:00 AM	Biology/Phenology (cont'd)
8:45 AM	Mating Disruption/SIR – *Moderator: Chris Adams (OSU)*
10:15 AM	**Closing Business** — *Rodney Cooper, OPDMC Chair; Allison Walston, Chair-Elect*

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For more information, see: http://opdmc.org/

Order of Presentations

FROM THE 94th ANNUAL

ORCHARD PEST AND DISEASE MANAGEMENT CONFERENCE

January 8, 9, & 10, 2020

Keynote Presentation: Wednesday, 4:00pm – 5:00pm*

Ridding Apples of their Worms: Reflecting on 30 Years of Semiochemical Collaboration to Support a Codling Moth Sterile Insect Program
Gary Judd, Agriculture and Agri-Food Canada

Presentation **Page**

Implementation— Moderator: Karol Krey (USDA-ARS) 1

Improvement Of Spray Coverage Using The Double-Spray Technique (VanSteenwyk)..... 3

Opportunities To Train Applicators To Improve Spray Coverage: Case Studies From Washington And California (Wunderlich) 3

Hitting the Target – Using the New WSU Spray Evaluator to Optimize Spray Timings Jones) 4

Shaded And Confused: Behavioral Exclusion Of Codling Moth Marshall) 4

Fast-tracking Codling Moth Female Removal Technology (Knight) 5

Thresholds & Monitoring— Moderator: Lynn Wunderlich (UC Extension) 7

Movement And Monitoring Of Navel Orangeworm In Walnuts (Wilson) 9

Trade-Offs In Monitoring Methods For Navel Orangeworm In The Presence Of Mating Disruption (Nikolich) 9

50+ Years OF Independent I.P.M. Consulting – A Personal Perspective (Stewart) 10

A Hard Day's Knight (Knight) 10

Biological Control— Moderator: Kacie Athey (WSU) 11

Dispersal And Parasitism Rates Of The Samurai Wasp, A Biological Control Agent Of The Brown Marmorated Stink Bug (Donahoo) ……...13

Presentation **Page**

Development of Precision-Guided Sterile Insect Technique to Control Spotted Wing Drosophila (Alton) 13

Initiating a Classical Biological Program for Spotted Wing Drosophila (*Drosophila suzukii*) in Canada (Moffat) 14

Aphid Management And Biological Control (Rudolph) 14

A Trio Of Traps, A Duo Of Parasitism Detection Methods For Trechnites, A Key Natural Enemy Of Pear (Schmidt-Jeffris) 15

Conservation Of Phytoseiids In Washington Apple Orchards (Bergeron) 15

Pathology/Diseases— Moderator: Tobin Northfield (WSU) 17

Incidence Of Crown Gall In A Recently Established Experimental Walnut Rootstock Block (Arnold) 19

Botrytis cinerea Infection at Different Stages of Pear Fruit Development (Hernandez) 19

Oregon State University Plant Clinic: 2019 Tree Fruit Sample Summary (Johnson) 20

X Disease: What Can We Learn From Previous Outbreaks? (Northfield) 20

Fungicides For Management Of Eastern Filbert Blight (Pscheidt) 21

Kernel Mold Of Hazelnut (Pscheidt) 21

Trunk Cankers And Associated Pathogens In New OSU Hazelnut Cultivars Resistant To Eastern Filbert Blight (Wiman) 22

Implications Of Fungicide Resistance In The Management Of Cherry Powdery Mildew In The Pacific Northwest (Swamy) 22

Distribution Of Tomato Ringspot Virus In Naturally Infected Cherry Orchards (Lutes) 23

Using An Intelligent Sprayer And Sulfur For Management Of Powdery Mildew (Warneke) 23

Invasive Species— Moderator: Greg Krawczyk (PSU) 25

BMSB Ate My Lunch (and Everything Else): WA Research Update (Hepler) 27

BMSB In Oregon Pear Orchards: Update On Current Status And Outlook For The Future (Hilton) 27

Spotted Lanternfly, *Lycorma delicatula* - A Potential New Invasive Pest Of Grapes And Fruit (Krawczyk) 28

No Crystal Balls! Predicting The Establishment Risk Of New Invasive Pests In The Pacific Northwest (Neven) 28

Presentation **Page**

Relationship Between Fruit Development And The Risk Of SWD Infestation (Gut) 29

Drosophila Suzukii Daily Dispersal Between Distinctly Different Habitats (Trait) 29

Integrated And Novel Management Strategies For *Drosophila Suzukii* (Walton) 30

Chemical Control/New Products— Moderator: Louie Nottingham (WSU) 31

Efficacy Of Plant Host Defense And Signaling Compounds In Preventing Ambrosia Beetle Infestations In Apple Trees (Agnello) 33

Repellents To Manage Pear Psylla: What We Know And Where We're Going (Nottingham) 34

Erythritol: Good For Your Waistline, Bad For Pear Psylla (Cooper) 34

Optimized Chemical Control Strategies For *Drosophila suzukii* Matsumura (Diptera:Drosophilida) Immature Life Stages And Population Modeling (Mermer) 35

30 Years Of Successful Use Of Codling Moth Granulovirus – Progress And Challenges (Jehle) 35

Susceptibility of Washington codling moth to CpGv (Nielsen) 36

Control Of Codling Moth In Walnuts (Peters-Collier) 37

Control Of Navel Orangeworm In Almonds (Peters-Collier) 37

Control Of Vine Mealybug In Grapes (Van Steenwyk) 38

Biology/Phenology— Moderator: Houston Wilson (UC Riverside) 39

Volatilized Fatty Acids To Determine Natal Hosts Of Spotted Wing Drosophila And Filbertworm (Andrews) 41

Gut-Content Analysis To Determine Previous Host Plants Of Leaffooted Bug (*Leptoglossus zonatus*) Infesting California Orchards (Evans) 42

Behavior Differences Of Codling Moth Against *Cydia pomonella* Granulovirus (CpGV) (Fan) 42

Using Transcriptomics To Target Key Behaviors Of Pear Psylla (Krey) 43

Biology And Management Of The Pacific Flatheaded Borer In Hazelnuts (Mugica) 43

Biology And Morphometrics Of The Pacific Flatheaded Borer (Keyes) 44

Temperature Effects On Oviposition By Cherry Fruit Fly In Different Stages Of Sweet Cherry (Yee) 44

Presentation **Page**

Mating Disruption/SIR— Moderator: Chris Adams (OSU) 45

Ovipositional Cues For Filbertworm: The Search Begins (Miller) 47

Practical Aspects Of Mating Disruption For Navel Orangeworm (Burkes) 47

Adapting SIR for Farm-Scale Application (Adams) 48

Sterile Insect Release For Codling Moth Control In Apples (Athey) 48

Dispersion Of Sterile Codling Moths In The Apple Orchard (Curtiss) 49

Development Of Sterile Insect Technique For Navel Orangeworm: Field Trials (Wilson)……..49

Minutes of the 93nd Annual Meeting 51

The Rubber Chicken Award 57

Travel Scholarships for Students 59

Implementation—

Moderator: Karol Krey (USDA-ARS)

Improvement Of Spray Coverage Using The Double-Spray Technique

Robert A. Van Steenwyk[1], Stephen R. Peters-Collaer[1] and Barat Bisabri[2]
[1]University of California, Dept. of ESPM, Berkeley, CA, [2]Bisabri Ag Research and Consulting, Newman, CA

Keywords: Spray coverage

Abstract: Spray coverage near the top of very large trees is difficult and often out of the reach of conventional spray rigs. Inadequate coverage at the tops of trees can lead to increased insect and disease damage which can result in a reduction in crop yields. The Double-spray technique was developed during a previous study on spray drift mitigation and showed promise as a method to increase coverage high in the tree canopy. The Double-spray technique involves two sprayers driving and spraying parallel to each other so that each spray manifold is opposing. The spray rigs apply the pesticide normally. This technique was evaluated and compared to the grower standard spray method on very large (50+ft.) 'Chandler' walnut trees near Gridley, CA. The orchard was sprayed with 100 gallons of water/acre + 0.15 gal/100 gal of Aquashade dye. Spray coverage was assessed at 20 ft., 30 ft., and 40 ft. At each assessment site, coverage was determined using two 8.9 cm X 20.3 cm rectangular pieces of Kromekote paper wrapped around two aluminum beverage cans. Percent coverage on the Kromekote paper was determined using ImageJ. The Double-spray technique significantly increased coverage as compared to the grower standard, although aligning the two spray rigs proved challenging. A synchronization device needs to be developed and further research is needed before the technique can be recommended for grower use.

Opportunities To Train Applicators To Improve Spray Coverage: Case Studies From Washington And California

Lynn Wunderlich[1], Gwen-Alyn Hoheisel[2], Franz Niederholzer[3]
[1]University of California Cooperative Extension (UCCE) Farm Advisor, Placerville, CA, [2]Washington State University Regional Extension Specialist, Prosser, WA,[3]UCCE Farm Advisor, Yuba City, CA

Keywords: Airblast sprayer, calibration training, coverage

Abstract: Airblast spray coverage is critical for safe, economic and effective IPM; yet is often overlooked. A national spray application work group (SAWG) established in 2013 supported "train the trainer" programs led by internationally recognized experts for 15 extension professionals. Within two years, SAWG participants then led 39 workshops training 1577 producers. Recently, Washington and California SAWG members secured additional funding to develop and deliver airblast sprayer calibration curriculum. WA has trained approximately 600 producers through hands-on and online training. In surveys 1- and 2-years post training, participants reported significant changes, such as regularly maintaining sprayers, changing nozzles, and checking speed. In CA., a needs assessment revealed that "checking coverage" was ranked as the most important training topic, and while all respondents ranked "practices to reduce drift" high in importance, specific topics related to spray drift management were rated much lower. A full day hands-on course was developed and to date, 77% of course trainees said they may or probably will use low drift nozzles and check their coverage with water sensitive paper. A publicly available online course is also being developed. Prioritizing training, funding and training adequate numbers of trainers, and delivering to Hispanic applicators pose challenges to the industry.

Hitting the Target – Using the New WSU Spray Evaluator to Optimize Spray Timings

Matthew Jones[1], Stefano Borghi[1], Vince Jones[1]
[1]Washington State University, Tree Fruit Research and Extension Center, Wenatchee, WA

Keywords: decision support tools, phenology models, spray timing

Abstract: Analyzing the effectiveness of spray programs can be extremely difficult. In this presentation I will talk about the new WSU 'Pesticide Effect Evaluator', an open-source tool designed to help evaluate how a specific spray program affected pest populations compared to a no-treatment control population. This tool combines pest phenology models with user-entered spray records to help growers/managers understand how the timings of their treatments resulted in the effectiveness of their program. We feel this tool will greatly assist growers and managers in creating more targeted pest management decisions.

Shaded And Confused: Behavioral Exclusion Of Codling Moth

Adrian Marshall and Elizabeth H. Beers
Washington State University, Tree Fruit Research and Extension Center, Wenatchee, WA

Keywords: netting, codling moth

Abstract: As the tree fruit industry shifts towards planting dwarf apple varieties, Washington orchardists have begun employing shade netting structures to protect their fruit from sunburn. While shade netting typically covers only the top of the orchard, some growers enclose the entire orchard. This complete coverage can create a barrier to certain insect pests, and research in France and Canada has shown that full-enclosure exclusion netting can be an effective control technique for codling moth in apple orchards. We conducted two field trials to test the ability of commercial shade netting to exclude codling moth and prevent damage at a WSU research orchard using small (3 trees) and large (48 trees) cages. Both field trials were conducted from 2018-2019. The small cage trial tested the shade nets' permeability to codling moth by releasing and recapturing fluorescent marked sterile moths inside and outside the netted cages compared to a no-net control. The large cage trial evaluated the ability of shade net to prevent recolonization of codling moth after plot sanitation. The results of the mark, release, and recapture trials showed that netting prevented codling moth movement into the netted plots, but they were able to migrate out of the plots suggesting the netting is excluding codling moth due to behavior. The large cage trials caught significantly less codling moth throughout the season, and first-generation damage was lower in the cages. However, at harvest the percent codling moth damage was not significantly different between the control and the cage treatments with both reaching infestation levels. These outcomes show that full enclosure netting for sunburn protection can reduce codling moth immigration into orchards but once established it no longer has an effect.

Fast-tracking Codling Moth Female Removal Technology

Alan Knight [1], Michele Preti [2], Esteban Basoalto [3], and Valentina Mujica [4]
[1] Private Consultant, Yakima, WA, [2] Free University of Bolzen, Italy, [3] Austral University, Chile, and [4] INTA, Uruguay

Keywords: Codling moth, *Cydia pomonella*, rosy apple aphid, *Dysaphis plantaginea*, monitoring, kairomones, sex pheromone

Abstract: Following the unexpected discovery in 2018 that a 4-component blend including pear ester, nonatriene, pyranoid linalool oxide, and acetic acid could increase captures of female codling moths by 3-4-fold, a large project was initiated that included 25 paired apple and pear blocks across WA, OR, CA, and CO. All treated blocks had 25 traps per acre. All traps were initially baited with a new pvc Combo-P lure plus acetic acid provided by Trécé Inc. Lures in the second generation were replaced by either 4K lures or the 5K which also included the sex pheromone of codling moth. Studies included 3,600 bucket traps which were all serviced once at mid-season. Data were also collected prior to harvest. During the summer V. Mujica counted 64,202 moths, sexed 39,510 of them, and dissected 4,214 females to ascertain their mating status. Across the paired blocks the use of the traps reduced fruit injury 30-60% at mid-season and 40-70% prior to harvest in all but two blocks. In these two outliers the trapped area was deliberately placed in the area of much higher pest pressure. In these two sites the levels of fruit injury were brought down to the same level as the lower pest area. Progress was also made with a comparison of trap types in which a milk jug caught the greatest number of moths. Comparisons of quart, half-gallon and gallon jugs found that all worked similarly and the use of two holes from 1.5 to 3" were all effective. The addition of 1-2% neem oil to the mineral oil was an unfortunate choice. Future studies will use vegetable glycerin mixed with oil. Trap densities between 15-40 per acre demonstrated that higher densities should be used to manage higher pest pressures. Seasonal studies demonstrated the Cidetrak MegaLure 4K lasted > 8 weeks and that adding the sex pheromone to create a 5K lure decreased female catches. These results will be used to develop a more robust program for 2020.

Thresholds & Monitoring—

Moderator: Lynn Wunderlich (UC Extension)

Movement And Monitoring Of Navel Orangeworm In Walnuts

Houston Wilson[1], Emily Symmes[2], Jhalendra Rijal[3], Chuck Burks[4]
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Keywords: almond, walnut, Navel Orangeworm, trapping, pheromone

Abstract: Navel orangeworm (Pyralidae: *Amyelois transitella*) (NOW) is a major pest of pistachio, almond and walnut in California, where these crops account for more than 1.9 billion acres of production valued at over $6 billion. Infestation of nuts by NOW larvae not only diminishes crop quality and yield, but also increases the likelihood for contamination with aflatoxin, a known carcinogen that is heavily regulated in key export markets. Differences in the phenology of these three nut crops results in slightly differential periods of vulnerability as well as harvest timing, such that almonds can be readily utilized as a host prior to walnuts and are harvested earlier as well. The ability of NOW to reproduce on almonds early in the season, followed by the mass removal of this host material with harvest, may have implications for subsequent NOW activity in walnuts. As such, NOW movement between almond and walnut was examined in 2019, building upon related work conducted in 2017 and 2018. Weekly trap counts were compared between wing-traps baited with a pheromone lure (which capture males only), a pistachio/almond meal bait bag (which capture gravid females only) and a phenyl proprionate (PPO) lure (which can capture both males and females). Monitoring was carried out in multiple walnut sites throughout the Central Valley that were situated in landscapes heavily dominated by either walnuts or almonds. NOW infest levels were quantified at harvest as well. Trap capture data were evaluated relative to trap lure type, landscape context and crop infestation levels. Subsamples of trapped moths were analyzed using fatty acid profiles to distinguish the larval host (walnut or almond) in order to determine the extent and timing of NOW spillover from almond into walnut orchards.

Trade-Offs In Monitoring Methods For Navel Orangeworm In The Presence Of Mating Disruption

Gabriela Nikolich[1], Christeen Abbott-Hearn[2], and Chuck Burks[1]
[1]U.S. Dept. of Agriculture, Agricultural Research Service, Parlier CA; [2]Pacific Biocontrol, Kingsburg, CA

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

Abstract: Navel orangeworm (NOW) is a key economic pest in California tree nut crops. Egg traps are used to monitor NOW in mating disruption blocks where pheromone lures are ineffective, and observations of red (fertile) eggs on traps have caused confusion and concern among pest managers. We used laboratory and field experiments to examine the effect of mating on the number of eggs laid, the development of eggs, and substrate preference; and field experiment to examine the effects seasonality and position in the orchard on oviposition in orchards with and without mating disruption. Unmated NOW females lay fewer eggs, later in adult life, and these eggs do not turn red. More importantly, mated females show greater preference for a more suitable oviposition site (i.e., an egg trap vs. a paper filter) than unmated females. This is consistent with the field observation that almost all moths captured in ovipositional bait traps are gravid females. In orchards under mating disruption, there were consistently more eggs on traps near the edge of the orchard than on traps nearer the middle. In contrast, there were similar numbers of

eggs on traps on the edge and in the center of orchards not under mating disruption. These observations indicate that eggs on egg traps in orchards under mating disruption are likely fertile, but they are not necessarily an indication of failure of mating disruption.

50+ Years OF Independent I.P.M. Consulting – A Personal Perspective

Jim Stewart PCA
Associates Ag IPM Consultants Inc.
Exeter, CA

Keywords: consulting, PCA, IPM, Monitoring

Abstract: Jim Stewart is an independent Pest Control Advisor (PCA). He has consulted for over 50 years on citrus, stone fruits, and vine crops produced in California's Central Valley. After attending Ventura College and the University of California at Davis, Mr. Stewart received his B.S. degree in Entomology from the University of California at Berkeley in 1962, where he interacted with IPM pioneers Drs. Ray Smith, Kenneth Hagen, Robert van den Bosch, and Vernon Stern. He was one of the early uses of IPM and contributed significantly to its adoption among California growers. Mr. Stewart is a highly respected PCA, who continues to serve the agricultural community of the San Joaquin Valley.

A Hard Day's Knight

Alan Knight
Private Consultant, Yakima, WA

Keywords: Codling moth, *Cydia pomonella*, monitoring, kairomones, sex pheromone

Abstract: Looking at 30 years of Knight. A review of applied insect ecology research focusing on pheromone mating disruption, insect behavior, kairomones, monitoring, and pest phenology with special emphasis on collaborations to help tree fruit growers around the world.

Biological Control—

Moderator: Kacie Athey (WSU)

Dispersal And Parasitism Rates Of The Samurai Wasp, A Biological Control Agent Of The Brown Marmorated Stink Bug

Claire Donahoo[1], David Lowenstein[2], Richard Hilton[3], and Nik Wiman[2]
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Keywords: samurai wasp, *Trissolcus japonicus*, brown marmorated stink bug, *Halyomorpha halys*, parasitoid, adventive species

Abstract: The brown marmorated stink bug, *Halyomorpha halys*, is a rapidly spreading, polyphagous and invasive pest that has caused millions of dollars of economic damage in US specialty crops and is an increasing problem in the Pacific Northwest. In the home range of *H. halys*, the samurai wasp (*Trissolcus japonicus*) is known to be an efficient parasitoid of the pest, with very high parasitism rates of *H. halys* eggs (>90%). As of 2018, Oregon State University had redistributed the adventive agent at sites across four ecoregions in Oregon with more releases in progress. In 2018 and 2019, we placed sentinel egg masses of *H. halys* and yellow sticky cards in areas with established *T. japonicus* populations in urban, agricultural, and riparian habitats in various locations around the state of Oregon. We collected the egg masses 5-7 days after release, while sticky cards were gathered at variable intervals. We also collected wild egg masses of *H. halys* and assessed them for parasitism by *T. japonicus*. Here, we present the parasitism rates of both the sentinel and wild egg masses, as well as the locations in Oregon where *T. japonicus* were captured by the yellow sticky cards.

Development of Precision-Guided Sterile Insect Technique to Control Spotted Wing Drosophila

Gordon R. Alton[1], Omar S. Akbari[2] and Nikolay P. Kandul[2]
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Keywords: Spotted Wing Drosophila, *Drosophila Suzukii*, Knock-Out, Sterile Insect Technique, CRISPR.

Abstract: The sterile insect technique is an environmentally safe and proven technology to suppress wild insect populations. However, the radiation-based technology in use since the 1950s is not commercially viable. As such, we have created a novel CRISPR-based technology termed “Precision-Guided Sterile Insect Technique”. This technology enables simultaneous sexing and sterilization of insect crop pests. We have demonstrated proof-of-concept in Drosophila melanogaster and are near completion of the key genetic lines in *Drosophila suzukii*. *D. suzukii* is also known as the spotted wing drosophila and the female insect is the major crop pest of berries and cherries worldwide. We intend to release only sterile adult male spotted wing drosophila into the field where they will find and mate with the female crop pest. Since the resulting eggs are not fertilized, they do not hatch, and the pest population is safely controlled without the use of chemicals. The “Knock-Out” product will be deployed by drone on grower’s fields as a direct replacement for chemical pesticides.

Initiating a Classical Biological Program for Spotted Wing Drosophila (*Drosophila suzukii*) in Canada

Chandra Moffat[1], Howard Thistlewood[1], Mairi Robertson[1], Brigitte Rozema[1], Debra Moreau[2], Paul Abram[3]
[1]Agriculture and Agri-Food Canada, Summerland Research and Development Centre, Summerland BC,
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[3]Agriculture and Agri-Food Canada, Agassiz Research and Development Centre, Agassiz BC

Keywords: Spotted wing Drosophilia

Abstract: Management of invasive Spotted wing drosophila (SWD) is challenging as flies persist in refugia of native fruiting shrubs year-round. Two species of Asian parasitoids show promise as candidate classical biological control agents. Surveys of endemic drosophilids, potentially susceptible to non-target attack, are in progress in preparation for quarantine host-specificity testing. We present data on the non-target Drosophilid fauna in areas of Canada heavily infested with SWD and their host-plant associations.

Aphid Management And Biological Control

Erica Rudolph, Heather Andrews, Nik Wiman
Oregon State University, North Willamette Research and Extension Center, Aurora, Oregon.

Keywords: *Myzocallis coryli*, Filbert aphid, *Trioxys pallidus, Corylus avellana*, Hazelnut, Biological control, Insecticide

Abstract: Filbert aphid, *Myzocallis coryli* Goetze (Hemiptera: Aphididae), is an indirect pest of the European hazelnut (*Corylus avellana* L.) worldwide. The aphid feeds on phloem from the leaves and husks and can cause damage that leads to a loss of yield. Beginning in 1984, populations of the parasitoid *Trioxys pallidus* Haliday (Hymenoptera: Aphidiidae) sourced from Spain, France and Italy were released into hazelnut orchards in the Willamette Valley, Oregon in an effort to control *M. coryli* populations. *T. pallidus* is well adapted to the climate of the Willamette Valley and can reduce aphid populations by 66% when *T. pallidus* populations are at their peak. Unfortunately, spring eclosion of *T. pallidus* occurs two weeks after the eclosion period of *M. coryli*, decreasing the efficacy of this biocontrol relationship. Aphid problems seem to be on the increase with overreliance on pyrethroids and changing climate as potential explanations. Control of *M. coryli* is further complicated, as it had developed resistance to several insecticides, which has likely resulted from the overreliance on broad-spectrum materials applied to manage other pests. The goal of this study was to (1) evaluate the efficacy of various aphid control products, (2) investigate the effects of these materials on the beneficial *T. pallidus* and other natural enemies. We applied eight different treatments to single trees in complete randomized blocks with five replications per treatment per site at two study sites. Samples of five randomly selected leaves were collected from each tree at each of the sites at 7 days after treatment (DAT), 15 DAT, and 23 DAT. The numbers of aphids, aphid mummies, *T. pallidus*, and other natural enemies were recorded. There was a significant difference between untreated controls and all treatments 7 DAT. Unfortunately, applications were made late in the season after natural enemies had already begun to manage *M. coryli* populations and no treatments were significant after 7 DAT. However, this illustrates the issue of pest tolerance and the important role of Extension to convince growers to resist treating aphid populations where biocontrol is active. Future studies will commence at an earlier time in the aphid population trajectory.

A Trio Of Traps, A Duo Of Parasitism Detection Methods For Trechnites, A Key Natural Enemy Of Pear

Rebecca Schmidt-Jeffris[1], Rodney Cooper[1], David Horton[1], Louis Nottingham[2], Rick Hilton[3], Stephen Castagnoli[4]
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Keywords: *Trechnites insidiosus*, pear psylla, *Cacopsylla pyri*, monitoring, parasitism

Abstract: Pear psylla is the most serious pest of Washington pear and is responsible for half of pest management costs. The current, pesticide-reliant psylla management program is failing growers due to pesticide resistance. Biocontrol measures are heavily under-utilized but have strong potential to succeed due to increased grower interest. Although the parasitoid *Trechnites insidiosus* can cause high levels of psylla mortality, its integration into conservation biocontrol programs is severely limited by lack of information about its biology. We sought to better understand how Trechnites adult capture relates to psylla parasitism levels. To do this, we compared the current monitoring method (beat trays) to standard sticky cards, screened sticky cards, and a new 3D-printed tube trap. We also compared psylla nymph dissection to PCR detection of Trechnites DNA as methods for monitoring field parasitism. Beat tray sampling proved to be very poor for estimating Trechnites abundance, catching few Trechnites and many look-alike encyrtids. The tube trap resulted in adequate trap catch and lower processing times than either sticky trap. PCR was much more likely than dissection to detect the presence of Trechnites within a nymph. This discrepancy may be due to the superior ability of PCR to detect the smaller and visually difficult-to-detect stages (eggs and new larvae) of Trechnites or to detect dead Trechnites larvae encapsulated during the host's immune response. Now that an efficient adult monitoring method has been identified, future work will attempt to formally quantify the relationship between adult populations and levels of biological control.

Conservation Of Phytoseiids In Washington Apple Orchards

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Keywords: non-target effects, Phytoseiidae, predatory mites, integrated mite management

Abstract: Codling moth is the major pest of apple in Washington apple orchards. Management previously relied heavily on broad-spectrum pesticide use leading to secondary outbreaks by *Tetranychus urticae*. Due to a need for alternative control to prevent *T. urticae* outbreaks, integrated mite management (IMM) using *G. occidentalis* was developed. IMM is still currently used, but the pesticide regime has shifted from broad-spectrum pesticides to more selective pesticides leading to a resurgence in predatory mite diversity and abundance. In particular, *Amblydromella caudiglans* is increasing in dominance across the state begging the question of the viability of this species for biocontrol. Here, we investigate the lethal and sub-lethal effects of commonly used pesticides on *A. caudiglans*, and compare the non-target effects of *G. occidentalis* vs. *A. caudiglans* to determine the viability of *A. caudiglans* in IMM. Results suggest that

Mancozeb has significant effects on all factors examined for *A. caudiglans*. Additionally, Captan was the only fungicide that did not significantly reduce the number of live larvae. For *A. caudiglans*, chlorantraniloprole, cyantraniliprole, and cyclaniliprole are the most selective products for all factors. When we compare species, *A. caudiglans* is more sensitive for mortality, fecundity, and egg hatch, but both species are very sensitive to a reduction in live larvae for all broad-spectrum products. Results for both species indicate similar results for selective pesticides. Overall, *A. caudiglans* is more sensitive than *G. occidentalis*, but is still a viable biocontrol agent and IMM plans should be updated to ensure proper management decisions are made.

Pathology/Diseases—

Moderator: Tobin Northfield (WSU)

Incidence Of Crown Gall In A Recently Established Experimental Walnut Rootstock Block

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Keywords: crown gall, rootstock, walnut

Abstract: A walnut trial was planted in the spring of 2016 evaluating the effects of rootstock and tree density on walnut growth and production. 'Chandler' was June-budded to either seedling Paradox, or one of two clonal rootstocks, VX211, or RX1 and planted at the densities of 22'x22', 26'x26', and 30'x30'. Each of the nine treatments consisted of three rows of eight respectively spaced trees with four replicate blocks. The orchard was maintained under grower standard practices. In 2019, incidence of crown gall was assessed in each of the three rootstocks. Overall, Paradox seedling had higher crown gall incidence than RX1 and VX211.

Botrytis cinerea Infection at Different Stages of Pear Fruit Development

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Keywords: *Botrytis cinerea*, gray mold, pear, fungicides

Abstract: The fungal pathogen, *Botrytis cinerea*, is capable of causing a postharvest disease known as gray mold in pears. To understand the disease epidemiology, we isolated *B. cinerea* from pears collected at different stages during their development. These stages included fruit set, mid-summer, and commercial maturity. Out of the collected pears that were grown conventionally (n = 126), 43.33% were infected with *B. cinerea* at the fruit set stage, 4.17% were infected at the mid-summer stage, and 12.50% were infected at commercial maturity. Out of the collected pears that were grown organically (n = 126), 73.33% were infected with *B. cinerea* at the fruitlet stage, 16.67% were infected at the mid-summer stage, and 12.50% were infected at commercial maturity. This suggests that infection by *B. cinerea* begins as early as fruit set. The fungicides Manzate Pro-Stick, Ziram 76DF, Ph-D, and Botran 5F which contain the active ingredients of mancozeb (FRAC M3), ziram (FRAC M3), polyoxin D (FRAC 19), and dicloran (FRAC 14) respectively, were also tested against 21 strains of *B. cinerea* at concentrations of 0, 0.1, 10 and 100 µg/ml as well as the maximum label rate. The Botrytis strains were grown on PDA plates and then transferred to PDA plates amended with the different concentrations of fungicides. Fungal growth was measured after 3 days by taking two perpendicular measurements of the diameter of the fungal colony. Fungal growth on plates amended with fungicides was compared to fungal growth on non-amended PDA plates. The average concentrations to reduce radial growth by 50% (EC50) for mancozeb, ziram, polyoxin D, and dicloran were 69.01 µg/ml, 162.78 µg/ml, 53.39 µg/ml, and 15.04 µg/ml respectively. For mancozeb, EC50 values ranged from 31.76 µg/ml to 237.47 µg/ml. For ziram, EC50 values ranged from 32.82 µg/ml to 393.79 µg/ml. For polyoxin D, EC50 values ranged from 14.32 µg/ml to 11140.90 µg/ml. Finally, for dicloran, the only fungicide not registered for use on pear, EC50 values ranged from 6.45 µg/ml to 42.96 µg/ml. Overall, this suggests differential sensitivities of Botrytis strains to fungicides with different modes of action.

Oregon State University Plant Clinic: 2019 Tree Fruit Sample Summary

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Keywords: diagnostics, biotic disease, abiotic disease, tree fruit, summary

Abstract: The Oregon State University Plant Clinic is a valuable resource for growers and homeowners alike to send in potentially diseased plant samples. The samples are processed and given a diagnosis based on the symptoms, pathogens recovered, and molecular assays performed. Plants are brought in from all around the Pacific Northwest, many of these being tree fruit samples. Abiotic and biotic diseases, as well as non-disease based symptoms, have all been present on the samples throughout 2019. Abiotic disease symptoms include but are not limited to nutritional deficiencies, weather changes, and sunburn. Biotic disease symptoms have been found on most plant parts, and pathogenic detection/recovery included most types of pathogenic microbes. Small mammal feeding, insect damage, and mechanical damage have all been seen as symptoms on trees. A summary of the tree fruit samples sent into the Plant Clinic can not only help to understand the pathogenic pressures growers are currently facing, but also cultural practices that may be facilitating disease.

X Disease: What Can We Learn From Previous Outbreaks?

Tobin Northfield
Washington State University

Keywords: X disease, little cherry disease, leafhoppers, stone fruits

Abstract: X disease reduces fruit size and quality in cherries, nectarines and peaches and has no cure. Washington and Oregon orchards are currently experiencing an X disease epidemic. Previous outbreaks of X disease included an outbreak in the Pacific Northwest in the 1940s and 50s, and a Californian epidemic in the 1970's and 80's. In each case, the outbreak was primarily survived through the removal of diseased trees. Each outbreak also included a surge of research that identified leafhoppers as vectors, identified general leafhopper phenology, measured phytoplasma incubation times within leafhoppers, alternative host plants, and best leafhopper tracking methods, despite not having access to current molecular technology. Here, I will present the insights gained during research conducted during previous outbreaks to inform our management of the current X disease epidemic in Washington and Oregon.

Fungicides For Management Of Eastern Filbert Blight

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Keywords: hazelnut, chemical control, fungicides, *Anisogramma anomala*, eastern filbert blight,

Abstract: After two years of low disease pressure, overall eastern filbert blight (EFB) pressure was normal for spring 2018 as indicated by the average of 5 cankers per non-treated tree. This resulted in good evaluations of fungicides that were in the trial. Fungicides that result in zero or low canker numbers included Bravo, Indar, Kocide 3000, Merivon, Quadris Top, Quilt Xcel, Thiram, Tilt, Ziram, the newly registered Aproach and soon to be registered Cevya and Miravis Duo. When new EFB resistant cultivars were released growers were surprised to find some trees with EFB cankers. Inoculation experiments confirmed earlier results that it is related to the dose of fungal spores. Jefferson trees can become infected if the dose of spores is high enough. There was no significant yield difference between pruning or not pruning fungicide treated Ennis trees with EFB for the 4th year in a row. Minimizing or even eliminating pruning in heavily infected orchards may help save growers money as they transition to new orchards.

Kernel Mold Of Hazelnut

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Keywords: hazelnut, chemical control, fungicides, kernel mold, Luna Tranquility,

Abstract: Mold research has shifted from pre- and postharvest to flowering and early shoot growth to see when fungi are gaining entrance to the nut. Luna Tranquility (a non-registered fungicide) treated trees had less mold than non-treated trees when applied during shoot growth for only one of the high molding hazelnut selections. Fungicide application in a commercial Lewis orchard did not result in lower mold. As usual, mold proves to be an elusive disease to understand and characterize.

Trunk Cankers And Associated Pathogens In New OSU Hazelnut Cultivars Resistant To Eastern Filbert Blight

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Keywords: Diplodia, *Xanthomonas*, Fusarium, Chondrostereum, Diporthe, Cytospora

Abstract: Eastern filbert blight (EFB), the devasting disease of European hazelnut caused by the fungal pathogen *Anisogramma anomala* was at one time causing as slow decline toward extinction for Oregon's unique nut industry. The Oregon State University Hazelnut Breeding Program has now released six new EFB-resistant production cultivars that are now planted widely on more than 30,000 Ac. With the exception of fall copper applications for bacterial blight caused by *Xanthomonas arboricola p.v. coryli*, there is almost no fungicide use in these new orchards. It is increasingly common to find trunk cankers on the new cultivars that are not associated with EFB, and cultural practices have been implicated in causing wounds or weakening trees so that they are effectively exploited by pathogens. This presentation will review some of the pathogens associated with these cankers collected from the field in the Willamette Valley, Oregon. Some inoculation experiments on potted hazelnut trees will also be discussed.

Implications Of Fungicide Resistance In The Management Of Cherry Powdery Mildew In The Pacific Northwest

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Keywords: Cherry Powdery Mildew, *Podosphaera clandestina*, FRAC, Fungicide resistance, molecular and bioassay survey

Abstract: Cherry powdery mildew, which is caused by *Podosphaera clandestina*, is a persistent disease affecting cherry orchards in the Pacific Northwest. Management of the disease requires heavy and repeated use of fungicides throughout the fruit development period and extends beyond harvest. Synthetic fungicides representing FRAC Group 11 are used singly or in combination with other FRAC groups (e.g. FRAC 7). Although extremely efficient when introduced, these fungicides are prone to developing resistance by the pathogen and they are categorized as "High-risk" compounds by FRAC. The potential of fungicide resistance to FRAC 11 was studied on multiple *P. clandestina* isolates collected in all cherry-growing regions of Washington and Oregon. We identified several isolates that were insensitive to FRAC 11 compounds in leaf-disc bioassays and further determined to be resistant by identifying the target gene mutation that confers resistance to the pathogen. Because the FRAC 11 resistance problem was found to be widespread, the continued use of such fungicides will exert greater selection pressure on the remaining effective fungicides (other than FRAC 11) and exacerbate the management costs. Our lab is currently working on finding sustainable solutions by providing alternative disease management programs that do not include Group 11 fungicides.

Distribution Of Tomato Ringspot Virus In Naturally Infected Cherry Orchards

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Keywords: sweet cherry, virus, Tomato ringspot virus, distribution, nematode, *Xiphinema*

Abstract: A statewide diagnostic survey in 2016-2017 revealed the presence of important virus and phytoplasma induced diseases that threaten the Oregon sweet cherry industry. During this survey orchards in The Dalles area were found with Tomato ringspot virus (ToRSV) infected trees. The distribution of Tomato ringspot virus (ToRSV) was studied in 2018-2019 at two commercial orchards in The Dalles. The dagger nematode vector, *Xiphinema spp*, was found in association with symptoms at both orchards. Visual symptoms of enations (gall-like formation on the underside of the leaf), as well as rosetting (bunching of leaves due to shortened internodes) were found reliably associated with ToRSV infected trees. A low percentage (1-6%) of samples without obvious symptoms also tested positive for ToRSV, highlighting the importance of virus testing. These diseases kill trees and/or reduce yields and efforts should be made to find and remove infected trees. We hope these surveys have been a wakeup call for the Oregon sweet cherry industry to take action on important diseases that threaten cherry production.

Using An Intelligent Sprayer And Sulfur For Management Of Powdery Mildew

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Keywords: Intelligent sprayer, sulfur, powdery mildew, *Erysiphe necator*, chemical control, spray coverage, fungicides, grape

Abstract: The Intelligent Sprayer Project consists of a multi-discipline research team across the U.S. working on improving spray application technology in specialty crops. The team has moved from proof of concept to evaluation of standard sprayers retrofitted with Intelligent Spray System (ISS) components. The sprayer used in this study (50-gallon Pak-blast, Rears Mfg., Coburg, OR) was a standard "off-the-shelf" sprayer retrofitted with a Lidar laser sensor, Doppler speed sensor, embedded computer, and individual pulse width modulation solenoid valves at each sprayer nozzle. A spray console wired to the system allowed use of the sprayer in either the automated (using ISS components) or standard (full on/off) operation mode. In 2018 and 2019, fungicides were applied using the ISS for powdery mildew management to Pinot noir and Pinot gris vines at the Botany and Plant Pathology Field Laboratory in Corvallis, OR. The treatments focused on evaluating the efficacy of different sulfur rates and output volumes from the ISS on management of grape powdery mildew on leaves and clusters. In 2018, when the sprayer was used in automated mode with the default ISS settings and sulfur at 5#/100gal, significantly higher powdery mildew levels were observed on leaves and clusters than when 5#/100gal sulfur was applied in standard mode. In 2019, when the concentration of sulfur or the spray volume parameter in the ISS settings was increased in automated mode, more sulfur was applied using in automated mode, and powdery mildew levels on clusters were not significantly different than those applied in standard

mode. In addition, use of synthetic fungicides in automated mode in 2019 resulted in significantly lower powdery mildew levels on leaves and clusters than sulfur treatments (5#/100gal and 20#/100gal) applied in standard and automated mode. Overall, the ISS should prove to be an effective system to reduce pesticide quantity, water, and/or labor in both vineyard and orchard systems.

Invasive Species—

Moderator: Greg Krawczyk (PSU)

BMSB Ate My Lunch (and Everything Else): WA Research Update

Jim Hepler and Elizabeth Beers
WSU-TFREC, Wenatchee, WA

Keywords: BMSB, habitat, *Trissolcus, Halyomorpha*,

Abstract: The brown marmorated stink bug, *Halyomorpha halys*, has continued to expand its range in WA state, threatening the lucrative tree fruit industry centered east of the Cascades. This arid region presents a novel environment to BMSB, with climate, flora, and management practices unlike those in the eastern US. In part due to its recent arrival to the PNW, aspects of its biology, behavior, and effective management under these conditions remain incompletely explored. In 2019, the Beers lab conducted or continued several studies examining the suitability of the shrub-steppe flora for BMSB establishment, the management of BMSB in an orchard context with attract-and-kill strategies, and the non-target effects of the potential biocontrol agent *Trissolcus japonicus*.

BMSB In Oregon Pear Orchards: Update On Current Status And Outlook For The Future

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Keywords: brown marmorated stink bug, *Halyomorpha halys*, pear, *Pyrus communis*

Abstract: Sticky panel traps baited with combination lures have been used to monitor BMSB in southern Oregon for the past three years (2017-19). Over that time period the sticky panel trap has been compared to the pyramid trap at three sites, all of which are located adjacent to pear orchards. In 2019, sticky panel traps were deployed along the edge of pear orchards in southern Oregon and in the Hood River region. Results of this trapping effort along with information and observations on BMSB damage to pear fruit will be presented. Releases of the samurai wasp, *Trissolcus japonicus*, were initiated in Oregon in the fall of 2016 and have continued since then. An update will be provided on the samurai wasp release program in southern Oregon and potential management options for BMSB in pear orchards will be discussed.

Spotted Lanternfly, *Lycorma delicatula* - A Potential New Invasive Pest Of Grapes And Fruit

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Keywords: *Lycorma delicatula*, SLF insecticide efficacy, SLF monitoring, pome fruit, stone fruit

Abstract: A new invasive insect species, spotted lanternfly (SLF), *Lycorma delicatula* (White), (Hemiptera: Fulgoridae) was discovered in Pennsylvania, USA in September 2014. During the summer 2018 and 2019 multiple research projects were initiated to understand the available management and monitoring options for this insect. Residual and direct contact insecticide bioassays revealed good efficacy of compounds from various IRAC groups such as neonicotinoids, pyrethroids, carbamates and organo-phosphates. SLF nymphs were also affected by products approved for organic production such as natural pyrethrum and mineral oils. Complete mortality of eggs was observed after treatment of overwintering egg masses with chlorpyrifos while partial mortality was observed after treatments with dormant oils, flupyradifurone and dinotefuran. To better understand the movement and behavior of SLF adults and nymphs two commercially available SLF monitoring lures were also tested in field setting inside vineyards, orchards and in woods. Unfortunately, when lures were combined with clear sticky traps, pyramid traps or placed with insecticide treated nets none of the tested lure x trap combinations was attractive to nymphs or adults SLF. Additional studies are planned to better understand the potential impact of this new invasive insect species on fruit orchards and vineyards.

No Crystal Balls! Predicting The Establishment Risk Of New Invasive Pests In The Pacific Northwest

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Keywords: spotted lanternfly, ecological niche model, MAXENT, tree-of-heaven

Abstract: New invasive pests are expected to spread and persist globally. While the brown marmorated stink bug has been detected in some parts of Washington State, the establishment risk of new invasive pests such as blueberry maggot and spotted lanternfly in western United States (U.S.) has not been assessed. The spotted lanternfly is an invasive pest in the eastern U.S. that could threaten economically important tree fruits in other parts of the U.S., including in the Pacific Northwest. Here, we used the MAXENT ecological niche model and determined whether the spotted lanternfly could establish in the western U.S. if introduced there. Results indicated that if introduced, it can establish in most fruit-growing regions of the Pacific Northwest. Spotted lanternfly suitable habitats are found in both Washington and Oregon States. In addition, forecast maps indicated that the distribution of the pest is closely aligned with that of the tree-of-heaven, an invasive tree species and the pest's major host. Proactive measures including control of tree-of-heaven are needed to prevent the introduction of the pest into the Pacific Northwest.

Relationship Between Fruit Development And The Risk Of SWD Infestation

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Keywords: Spotted wing drosophila, *Drosophila suzukii*, degree day, color, puncture pressure

Abstract: For tart cherries, a crop that has a legally mandated zero tolerance for infestation of harvested fruit, spotted wing drosophila (SWD) has become the number one pest management challenge. Growers have adopted a conservative approach to controlling SWD that has resulted in an additional four insecticide sprays on average each season since 2015. Currently we hypothesize that some of these sprays may be unnecessary in a given season, but without a more precise means of predicting infestation risk, growers must protect the crop and have no other option but to err on the side of caution. Our MSU team has been working to provide tart cherry growers with a model that will help them determine when periods of high vs. low risk are occurring given the conditions of a particular season. During the 2018 and 2019 field seasons, we conducted studies with the aim of quantifying the relationship between fruit development and the risk of SWD infestation. Tart cherries were collected from a Montmorency orchard at the Northwest Michigan Horticultural Research Center (NWMHRC), Traverse City, MI. Samples of at least 600 fruit were collected every 2-3 days starting after pit hardening and continuing through harvest. Fruit were brought back to the laboratory where the following fruit characteristics were measured on a portion of the collected fruit: firmness, penetration force, fruit weight, brix and color. Another subsample of fruit was used in no-choice bioassays to assess the potential for infestation by SWD. Infestation was highly correlated with the increasing ratio of R to G on the RGB color scale and with the decreasing force required to penetrate the fruit skin as fruit matured. Furthermore, we were able to development a fruit development model that predicts the risk of SWD infestation. Based on the model, fruit are susceptible to infestation beginning at about 530 accumulated Growing Degree Days (base 4°C) from full bloom. Risk remains low for another 120 Growing Degree Days, at which point the risk of infestation is high if SWD is present and environmental conditions are favorable.

Drosophila Suzukii Daily Dispersal Between Distinctly Different Habitats

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Keywords:

Abstract: *Drosophila suzukii* (Matsumura) (Diptera: Drosophilidae) is an insect pest originating in South-East Asia that has invaded Europe (EU) and the Americas. This insect has caused extensive economic damage to the soft fruit industry in all countries to which it has spread. *Drosophila suzukii* population management relies primarily on chemical pesticides, an approach with serious drawbacks including the

risk of residues on fruit and development of insecticide resistance. *Drosophila suzukii* dispersal from surrounding vegetation is believed to significantly increase the risk of crop damage. Despite increasing evidence that environmental configuration and composition strongly affect *D. suzukii* population levels and activity, the effects of landscape and abiotic factors including temperature and humidity on its movement is still poorly understood. For this reason, during the summer of 2017, we employed a mark-capture strategy using protein markers during middle July and early August. Within the experimental setup, flies were captured in food-baited traps, and later analyzed for the presence of the marker through an ELISA procedure. Our data suggest that more suitable temperature, humidity, and a diverse suite of alternative hosts found in the surrounding forest vegetation likely drove the recorded dispersion. Most of the captured *D. suzukii* marked within the crop were collected in surrounding forest vegetation within 24 hours of the marking event during each of the periods of collection. Results strongly indicated how humidity, temperature and alternative hosts are key drivers of *D. suzukii* populations in different habitats.

Integrated And Novel Management Strategies For *Drosophila Suzukii*

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Keywords: Seasonal Biology, Modeling, Cultural and Chemical control, Integrated Pest Management

Abstract: Spotted-wing drosophila, *Drosophila suzukii*, is a worldwide pest of soft-skinned, stone and small-fruit. This species is able to utilize different habitats and substrates for both nutrition and reproduction. This capacity can be attributed to a significant capacity for adaption, a topic of multiple investigations. Here we will discuss seasonal biology, overwintering survival strategies, the use of population models, cultural, behavioral and chemical management options within the context of a whole-production management system. Practitioners affected by this insect are currently largely dependent on agrochemicals in order to maximize yields and maintain quality standards. In some cases, these crops have agrochemical input costs that are 61 times higher than non-specialty crops, in part because of this damaging insect. *D. suzukii* management costs can comprise up to 1/6th of the production costs of fruit production. These inputs however result not only on economic costs. Additional costs include those to the environment, pesticide resistance, and secondary pest outbreaks. The introduction of new control strategies including agrochemicals can be slow and corporate consolidations have reduced the number of organizations investing in R&D, which negatively affects the availability of novel control strategies. The goal of this talk is to provide a perspective of how season-long coordinated, novel, and conventional management strategies can result in significant savings to practitioners.

Chemical Control/New Products—

Moderator: Louie Nottingham (WSU)

Efficacy Of Plant Host Defense And Signaling Compounds In Preventing Ambrosia Beetle Infestations In Apple Trees

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Keywords: black stem borer, *Xylosandrus germanus*, apples, trunk sprays, methyl salicylate, verbenone

Abstract: The ambrosia beetle *Xylosandrus germanus* has been documented as causing tree death and decline in dozens of NY apple orchards since 2013, mostly in young dwarf apple plantings. Preventive trunk sprays using chlorpyrifos or pyrethroids have not provided acceptable levels of control, nor have topical applications of the repellent verbenone, a component of an anti-aggregation pheromone produced by various species of bark beetles that has been found to repel this and related species of scolytines from traps and attractive host trees. In 2019, we tested trunk applications of different repellents for *X. germanus* control in potted apple trees, waterlogged to stress them to produce ethanol, and placed inside wooded areas directly adjacent to orchard sites. The preventive treatments, applied on 15 May, included different topical formulations of methyl salicylate (a host defense and signaling compound), alone and combined with verbenone. The methyl salicylate+verbenone combination product was applied at one of two timings, either 15 May (start of the 1st flight) or 12 June (start of the 2nd flight), to assess its usefulness later in the season. Additional treatments were the Systemic Acquired Resistance (SAR) activator products Actigard, Regalia, and a formulation of Salicylic Acid; the insecticide Lorsban (chlorpyrifos) was used as a grower standard comparison. The three SAR treatments were applied twice more, at 4-week intervals: 12 June and 9 July; this 3-spray regimen was used in an attempt to maximize their potential effect over the part of the season when the majority of the infestations were assumed to occur. Trunk and tree damage was assessed among the different treatments in early July and at the start of September, to determine what effect these repellents had in preventing attacks by this ambrosia beetle. On the Sept evaluation date, the treatments with the fewest infestation sites (holes) were the early application of verbenone+methyl salicylate, and verbenone. The fewest number of galleries containing adults was seen in the verbenone+methyl salicylate combination treatments (both timings), as well as in the Untreated Checks. Brood numbers were uniformly low in all the treatments this season. The only treatment to break out statistically was the Salicylic acid, but only on the July evaluation date. The fewest numbers of empty or aborted galleries were found in the combination verbenone+ methyl salicylate early treatment, on both evaluation dates. In general, of all the treatments, the early verbenone+methyl salicylate application showed the most uniform trend of the lowest infestation characteristics on both evaluation dates. Among the SAR treatments, Actigard tended to show marginally greater effectiveness than Regalia, and the Salicylic acid had the least.

Repellents To Manage Pear Psylla: What We Know And Where We're Going.

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Keywords: repellents, pear psylla, Surround

Abstract: Managing pear psylla requires a delicate balance of active management without disrupting natural enemies, i.e. a "soft program". For over a decade, kaolin clay (Surround) has become an important tool for soft psylla programs in the PNW. Kaolin is a non-insecticidal sprayable powder (particle film) that deters adult psylla from invading orchards and reduces oviposition from adults that are already present. Kaolin residues are long lasting on trees, which is beneficial for psylla control but can be problematic if found on fruit during packing. Due to this concern, other less persistent particle films are being used for summer psylla control, including diatomaceous earth and calcium carbonate. In this project we compared these three particle films for effects on psylla, residue decay on bark and leaves, effects on natural enemies and persistence on fruit. Our findings offer a better understanding for how to use particle films for psylla management throughout the pear growing season.

Erythritol: Good For Your Waistline, Bad For Pear Psylla

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Keywords: pear psylla, *Cacopsylla pyricola*, pear, erythritol

Abstract: Erythritol is a sugar alcohol sweetener commonly used as an FDA-approved alternative to dietary sucrose. Although erythritol is safe for human consumption, it is toxic to fruit flies. Laboratory and field experiments were conducted to determine if erythritol is also toxic to pear psylla, a key insect pest of pear. Ingestion of erythritol from liquid diets killed pear psylla nymphs and adults in a dose-dependent manner, with >90% of psylla killed within 3 days after feeding on 20-30% (w/v) solutions. Erythritol also killed pear psylla when applied topically to leaves in both laboratory and field trials, but only when erythritol was first heat-dissolved into solution. Results of these studies demonstrated that erythritol could be developed into a new safe tool for psylla control.

Optimized Chemical Control Strategies For *Drosophila suzukii* Matsumura (Diptera:Drosophilida) Immature Life Stages And Population Modeling

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Keywords: SWD, insecticide, blueberry, blackberry, raspberry, cherry

Abstract: *Drosophila suzukii* is one of the invasive pests that can infest multiple hosts i.e. strawberry, blueberry, cherry, blackberry, and raspberry. Life cycle of *D. suzukii* is relatively short which makes it reasonably difficult in order to control the population levels down to prevent fruit infestation. Insecticide applications are one of the major control methods to reduce the *D. suzukii* adult population under control. However, less is known about insecticide effects on immature life stages i.e. eggs and larvae and their impact on whole population level. Insecticides were applied at field recommended rates on cherries and different variety blueberries i.e. highbush, lowbush, and rabbiteye in the laboratory to evaluate egg, first, second and third instar larvae mortality. Spinetoram, cyantraniliprole, malathion, methomyl, spinosad and phosmet resulted in relatively high mortality of all immature life stages. Zeta-cypermethrin, cyclaniliprole, and fenpropathrin applications resulted in lower mortality of egg and all larval instars. In addition, malathion was tested on lowbush blueberries with different fruit sizes (large, medium, and small) in the laboratory and no statistical difference found in mortality rates depending on fruit sizes. Semi-field experiments on raspberries showed no statistical difference in mortality with acetamiprid and spinetoram compared to the control in all life stages. Mortality data from the laboratory experiments were combined to create a refined *D. suzukii* population model. The model simulations revealed that the timing and order of different insecticide classes are highly important to control *D.suzukii* population levels. Model simulations included early applications of more effective insecticides resulted in high immature mortality and greater individual reductions of *D. suzukii* compared to treatments where the insecticides were less effective.

30 Years Of Successful Use Of Codling Moth Granulovirus – Progress And Challenges

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Keywords: CpGV, codling moth, virus, resistance

Abstract: *Cydia pomonella* granulovirus (CpGV) is indispensable for an efficient control of codling moth (*Cydia pomonella* L.) in organic pome fruit production. In addition, it is an important and environmentally friendly tool in integrated production systems. Since its first registration in 1989 in Switzerland, CpGV products have been registered in nearly all apple growing countries worldwide where codling moth is a major pest. After the first CpGV isolate was found in Mexico in 1964 and then successfully developed as pest control agent, novel CpGV isolates with different virulence patterns have been identified. By molecular means, CpGV can be distinguished in seven phylogenetic lineages, termed group A-G, providing

a considerable natural genetic diversity. During the last decade more than 50, mainly organic apple plantations with codling moth populations showing low susceptibility to commercial CpGV products have been identified in different European countries. By genetic analyses and susceptibility testing three different types of resistance (type I-III) were revealed; they differ in the mode of inheritance as well as in the resistance mechanism. By exploiting the genetic diversity of CpGV and registering novel isolates as plant protection agents, it was possible to overcome resistance and to provide growers efficient tools in their continuing efforts to control codling moth. Today, the combination of different methods of codling moth control, such as hygiene measures, CpGV sprays, pheromone mating disruption, application of entomopathogenic nematodes are state-of-the art in organic pome production in Europe. The presentation will review previous and current research and developments to optimize application of CpGV.

Susceptibility of Washington codling moth to CpGv

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Keywords: codling moth, virus, resistance

Abstract: *Cydia pomonella* granulovirus (CpGv) is used worldwide for control of codling moth. It was initially isolated from larvae in Mexico and as an organically approved option, it became an important component of both conventional and organic apple production globally. In Europe up to 10,000-fold resistance to CpGV was observed in field populations. Three types of resistance are present in European populations and susceptibility depends on CpGv isolate and resistance type. In North America, CpGv is a critical component of management programs. However, management failures have been occurring. To identify if US populations have developed resistance to CpGv, we evaluated populations from Washington state with a history of virus use. Overwintering *C. pomonella* larvae were collected from organic orchards in Washington state with high population pressure. First and third generation laboratory-reared larvae were evaluated against the discriminating dose of CpGv-M as a baseline for virus resistance testing. Results were verified through identification of the 24-bp repeat in the CpGv pe38 gene. Select populations were assayed against additional CpGv isolates.

Control Of Codling Moth In Walnuts

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University of California, Dept. of ESPM, Berkeley, CA

Keywords: Codling moth, *Cydia pomonella* L., Altacor 35WG, Agrimek 0.70SC, Intrepid Edge, Intrepid 2F, Delegate 25WG

Abstract: A field study was conducted in a walnut orchard near Tracy, CA to evaluate the efficacy of two experimental treatment regimes compared to a grower standard treatment regime and an untreated check for the control of codling moth (CM). The experimental treatment regimes were: 1) Altacor 35WG for the first CM generation fb Intrepid Edge for the second-generation fb Altacor 35WG for the third generation and 2) Intrepid Edge for the first CM generation fb Altacor 35WG for the second-generation fb Intrepid Edge for the third generation. The grower standard treatment regime was Altacor 35WG for the first CM generation fb Delegate 25WG for the second-generation fb Altacor 35WG for the third generation. These treatments were replicated four times in a randomized complete block design with each replicate being an individual tree. Insecticides were applied with a hand-held orchard sprayer operating at 250 psi with a finished spray volume of approximately 250 gal/ace. Degree-day timings were used to determine application dates. Adult CM were monitored weekly from 22 March to 13 September with two pheromone traps. CM infested dropped nuts were monitored weekly from 22 May to 19 June. At commercial harvest on 21 September, 125 nuts per replicate (500 nuts per treatment) were collected and inspected for CM infestation. The experimental treatment regimes and the grower standard had a significantly lower total CM infestation compared to the untreated check. Treatment regime No. 1 had significantly lower total CM infestation compared to treatment regime No. 2 and the grower standard.

Control Of Navel Orangeworm In Almonds

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Keywords: Navel orangeworm, *Amyelois transitella*, Brigade 2EC, Altacor 35WG, KFD-247, Intrepid Edge, Intrepid 2F

Abstract: A study was conducted in an almond orchard near Manteca, CA to evaluate the efficacy of Brigade 2EC, Intrepid 2F, Altacor 35WG, KFD-247 and Intrepid Edge for the control navel orangeworm (NOW). Treatments were replicated four times in a randomized complete block design with each replicate being an individual tree. Treatments were applied with a hand-held orchard sprayer operating at 200 psi with a finished spray volume of approximately 150 gal/acre. Treatments were applied on 10 July at the beginning of husk split (5% or less) on the outside row and on 16 July to the inside row. At this time eggs were present on NOW egg traps and moths were captured in pheromone traps. A second treatment was applied on 23 July to the outside row and 30 July to the inside row. The outside row started split about 7 days before the inside row and replicates 1 and 2 were located on the outside row and replicates 3 and 4 were located on the inside row. The NOW population was monitored with egg and pheromone traps placed in the orchard on 13 June and monitored weekly. Eggs traps were monitored until 16 July while the pheromone traps were monitored until 5 September. At commercial harvest on 10 September, 250 nuts per replicate (1000 nuts per treatment) were collected and inspected for NOW infestation. All

treatments except for Altacor 35WG resulted in significantly lower percent total NOW infestation compared to the untreated check with Intrepid Edge resulting in the numerically lowest infestation.

Control Of Vine Mealybug In Grapes

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Keywords: Vine Mealybug, *Planococcus ficus*, Admire Pro, Sivanto HL, Movento 2SC, Lorsban Advanced, Sequoia

Abstract: A field study was conducted in a vineyard near Manteca, CA to evaluate the efficacy of several treatment regimes for control of vine mealybug (VMB). Treatments included post-harvest (2018) and delayed dormant applications of Lorsban Advanced fb Movento 2SC fb Sequoia, post-harvest and delayed dormant applications of Sequoia fb Movento 2SC fb Sequoia, and an application of Movento fb Sequoia. An additional four treatments included different combinations of Sivanto HL (High Level), Admire Pro and Movento 2SC. All 7 treatments were compared against an untreated check. Treatments were replicated four times in a randomized complete block design and each replicate was three vines long. Chemicals were applied with a hand-held orchard sprayer operating at 200 psi with a finished spray volume of 150 gal/acre. Application dates were based on grape phenology. VMB infestation was monitored by 1 min timed searches every 2-3 weeks from mid-May to the end of July. At commercial harvest on 5 September, 25 grape clusters per replicate (100 per treatment) were collected and inspected for the presence of VMB. Those fruit clusters with mealybugs present were listed as unmarketable. All treatments had a numerically lower percentage of unmarketable clusters than the untreated control. The post-harvest and delayed dormant applications of Lorsban Advanced fb Movento fb Sequoia treatment, the post-harvest and delayed dormant applications of the Sequoia fb Movento 2SC fb Sequoia treatment, and the Movento 2SC fb Sequoia treatments had significantly fewer unmarketable clusters than both Movento 2SC alone and the untreated check.

Biology/Phenology—

Moderator: Houston Wilson (UC Riverside)

Volatilized Fatty Acids To Determine Natal Hosts Of Spotted Wing Drosophila And Filbertworm

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Keywords: filbertworm, *Cydia latiferreana*, spotted wing drosophila, *Drosophila suzukii*, lipid, tagging, host association

Abstract: The hosts of filbertworm *Cydia latiferreana* Walsingham (Lepidoptera: Tortricidae) were oaks and California hazelnut (*Corlyus cornuta ssp*. Californica (A. DC.)) Sharp until the introduction of the European hazelnut (*Corylus avellana* L.) to the Pacific Northwest as a crop in the mid 1800's. Since then, this native moth has been the primary pest of European hazelnuts grown in the Pacific Northwest. Spotted wing drosophila *Drosophila suzukii* (Matsumura) (Diptera: Drosophilidae) is an exotic Asian fruit fly that appeared in Oregon around 2009. D. suzukii can be devastating in soft fruit crops including cherries, blueberries, caneberries and strawberries. Alternate hosts of both pests provide refugia that pests can use for development and survival and may interact with populations that infest farms, confounding management efforts. Understanding alternate host dynamics and movement of key pests such as *C. latiferreana* and *D. suzukii* between hosts is critical to optimize pest control. For insects that primarily acquire lipids in the larval stage, volatilized fatty acid profiles of the adult stage offer a methodology for determining the natal host and movement patterns. The technique has several advantages over other techniques that are used to mark insects and determine their movement. Studies performed on Navel orangeworm *Amyelois transitella* (Walker) (Lepidoptera: Pyralidae) in California pioneered this method to evaluate movement of moths between different nut crops, and can accurately identify natal hosts. We conducted lipid analyses on *C. latiferreana* and *D. suzukii* that were raised on various diets and found that we can discriminate the host based on fatty acid profiles with a high level of confidence. These results and next steps for application of the technique to answer critical questions for pest management will be discussed.

Gut-Content Analysis To Determine Previous Host Plants Of Leaffooted Bug (*Leptoglossus zonatus*) Infesting California Orchards

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Keywords: western leaffooted bug, *Leptoglossus zonatus*, tree crops, landscape ecology, molecular techniques, gut content analysis

Abstract: Leaffooted bugs (LFB, *Leptoglossus spp*.) are phytophagous insects known to feed on a wide array of weeds and crops across California. In the San Joaquin Valley LFB are recognized as a common pest of more than 20 crops and is especially problematic in several orchard crops such as almonds, pistachios, and pomegranate. LFB enter the orchard during early in fruit development, and feed on the fruits directly. Feeding at this stage results in blemishing and shriveling of the harvested product; a major issue for fresh market produce. The greatest challenge in management is predicting LFB's initial infestation. LFB first enter the orchards in the late spring, migrating from unknown overwintering host(s). Identifying LFB's overwintering host(s) would allow pest control professionals and growers to monitor overwintering populations and provide essential data for predicting infestation dates. Here we describe the design and implementation of a DNA gut content analysis for LFB. Gut content analysis involves sequencing barcode genes from the plant DNA found in the guts of captured LFB. By doing so, we can retroactively identify the insect's previous hosts. This includes proof-of-concept experiments that establish protocols for LFB dissection, gut content isolation, DNA extraction, and amplification of the barcode trn-F intergenic spacer region. Initial results suggest that gut content analysis is a viable tool for the identification of overwintering host plants. Preliminary data has shown that the established protocol successfully isolated LFB diet and can be verified via Sanger Sequencing. Further trials are being conducted on wild specimens to isolate unknown hosts which are verified with Next Generation Sequencing.

Behavior Differences Of Codling Moth Against *Cydia pomonella* Granulovirus (CpGV)

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Keywords: codling moth, behavior differences, less susceptible, CpGV

Abstract: Codling moth (CM, *Cydia pomonella*, L) is an important fruit pest in apple production, especially in organic orchard. *Cydia pomonella* granulovirus (CpGV) is an effective and environment friendly bioinsecticide to manage CM population under the economic threshold. When CM becomes less susceptible against CpGV, the different behavior patterns were displayed, which was investigated in this study. Droplet feeding method was applied to determine the preference of susceptible and less-susceptible CM strains to CpGV. Five to ten neonates were exposed to CpGV and water for choice test in petri dish. Blue and red Food coloring were added into droplets to distinguish whether CM neonates take CpGV, water or nothing. Susceptible and less-susceptible CM neonates show different responses to not only CpGV but also different colors. This result provides a new path to understand why CM become less susceptible on the basis of different behaviors. CM preferable color may be applied to attract CM neonates more efficiently before it bore into apple, resulting in control CM before it causes damages.

Using Transcriptomics To Target Key Behaviors Of Pear Psylla

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Keywords: pear psylla, *Cacopsylla pyri*, phenological traits, behavior, gene expression

Abstract: Pear psylla occurs as two seasonal morphotypes - summerform and winterform - that differ in behaviors and biological traits including diapause, plant attraction, susceptibility to insecticides, and association with bacterial endosymbionts and plant pathogens. Initial results demonstrate variable gene expression among summerform, diapausing winterform, and post-diapause winterform pear psylla, and results are consistent with observed differences among the populations in behavior and biology. The top 50 highest expressed genes from each population were identified and compared to sequences deposited in the NCBI database. Genes were then categorized based on their putative function (immunity, muscle, photoreception, vitellogenin, or other biological processes) and origin (ribosome, mitochondria, Arsenophonus or Carsonella), or were designated as unknown. Although changes in behaviors and phenotypes associated with summerform, diapausing winterform, and post-diapause winterform psylla are well-documented, the timing for these behavioral changes and mechanisms controlling behaviors are not currently understood. The results of our studies will allow us to pinpoint the exact timing for these changes and will contribute to our long-term goal of providing a better understanding of winterform biology and improve management of this bottlenecked population.

Biology And Management Of The Pacific Flatheaded Borer In Hazelnuts

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Keywords: pacific flatheaded borer, *Chrysobothris mali*, hazelnuts, damage, phenology, insecticides

Abstract: The continued shift in the hazelnut industry from eastern filbert blight-susceptible orchards to new resistant varieties has resulted in the planting of thousands of new acres, providing an opportunity for the Pacific Flatheaded Borer (PFB, *Chrysobothris mali*, Coleptera: Buprestidae) to cause major problems to these new plantings. Recent dry, hot summers, suboptimal planting sites, and poor management have contributed to the problem. The literature suggests that PFB, like other flatheaded borers, are attracted to the stress signals emitted by establishing and struggling young trees. Female borers find vulnerabilities in the bark to lay their eggs. Larvae hatch, burrow into the tree, and feed on the cambium layer leading to girdling and loss of transpiration, and ultimately cause dieback or death of the tree. Trees that survive initial borer attacks can be severely weakened and risk future trunk failure due to wind or nut load. Inadequate knowledge of PFB has resulted in devastating crop losses for some growers. Cultural practices that reduce tree stress can be preventative measures against PFB, however, many new plantings are treated with insecticides. The timing of insecticide applications is integral to their efficacy. From 2017 to 2019 we've followed PFB phenology to create an emergence curve and have implemented multiple chemical and plant protection trials to test their efficacy against PFB.

Biology And Morphometrics Of The Pacific Flatheaded Borer

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Keywords: Pacific flatheaded borer, Buprestidae, *Chrysobothris mali*, phenology model

Abstract: *Chrysobothris mali* Horn, (Coleoptera: Buprestidae) also known as the Pacific flatheaded borer, is native to the Pacific Northwest, and is particularly attracted to stressed young trees. Although considered a generalist, recently there has been an increase in reports of hazelnuts being attacked, which is due partly to a rapid rise in new acreage, and a shift towards hotter, drier summers. Cultural control tactics such as providing adequate water and avoiding damage (e.g. sunburn, chemical, mechanical) to the trunk are the first line of defense in preventing damage, but in some high pressure situations, or when it is difficult to maintain tree health, it may be necessary to apply chemical control. As with any pest, it is important to understand its biology to prevent infestation. Over the past three years we have worked to develop a phenology model by keeping infested wood in field cages, and then observing development and later adult emergence. Being able to predict beetle flight will help growers time spray applications to target beetles when they are most vulnerable, and therefore optimize efficacy. We have also collected data on adult flight under ambient conditions in the field cages to obtain a better understanding of their ability to fly under a variety of conditions that they would experience during the summer. Finally, we measured the size of adult emergence holes in relation to tree caliper to see if there is a correlation between tree and beetle size.

Temperature Effects On Oviposition By Cherry Fruit Fly In Different Stages Of Sweet Cherry

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Keywords: *Rhagoletis indifferens*, sweet cherry, oviposition

Abstract: Fruit developmental stage and temperature affect oviposition by tephritid fruit flies, but their individual effects at different levels of the other have not been studied. Here, the hypothesis that temperature effects on oviposition rates by western cherry fruit fly vary in different developmental stages of 'Bing' sweet cherry was tested. Different oviposition patterns across cherry stages were detected and were probably caused by the degree of acceptability of the stages. Findings suggest complex relationships could exist between temperature, sweet cherry stage, and oviposition by flies in nature, and that these might result in dynamic daily or seasonal oviposition patterns in cherries.

Mating Disruption/SIR—

Moderator: Chris Adams (OSU)

Ovipositional Cues For Filbertworm: The Search Begins

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Keywords: Filbertworm, *Cydia latiferreana*, hazelnuts, oviposition, mating, volatile organic compounds

Abstract: Filbertworm (*Cydia latiferreana*) is a key pest of hazelnuts for which control with mating disruption has recently become a commercially available option. Results with commercial use of filbertworm (FBW) mating disruption have been variable. As such, our interests have turned to identifying plant-derived volatile organic compounds that serve as mating and ovipositional cues for filbertworm. Such compounds could be used to enhance monitoring of FBW in mating disrupted orchards and could potentially be used to enhance mating disruption itself. We performed volatile extractions from three varieties of hazelnuts (*Corylus avellana*) and an alternative host, Oregon white oak (*Quercus garryana*). Using adsorbent sampling, we collected volatiles from both leaves and nut clusters during July and August (when nuts were maturing) and again in October (when nuts were mature). We characterized the extractions using atmospheric pressure chemical ionization – mass spectrometry (APCI-MS). Here we present preliminary results from these analyses as well as the behavioral response of adult FBW to the host plant volatiles in flight tunnels.

Practical Aspects Of Mating Disruption For Navel Orangeworm

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Keywords: navel orangeworm, *Amyelois transitella*, almond, pistachio, mating disruption

Abstract: Mating disruption is used to help manage the navel orangeworm on up to 500,000 of tree nut crops. Aerosol dispensers are the most common formulation, and all formulations use an incomplete pheromone blend consisting solely of (Z11, Z13)-hexadecadienal. Profile analysis (examination of capture and males in pheromone traps as a function of spatial density of dispensers) demonstrated a sharp drop of males captured with a very low density of dispensers, and then an approximately linear relationship between 90 and approaching 100% suppression This near-linear portion of the profile includes both dispenser densities in which crop protection has been demonstrated, and densities in which it is unlikely. Suppression of males in pheromone traps was lost the next night after dispensers were removed, suggesting that the active ingredient was not persistent in the orchard environment. For most of the summer pre-harvest period turning the dispensers off either one or two hours before the end of the pre-dawn period of sexual activity provides the same amount of suppression of sexual communication as emission throughout the period of sexual activity; suggesting that encountering the pheromone from the mating disruption dispensers had a persistent effect on males. During the autumn postharvest period, only emission prior to midnight suppressed communication on nights on which the temperature fell below 19°C (66°F) by midnight. Together, these observations are consistent with a noncompetitive or hybrid mechanism of mating disruption, in which neurological effects are important. This suggests that mating disruption for the navel orangeworm using high-emission dispensers might be less density- dependent than some systems. Challenges include high dispersal capacity of mated females and rapid breakdown of the pheromone component used for mating disruption for this species.

Adapting SIR for Farm-Scale Application

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Keywords: Codling Moth, Sterile Insect Technique, Dispersion

Abstract: Codling moth (*Cydia pomonella*) is still the key apple pest that growers must control to produce marketable crops. There are several control options for CM, including insecticides, mating disruption, and virus. However, the efficacy of these tactics as stand-alone controls has diminished over time and managing this key pest has again become challenging. Currently, in conventional production, effective control is accomplished by 4-5 pesticide applications per season. Over time we have seen this pest develop resistance to a number of conventional pesticides, as well as the virus controls. Reducing overuse of these chemistries is key to preserving of our remaining pesticides. Sterile Insect Release (SIR) has been successfully used to control CM in British Columbia, where their rearing facility produces 1.5 million sterile moths per day. Over the last several years we have looked at ways to optimize this tool for use as part of an IPM program in Michigan. By investigating release patterns, release techniques (including drones), and total number of moths needed for effective control, we hope to find efficiencies in this technique that will make this tool an affordable part of an IPM strategy.

Sterile Insect Release For Codling Moth Control In Apples

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Keywords: codling moth, *Cydia pomonella*, sterile insect release, SIR, organic apple

Abstract: Sterile insect technique has been used since the 1950s to eradicate pests from a region. An area-wide project in Canada using sterile codling moth for moth control in apples has been operating for about 30 years with good success in suppression of codling moth. In Washington state, organic apple growers were experiencing higher than expected fruit damage. They wanted to find a solution that was non-insecticidal to avoid secondary pest outbreaks. In 2018, a program of sterile codling moth release began in organic apples in Okanogan County, WA. We used three treatments, the standard release rate of sterile moths, a high rate of moths, and a control where there are no moths released. Our recapture rate of sterile moths throughout the growing seasons did not mirror the release rates. Moth recapture rates varied throughout both seasons but in general, the recapture rates did not always correlate with the moth release rate. When three times the moths were released, three times the moths were not recaptured. In year one, we found a significant reduction in codling moth damage in blocks where we utilized sterile codling moths. In year two, the relationship was not as strong, but the mean overall codling moth damage was <0.75%.

Dispersion Of Sterile Codling Moths In The Apple Orchard

RT Curtiss and Larry Gut
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Keywords: Codling Moth, Sterile Insect Technique, Dispersion

Abstract: Releases of sterile codling moths have been conducted successfully in British Columbia for decades on an area-wide basis with the goal of achieving local eradication and area-wide suppression. These moths are now available for release on a farm-scale in the US, but much is unknown about how best to employ them when not part of an area-wide program. We are focused on studying on-farm dispersion of released moths to understand where and how to use sterile insects in this novel manner. Trials examining dispersion of sterile codling moths were conducted in 2018 and 2019. Several factors influence movement including the conditions at release and the characteristics of the orchard. We will be reporting data on the impact of release time, location, and altitude, and orchard topography, architecture, and physical structures.

Development Of Sterile Insect Technique For Navel Orangeworm: Field Trials

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Keywords: SIT, NOW, navel orangeworm

Abstract: The California pistachio and almond industries recently initiated a cooperative project with USDA APHIS-PPQ to develop and explore the use of sterile insect technology (SIT) for control of navel orangeworm (Pyralidae: *Amyelois transitella*) (NOW). NOW is arguably the most important pest of pistachio, almonds and walnuts in California, where these crops account for more than 1.9 million acres of production valued over $6 billion. This project leverages the ability of the USDA Pink Bollworm Rearing Facility (Phoenix, AZ) to mass-rear, irradiate and ship out upwards of 1 million NOW per day for release in California. Currently, a pilot program is evaluating the impacts of releasing irradiated NOW over approximately 2,000 acres of pistachios while associated USDA-ARS and UC scientists are conducting preliminary evaluations of moth quality and dispersal. Here, we report the results of multiple field trials carried out in 2018 and 2019 to evaluate the effects of irradiation and release mechanism on moth dispersal, recapture rate and reproductive competitiveness.

Minutes of the 93nd Annual Meeting

Orchard Pest & Disease Management Conference
Hilton Hotel, Portland, Oregon
January 9-11, 2019

I. Call to Order

The opening business meeting of the 93rd Annual OPDMC Meeting was called to order by Chair Art Agnello at 9:06 am (PST) on January 9, 2019. Chair Agnello welcomed approx. 200 attendees to the joint entomology and plant pathology session who presented 47 papers and posters. Chair Agnello asked for each attendee to make a brief self-introduction. Chair Agnello announced that this year was our first time to merge the insect and plant disease sessions and gave a warm welcome to our plant pathology colleagues. The sessions and moderators:

Mating Disruption/SIR	Alix Whitener
Implementation	Chris Adams
Thresholds/Monitoring	Houston Wilson
Biological Control	Jhalendra Rijal
Pathology/Diseases	Broc Zoller
Invasive Species	Rick Hilton
Chemical Control/New Products	Louie Nottingham
Biology/Phenology	Betsey Miller

II. Old Business

A. Approval of the 2018 Minutes: Secretary Alston announced that the 2018 minutes were posted on the OPDMC website and printed in the back of the abstract booklet. She asked for amendments. There were none. It was moved, seconded, and voted to approve the 2018 minutes.

B. Treasurer's Report: Treasurer Nik Wiman presented the 2018 Treasurer's Report. Treasurer Wiman reported that we were in arears on paying for website management and program/abstract development to WSU, and that we caught up this past year. Therefore, our balance carried forward will likely be less than $100 in the coming year.

Total Cash & PayPal Balance as of 1/1/2018	$4,401
Total Income	$19,980
Total Expenses	$23,890
Total Cash & PayPal Balance as of 12/2/2018	$491

There was a call for questions; there were none. It was moved, seconded, and voted to approve the 2018 treasurer's report.

Chair Agnello called for other old business. There was none.

III. New Business

A. Executive Director Peter McGhee made some general announcements: 1) the stage flooring is uneven, approach the podium with care; 2) let him know about any hotel issues; and 3) there will be no USDA ARS talks, including the keynote address, because of the U.S. government shutdown.

B. Committee Assignments:
   a. Nominations: Rebecca Schmidt-Jeffris (Chair), Charles Costlor, and Bob Van Steenwyk
   b. Audit: Betsy Beers (Chair), Rick Hilton, and Betsey Miller
   c. Resolutions: Robert Orpet (Chair), Alix Whitener, and Broc Zoller

C. Chair Agnello called for the names of any members that had passed away during the last year.
   a. Chuck Engles with UC Cooperative Extension, Sacramento, CA
   b. Doug Gubler with UC Davis, CA
   c. A moment of silence was given in their recognition

D. Chair Agnello provided conference announcements:
   a. Although there are missing presentations as our ARS colleagues are unable to be here, please keep your talk to about 15 min with time for Q&A.
   b. No keynote speaker due to the government shutdown. The mixer will begin at 5 pm this evening (Wed).
   c. No featured presentations.
   d. The poster session will be held during the coffee break on Thursday at 10:00 am.
   e. After the Pathology/Diseases session on Thursday there will be a brief discussion about member preferences for incorporating the pathology sessions into the general meeting sessions.
   f. Reminder about the Rubber Chicken and Golden Apple Awards.
   g. The Scholarship Committee should meet briefly near the podium at the start of the lunch break today (Wed) to receive their input on the recommended protocol going forward.

E. Melissa Tesche, Scholarship Committee Chair, gave the Scholarship Committee Report. Industry donations included Corteva, FMC, and SIR (Gold Level); Arysta Life Sciences (Silver Level). 2019 student scholarship recipients:
   a. Robert Orpet, Robert Curtiss, Adrian Marshall, Lauri Lutes, and James Hepler.
   b. The Scholarship Development Committee will hand off to the ongoing Scholarship Committee

F. Chair Agnello provided speaker instructions and called for any other new business. There was none.

Chair Agnello called for a motion to close the opening business meeting. It was moved, seconded, and voted to close the opening business meeting. Chair Agnello introduced the first session moderator, and the presentations commenced.

At the conclusion of the morning session, the Scholarship and Nominations Committee met to discuss development of the on-going Scholarship Committee. The following recommendations were stated:

I. -Single committee composed of representatives: 2 industry, 2 academic, 2 field consultants, and 1 student. The student member will engage in the scholarship plan and call for nominations, but not in the student selection process.
II. -Each member serves a 3-year term.
III. 2 of 6 members replaced annually to stagger member tenure.
IV. Student member replaced annually

IV. Closing Business Meeting

Exec Dir McGhee called the closing business meeting to order on January 11, 2019, at 10:49 am.

A. Old Business
    a. Representing Secretary Alston, Executive Director McGhee gave a summary report of discussions and decisions from the 2019 Board of Directors' meeting held on January 9 at noon:
        i. 213 registered members in 2019
        ii. Term limits for officers/board members - we discussed a 5-yr term with option for renewal
        iii. Review and revise bylaws to reflect current protocols
        iv. Develop and add a code of conduct for the organization to the bylaws and website
        v. Include a pathology member on the Board
        vi. Meeting duration will be 2.5 days in 2020
        vii. Exec Dir McGhee will renegotiate hotel contract for 2021-22; will reassess meeting duration at that time, but we currently fill the full 2.5 days with the program
    b. Treasurer Wiman presented the final treasurer's report. OPDMC is in a more favorable position than originally reported at the opening business meeting, estimating the bank balance after paying 2019 invoiced will be approximately $5k.

B. New Business
    a. Exec Dir McGhee called for any other new business.
    b. Larry Gut suggested that the Rubber Chicken Award might have lived its useful life, citing changing times and a desire to ensure that OPDMC remains a supportive and positive conference. It was moved and seconded that the Rubber Chicken be retired. Members discussed the motion, with many of the younger membership expressing support for keeping the award—with the belief that, with some friendly reminders, the nominations can and will be made good-spirits as originally intended. A vote was held, and the motion failed by a considerable margin, and so the Rubber Chicken lives.

C. Committee Reports:
    a. Scholarships: Melissa Tesche, Chair, gave a report on the creation of the Student Travel Scholarship. The committee was tasked with the goal of turning industry contributions into travel funds for student scholarship. A survey was created to solicit membership

input into the structure of the scholarship, and the results (39 responses) were used in the development of the Terms of Reference (ToR). The ToR are now available on the website, and OPDMC membership was encouraged to review and provide comment.

b. Nominations: Rebecca Schmidt-Jeffris, Chair, gave the report.
    i. Allison Walston was nominated as Chair-Elect for 2020
    ii. Secretary: There were two nominations for Secretary—Alix Whitener and Chris Adams. A vote was held, and Alix Whitener was elected as Secretary.
    iii. Treasurer: Nik Wiman's nomination was unopposed and he was acclaimed as Treasurer.
    iv. Program Chair: Betsy Beers nomination was unopposed, and she was acclaimed as Program Chair.
    v. Scholarships Committee: Alix Whitener was nominated as Scholarship Chair, along with nominations for academic representatives Tobin Northfield and Emily Symmes, industry representative Melissa Tesche, Field Consultant Representatives Teah Smith and Travis Schoenwald, and student representative Adrian Marshall.
    vi. Call for motions and vote to approve the nominations; all officers were voted in.
c. Audit: Betsy Beers, Chair, gave the report. The Audit Committee reviewed and accepted the financial report, and report that the OPDMC financial records are in good order. There was a motion, second and vote to approve the Audit Report.
d. Resolutions: Robert Orpet, Chair, gave the report. Jeanine Lowrimore and Tina Phelps were thanked for their service in covering the registration desk. Chris Sater was acknowledged for all of her meeting support (proceedings, maintaining OPDMC website, and arranging for pesticide credits). Bruce Greenfield was acknowledged for his annual support in transporting projection equipment, setting up meeting displays and poster boards, and for assisting with the registration desk. There was a motion, second and vote to accept the resolutions.

D. Executive Director McGhee called for nominations for the Rubber Chicken Award.
    a. Jim Hepler was nominated for having the largest frass pictures shown this year (and possibly ever)
    b. Rick Hilton was nominated for false advertising because he signed up for BMSB talk in the Invasive Species section of the conference, but then proceeded to spend half of his presentation talking about codling moth. Betsy Beers gave an impassioned "Vote for Hilton" speech, noting that he had not yet received the award and it would be a real shame if Rick was able to retire before finding himself on the receiving end of the chicken.
    c. Donald Trump was nominated for allowing a government shutdown that robbed us of our ARS colleagues and at least 7 presentations.

d. Nathan Moses-Gonzales was nominated for including 'epic' dance-club-techno music in his talk and then pretending it was an accident.
e. Tobin Northfield was nominated for not only punching the microphone in emphasis during his talk, but for starting the trend of emphatic microphone punches that followed.
f. Brock Zoller was nominated for using a color scheme so awful that is made Pete worry that the projectors had simultaneously gone on the fritz.
g. Executive Director McGhee asked the award nominees to leave the room and called for a vote on the Rubber Chicken Award. Rick Hilton won in what can only be describes as a landslide victory. He graciously accepted his fowl award.

E. Executive Director McGhee called for nominations for the Golden Apple Award.
   c. Nathan Moses Gonzales was nominated for the award, as well as Best Soundtrack, Best Producer, and Best Steve Jobs impression for his techno-talk.
   d. Tianna DuPont was nominated for giving excellent talks in both the pathology and the entomology sections of the meetings.
   e. Erica Rudloph was nominated for her great presentation and her poise as an undergraduate inform of a large and occasionally intimidating bunch.
   f. Executive Director McGhee asked the award nominees to leave the room and called for a vote on the Golden Apple Award. Tianna DuPont won the award and graciously accepted.

F. Exec Dir McGhee thanked all of the session leaders, Chris Sater, Bruce Greenfield, registration desk volunteers, and all of the executive committee members for making the conference run smoothly.

G. Exec Dir McGhee announced next year's meeting dates: January 8-10, 2020 at the Downtown Hilton, Portland.

H. Executive Director McGhee asked Betsy Miller to accept the gavel on behalf of Chair-Elect Cooper, and Betsy closed the meeting with the pounding of the gavel at 11:57 AM (Incoming Chair Rodney Cooper was able to attend the 2019 meeting due to the government shutdown).

Respectfully submitted,
Diane Alston, Secretary
Orchard Pest and Disease Management Conference, January 9-11, 2019

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Board Member Signatures

Peter McGhee, Executive Director — Date: 1/9/19

Arthur Agnello, Chairperson — Date: 1/9/19

Harvey Yoshida, Past Chairperson — Date: 1-9-19

Rodney Cooper, Chairperson Elect — Date: not present government shut-down

Elizabeth Beers, Program Chair — Date: 1/9/19

Nik Wiman, Treasurer — Date: 1/9/19

Diane Alston, Secretary — Date: 1/9/19

The Rubber Chicken Award

An enduring tradition of informality is the nomination, voting, and awarding of the Rubber Chicken to one of the presenter during the closing business meeting. The Rubber Chicken may be awarded for a variety of reasons, but egregious behavior in some aspect of presenting a scientific talk is the underlying theme: too long, too short, poor organization, illegible slides, and over-spinning research results are frequently cited.

Notables who have received the award include:

- **Clancy Davis**, Berkeley, California for his quiet, sober, professional demeanor on all occasions.
- **Stan Hoyt**, Wenatchee, Washington for failing to enliven methods of presentation of papers.
- **Don Berry**, Medford, Oregon for never having made a single comment over 20 years.
- **Pete Westigard**, Medford, Oregon for returning from a sabbatical with 400 color slides (all failures) and a new child (a success).

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

- **Doug Light (2003)**, USDA, Albany, California, for showing incomprehensible data slides again and again and again. (Chemists…)
- **Stephen Welter (2004)**, University of California, Berkeley, for inappropriate behavior by leaving the meeting prior to giving his presentation.
- **Bob Van Steenwyk (2005)**, University of California, Berkeley; Bob suffered at the hands of technology and he could have been forgiven for these technical glitches; however, the membership was in a surly mood after the prolonged business meeting. Bob graciously accepted the award.
- **Alan Knight (2006)**, USDA-ARS, Wapato, Washington, for not submitting a talk.
- **Andy Kahn (2007)**, Wenatchee, Washington, for giving a much too long presentation and refusing to yield the podium - Andy subsequently decapitated our alopeciate friend.
- **Jim Miller (2008)**, Michigan State University, for attempting to coerce the entire membership into his cult of the pheromone, and for admitting to having intimate relations with codling moths; Jim was responsible for the demise of yet another unfeathered friend.
- **Peter Shearer (2009)**, Oregon State University, Hood River, for forgetting, like Dorothy, that he was not in Rutgers anymore (For those of you not present, he gave his talk as the new director of the Hood River Station MACAREC, using the Rutgers template).

- **Harvey Reissig (2010)**, Cornell University, Geneva, for his presentation that introduced a new web based IPM decision support system for NY apple growers that was actually a chemical spray calendar disguised as an IPM program (well played, Harvey, well played…).
- **John Dunley (2011)**, Wilbur-Ellis, Cashmere, Washington, for not being present each morning to turn on the lights, the projector, and the laptop computer before the meeting began. He also assumed that at least one of the many well-educated members of the Conference (ahem, Broc Zoller), most of whom were lugging their own laptops, would be able to find the correct button to turn on the conference laptop, and that labels on the two (!) cords would make the connections between the laptop and projector clear. He was proven to be incorrect.
- **Larry Gut (2012)**, Michigan State University, for now conducting research on pheromone puffers (and finding them effective) after 'pooh-poohing' them for many years.
- **Don Thomson (2013)**, DJS Consulting Services, for delivering the keynote speaker's address in his introduction of Camille before she had a chance to deliver her own presentation. Also, Don temporarily lost the rubber chicken in the foyer, but he did later recover it.
- **Doug Light (2014)**, USDA ARS, Albany, California, for blatantly promoting his own product during his presentation.
- **Brad Higbee (2015)**, Paramount Farms, CA, for delivering an extended talk under false pretenses, breaking the new OPDMC computer, and bragging about his 40-acre research plots.
- **Betsy Beers (2016)**, Washington State University, Wenatchee, for the incompatibility of the slideshows presented by herself and her students despite the fact that she keeps the meeting computer.
- **Lisa Neven (2017)**, USDA-ARS, Wapato, Washington, for submitting her talk late, two times, and including incorrect information on Okanagan Co. in her presentation.
- **Lucia Varela (2018)**, University of California Cooperative Extension, Santa Rosa and Napa, for claiming that she had not seen the slides prior to the presentation; however, she was second author on the presentation; for making personal statements without supporting data; for claiming to have visited every backyard in Chile to see that all had grapevines; and she requested to the audience – "shoot me".
- **Rick Hilton (2019),** was nominated for false advertising because he signed up for BMSB talk in the Invasive Species section of the conference, but then proceeded to spend half of his presentation talking about codling moth.

Travel Scholarships for Students

INDUSTRY SPONSORS

For many years, industry participants in OPDMC have been asking for a way to lend financial support the event. Now there is a way to support both OPDMC and the next generation of IPM specialists!

Industry contributions will be accepted in any amount, and sponsors will be recognized in the following categories: Bronze (up to $249), Silver ($250-$499), and Gold ($500+). Contributing organizations will be recognized in the conference program, as well as in the opening and closing business meetings.

INTERESTED STUDENTS

To qualify for the scholarship, students must:

- Submit a complete application
- Attend OPDMC and present a talk
- Be available to help with either conference set up or take down.

The selection committee will review applications and select award recipients from qualified applicants. The number and value of scholarships awarded will depend on the total amount of donations received.

FOR MORE INFORMATION

Visit https://opdmc.org/home/scholarships/

Thank You

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