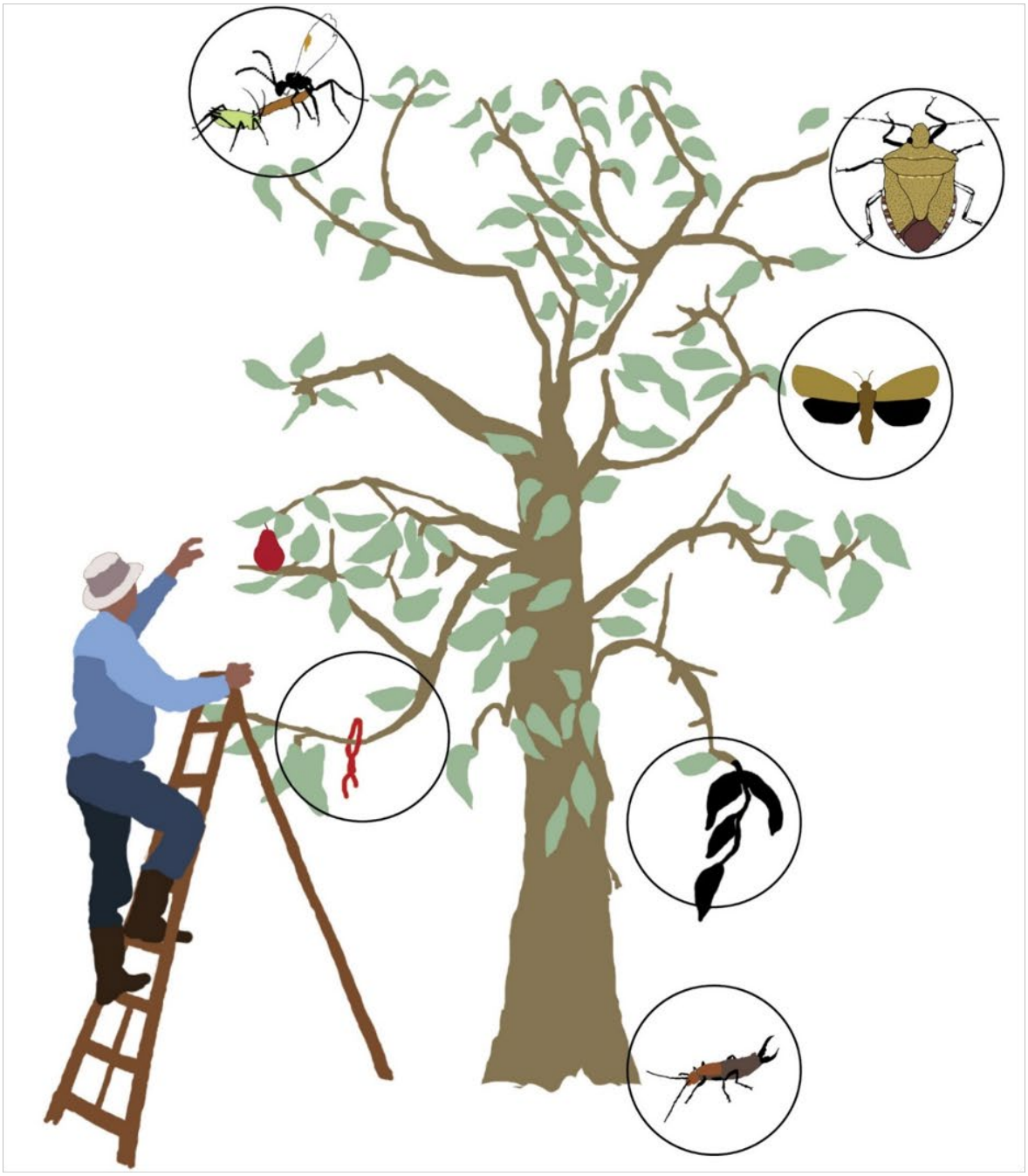
93rd Annual

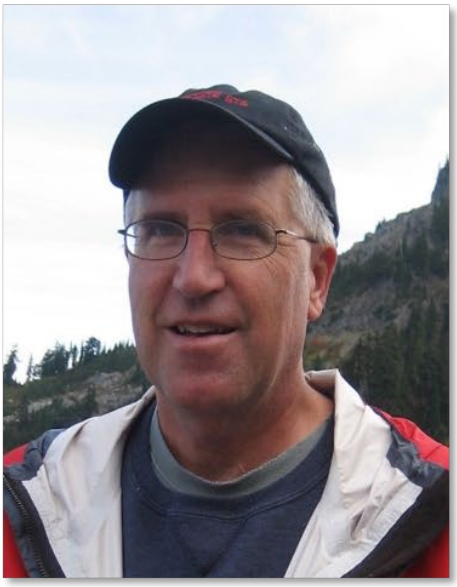
Orchard Pest & Disease Management Conference

Keynote address: "A Fortunate Son: My Entomological Path"
Alan Knight, USDA-ARS, Wapato, WA



Hilton Portland, Portland, Oregon
January 9-11, 2019

Keynote Speaker: Alan Knight



Dr. Alan Knight is approaching 30 years as a research entomologist with USDA, Agricultural Research Service in Yakima, WA and has given just over 100 talks at our annual meetings beginning in 1984. He has been a past Chairman of the meeting, many times a section moderator, and a proud rubber chicken recipient.

Knight received his bachelor's degree in biology with highest honors from University of North Carolina in 1976 and his MS degree from the Botany Department in 1979. After several twists and turns he was awarded a PhD in entomology from Oregon State in 1986. Alan has authored or co-authored more than 200 papers in refereed journals and has been fortunate to be invited to write several book chapters and attend a range of international meetings and visit other researchers.

While in Yakima, Alan's research has focused on developing tools that growers can use to effectively manage tortricid pests, such as codling moth, oriental fruit moth, and leafrollers. The breadth of this work has ranged from resistance monitoring to development of new attractants and adjuvants to improve monitoring, mating disruption, and the efficacy of insecticide sprays.

Dr. Knight remembers the old Imperial Hotel and the drinking and smoking in the bar after intimate meetings filled with colorful presentation by the old guard. Dr. Knight today acknowledges that he is part of the new Old Guard and will share his career highlights and his philosophical rants with us today.

About the Artist

Monica A. Farfan is a USDA-NIFA Postdoctoral Fellow studying predatory mite communities and biocontrol in specialty cropping systems at the Clemson University Coastal Research and Education Center in Charleston, SC. She enjoys both scientific and artistic work in socioecological systems. Her work can be viewed at https://sites.google.com/view/mite-monica/home and at https://mitemonica.carbonmade.com/

About the Cover

The art on the cover is a stylized version of the Peter's tree logo, created by Betty LaDuke Westigard to honor her husband Peter Westigard, a long-time OPDMC member. The Peter's tree logo has been featured on the cover of the abstract booklet since 2012. The circles on the tree represent the Importance the different sections of the OPDMC meeting (mating disruption, biocontrol, invasive species, disease management, biology/phenology, monitoring, etc.) play in getting tree fruit into the hands of the consumer.

93rd Annual Orchard Pest and Disease Management Conference

Orchard Pest and Disease Management Conference
2019 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 9th	
8:00 AM	**Registration/Name Tag Pickup**
9:00 AM	**Opening Business—***Art Agnello, OPDMC Chair*
10:00 AM	Mating Disruption/SIR – *Moderator: Alix Whitener (FMC Corporation)*
12:00 PM	**Lunch (on your own)**
1:30 PM	Implementation – *Moderator: Chris Adams (MSU)*
2:00 PM	Thresholds/Monitoring – *Houston Wilson (UC Riverside)*
3:00 PM	**Coffee Break**
3:30 PM	Biocontrol – *Jhalendra Rijal (UC Cooperative Extension)*
4:00 PM	*Keynote Address:* **A Fortunate Son: My Entomological Path** Alan Knight, USDA-ARS
5:00 PM	**Adjourn**
5:00 – 7:00 PM	**No Host Mixer (Hilton Lobby)**
Thursday, January 10th	
8:30 AM	Biocontrol (cont'd)
9:00 AM	Pathology/Diseases – *Moderator: Broc Zoller (The Pear Doctor)*
10:00 AM	**Coffee Break/Poster Session**
10:30 AM	Pathology/Diseases (cont'd)
12:00 PM	**Lunch (on your own)**
1:30 PM	Invasive Species – *Moderator: Rick Hilton (OSU)*
3:15 PM	**Coffee Break**
3:45 PM	Chemical Control/New Products – *Moderator: Louie Nottingham (WSU)*
5:00 PM	**Adjourn**
Friday, January 11th	
8:30 AM	Chemical Control/New Products (cont'd)
9:00 AM	Biology/Phenology– Moderator: *Betsey Miller (OSU)*
10:30 AM	**Closing Business** — *Arthur Agnello, OPDMC Chair; Rodney Cooper, Chair-Elect*

Orchard Pest and Disease Management Conference
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For more information, see: http://opdmc.org/

Order of Presentations

FROM THE 93rd ANNUAL

ORCHARD PEST AND DISEASE MANAGEMENT CONFERENCE

January 9, 10 & 11, 2019

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

A Fortunate Son: My Entomological Path
Alan Knight, USDA-ARS

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Mating Disruption/SIR—

Moderator: Alix Whitener (FMC Corporation)

Adapting SIR from Eradication to IPM: Issues to Consider

Tobin D. Northfield[1], Elizabeth H. Beers[1], Jay F. Brunner[1], David W. Crowder[2], Vince P. Jones[1]
[1]Washington State University, Tree Fruit Research and Extension Center, Wenatchee, WA
[2]Washington State University, Dept. of Entomology, Pullman, WA

Keywords: codling moth, *Cydia pomonella*, apple, sterile insect technique

Abstract: Sterile insect release, or sterile insect technique programs focus on mass producing sterile insects to disrupt mating success of wild females. Theory suggests that sustained releases will eventually lead to eradication of the pest population when a series of conditions are met, which have been identified by theoretical studies. Indeed, the goal of most SIR programs has been complete eradication of pest populations and the development of theory has reflected this focus. Decades of theoretical research has generally narrowed the determinants of SIR program success to a few key factors: i) the number of times wild females mate, the competitiveness of sterile males relative to their wild counterparts, and iii) the minimum number of sterile males (relative to the abundance of wild males) that need to be continuously released to eventually reach eradication. In some cases SIR has led to successful eradication, greatly improving the industry the pests influence. However, in other cases SIR has suppressed pest populations, but not to the point of eradication, leading to interest in adapting such techniques for pest management. While, the ultimate goals of eradication vs IPM are similar (both aim to reduce pest abundance) they are practically very different. Thus, SIR theory focused on eradication has traditionally ignored factors such as seasonal patterns of pest abundance and use of other control methods. Here, I will discuss some key mismatches between current SIR theory and practice for IPM and the highlight key information needed to evaluate the potential to successfully integrate SIR into IPM programs.

Pioneering Drone Technology for Codling Moth S.I.T.

Evan Esch[1], Rachael Horner[2], Dustin Krompetz[3], Tom Sullivan[2], Melissa Tesche[1], and Max Suckling[2]
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[2] The New Zealand Institute for Plant and Food Research, Biosecurity, Lincoln, CAN, New Zealand;
[3]M3 Consulting Group Ltd., Dayton, OH, USA

Keywords: codling moth, *Cydia pomonella* (L.), sterile insect technique, apple, pear, drone, unmanned aerial system

Abstract: Aerial release is widely accepted to be the best means of dispersing sterile insects. However, this approach is not always practical or economical. Recent advances in unmanned aircraft systems (UAS) have created opportunities to employ aerial release of sterile insects in situations where it was previously not feasible. The practical application of this technology for releasing sterile codling moths *(Cydia pomonella* (*L.*)) was investigated through field experiments. Marked, sterile moths were released from a UAS 25 and 50 m above a grid of pheromone baited traps in experimental orchards. Most of the sterile codling moths were recaptured within ± 50 m of the UAS flight path. Recapture rates did not differ between the two release heights, despite strong winds in the area. Insects tended to be recaptured at greater distances from the flight path when released from a greater altitude. Recapture rates were also compared between UAS and a typical all-terrain vehicle (ATV) modified by the Okanagan-Kootenay Sterile Insect Release Program to release sterile moths. Recapture rates tended to be higher when moths were

released from a UAS (19%) than ATV (11%), though not significantly so (t=3.0, df=4, p=0.057). These experiments show that UAS's are as effective as ATV's at releasing sterile codling moths and are the starting point for the practical application of this technology on a broader scale.

Advancements in Unmanned Aircraft Systems for use in Applications of Sterile Insect Technique

Nathan Moses-Gonzales
M3 Consulting Group, Unmanned Aircraft Systems Initiatives. Dayton, OH

Keywords: pink bollworm, *Pectinophora gossypiella,* codling moth, *Cydia pomonella,* sterile insect, drone

Abstract: Unmanned aircraft systems (UAS) offer a means of releasing sterile insects aerially, can be deployed on short notice in a rapid response scenario, are less expensive and offer a safer means to release sterile insects than their traditional, manned aircraft counterparts. Technologically, UAS affords researchers the ability to rapidly prototype systems and components with considerably less financial burden than their manned counterparts and biologically, provide a high quality released insect accurately targeted at the release site. UAS provide a high level of precision and can be deployed as an aerial release component with minimal setup and teardown time. UAS have successfully released pink bollworm (*Pectinophora gossypiella*) and codling moth (*Cydia pomonella*) with studies showing the sustained competitiveness and longevity of the insects post-release. During the summer of 2018, M3 Consulting Group, Washington State University and OSKIR conducted a 22 week pilot project to assess the viability of Sterile Insect Release (SIR) on the US side of Okanagan Valley (See the system in action at: https://youtu.be/bub2JPRwic8) The results of this effort are discussed by Beers (2019). Here, we describe the use of UAS and discuss how these tools may improve not only how we manage insect populations, but also how we establish, maintain and protect our horticultural systems.

These Are the Drones You're Looking For: WA-SIR Project Year 1 Update

Elizabeth H. Beers[1], Kacie Athey[1], Tobin Northfield[1], Jay Brunner[1], and Dave Crowder[2]
[1]Washington State University, Tree Fruit Research and Extension Center, Wenatchee, WA
[2]Washington State University, Dept. of Entomology, Pullman, WA

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

Abstract: A project was initiated in the spring of 2018 to investigate the efficacy and practicality of using sterile insect release (SIR) of codling moth in Washington State. Increasing insect pressure, especially in organic orchards where fewer insecticide options are available, have stimulated interest in supplementing existing programs with SIR. This program was made possible by the ability to purchase excess sterile moths from the Osoyoos rearing and sterilization facility in British Columbia. Three treatments: 1) standard rate of SIR; 2) high/variable rate of SIR; and 3) check were deployed in replicated plots using 4-8 acre sections of orchards. Recapture rate of sterile moths in the release plots varied considerably throughout the season, but peaked during July and August. Sterile:wild ratios (overflooding ratios) ranged from about 2-20 depending on treatment and the status of the wild moth flight. Wild moths (treatment average) were generally below 10 moths/trap/week, although some hotspots (high captures) were apparent. The CM damage at the end of the first generation was <0.5% in all treatments, with a non-

significant trend for lower damage in the 2 SIR release plots in comparison to the check. The trend was the same in the preharvest sample, but the SIR treatments had significantly lower damage than the check.

Sterile Insect Release; a New Tool for Codling Moth Control in Michigan

Christopher Adams[1], Larry Gut[1]
[1]Michigan State University, Tree Fruit Entomology

Keywords: sterile insect release, SIR, codling moth, *Cydia pomonella,* autocidal control

Abstract: Codling moth (CM) is a key apple pest that growers must control to produce marketable crops. Without effective control growers can face major crop loss. 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 and managing this key pest has become quite challenging. Currently, effective control is accomplished by 4-5 pesticide applications per season. Over time we have seen this pest develop resistance to conventional pesticides. Reducing possible over-use of these chemistries is key to preserving 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 two years we have looked at ways to optimize this tool by investigating release patterns, and the number, or ratio of sterile to wild, needed for control.

Effect of Timing and Release Method on SIR Moth Dispersion

Rob Curtiss, Chris Adams, Larry Gut
Department of Entomology, Michigan State University, Lansing, MI

Keywords: codling moth, *Cydia pomonella*, sterile insect release, apple, marked release/recapture

Abstract: In these experiments, we compared moth dispersion following releases from a single central location and spread evenly across a 10 acre orchard, and we explored the dispersion of moths released at different times of the day. The two approaches to releasing sterile moths produced similar and uniform patterns of recapture, and there was an observable effect of time of day on dispersion. Our evaluation of the options for releasing moths for the purposes of SIR reveal that releasing moths from only a few locations is just as effective as evenly distributing them across the entire block, and that time of day is an important consideration when releasing moths. Moths exhibit the ability to quickly disperse throughout the orchard once they have been released from only a limited number of locations in the orchard. This outcome is good news for the economics of CM SIT.

Laboratory and Field Assessment of Performance of Irradiated Navel Orangeworm Males and Females

Charles Burks[1], Houston Wilson[2], and Gregory Simmons[3]
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Keywords: navel orangeworm, *Amyelois transitella*, sterile insect technique

Abstract: The imminent eradication of the pink bollworm from the U.S., and the regional importance of the navel orangeworm in California, has created interest in navel orangeworm sterile navel orangeworm as part of area-wide control for this species. The USDA-APHIS sterile insect release facility in Phoenix AZ is producing irradiated navel orangeworm in support of this effort. In 2018 navel orangeworm produced in the Phoenix facility were irradiated as adults (both sexes) at 300 Gy and released on a pilot scale to demonstrate capacity. Smaller scale laboratory and field studies were used to assess the competitiveness of the moths produced. A laboratory study found that irradiated male and female navel orangeworm shipped overnight from Phoenix mated at similar levels to locally reared, non-irradiated adults. Field assays with mating tables in a small research plot produced similar results, and further showed that irradiated, shipped females were competitive with local females in attracting males. However, very few of the males releases (~3,000 mixed sex moths per acre per week) were captured in these mating assays. Similar results were obtained with larger, more wide-spread trap grids at aerial release sites in the presence and absence of mating disruption. These results indicate that, under current conditions, the females are more competitive than the males. Small-to-medium scale field studies will be used to identify factors that could increase male competitiveness, and also to identify which laboratory assays best predict field performance in this species.

Effective Mass Trapping of Codling Moth

Alan Knight[1]and Valentina Mujica [2]
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Keywords: apple, codling moth, *Cydia pomonella*, sex pheromone, kairomones

Abstract: I gave a talk here two years ago about my current work then on developing new approaches for mass trapping of codling moth, *Cydia pomonella* (L.). I felt that the real question in 2017 was whether mass trapping can be used together with careful monitoring and a supplementary insecticide program (IPM) and be as effective as the current use of mating disruption when the pest populations are low? Some of these questions were answered by Dr. Peter Landolt in 2017 using 50 delta traps per acre baited with pear ester plus N-butyl sulfide and acetic acid lures to manage codling moth in commercial orchards. I waited for this and in 2018 I continued my interest in mass trapping by working with a regular organic grower with moderate levels of pest damage, instead of the abusively high densities of pests I have played with over the past 20 years. Our approach has been to use 24 traps per acre (my birthdate, my player number in fencing and basketball days, and my favorite two-digit number) but it also converts to 60 per hectare and I found early on (before 911) that this spacing worked well with pear ester attracting moths. Our 2018 field trials continued with the use of Combo lures (a new more robust PVC version from Trécé Inc.) plus acetic acid lures. We were able to set up four blocks (3-4 acres each) paired with identical plots

without mass trapping. All orchards were also treated with Cidetrrak CMDA PP at 400 dispensers per acre. We used green bucket traps loaded with organic oil and vinegar homebrew and these traps were only serviced once at mid-season. All moths were sexed and all females were dissected to determine their mating status. At midseason we had reduced fruit injury by 57% and prior to harvest by 71% with ca. 5.0% fruit injury in the untreated. Early in the season we only caught 15% females but this increased to 40% in the second half. Levels of female virginity were 23% at mid-season and < 20% later in the season in the bucket traps. The grower considered this to be a great success and plans on treating all of his orchards in 2019 with mass trapping!

The really good news was that we discovered a much more effective kairomone lure (***4-way K***) that increased catches of female codling moth by 20-fold compared with the Combo lure and 4-fold when compared with N-butyl sulfide plus pear ester and acetic acid. The blend was actually more attractive than a sex pheromone lure for total moth catch and also slightly better than the Combo plus AA combination for total moths. A sex pheromone lure can be added to ***4-way K*** to further increase male captures without reducing female catches. The kairomone lure was effective early, mid and late in the season and in blocks with very few fruit, and in blocks with heavy fruit loads that were uninjured, moderate injury and heavy injury with rotting fruits on the orchard floor. This discovery has been submitted for publication and hopefully we can announce the components of this blend at the meeting. Studies are also continuing in South America to explore a range of substitutions in this kairomone blend that could help to make it more practical due to cost and stability issues.

A third development is that we have been working with the ***Zero-fly*** insecticide treated netting for both codling moth and obliquebanded leafroller (OBLR). Laboratory trials have shown that it is not repellant and kills moths that land on the netting following as short as a 5 second exposure. We have measured both lethal and sublethal effects from these brief exposures. In the field we ran 1-acre trials with 24 'grey ghosts' per acre baited with the new PVC Combo lure plus acetic acid and were able to reduce moth catch and fruit injury by codling moth at mid-season. Unfortunately, we did not replace the lures mid-season and no improvement was seen in the treated plots by the end of the season. Also, no useful field data were collected for OBLR due to the unexpected lack of the pest in our experimental plots.

In addition, we are continuing to look at the use of combined monitoring and mass trapping of tortricids with our new lures. The ***4-way K*** lure does not inhibit catches of oriental fruit moth, *Grapholita molesta* (Busck) using sex pheromones, terpinyl acetate and acetic acid combined lures.

Implementation—

Moderator: Chris Adams (MSU)

Spray Drift Mitigation Using Opposing Air-Blast Sprayers

B. Bisabri[1], R. A. Van Steenwyk[2], J. P. Siegel[3], C. S. Cabuslay[2], J. M. Choi[2], J. W. Steggall[4], K. C. Mace[4], S. W. Blecker[4], P. A. Poe[4] and P. Klassen[5]
[1]CURES, Newman, CA,[2]University of California, Dept. of ESPM, Berkeley, CA, [3]USDA–ARS, Parlier, CA,[4]OPCA-CDFA Sacramento, CA, and [5]CURES, Fresno, CA

Keywords: drift, mitigation, coverage, mortality

Abstract: Spray drift from orchards into environmentally sensitive areas can be significantly mitigated using opposing air-blast sprayers while at the same time maintaining equal or better coverage as compared to conventional application methods. Studies were conducted on almond, pistachio, and walnut orchards in the San Joaquin Valley of California using both engine driven and PTO orchard air-blast spray equipment. Two methods of application were evaluated and compared to the grower standard spray method and an untreated check. The two methods were: 1) two sprayers driving and spraying parallel to each other on the outside row with the inside sprayer applying normally, but the outside sprayer having the inside manifold spray solution and air on but the outside manifold having the spray solution and air off (double spray); and 2) similar to the first method but the outside sprayer having the inside manifold spray solution off and air on followed by the sprayer returning along the outside of the orchard to spray the outside of the row with the inside manifold spray solution and air on but the outside manifold having the spray solution and air off (air-in). The orchards were sprayed with 125 to 240 gallons water/acre + 1/2% v/v horticultural oil at 2.0 to 2.4 miles per hour. Drift was measured using water-sensitive papers placed 25 ft, 37.5 ft, 50 ft, 100 ft, 150 ft, 250 ft, and 400 ft from the dripline and downwind from the orchard in an open field depending on the orchard type and spray equipment.

Spray coverage was measured in separate studies in the same orchards as the drift studies. In each coverage study, there were four treatments (as above) replicated four times and sprayed with 125 to 240 gallons water/acre + 1/2% horticultural oil, 0.015 gal/100 gal AquaShade and 10 fl. oz/100 gal Intrepid 2F applied at ca. 2.0 miles per hour depending on the study. Spray coverage was estimated using three methods 1) amount of coverage of Kromekote paper wrapped on aluminum cans using ImageJ, 2) navel orangeworm larval mortality from filter papers using a bio-assay technique, and 3) amount of methoxyfenozide from filter papers using chemical analysis. Two aluminum cans wrapped with Kromekote paper and 50 filters papers were placed high and low in the tree canopy in the center of each replicate. The results of drift and coverage studies will be discussed along with future directions of this research.

Reflective Plastic Mulch: an Alternative Approach for Early Season Management of Pear Psylla

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

Keywords: pear psylla, *Cacopsylla pyricola*, pears, repellents

Abstract: Pear psylla, *Cacopsylla pyricola*, has been one of the most challenging pests of pears in the PNW since its introduction in the 1940s. This insect feeds on the plant's phloem and excretes large quantities of honeydew which marks fruit, inhibits photosynthesis, and creates unpleasant conditions for orchard workers. Managing winterform psylla in the early spring is imperative due their high winter survival and low natural enemy activity during the invasion period. However, the conventional approach involving repeated broad-spectrum sprays severely diminishes natural enemy communities necessary for late season control. This results in late season fruit injury and high survival going into the overwintering stage, perpetuating the cycle. Repelling psylla adults instead of killing them with insecticides should achieve the same goal of early season suppression, but with lower impacts to natural enemies. Two methods that effectively repel winterform psylla are foliar Surround sprays and laying reflective plastic mulch in weed strips. This study examined the effects of substituting early season insecticide sprays with either Surround or reflective plastic mulch. Two programs involving Surround or reflective mulch followed by softer spray regimes were compared with a season-long conventional program and an untreated check. Both Surround and reflective mulch programs resulted in similar or improved control of psylla and injury compared with conventional and check blocks. Effects of repellent treatments on natural enemies were variable, suggesting the need for further non-target examinations.

Thresholds/Monitoring—

Moderator: Houston Wilson (UC Riverside)

Natural Enemies in North Central Washington Pear Orchards: Tipping the Balance toward Bio-Based IPM?

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Keywords: pear, *Deraeocoris*, Campylomma, green lacewings, *Chrysoperla carnea*, *Chrysopa nigricorni*, Trechnites, *Trechnites insidiosus*, *Trechnites psyllae*

Abstract: Pear growers in North Central Washington are facing increasing psylla pressure. In a recent project working toward sustainable pear IPM we scouted 20 commercial orchard blocks for 26 weeks during two years for natural enemies and pests. Our goal is to test the efficacy of selective IPM programs and to create natural enemy thresholds ('scorecard') for pest management decision making. Preliminary data documents that the most abundant natural enemies are *Deraeocoris*, *Campylomma*, green lacewings (*Chrysoperla carnea, Chrysopa nigricornis*), and *Trechnites (Trechnites insidiosus* or *T. psyllae)*. Plots under organic management maintained both high natural enemy numbers and low pest pressure. Plots under selective IPM management quickly increased natural enemy populations and pest pressure was not significantly different than conventionally managed plots. Of natural enemy metrics evaluated, the average number of all natural enemies captured per week in sticky traps with volatile lures, and the number of Campylomma captured in sticky traps with volatile lures provide the most promising measurements for future threshold evaluation.

Wind Tunnel and Field Evaluation of Semiochemical Baited Traps Capable of Remotely Monitoring of Codling Moth (*Cydia Pomonella*)

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Keywords: codling moth, *Cydia pomonella,* apple, pear, walnut, remote monitoring, monitoring tools

Abstract: Monitoring is a critical component of codling moth (*Cydia pomonella*) management. Monitoring pest phenology with pheromone trap counts allows growers to identify infested plots and appropriately time the application of pesticide sprays. Unfortunately, processing pheromone traps can be a time-consuming process. Semios has developed several novel codling moth traps (the standard Semios trap and the triangle trap) which incorporate digital cameras and machine learning algorithms to automate trap counts and reporting. For this technology to be effective and readily implemented, the underlying trap must perform similarly to commercial standards. In a series of experiments, we compare the efficacy of these novel codling moth trap designs with a commercial standard, the delta trap. In wind-tunnel experiments, all traps performed similarly. Importantly, capture rates in trials between novel and delta traps were not significantly different. However, trap design did influence codling moth behavior during wind tunnel flights as more moths contacted the exterior of the standard Semios trap before being caught compared to other trap designs. In 2014 and 2017 we conducted field trials to examine the efficacy of the standard Semios trap and the delta trap. In both field trials the position of the trap within the field was an important factor in determining the number of codling moth captures, and in both trials, all trap designs caught a similar number of codling moth. The data presented suggests that the novel codling moth traps can be incorporated into codling moth management programs using currently recommended monitoring schedules and thresholds.

Monitoring for Navel Orangeworm in the Presence of Mating Disruption

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Keywords: navel orangeworm, *Amyelois transitella*, monitoring, mating disruption

Abstract: Mating disruption for navel orangeworm is used in an increasingly high proportion of California almond and pistachio orchards. This practice completely shuts down pheromone traps in blocks in which it is used, and profoundly suppresses them in neighboring blocks. Phenyl propionate (PPO) and a five-compound kairomone blend were therefore evaluated for use in monitoring under these circumstances. When presented in wing traps, both PPO and kairomone blend captured more than the 0 moths captured with pheromone alone in the presence of mating disruption. Both attractants also captured significantly more adults in mating disruption blocks when presented with a pheromone lure in wing traps compared to wing traps containing only PPO or kairomone blend. PPO captured more adults than kairomone blend in mating disruption blocks, whether in the presence or absence of a pheromone lure. Comparison of NOW adults captured with PPO presented with or without pheromone in wing traps, stock delta traps, delta traps modified by cutting openings in the sides, and bucket traps suggest that an open-sided trap is important for the synergy observed between PPO and pheromone lures in wing traps.

An Evaluation of a Novel Remote Trapping Technology for the Monitoring of California Red Scale (Hemiptera: Diaspididae)

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Semios Technologies Inc., Vancouver, British Columbia, Canada

Keywords: California red scale, *Aonidiella aurantii*, citrus, remote monitoring, monitoring tools

Abstract: Monitoring is an essential component of California red scale (*Aonidiella aurantii*) management. Pheromone trap counts allow growers to determine the occurrence of CRS flights and appropriately time the application of pesticide sprays. However, processing CRS traps is a time-consuming process. Semios is developing a novel CRS trap which incorporates digital cameras and machine learning to automate CRS trap counts and pest reporting. For this technology to be effective the underlying CRS trap should perform as well as commercially available traps. During the 2018 growing season, Semios conducted a field experiment based in Tulare County, California to compare the efficacy of a novel CRS trap design to a commercial standard. The two trap designs were compared based on CRS trap counts and the occurrence of management thresholds (e.g., trap counts of 1000+ CRS). Data analysis suggests that both trap designs provide equivalent information content. Both trap types detected CRS flights at the same time, and CRS trap counts were similar throughout the sampling period. Importantly, there was no difference between trap types in the number of traps that reached the management threshold of 1000+ CRS. These data suggest that the Semios CRS trap can be incorporated into CRS management programs using currently recommended monitoring schedules and thresholds.

Improving Integrated Pest Management of Leaffooted Bug on Almond and Pistachio in the San Joaquin Valley

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Keywords: leaffooted bug, *Leptoglossus zonatus* (Dallas), pomegranate, cold tolerance

Abstract: During the fall of 2015 and 2016, and the fall and spring of 2017 I conducted growth chamber experiments in the laboratory evaluating the cold tolerance of adult leaffooted bug, *Leptoglossus zonatus* (Dallas). Results showed that *L. zonatus* has a greater tolerance of cold than previously understood. At an exposure period of four hours, a temperature of -6 °C was required to kill approximately 50% of the exposed adults.

To evaluate population dynamics and validate laboratory cold tolerance experiments, I monitored field populations of leaffooted bug infesting a 2.6 km-long hedgerow of unmanaged pomegranates, located near Reedley, Fresno Co. Ambient temperature at the Reedley site was measured with HOBO temperature loggers and reached below freezing on 11 dates for a duration of one to seven hours. No significant difference in the number of adults or nymphs occurred among the dates indicating that cold events did not significantly affect mortality. Moreover, on all sample dates, no detectable mortality was observed during visual inspections of vegetation around aggregations and of the soil surface near monitored aggregations.

The population dynamic study indicated that *L. zonatus* produced a full generation on pomegranate between September and late October. As individuals developed to adults, they emigrated from pomegranate to aggregate on more sheltered overwintering plant substrates, such as Italian cypress and Mediterranean palm. Overwintering aggregations dispersed by early March.

Moreover, I conducted laboratory and field experiments evaluating pyrethroids, pyrethrum, clothianidin, and biological insecticides against adult and immature *L. zonatus*. Although, clothianidin and pyrethrum provided some contact activity, the pyrethroids, lambda cyhalothrin and bifenthrin were the only insecticides that provided residual activity. Implications of these findings for improving integrated pest management of leaffooted bug will be discussed.

Biological Control—

Moderator: Jhalendra Rijal
(UC Cooperative Extension)

Love Thy Neighbors? Beneficial Insects and Pests in a Mixed Orchard Landscape

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Keywords: pear, cherry, biocontrol, predators, parasitoids, disruption, insecticides.

Abstract. The role of mixed agricultural ecosystems resembling a mosaic landscape on pest management has become a topic of increasing interest. The underlying principle is that diverse agroecosystems provide various niches and resources to support a healthy population of predators and parasitoids that can keep pest densities low throughout the whole year. However, management of the surrounding landscape can also have negative impacts on a target crop. In the Hood River valley, it is common to have orchards of neighboring pear and cherry blocks, but the benefits and drawbacks of such mixed agroecosystem are not understood. Specifically, it is hypothesized that chemical control against the newly introduced spotted-wing drosophila in cherry orchards is negatively affecting integrated pest management of pear orchards in neighboring blocks. It is possible that frequent applications of broad-spectrum insecticides for the control of spotted wing drosophila are also eliminating populations of beneficial arthropods that migrate to pear orchards and prey on pear psylla. As such, it becomes necessary to elucidate the links between cherry pest control and pear pest control in mixed orchards. It is futile to give management recommendations without an understanding of the long-term fluctuations in the arthropod community, and the factors that can drive them. The aim of this study is to determine if there is an ecological correlate between proximity to cherry orchards and the abundance of pear psylla and beneficial arthropods in pear orchards. Specifically, we assess if (1) pear blocks adjacent to cherry blocks have higher or lower pest: beneficial insect ratios compared to isolated pear blocks, and (2) which ecological factors correlate with the diversity and assemblage of beneficial arthropod communities in pear orchards. The results from this study can aid in management decisions for pear and cherry growers, particularly in areas where farms growing both pears and cherries are common.

Trissolcus japonicus Redistribution Efforts in Orchard Crops and Small Fruits

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Keywords: Brown marmorated stink bug, *Halyomorpha halys*, survey, dispersal

Abstract: *Trissolcus japonicus*, the samurai wasp, an egg parasitoid of the brown marmorated stink bug (BMSB) has been detected annually in Oregon since 2016. Samurai wasp is expected to provide relief in BMSB management, but its small size complicates efforts to identify the parasitoid's impact. To improve biological control of BMSB, we redistributed samurai wasp at multiple eco-regions, evaluated dispersal in crops, and surveyed for winter survival at all release sites. In three years, we detected samurai wasp 62 times, mostly through sentinel egg masses and yellow sticky cards. At 19 of these sites, samurai wasp was detected for two or more seasons, and this includes 8 sites with intentionally distributed populations. Urban sites comprised 65% of *T. japonicus* detections. Once released, samurai wasp has been found up to 164 feet away. Limited recapture distance and non-target risks from insecticide application may restrict samurai wasp release efforts and parasitism to urban and semi-natural areas.
Biological Control

It's Like Comparing Apples to Strawberries (and Tomatoes): Rethinking Pesticide Selectivity

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Keywords: predatory mite, Phytoseiidae, pesticide non-target effects, *Neoseiulus fallacis*, *Neoseiulus californicus*, *Phytoseiulus persimilis*, *Galendromus occidentalis*, twospotted spider mite, *Tetranychus urticae*, strawberry, apple, tomato, Brigade WSB (bifenthrin), Agri-Mek SC (abamectin), Acramite 50WS (bifenazate), Kanemite 15 SC (acequinocyl), Nealta (cyflumetofen), Portal XLO (fenpyroximate), Vendex 50 WP (fenbutatin-oxide), Oberon 2 SC (spiromesifen), Savey 50DF (hexythiazox), Zeal Miticide (etoxazole), Select Max (clethodim), Sandea (halosulfuron-methyl), Xtendimax (dicamba), GoalTender (oxyfluorfen), Valor Sx (flumioxazin), Dual Magnum (*S*-metolachlor), Devrinol 50-DF (napropamide), Callisto (mesotrione)

Abstract: The field of evaluating pesticide non-target effects on natural enemies is rapidly advancing. For many key natural enemies, the selectivity of a variety of insecticides has been well-studied. However, as management practices change, the natural enemy complex within a system may change. Additionally, newer IPM research emphasizes a systems approach to pest management. Therefore, it is important to explore non-target effects for more than just a limited number of key natural enemies and to examine impacts of management of non-insect pests. Here, we report non-target effects of acaricides registered in strawberry for predatory mites that are common in a variety of crops. We also examine potential non-target effects of common herbicides on the predatory mite *Phytoseiulus persimilis*. Several acaricides that are labelled as selective (bifenazate, acequinocyl) were found to have significant non-target effects on *Neoseiulus fallacis* and *N. californicus*, but not other species. Additionally, for some products, the life stage most strongly impacted the phytoseiid varied by species. Some herbicides, *S*-metolachlor in particular, caused high mortality in *P. persimilis* and may be disruptive to spider mite biological control. Additional research is needed to determine the impact of herbicide application on biological control in a variety of systems. Therefore, while comparing toxicity between two species might be like comparing apples to oranges, using results gleaned from highly different crops may better inform IPM.

Pathology/Diseases—

Moderator: Broc Zoller (The Pear Doctor)

Fire Blight Management Experiences in Sacramento Valley and Coastal Mountain Pears of California 1973-2018

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The Pear Doctor, Inc., Kelseyville, CA

Keywords: fire blight, fire blight prediction, *Erwinia amylovora*, pear

Abstract: A model for predicting fire blight bacterial development based on accumulated heat above 65F was developed in the early 1970's (Van der Zwet, T. et al., 1988.Plant Dis.72:464-472 http://www.apsnet.org/publications/PlantDisease/BackIssues/Documents/1988Articles/PlantDisease72n06_464.pdf). The system predicts times during which increased and decreased treatment frequencies are advisable or permissible based on heat accumulation leading into expected rain events or warm dew situations. Use of this system 1976-1999 generally resulted in improved control of the disease even in years predicted to be among the worst (Zoller, B.G. 2000.Proc.WOPDMC74:103-104. http://entomology.tfrec.wsu.edu/wopdmc/2000PDF/8-TREE%20FRUIT/Tree%20Fruit%2000-1.pdf..Subsequent experience using the system 2000-2018 has generally been supportive of the models predictions, although certain special case seasons such as hail occurring after infections have already occurred earlier, and low winter chilling resulting in extended bloom are thought to remain difficult at times in warm seasons.

The development of fire blight is favored by simultaneous warm, moist conditions following extended warm periods which have allowed build up and distribution of the *Erwinia amylovora* causal bacteria in flowers. The disease can limit the production of sensitive pome fruit cultivars to semi-arid areas of the United States. Unfortunately, the springtime conditions prevailing in California fruit districts may not always be dry and blight free. Ideal conditions for fire blight development occurred in the Central Valley region during 1997, 2000 and 2015, for example. A summary of pear fire blight management for the period 1976-1986 was published earlier (1). This article also included many details regarding monitoring and isolation procedures to detect the bacteria on the trees. Other summaries of California pear blight management through 1999 and 2002 also are available (2,3,4,5). The summary here logs experiences through 2018 and documents currently diminishing blight control in the Sacramento Valley compared with earlier efforts. In order to understand exactly how favorable the conditions must be for disease development, it is important to quantify the three necessary factors as follows:

Critical Factors Determining Disease Numbers

(1) Inoculum Potential. The number of older infections or "holdovers" from previous seasons is the inoculum potential. Research has pointed to the fact that successful blight control programs are predicated on meticulous holdover removal prior to bloom. Later applied chemical treatments, even at high frequency, are not capable of entirely substituting for this step prior to a season favorable for blight (Figures 1 and 2).

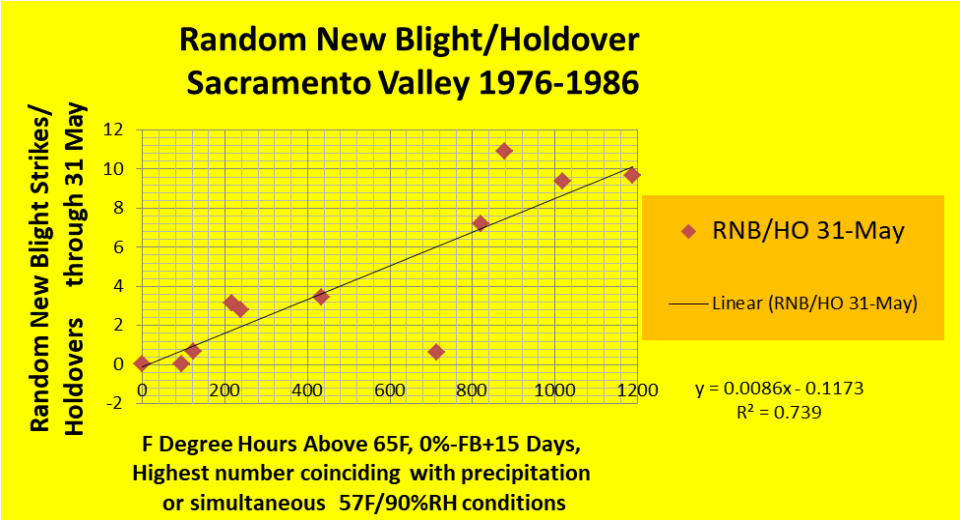

Figure 1

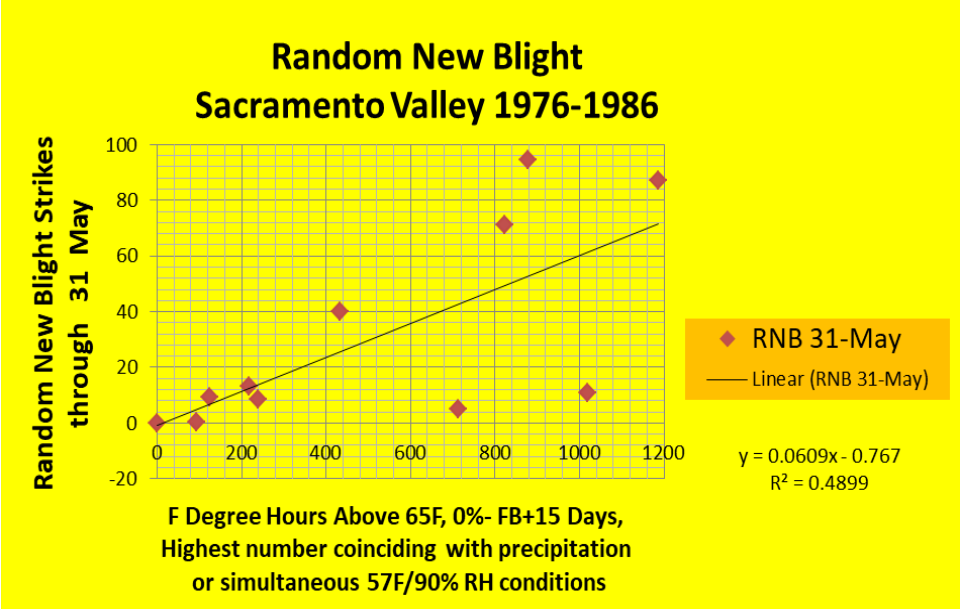

Figure 2

Figures 1 and 2. The relationship between Holdover (HO) inoculum potential and warm, moist conditions favorable for new infections can be seen in comparing these two figures describing Random New Infections (RNB) counted through 31 May 1976- 1986 in the mid-Sacramento Valley. When the RNB number is divided by HO number as in Figure 1, the data points are a better fit with one another than just using the RNB number as in Figure 2, and the linear R^2 value is much higher and more significant. It should be noted that these are random infections at least 2 trees distant from holdovers.

(2) Blossom Numbers. Blossom numbers are at a season maximum during the period early bloom through 15 days past full bloom, which makes this the most critical period in avoiding the potentially most devastating situations. Additional secondary bloom continues well past this time in late April and May. Because of warmer temperatures later in the season, these blossoms are very blight susceptible and

require continuing protection. Observations suggest that infections occurring as a result of favorable weather through 15 days past full bloom increase the inoculum potential to impact the number of new infections that occur later in the season.

Seasons of low winter chilling can also result in a longer primary bloom period with increased early season secondary bloom, as well.

(3) Weather Favorability. Extended warm periods favor bacterial build up on the stigmas of blossoms. Rainfall or the simultaneous occurrence of warm humid conditions, often at night, supply a moisture film allowing movement of the bacteria to the actual infection courts, the nectaries of the floral cup of the flowers. Moisture also allows movement of bacteria from existing earlier infections into all sorts of wounds, such as from hail or frost, as well.

Application of Degree Hours to Describe the Disease in California

In California, two models are routinely employed in fire blight forecasting, particularly in the pear industry. The first is a mean temperature model, which is a simple rule-of-thumb predicting that fire blight bacteria are first present in blossoms, once mean temperatures of near 60° F are reached for the first time in bloom (6,7). The second model, the Zoller degree hour system, is a clinical prediction system which is an outgrowth of work describing growth of the pathogen *in vitro* and of heat summation concepts developed earlier to describe blight epiphytotics in New York and Illinois (8,9,10,11). It is based on blossom monitoring studies in California pear orchards as well as disease incidence observations (Figures 3-4) (1,3,12,13). Some aspects of this model have been incorporated into the Maryblyt model, which has found use in California apples (14,15,16). A related degree hour model has been developed in Washington State and is widely used in pears and apples (17)

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Figures 3 and 4. Percent of samples colonized with *E. amylovora* vs. degree hours above 65°F since the last three-day period with no temperature above 65° F. The rate of colonization of pear flowers becomes greater with increases in the accumulated degree hours prior to sampling. The reaching of 500 F degree hours in the Sacramento Valley (600 degree hours in Lake County) is used as a trigger to increase treatment frequency if it occurs during major bloom periods with rain or warm night conditions predicted.

Use of the Zoller degree hour system is presented below as a 45 year (1973-2018) summary of commercial management of fire blight for the Sacramento Valley and North Coast pear districts of California. The accumulation of 150 degree hours (250 degree hours in the North Coast) above 65° F usually occurs on the same day in a district that the mean temperature threshold is crossed. Although both models predict the first appearance of the fire blight bacteria in blossom samples, the degree hour model allows treatment ahead of this time if necessary in very sensitive situations. These cases might include, for example, when overwintering cankers are too numerous, use of the model with the fire blight sensitive Starkrimson cultivar, or after a winter of particularly low chilling when cankers may be suspected to be more active leading into the season. The degree hour model also resets in those seasons which may trigger early season concern from warm temperatures during bloom, but which may subsequently revert to extended periods of cold temperatures less conducive to blight bacteria population development. The real value of the system, however, comes in those difficult times predicted to require increased treatment frequency to match increased bacterial multiplication and spread in orchards. This necessity to alter treatment response is dictated by the lengthy California primary and secondary bloom season of 2-3 months in pears.

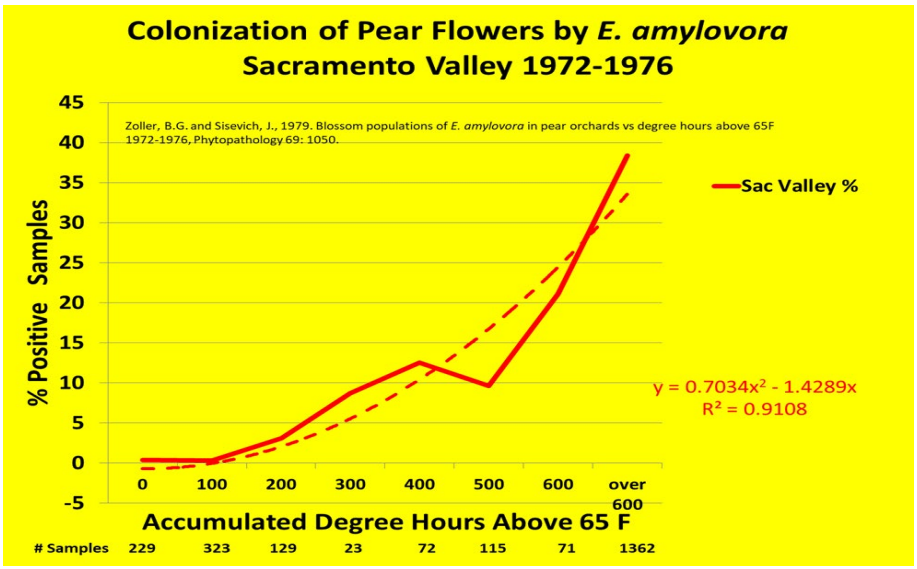

Figure 3

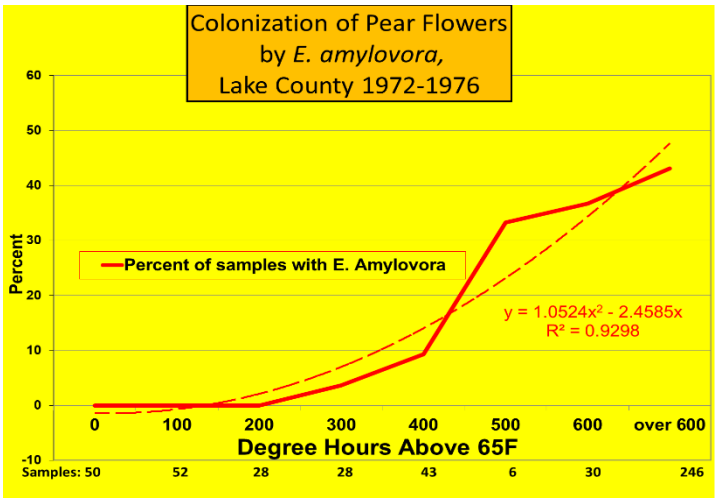

Figure 4

Fire blight infection periods are certain wetting events supplying a moisture film, such as rainfall or the simultaneous occurrence of 57° F temperatures (or greater) with at least 90% relative humidity. These latter events can be read using hygrothermographs, and are likely related to the development of warm moisture films at night or early morning in the absence of rain. The role of moisture in movement of the pathogen from blossom stigmas to nectary infection courts has been described (18, 19).

During 1976 to 1986, extensive monitoring of individual infections occurring in 'Bartlett' pear orchards in the middle Sacramento district around Yuba City was performed. This assessment showed a high correlation of the ratio of new infections to older, holdover infections, with the number of heat units accumulated prior to those wetting events described above during the period early bloom through full bloom plus 15 days (1). The record of seasonal accumulated degree hours above 65° F prior to infection periods during 1973-2002 in the mid- Sacramento Valley area around Yuba City is shown (Figure 5). The record of new infections counted per block (divided by holdovers present) through May 31 is included so

that the correlation with accumulated prior heat for the 1976-1986 period is apparent. Later experiences 1987-2002 can also be compared with the blight potential as predicted by degree hours. As can be seen, control experiences greatly improved since the 1976-1986 period in spite of many years with blight favorable heat unit accumulation (2,3,4,5).

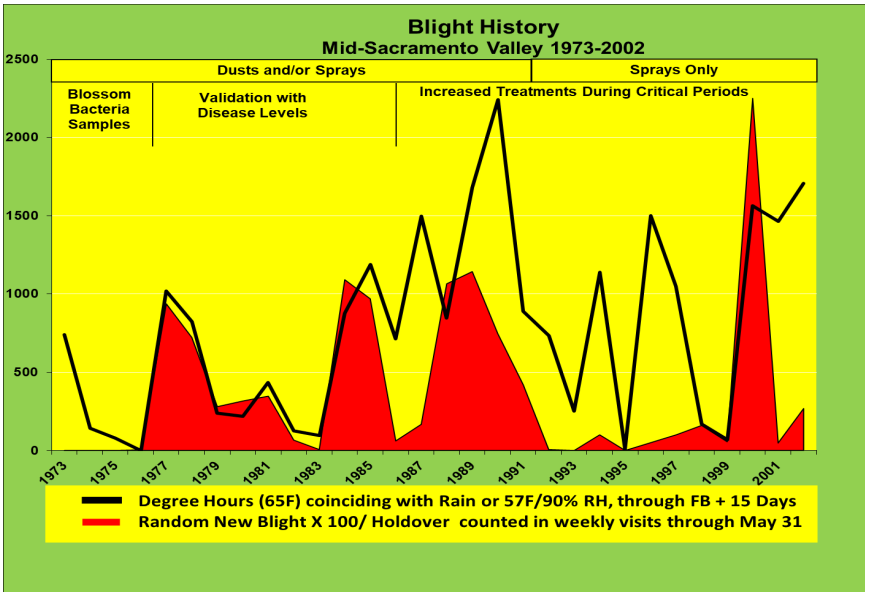

Figure 5

Figure 5. During the 1976-1986 period when infections were counted, the correlation between the accumulated degree hours preceding infection periods and the ratio of new infections to holdover infections was high; Y=-0.15+0.00087X; r=0.86; P=0.001. Increased treatment frequency in 500 F degree hour seasons 1986-2002 usually resulted in lower disease incidence, even in favorable seasons. Treatments applied are described in the caption under Figure 6.

Action Thresholds Suggested by Degree Hours in California

As a result of these experiences in the mid-Sacramento Valley in the 1980's, focus was begun on seasons of at least 500 F degree hour accumulations as ones which require shortened treatment intervals if these heat units occur during major bloom periods with high night temperatures. This has worked well enough that it was usually possible in the next 25 years to achieve good blight control even in seasons predicted to be among our worst. The final step allowing success in difficult years had been the total abandonment of dust formulations as treatments since 1991. Blight years had not been completely eliminated, but control success had become more frequent, even in years predicted by heat units in the past to have been potentially difficult. 1997 was such a season in which over 1000 degree hours accumulated in all Sacramento-San Joaquin Valley areas prior to infection periods during the most critical early bloom through full bloom plus 15 days time frame. In spite of this, orchardists utilizing the degree hour system achieved excellent blight control while much of the Central Valley pear and apple industries suffered blight so severe it even reached the local newspapers. A similar occurrence of over 1000 degree hours accumulated prior to warm, humid infection periods developed again in 2000 to devastate large areas of the Sacramento pear district, when winds and poor economic conditions hampered treatments. Unfortunately this occurred in some orchards in spite of the lessons of the previous 20 years!

Action thresholds expressed in accumulated degree hours [one degree hour = time spent 1 hour one degree above 65° F] for use of this system are listed in the UCIPM-DPR California Pestcast System and in the table, below (3,4,5).

(http://www.ipm.ucdavis.edu/DISEASE/DATABASE/fireblight.html)

Sacramento Valley Degree Hour System Action Thresholds

http://www.ipm.ucdavis.edu/MODELS/FBEA/aboutfireblight.html

Degree-Hours	Weather	Action
0	Not relevant	None
1-150	Rain predicted within 24 hours	Spray in the 24 hr. period prior to rain
150-500	Predicted rain or warm, humid weather where the Temperature is at least 57F and Humidity is at least 90%	Repeat treatment every 3-4 days with treatment in the 24 hours prior to predicted conducive weather
Over 500	Predicted rain or warm, humid weather where the Temperature is at least 57F and Humidity is at least 90%	Treat every other day during major bloom

Treatments are half treatments applied every other row. Higher thresholds (+ 100 added to each threshold) are used in the North Coastal Mountain districts as long as dormant season chilling has been typically greater than in the Sacramento Valley districts.

The thresholds for Sacramento Valley pear orchards are listed in the table. Higher thresholds are used in the colder, less blight prone northern California coastal mountain districts as long as winter chilling has been typically greater than Sacramento Valley areas. Freezing temperatures during primary bloom and later can also often delay pathogen establishment in these districts. Treatments refer to half treatments applied every other row. See the discussion below of current control materials used.

The key to successful use of the degree hour system is to carefully monitor the accumulation of heat [degree hours above 65° F since the last 3-day period of no temperatures above 65° F] each day. This allows identification of the frequency of treatments needed based on blossoms present. High accumulations (over 500 in the Sacramento Valley and over 600 in the North Coast) during the maximum blossom period of early bloom through 15 days past full bloom do not occur every year, but are to be especially feared when they do.

Watch the nightly weather forecasts to predict the continuing heat accumulation and to note approaching fronts, which can bring precipitation. However, sometimes no precipitation results, but infections can occur anyway, as the night temperature of moisture films (dew) increases with the first arrival of these sometimes-rainless changes in atmospheric moisture content. There is no control of this, only a too late reaction to these conditions as they pass. The best practice has been to increase treatment frequency

according to the heat unit thresholds without waiting to see predictions of moisture. This is the only way to be protected ahead of a dangerous situation, which may occur and leave no chance to apply treatment in a timely fashion.

Current Control

Control treatments are currently oxytetracycline in fresh market orchards needing cosmetically clean fruit finish. In processing orchards and currently in organic orchards, copper materials are also used. Resistance to streptomycin is present in all pear districts (20,21,22,23,24,25). Consequently, this material must be used sparingly. Unfortunately resistance to oxytetracycline has now also been identified in the Sacramento Delta district, at least. The new antibiotic, kasugamycin, has just been registered in California in 2018, but for somewhat minimal use (26).

The fear of loss of antibiotics for control of the disease has spawned an on-going search for biological control agents the last 25 years. This effort in California has been funded by the California pear industry and carried out by University of California plant pathologists (27,28). A parallel effort is being carried out in the Northwest (29,30,31,32,33). The results to date are promising and a commercial product, Blight Ban A506™ has had some use for many years. This material has been suppressive of infection numbers, but needs antibiotic augmentation for success in most commercial situations. This is unfortunate, since the most utilized antibiotic, oxytetracycline, as well as certain pear scab fungicides and coppers may not be tank mixed nor be applied within 2 days of the biological control agent without reducing its colonization of pear blossoms (31). Use of alternative materials such as Blight Ban A506 in combination with antibiotics shows the complexity and integration necessary to manage fire blight if total reliance on antibiotics is to be avoided. Another new biological product is Bloomtime Biological with similar complexities of integration. The yeast product Blossom Protect has performed well in fire blight control studies but can contribute significantly to fruit russet in moist conditions. Fungicides such as sulfur are also inhibitory to the yeast that is the basis of this product (32).

Unfortunately, recent disease control experiences in the Sacramento Valley support the fear and discovery cited above that increasing resistance to the most widely used control product, oxytetracycline, may be contributing to reduction in control. Increasing numbers of infections in the mid Sacramento Valley district have been experienced in 3 of the last 5 years in spite of model specified increased treatment frequency in the critical period through full bloom plus 15 days (Figure 6).

Every other row (EOR) half treatments of wettable coppers at 0.4-0.5 lb metallic copper equivalents (MCE) or copper dusts at 0.45 lb MCE/acre were applied in the 1970's. Oxytetracycline use began in the late 1970's and has continued to the present in the mid Sacramento Valley district at 200 ppm oxytetracycline (0.5 lb of 17-18% material) applied EOR 50 gal/acre. In the North Coastal mountain districts half these 200 ppm oxytetracycline amounts (0.25 lb) are used EOR 25 gal/acre, and mixed with 60 ppm streptomycin (1.2 oz of 17% material EOR 25 gal/acre). From 2013 to 2018 in the mid-Sacramento Valley orchards, streptomycin at 60 ppm (2.4 oz of 17% material EOR 50 gal/acre has been added to the terramycin treatments, as well.

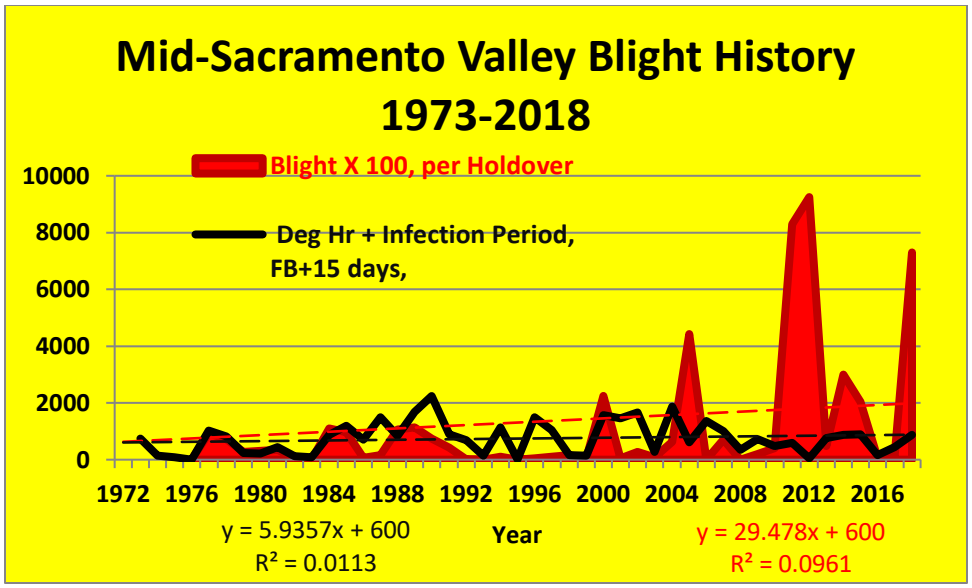

Figure 6

Figure 6. Continuation of the data of Figure 5 with the same increased treatment frequency in blight favorable bloom period years, to include 2003-2018 experiences. Disease levels have been much higher in the recent 2011, 2014, 2015 and 2018 favorable seasons. (Disease levels were also high in an unfavorable season 2012 as a result of some inadvertent treatment omissions at 16-21 days after full bloom when the season subsequently became favorable0.

In one of 10 mid Sacramento Valley blocks in 2018 kasugamycin (32 oz of 2% material) was used once EOR 50 gal/acre.

For the last 7 years or so, delayed dormant copper treatments (at higher treatment levels than used during the bloom season (have been applied to Bartlett pears with oils just prior to green tip in the mid SacramentoValley district and partially in the North Coastal mountain district to blocks with higher blight experienced the previous year, especially in blight sensitive varieties like Bosc and Starkrimson. Research has shown that in 3 of 4 seasons of trial that the treatment delayed the epiphytic population development in blossoms, later (34).

The Mid-Sacramento Valley district has enjoyed the most favorable fire blight conditions over the years. Lower in the Sacramento Valley near Walnut Grove, closer to the gap in the coastal range that is the outlet to San Francisco Bay, more winter-chilling fog and cooler sea breezes create a typically earlier and crisper bloom situation with lower temperatures that have resulted in historically less fire blight. In spite of this, 2015 and 2018 resulted in predictably the worst blight in the state in this district. Part of the problem likely was that these conditions had not surfaced as severely for 11 years previously, and some may have become accustomed to an easier blight environment. Resistance to both streptomycin and oxytetracycline are known in the district (26). New copper materials were also used that are far lower in MCE than those used successfully in the 1970's, and may have received their first real test.

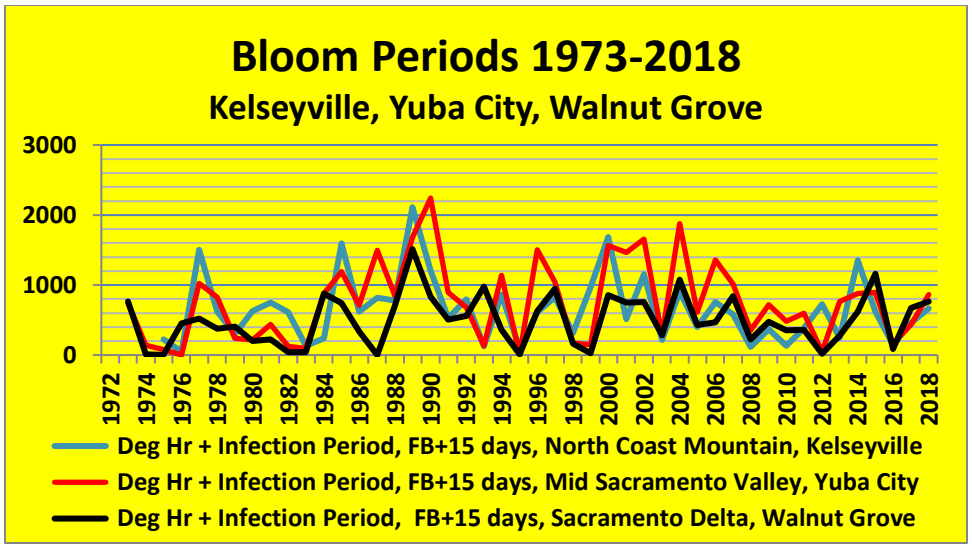

Figure 7

Figure 7. The maximum degree hours 1973-2018 coinciding with rain or warm dew (simultaneous 57°F and 90% RH) infection periods during the critical bloom period through 15 days past full bloom is graphed for comparison of three pear districts, North Coastal Mountain (Kelseyville), Mid-Sacramento Valley (Yuba City) and Sacramento Delta (Walnut Grove).

In the North Coastal Mountain district around Kelseyville, the bloom + infection period conditions are also generally much lower than the Mid-Sacramento Valley, especially when it is considered that treatment thresholds are 100 degree hours less than in the valley districts. Typically excellent winter chilling results in narrow bloom periods that progress with less heating. It is probably also helpful that blight cankers may need more time to become active in the spring under these conditions (35).

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Epidemiology of Botrytis spp. of Pome Fruit in the Pacific Northwest

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Keywords: organic, preharvest, wetness, management, gray mold

Abstract: *Botrytis cinerea* is the major species infecting apples and pears in the Pacific Northwest. The fungus infects flowers and fruits in the orchard but because of the relatively dry summers in the region, infections remain latent until gray mold symptoms develop after several months of cold storage. In an effort to enhance current management practices, we undertook a study to better understand the epidemiology of *B. cinerea* in the PNW pear and apple orchards and its impact on gray mold development in storage. In 2018, experiments were conducted in 4 commercial apple orchards and 2 pear orchards in central Washington and 2 pear orchards in Hood River, Oregon. For each crop, two conventional and two organic orchards were included. Samples (flowers and fruits) were collected four times from bloom to harvest and subjected to qPCR assays to detect and quantify *B. cinerea* latent infections. Preliminary results indicate that pear fruit from Hood River, OR are more prone to botrytis infections because of the relatively wetter growing season, suggesting a more important role of wetness in infections. However, pear and apple fruit collected from central Washington were also infected. As expected, organic orchards yielded more infections than conventional orchards. Overall, inoculum loads of *B. cinerea* decreased between bloom and fruit set and then increased afterward until harvest. These findings will help enhance current management recommendations.

Gray Mold Storage Rot Management in Pears

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Keywords: *Botrytis cinerea*, gray mold, chemical control

Abstract: Gray mold caused by *Botrytis cinerea* is the common postharvest rot disease of pome fruits in WA and OR. In a survey conducted in 2017 and 2018 in southern Oregon, isolates of *B. cinerea* were retrieved from bud break to fruit set stages of fruit development. In an effort to establish bloom time fungicide program for gray mold management, three registered fungicides with active ingredient cyprodinil, triflumizole, dodine, and one nonregistered fungicide, iprodione were tested for their efficacy to control gray mold on Bosc pears. The fungicides were tested in both plate and fruit assays. Twenty *B. cinerea* isolates were tested against four fungicide concentrations, 0.01, 0.1, 1, and 10 µg/mL for mycelial growth on artificial media plates and compared to growth on non-fungicide plates. The effective concentration to reduce radial growth by 50% (EC50) was calculated for each pathogen-fungicide combination. On fruit assays, sensitivity of the same isolates were tested against the maximum labeled rate of each fungicide on wound inoculated fruits. The EC50 for isolates against cyprodinil, triflumizole, dodine, and iprodione ranged from 0.86 to 25.63, 0.38 to 1.53, 68.35 to 691.6, and 0.53 to 1.32 µg/mL respectively. Based on fruit assays, 25% of the isolates had reduced sensitivity to cyprodinil, 70% to triflumizole, 35% to dodine, and none to iprodione. These results suggested a possibility of indirect selection of resistant *B. cinerea* population to fungicides used against pear scab, and also a sensitivity to new group of fungicide with a possibility of inclusion in a fungicide rotation program.

Evaluating Alternative Strategies for Apple Replant Disease Control

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Keywords: replant disease, mustard meal, anaerobic disinfestation

Abstract: Past research has shown that mustard meal and anaerobic disinfestation perform as well as fumigation in the control of replant disease in the short-term and out-perform fumigation over time. This project scales-up mustard meal and anaerobic disinfestation to the field scale in order to evaluate the efficacy of these treatments across variable orchard soils and investigate practical application and economic viability. In 2017 a 12-acre trial with one-acre replicates was implemented in Royal City WA. In 2018 one-acre trials were implemented in Rock Island and Tonasket WA. Application methods and preliminary results will be discussed.

Mid-Columbia Survey for Little Cherry Diseases

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Keywords: sweet cherry, survey, virus, phytoplasma, little cherry disease, X-Disease, *Little cherry virus 1*, *Little cherry virus 2*, *Candidatus* Phytoplasma pruni

Abstract: Little cherry disease is caused by three pathogens, *Little cherry virus 1, Little cherry virus 2*, and *Candidatus* Phytoplasma pruni (also known as X-Disease or Western X-Disease). Since 2010, *Little cherry virus 1* and *2*-induced little cherry disease has been known to occur in Washington. Historically, only little cherry disease caused by *Candidatus* Phytoplasma pruni has been reported in Oregon. Little cherry disease symptoms were observed in Oregon during a statewide survey for viruses on sweet cherry conducted in 2016-2017. Due to the close proximity and interactions between the Washington and Oregon sweet cherry production industries, it was unclear which pathogens were associated with the diseases observed. A subsequent survey was conducted in order to identify how prevalent the diseases were in Oregon's most prominent commercial production region, the Mid-Columbia, as well as the causal agent(s). Samples were collected in Mosier, OR; The Dalles, OR; and Dallesport, WA, from trees expressing symptoms of little, immature fruit at harvest and diagnosed for *Little cherry virus 2* and *Candidatus* Phytoplasma pruni using specific and general real-time PCR assays, respectively. Of the 27 symptomatic samples collected, 27 tested positive using a general phytoplasma real-time PCR assay, indicating that the little cherry disease observed in the region in 2018 was phytoplasma-induced. The survey will be continued in 2019 to target different areas in the region, including Hood River, OR and White Salmon, WA.

Fruit Tree Disease Update from the OSU Plant Clinic

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Keywords: pome fruit, stone fruit, hazelnut, fungal disease, diagnosis, canker diseases

Abstract: Over the past five years, the OSU Plant Clinic had diagnosed several fungal diseases of hazelnuts, pome- and stone fruits on trees originating from Oregon and Washington. None of these diseases had been reported at the time we found them. The pathogens responsible included *Cryptosphaeria pullmanensis, Cytospora chrysosperma, Botryosphaeria obtusa*, *B. stevensii, Eutypa laevata, Lasiodiplodia* and *Sclerotium rolfsii* on apple; *Gymnosporangium sabinae* and *Cylindrocarpon* on pear; *Calosphaeria pulchella* on sweet cherry and peach; *Anisogramma anomala* on Turkish hazelnut; and *Botryosphaeria, Valsa,* and *Diaporthe* on European hazelnut. Correct identification of plant diseases, especially ones not previously reported, is the first step towards an efficient disease management plan. It can also provide valuable information on what the alternate host species, if any, might be.

Efficacy of an Intelligent Sprayer on Powdery Mildew

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Keywords: powdery mildew, *Erysiphe necator*, grape, *Vitis vinifera*, Pinot Noir, Microthiol Disperss, sulfur

Abstract: The Intelligent Sprayer Project consists of a multi-discipline research team across the USA 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. A Rear's 50 gallon Pak-blast sprayer was retrofitted in 2018 with ISS components and, in consultation with vineyard managers, four sulfur treatments were evaluated in a block of 'Pinot Noir'. After a single season, the intelligent spray system did not control powdery mildew on leaves or clusters as well as a standard sprayer. Factors that contributed to this result included severe powdery mildew pressure, use of the non-systemic fungicide sulfur and use of initial ISS settings. Spray card coverage was similar between treatments which indicated the main factor was low spray volume (not enough sulfur/acre) applied with the ISS. Future trials should test higher PWM duty cycles by setting the spray volume higher or use of more concentrate fungicide solutions. With some minor adjustments the ISS should prove to be an effective system to reduce pesticide quantity, water and/or labor.

Invasive Species—

Moderator: Rick Hilton (OSU)

BMSB and IPM in Southern Oregon: an Irresistible Fruit Meets a Movable Insect

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Keywords: chlorantraniliprole, brown marmorated stink bug, codling moth, *Cydia pomonella*, *Halyomorpha halys*, methoxyfenozide, tebufenozide

Abstract: IPM programs in pear orchards rely on selective control of key pests such as codling moth. Mating disruption and granulosis virus are highly selective and can be used to manage codling moth but, in some cases, may need to be supplemented with additional control measures. The diamides, e.g., chlorantraniliprole, can provide substantial control of codling moth with minimal disruptive effects to natural enemies. However, overreliance on one chemistry, particularly treating successive generations of codling moth, is a practice that is widely discouraged. In 2018, two currently registered insect growth regulators, methoxyfenozide and tebufenozide (IRAC group 18—ecdysone receptor agonists), were tested at the SOREC research orchard in replicated trials for control of 1st generation codling moth in Bartlett pears. While both IGRs significantly reduced codling moth damage compared to an untreated check, they were not as effective as chlorantraniliprole.

Brown marmorated stink bug (BMSB) was initially found in southern Oregon in 2012, since then BMSB populations have been increasing but BMSB was only recently been observed in pear orchards. Over the past few years, true bug damage has seemingly been on the increase in southern Oregon pear orchards using an IPM approach. It was assumed but not positively proven that some of this true bug feeding was due to BMSB. In 2018, fruit deformation resembling stony pit in pears was observed in multiple pear orchards using an IPM program. This damage was found across all pear cultivars, often along an orchard border, and is presumed to be the result of feeding by BMSB on fruit that is at an early stage of development. The potential discovery of serious BMSB damage to fruit in pear orchards using an IPM approach may require fundamental changes in those IPM programs as we attempt to successfully manage BMSB in a manner that minimizes disruptive effects on natural enemies.

Improved Trapping for Brown Marmorated Stink Bug Using Long Lasting Insecticide Netting (LLIN)

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Keywords: Stink bug, trapping, monitoring,

Abstract: Brown marmorated stink bug (BMSB) response to the aggregation pheromone used to bait traps often results in individual stink bugs not getting close enough to be captured. Thus, we explored the use of traps that employ long-lasting insecticidal netting (LLIN) to retain attracted bugs. LLIN traps were constructed using deltamethrin-impregnated netting zip tied to a shepherd's crook style post or attached to a wooden stake capped with a plastic cup. Weed barrier cloth was secured into the ground directly under the netting to provide a vegetation-free zone for nymphs to crawl onto the trap and for dead individuals to be readily visible. We compared catch at two heights by draping the fabric over a tall (84") or short (48") shepherd crook post. The potential effect of attractant potency was examined by baiting

traps with either one high-dose BMSB dual-component lure or three dual-component lures. Results revealed that height does not impact captures of BMSB in the LLIN trap, while higher lure potency increases catch. However, the increase in catch likely does not justify the added cost of using multiple lures. A better approach would be to use multiple traps baited with a single lure. We also compared the performance of the LLIN trap to the two most commonly deployed traps, the pyramid or panel. In the same study, we examined the effect of trap placement in relation to the crop-wood edge interface on captures of BMSB in the three trap types. In 2017, LLIN traps killed about twice as many BMSB per week compared to catches in nearby pyramid traps. In 2018, LLIN and pyramid traps captured similar numbers of stink bugs and both were substantially more effective than the panel trap. Female BMSB captures were especially low in the panel trap. Placing traps between the wood and orchard edge was the optimal position. Traps within the orchard had the lowest captures. The LLIN trap shows considerable promise for monitoring and also managing BMSB via mass trapping, however additional research is needed to optimize the design.

Fickle Flaps of Fate: Building a Better Stink Bug Trap

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Keywords: brown marmorated stink bug, *Halyomorpha halys*, ghost trap, poncho trap, pears, apples, deltamethrin, AgBio

Abstract: Attract-and-kill strategies for managing the brown marmorated stink bug, *Halyomorpha halys*¸ are under investigation as promising components of sustainable IPM programs. Of particular interest are traps combining BMSB pheromone lures with insecticide-infused netting, as these have the potential for substantial control without the need for insecticide sprays. These “ghost traps” or “ghost nets” are typically simple posts or planting hooks draped with pyrethroid-infused netting; their efficacy in an orchard environment is under investigation by several researchers in the mid-Atlantic states. While ghost traps appear highly effective at attracting and killing BMSB when deployed in and around orchards, their open structure is not optimal for retaining insects killed by the netting. Here we introduce a novel trap design developed to increase trap capture retention while improving overall efficacy. This design, nicknamed the “poncho trap,” incorporates panels of deltamethrin netting (AgBio) with sewn-in flaps that capitalize on the negatively geotactic behavior of stink bugs landing on vertical surfaces. This netting is draped over a frame of T-posts and suspended over retention tubs. We compared BMSB and non-target trap captures of poncho traps with a ghost-type trap design in an orchard experiencing confirmed BMSB damage in southern WA State. Significantly greater numbers of BMSB and non-target arthropods were recovered from poncho traps than from ghost traps; we hypothesize that the flap component of the poncho traps increase the time spent in contact with the insecticide netting, thereby increasing the likelihood of a lethal dose. Additionally, we observed high numbers of captured boxelder bugs (Rhopalidae) and conifer seed bugs (Leptoglossus occidentalis: Coreidae), and we suggest that components of the BMSB dual lure mimic late-season aggregation pheromones for these two species.

One Flew Over the Shade Net: Developing Stink Bug Exclusion Tactics

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Keywords: Migration, behavior, barriers, shade cloth, insecticide infused netting, brown marmorated stink bug, *Halyomorpha halys,* consperse stink bug*, Euschistus conspersus, Thyanta pallidovirens,* Conchuela bug, *Chlorochroa ligata*.

Abstract: Growers in North Central Washington have experienced high levels of stink bug induced damage to their crops over the past two decades. The historical management practice for stink bugs consists of a single broad spectrum insecticide application in late summer. Treatment is timed around senescence of the natural vegetation, which is believed to be when the bugs begin to migrate into orchards. The use of these nonselective insecticides has led to severe outbreaks of secondary pests such as spider mites and woolly apple aphids. In an effort to improve current management strategies we aim to determine migration behavior of stink bugs and implement mechanical exclusion techniques. During the 2017-2018 field seasons, we conducted two experiments to determine migration timing, height, and the efficacy of a net barrier to exclude stink bugs from apple orchards using 5 sticky barriers (2 × 3 meters) and three shade net barriers (3 × 50 meters). Results from both years found that stink bugs move between the orchard and the vegetation multiple times throughout the year starting as early as June, which opposes the traditional idea of one migration in August. There was a significant difference in height of flying, with the majority of stink bugs moving into the orchard above one meter and below 4 meters from the ground. The net barrier exclusion trial did not significantly affect stink bug densities in the orchards. However, it did intercept migrating stink bugs.

Characterization of Brown Marmorated Stink Bug (BMSB) Feeding Damage in California Almonds

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Keywords: brown marmorated stink bug, *Halyomorpha halys,* almonds, Nonpareil, California

Abstract: Brown marmorated stink bug (BMSB), *Halyomorpha halys* (Stål), is an invasive insect pest, causing a severe economic loss to several crops in much of the United States. In California, BMSB has been established in more than 15 counties, mostly in urban and residential areas. In the northern San Joaquin Valley of California, we reported the infestation of BMSB in peach in 2016 and almond in 2017. These are the first reports of BMSB in California agricultural crops including a new host, almond-a five-billion-dollar crop. In 2018 season, we found BMSB infestations in several new locations in almonds indicating the spread of BMSB to a much wider geographic area. We conducted a temporal feeding study to assess the extent of the damage that BMSB can do to developing nuts during the different times of the year using exclusion cages. The study was conducted in two varieties, Nonpareil and Monterey. Nine cages were infested with 3 BMSB adults/cage on a weekly basis from the last week of March through August (18 weeks for Nonpareil, 22 weeks for Monterey). The results showed that BMSB could do injury to the fruit and kernel except for the last 1-2 weeks of the fruit development. Majority of the nuts during the early stage were dropped, while mid-to-late season infestation resulted in damage to the kernel (gumming,

multiple dark spots, dimpled/depressed nuts, shriveled nuts). This information is critical for the development of effective monitoring and management plans targeting the brown marmorated stink bug in almond in California.

A Food-Grade Behavior Disruptor as a Management Tool for *Drosophila suzukii*

Marco Valerio Rossi Stacconi[1], Ryan Chave[1], Rachele Nieri[1], Rachel Blood[1], Jeff Yeo[1], Kyoo Park[1], Gabriella Tait[1], Clive Kaiser[2], Linda Brewer[1], Daniel Dalton[1], Alberto Grassi[2], Gianfranco Anfora[2], & Vaughn M. Walton[1]
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Keywords: Insect behavior manipulation, Integrated Pest Management

Abstract: Spotted-wing drosophila, *Drosophila suzukii*, is a worldwide pest of soft-skinned and small-fruit. This species is able to utilize different habitats and substrates for both nutrition and reproduction. This capacity can be attributed to multiple olfactory cues, a topic of multiple investigations. The current study aimed to investigate how insect behavior changed in the presence of the behavior disruptor. The behavior disruptor resulted in significant changes in *D. suzukii* activity in controlled laboratory studies. We recorded a significant reduction in egg laying in controlled field trials on blueberry, cherry, raspberry, winegrape, and strawberry. Small and large-scale field trials were conducted over periods of 2.5 to 21 days. Fruit exposed to predetermined *D. suzukii* populations in commercial-standard field settings displayed up to 76% reduction in damage. These findings were consistent irrespective of fruit type or environmental conditions.

These results indicate that the behavior disruptor significantly alters *D. suzukii* behavior to ultimately result in reduced damaged fruit. This reduction is due to a combination of altered behavior and the division of reproductive resources. These changes ultimately result in less fruit damage. The behavior disruptor can potentially result in significant reduction in insecticide dependence in all of the susceptible crops.

Chemical Control/New Products—

Moderator: Louie Nottingham (WSU)

Host Defense Chemicals as a Repellent to Ambrosia Beetle Infestations in Apples

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Department of Entomology, Cornell AgriTech at NYSAES, Geneva, NY

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

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 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 2018, 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. Additionally, individual ethanol lures were attached to each tree to increase their attractiveness to the beetles. The preventive treatments included different topical formulations and rates of verbenone alone and combined with methyl salicylate, a host defense and signaling compound. Trunk and tree damage was assessed among the different treatments in early July and at the end of August, to determine what effect these repellents had in preventing attacks by this ambrosia beetle. All the repellent treatments had fewer infestation sites than the untreated checks, and the combined verbenone+methyl salicylate treatments had the lowest incidences of galleries containing adults or brood.

Dimilin® 2L for Control of Overwintering Generation of Codling Moth and Increased Yield on Walnuts, 2015-2018

Darin B. Allred[1], Robert A. Van Steenwyk[2], and Barat Bisabri[3]
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[3]Barat Bisabri, Bisabri Ag Research & Consulting, Newman, CA

Keywords: Dimilin® 2L, diflubenzuron, ReTain®, (S)-trans-2-Amino-4-(2-aminoethoxy)-3-butenoic acid hydrochloride, walnut, yield enhancement, codling moth, *Cydia pomonella*, overwintering generation, provisional patent

Abstract: A study was conducted in a commercial 'Payne' walnut orchard near Tracy, CA for control of overwintering generation of codling moth (CM). Treatments were replicated five times in a randomized block design. Each replicate consisted of 5 acres. Treatments were Dimilin® 2L at 8 fluid ounces per acre plus the walnut blight spray and the walnut blight spray alone. The treatments were applied using the grower's PTO driven air-blast sprayer at 100 gallons per acre on March 21, 2015 and April 5, 2015. CM infested dropped nuts were evaluated May 13, May 20, June 3, June 18, and June 30, 2015 from five center trees in each replicate. There were significantly fewer cumulated CM infested dropped nuts per tree in the Dimilin® plus the walnut blight spray treatment compared to blight only treatment. A second study was conducted in a commercial 'Tulare' walnut orchard near Hamilton City, CA to evaluate the effect of Dimilin® in a tank mix with the walnut blight sprays on yield. Two treatments were replicated six times. Each replicate consisted of six trees wide by 14 trees long (1.5 acres). The treatments were Dimilin® 2L at 8 fluid ounces per acre plus the walnut blight spray and the walnut blight spray alone. The treatments

were applied on March 18, March 29, and April 5, 2016 at 50 gallons per acre using a skip-row technique. These applications targeted bloom from 1 to 100% catkin elongation. The number of CM infested dropped nuts was evaluated on May 27, 2016 from five center trees in each replicate. There was no significant difference between the two treatments in the number of CM infested dropped nuts. Commercial harvest was on September 23, 2016, nut weight was taken from two center trees per replicate. The Dimilin® plus walnut blight spray treatment significantly increased yield compared to the walnut bight spray alone. A third study was conducted in 2017 in a commercial 'Chandler' walnut orchard in Newman, CA, which compared Dimilin® 2L at 8 fluid ounces per acre to ReTain® at 11.7 ounces per acre and an untreated check. Dimilin® and ReTain® significantly increased yield compared to the untreated check and Dimilin® and ReTain® were statistically equivalent. A fourth study was conducted in 2018 in a commercial 'Tulare' walnut orchard in Hamilton City, CA. This study was a 100-acre split plot design with 4 and 5 subsamples of commercially harvested trailer loads as replicates. Treatments were Dimilin® 2L at 8 fluid ounces per acre plus the walnut blight spray and the walnut blight spray alone. The treatments were applied using the grower's GVF 10,000 Sonic Sprayers at 100 gallons per acre using a skip-row technique on April 17, and April 24, 2018. Dimilin® plus the walnut blight spray treatment significantly increased yield compared to the walnut bight spray alone. A provisional patent for Dimilin® 2L for yield increases on walnuts was submitted on February 16, 2018.

Can Codling Moth Granulosis Virus Also Control *Cydia latiferreana*?

Heather Andrews, Anthony Mugica, Erica Rudolph, and Nik Wiman
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Keywords: filbertworm, *Cydia latiferreana,* codling moth granulosis virus, hazelnut

Abstract: Filbertworm, *Cydia latiferreana* (Walsingham), is the primary direct pest of European hazelnut (*Corylus avellana* L.) grown in the Willamette Valley, Oregon where the majority of the US crop is produced. This native tortricid moth is easy and inexpensive to manage with pyrethroids (mainly β-cyfluthrin) timed according to a phenology model, but there are hidden costs to pyrethroid reliance including secondary pest problems. The nascent organic hazelnut industry in Oregon has had serious challenges managing this pest, as there are few products available and there is overreliance on spinosad. Filbertworm damage will continue to limit the organic sector of the industry until better options are available. Given the similarities between filbertworm and codling moth (*Cydia pomonella* L.), we adapted organic codling moth pest management strategies for apples to filbertworm management in hazelnuts. These tactics included cover sprays of the codling moth granulosis virus (CpGV), which is reported to be highly specific to codling moth, but also has activity against pea moth (*Cydia nigricana* F.). Other untested organic materials we examined included horticultural oils alone and with spinosyn products, and kaolin clay. We also examined softer conventional chemistries such as diamides, which could minimize impact on natural enemies.

Control of Codling Moth and Navel Orangeworm in Walnuts

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Keywords: codling moth, *Cydia pomonella* L., navel orangeworm, *Amyelois transitella*, twospotted spider mite, *Tetranychus urticae*, walnut aphid, *Chromaphis juglanicola*, Altacor 35WG, Intrepid Edge, Delegate 25WG, Assail 30SG, Enkounter, Agrimek 0.70SC, Intrepid 2F, chemical control, insecticides

Abstract: A field study was conducted in a walnut orchard near Tracy, CA to evaluate the efficacy of Altacor 35WG, Intrepid Edge, Altacor 35WG + Delegate 25WG, Enkounter + Altacor 35WG + Assail 30SG, Altacor 35WG + Enkounter + Assail 30SG, Altacor 35WG + Altacor 35WG combined with Agrimek 0.70SC + Delegate 25WG + Intrepid 2F against an untreated check. Seven treatments were replicated four times in a randomized complete block design with each replicate being an individual tree. Chemicals were applied with a hand-held orchard sprayer operating at 250 psi with a finished spray volume of approximately 250 gal/acre. Degree-day (DD) timings were used to determine application dates. Adult codling moth (CM) were monitored weekly with pheromone traps from 7 Mar to 11 September. CM infested dropped nuts were monitored weekly from 24 May to 14 June. One-hundred and twenty-five nuts per replicate (500 nuts per treatment) were collected and inspected for CM and navel orangeworm (NOW) infestation. Altacor 35WG and Intrepid Edge provided significantly better control of CM and NOW compared to the grower standard and the untreated check. Twospotted spider mite and walnut aphid were monitored weekly for three weeks after treatment applications by sampling 10 leaves per tree. There was no statistically significant difference between treatments.

Control of Walnut Husk Fly with Venerate in English Walnut

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Keywords: walnut husk fly, *Rhagoletis completa*, Venerate XC, GF-120, Entrust 2SC Molasses NuLure, chemical control, insecticides

Abstract: A field trial was conducted in a Chandler organic walnut orchard to evaluate the efficacy of Venerate XC at 2 and 4 qt/acre with and without molasses, Venerate XC at 2qt/acre with NuLure, Venerate XC at 2 qt/acre with GF-120 and molasses, Entrust plus molasses and molasses alone (check). The trial was conducted on a mature walnut orchard near Hilmar, CA with an extremely high overwintering walnut husk fly (WHF) population. Eight treatments were replicated six times in a RCB design. Treatments were applied using a hand-held orchard sprayer operating at 250 psi with a finished spray volume of 250 gal/acre. Application dates were: 17 July, 2, 16 & 29 August & 13 September. Adult WHF were monitored with two ammonia carbonate "supercharged" yellow apple maggot panel traps. The traps were placed in the orchard on 27 June and were monitored weekly from 6 July through 13 September. The traps and the ammonia carbonate bait were replaced weekly. Mid-season evaluation was conducted on 21 August. A minimum of 100 nuts were visually inspected for WHF infestation. The nuts were not removed from the tree as not to influence the final infestation evaluation. Prior to harvest at nut checking on 25 September, a minimum of 100 nuts per replicate were evaluated for WHF infestation. The nuts were removed from the trees and dissected to determine WHF damage and presence. In the mid-season evaluation, Venerate XC at 2 and 4 qt/acre alone, Venerate XC at 2 qt/acre with NuLure and Venerate XC at 2 qt/acre with

Entrust 2SC and molasses provided significantly lower infestation compared to the molasses check. Also Venerate XC at 2 qt/acre with NuLure and 4 qt/acre alone had significantly lower infestation compared to Venerate XC at 2 and 4 qt/acre with molasses. It appears that molasses reduced the efficacy of Venerate XC while NuLure increased the efficacy. However, previous laboratory studies showed greater feeding activity from molasses compared to NuLure. When the pH of the spray solution was determined, the pH spray solution of Venerate XC with 4% molasses using the growers water was 4.8 while the pH spray solution of Venerate XC plus 0.375% NuLure using the growers water was ca. 5.7, which would indicate that Venerate XC stability is adversely affected by the lower pH. The final evaluation showed similar result as the mid-season evaluation. Future research will examine the effects of pH on Venerate XC and Entrust 2SC.

Combining Trunk Injections of Systemic Insecticide and Fungicide in Apple to Simultaneously Control Foliar Pests and Apple Scab

Charles Coslor, Christine Vandervoort, and John Wise
Department of Entomology, Michigan State University, Lansing, MI

Keywords: apple, apple scab, *Venturia inaequalis,* obliquebanded leafroller, *Choristoneura rosaceana*

Abstract: Trunk injections reduce pesticide inputs and environmental exposure in trees, and recent work has addressed apple production systems. Insecticides and fungicides have been demonstrated for apple tree injection, however combinations of the two have not yet been tested. Trunk injections of the systemic insecticide emamectin benzoate and systemic acquired resistance (SAR) fungicide phosphorous acid were performed on mature apple trees to combine management strategies for foliar insect pests and apple scab (*Venturia inaequalis*). Injections of emamectin benzoate followed by phosphorous acid into the same set of injection ports resulted in higher mortality of *Choristoneura rosaceana* larvae and lower incidence of apple scab compared with untreated trees. Scab incidence on trees in which phosphorous acid was injected into the same set of ports before emamectin benzoate were not different from untreated trees early in the growing season. Injections of emamectin benzoate and phosphorous acid into the same holes in either order showed higher mortality and reduced larval feeding in *C. rosaceana* bioassays compared with products injected into separate holes. This study demonstrates that two pesticides can interact dynamically within the vascular system of a tree, which has important implications for expanding the utility of trunk injection for fruit tree management.

Control of Peach Twig Borer in Almonds

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

Keywords: peach twig borer, *Anarsia lineatella*, Intrepid 2F, PureSpray Green, Proclaim 5SG, Besiege 1.25ZC, Minecto PRO, Enkounter, chemical control, insecticides

Abstract: A field study was conducted in a second leaf Independence almond orchard near Hickman, CA to evaluate the efficacy of Besiege 1.25ZC at 12.5 fl oz/100 gal, Minecto PRO at 12.0 fl oz/100 gal, Proclaim 5SG at 4.8 oz/100 gal, Intrepid 2F at 16.0 fl oz/100 gal (conventional grower standard), Enkounter at 20.0 fl oz/100 gal, PureSpray Green horticultural oil at 1.5 gal/100 gal against an untreated check. Seven

treatments were replicated six times in a randomized complete block design with each replicate being an individual tree and a buffer tree between each treatment. Chemicals were applied on 8 May (391 DD from biofix) with a hand-held orchard sprayer operating at 200 psi with a finished spray volume of 50 gal/acre. Adult PTB were monitored weekly with pheromone traps placed in the orchard from 1 March to 12 June. PTB infested "flagged" shoots were monitored weekly from 18 May to 12 June. One hundred "flagged" shoots were dissected to determine percent infested by peach twig borer (PTB) and oriental fruit moth (OFM) larvae. Twenty-one PTB and 2 OFM larvae were observed in the "flagged" shoots. Proclaim 5SG, Besiege 1.25ZC, Minecto PRO, Enkounter, and Intrepid 2F had significantly better control compared to PureSpray Green horticultural oil and the untreated check.

Biology/Phenology—

Moderator: Betsey Miller (OSU)

Battling Blasted Buds: Monitoring and Efficacy Trials of Big Bud Mite in Hazelnuts

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

Keywords: *Phytocoptella avellanae*, *Cecidophyopsis vermiformis*, big bud mite, hazelnut, monitoring, acaricide

Abstract: Phytocoptella avellanae and *Cecidophyopsis vermiformis* are microscopic eriophyid mites that cause damage to developing hazelnut buds and are commonly referred to as "big bud mites". Damage caused primarily by *P. avellanae* manifests as enlarged, split buds termed "blasted buds" or "big buds". To date, broad-spectrum acaricides are often sprayed on a calendar basis, or when trees appear to have numerous blasted buds; however, this approach may not be entirely effective if applications do not coincide with bud mite migration, when adults and juveniles are most exposed to residues. This migratory period varies with environmental conditions and currently there are no definitive guidelines delineating the optimal time to spray for bud mites in the Pacific Northwest (PNW). Traps can be used to estimate when the migration occurs, but are very labor intensive and are not often utilized by growers. A predictive phenology model to guide management should be possible, and our goal is to generate the necessary data. We collected phenology data from 2016-2018 to develop a migration curve. Though broad-spectrum acaricides can effectively combat big bud mites with optimal timing, it is also important to rotate with different products that use different modes of action to reduce the likelihood of resistance development. In addition to investigating a migration curve, we also tested the efficacy of different acaricides that may be more effective and specific to big bud mites, therefore lessening the risk of secondary pest outbreaks.

Pacific Flatheaded Borer, an Old Problem for Orchard Establishment Revisited

Nik Wiman, Anthony Mugica, Heather Andrews, Aaron Heinrich, Erica Rudolph, and Tatum Keyes
Oregon State University, North Willamette Research and Extension Center, Aurora, OR

Keywords: Buprestidae, *Chrysobothris mali*, hazelnut, phenology, biocontrol, cultural control, chemical control

Abstract: Flatheaded borers (Buprestidae) are an increasing threat to ornamental, forest and orchard trees with climate change. In the Pacific Northwest, the Pacific flatheaded borer (PFB) has reemerged in recent years and has become the most significant insect pest of new hazelnut plantings (currently averaging 5,000+ acre/year planted in the Willamette Valley). The borers exploit establishing trees that may be stressed or damaged. Adult females lay their eggs on the trunks of the trees, often close to the soil line or in the lower 60 cm of the trunk. The larvae feed on the cambium layer and can girdle the tree. Loss of trees for first leaf orchards with this problem is often 30% with some growers experiencing far greater loss. Both painted trunks and trunks with plastic trunk guards are attacked. Our program has been examining the phenology of PFB as existing resources are either incorrect or apply poorly to the environment west of the Cascades. Information on the flight period is necessary to manage the pest successfully. Trial work to evaluate management tactics has proven very challenging because borers are attracted to unknown stress signals from the tree and PFB attacks are difficult to predict. In 2017, we attempted to stress potted trees by drowning their roots with limited success. Inadvertently, in another

project, we discovered that planting bare root trees late in spring after bud break seemed to attract borers. For 2018 we successfully utilized this approach to test PFB management tactics in a plot at the North Willamette Research and Extension Center (NWREC), and at a grower cooperator's orchard. We discuss cultural and biological controls for PFB, and chemical management approaches where our goal is to find the simplest and most effective treatment.

Using Transcriptomics to Understand Pear Psylla Behavior and Ecology

W. Rodney Cooper[1], Karol Krey[1], William Walker[2], Steven Garczynski[1], and David R. Horton[1]
[1]USDA-ARS, Wapato, WA, [2]Swedish University of Agricultural Sciences, Uppsala, Sweden

Keywords: pear psylla, *Cacopsylla pyricola*, winterform, behavior

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. Biology of the winterform morphotype also changes seasonally, in this case between diapausing and post-diapause portions of its lifecycle. Post-diapause winterforms during the re-entry period are highly attracted to pear but are not attracted to the color of foliage, while diapausing winterform often emigrate from pear after leaf-fall to settle on various non-pear shelter plants including visually attractive evergreens. Although these differences in behaviors among summerform, diapausing winterform, and post-diapause winterform are well-documented, the exact timing of certain shifts in behavior (especially by winterforms) is still unclear. Seasonal changes in gene expression related to biological traits have not been studied for pear psylla, even though this sort of information has proven highly useful to examine seasonal or other life-cycle shifts in behavior or physiology by other insect species. Researchers at the USDA-ARS and the Swedish University of Agricultural Sciences compared gene expression among summerform, diapausing winterform, and post-diapause winterform pear psylla. These comparisons will help us better understand differences between these three seasonal populations of psylla in attraction to pear and to foliage colors, susceptibility to insecticides, and onset of winterform diapause break.

Why and How to Conserve or Suppress Omnivorous Earwigs in Tree Fruits?

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

Keywords: apple, biological control, chemical control, earwig, *Eriosoma lanigerum*, *Forficula auricularia*, stone fruit, woolly apple aphid,

Abstract: European earwigs are omnivores, so they can eat pests but may also damage plants. This presentation reviews evidence of positive and negative roles for earwigs in pome and stone fruits, and how to suppress or conserve earwigs accordingly. Evidence suggests that earwigs are generally beneficial predators in pome fruits, as they have limited ability to damage apples and pears, but earwigs can be significant pests of stone fruits, which are relatively soft. Timing is crucial in avoiding or targeting management actions (including pesticide use and disturbance of soil) which affect earwig populations, as earwigs nest underground, forage on the ground, or forage in trees at different times of the year.

Rearing of Filbertworm (*Cydia latiferreana*): Successes and Setbacks

Betsey Miller and Vaughn Walton
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Keywords: filbertworm, *Cydia latiferreana*, hazelnuts, rearing, mating, larval survival, emergence, oviposition

Abstract: Filbertworm (FBW) is a key pest of hazelnuts in the Pacific Northwest. The majority of FBW research is conducted on wild populations in the field. For several years, efforts have been made to establish a laboratory colony of FBW so controlled experiments can be conducted to investigate mating and oviposition behavior as well as life table parameters. This year, we are pleased to report that we have successfully reared a complete generation of FBW from wild-collected larvae. Late-instar FBW were reared to adult emergence and mated in captivity. We tested two mating cage prototypes in both the laboratory and the field on a total of 132 mating pairs. The success of each mating scenario will be discussed. Across all mating scenarios, 44 females (33%) successfully mated and laid an average of 23 eggs in a lifetime; the actual number of eggs laid per female ranged from 1 to 206. For the entire cohort, 31% of eggs hatched into viable larvae, while mean viability per female was 16%. Hatched larvae were reared on a bean-based agar diet. Of a total of 346 larvae, 59 individuals (17%) survived to adulthood. Though mating was again attempted, no eggs were laid by the second generation. The varying success rates of the different stages of rearing (and potential contributing factors) will be discussed.

Movement of Navel Orangeworm Males and Females between Adjacent Walnut and Almond Orchards

Charles Burks[1], Jhalendra Rijal[2], and Emily Symmes[3]
[1]USDA Agricultural Research Service, Parlier CA; [2]UC Cooperative Extension, Modesto, CA; [3]UC Cooperative Extension, Oroville, CA

Keywords: navel orangeworm, *Amyelois transitella*, almond, walnut, dispersal

Abstract: The navel orangeworm is the principal insect pest of almond and pistachio and an important pest of walnut. The high flight capacity of the navel orangeworm and the marked expansion of all three of these tree nut crops in recent years makes inter-crop movement of navel orangeworm important to management of damage by this pest in these crops. Adjacent walnut and almond orchards were therefore monitored over the season in 2017 and 2018 in sites in the Sacramento Valley and the northern and southern San Joaquin Valley. Pheromone traps (males only) and pistachio bait traps (gravid females only) were used because it has been suggested that that the female bait traps have a smaller trapping radius and correlate better with crop damage. Analysis of fatty acids extracted from the non-feeding adults from these traps was used to distinguish between moths that had fed as larvae in the crop in which they were trapped ("residents") and moths that fed on a different crop ("immigrants"). For both males and females, there was a high proportion of residents in almond and a high proportion of immigrants in walnut in August and September. These data indicate a tendency toward net movement of navel orangeworm out of almond and into walnut as the almonds are harvested and the walnuts begin to become susceptible to navel orangeworm.

Poster Session

POSTER
Mating Disruption/SIR

Tangler LR Technology, Advanced Mating Disruption that Provides for Rapid and Cost-Effective Application

Chandra Maleckas-Bunker, and Brett Bunker
Ridge Quest Inc., Kent City, MI

Keywords: mating disruption, oblique banded leafroller, Tangler, *Choristoneura rosaceana*

Abstract: Mating disruption is among the most effective biopesticides for managing various lepidopteran fruit crop pests including obliquebanded leafroller (OBLR). Although this tactic has proven to be a viable alternative to insecticides for some key pests in lowering populations, it is yet to be embraced as an economically viable alternative to insecticides. The key problem being moths are trapped in low amounts, but damage still occurs in the block with past OBLR studies. Most recently, studies at Washington State University and Michigan State University have shown that resistance is a possibility in both chlorantraniliprole (active ingredient of Altacor) and spinetoram (active ingredient of Delegate). This shows the importance of a product for OBLR disruption that is an alternative to current products and addresses concerns with fruit damage.

This study tests the efficacy of the Tangler LR mating disruption dispenser for OBLR control in commercial apple orchards. Secondly, leafroller feeding damage analysis to shoots and fruit will be conducted. Lastly, several different application rates of Tangler LR, will be compared with emphasis on providing superior mating disruption and long-term population control.

POSTER
Chemical Control/New Products

IR-4 Program Projects Expand Registrations for PNW Specialty Crops

Michael Horak, Stephen Flanagan, Mika Tolson
UC Davis IR4 Program, Davis, California

Keywords: specialty crop registrations, IR-4 project, invasive pests, expanding registrations, new products, *Corylus maxima*, *Vaccinium corymbosum*, *Prunus avium*

Abstract: The IR-4 Project is the leading submitter of EPA petitions for specialty crop pesticide registrations in the United States. The IR-4 program at UC Davis cooperates with extension and university specialists to develop efficacy data to support IR-4 residue projects. Efficacy data and residue data is developed by WSU, OSU, and the University of Idaho to support caneberries, hops, grass seed, asparagus, pome fruit, filberts, and other PNW specialty crops. Specific examples of Procure ® (triflumazole) on filberts, Delegate (spinetoram) on blueberries, and Mustang Maxx (zeta-cypermethrin) on cherries will showcase IR-4's results and ongoing projects in the PNW.

POSTER
Pathology/Diseases

Biosynthesis of Iron Oxide Nanoparticles via *Skimmia laureola* and Their Antimicrobial Efficacy Against Olive Leaf and Fruit Spot Pathogen *Alternaria alternata*

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Keywords: Iron oxide nanoparticles, *Skimmia laureola, alternaria alternata,* antimicrobial.

Abstract: Plant pathogenic fungi cause economic important diseases in broad range of crops. The management of the orchard diseases heavily depends on pesticides application. The agrochemical use leads to the accommodation of deleterious toxin and pesticides resistance. To overcome the pesticide resistance, in this study, innocuous biogenic iron oxide nanoparticles were synthesized via *Skimmia laureola*. The synthesized nanoparticles were characterized through UV Spectroscopy, Fourier transform infrared spectroscopy, scanning electron microscopy and energy dispersive X-ray spectroscopy. The Scanning Electron Microscopy of the nanoparticles revealed nanorod morphology and average size was 30-250 nm. The fungus growth was significantly inhibited in media containing 4 mg/mL Fe_2O_3-SNPs. Degenerated, concentrated, and shriveled cell wall structures were revealed in scanning electron microscopy. The results demonstrated the biosynthesized nanoparticles have the potential to control devastative plant pathogen.

Minutes of the 92nd Annual Meeting

Orchard Pest & Disease Management Conference
Hilton Hotel, Portland, Oregon
January 10-12, 2018

I. Call to Order

The opening business meeting of the 92nd Annual OPDMC Meeting was called to order by Chair Harvey Yoshida at 9:00 am on January 10, 2018. Chair Yoshida welcomed approx. 200 attendees to the entomology session who presented 49 papers and posters, three featured talks, and one keynote address. Chair Yoshida asked for each attendee to make a brief self-introduction, and then introduced the session moderators. They were:

Biology/Phenology	Louis Nottingham
Mating Disruption/SIR	Chris Adams
Implementation	Larry Gut
Thresholds/Monitoring	Chuck Burkes
Biological Control	Peter Shearer
Invasive Species	Alix Whitener
Chemical Control/New Products	Barat Bisabri

II. Old Business

A. Approval of the 2017 Minutes: Secretary Alston announced that the 2017 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 2017 minutes.
B. Treasurer's Report: Treasurer Nik Wiman presented the 2017 Treasurer's Report (see Treasurer's Report posted at the end of the minutes). There was a call for questions; there were none. It was moved, seconded, and voted to approve the 2017 treasurer's report.

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

III. New Business

A. Executive Director Peter McGhee provided an update on the OPDMC contract with the Hilton Hotel: room prices will increase by $10 next year, AV Technical Services costs have increased significantly, OPDMC registration prices were increased in 2018 to increase our carry-forward balance to catch up on paying Betsy Beers/Chris Sater for meeting support.
B. Committee Assignments:
    a. Nominations: Alan Knight (Chair), Rick Hilton, and Bob Van Steenwyk
    b. Audit: Betsy Beers (Chair), Tim Ksander, and Randy Hansen
    c. Resolutions: Alix Whitener (Chair), Louis Nottingham, and Adrian Marshall
C. Chair Yoshida called for the names of any members that had passed away during the last year.
    a. Lerry Lacey with USDA ARS, Wapato, WA passed in 2017. A moment of silence was given in recognition of Dr. Lerry Lacey.

D. Chair Yoshida provided conference announcements:
    a. Keynote speaker Harvey Reissig, Professor Emeritus, Cornell University will speak at 3:30 pm today, followed by a mixer in the lobby at 5:00 pm.
    b. The poster session will be held during the coffee break on Thursday at 9:45 am.
    c. The featured presentations will be on codling moth control in the Canadian Okanagan Valley by Melissa Tesche today at 11:30 am, and on the food narrative project by Larry Gut today at 2:15 pm. An entomology for fun presentation on state insects and fruits will be given by Rick Hilton on Thursday at 11:30 am.
    d. The disease conference session will be held in Broadway I and II today and tomorrow.
E. Chair Yoshida asked audience members to turn cell phones to the silent mode, and to take conversations into the lobby. He then provided presentation instructions to speakers: presentation length guideline is 15 min; the session moderators will manage talk lengths to allow flexibility for high levels of interest and discussion as needed. Chair Yoshida reminded the speakers of the looming Rubber Chicken Award ☺.

Chair Yoshida called for a motion to close the opening business meeting. It was moved, seconded, and voted to close the opening business meeting.

F. Because the opening business meeting concluded ahead of schedule, Executive Director McGhee took the opportunity to present a summary of results from the member survey conducted in 2017. The major findings included:
    a. A 2-day meeting length was preferred with preferences split between meeting on W-Th vs Th-F. For the next two years, the meeting length will be 2.5 days as this is duration negotiated with the current hotel contract.
    b. Preference to begin the meeting at 9:00 am on the first day, and end in the afternoon or mid-morning of the final day (depending on meeting length).
    c. The most common modes of travel to attend the meeting were airline and vehicle.
    d. Attendees were split on whether or not they like to arrive early/stay late to enjoy the Portland venue.
    e. The Hilton Hotel was rated at 8-9 on a scale of 10 by the majority of attendees.
    f. The AV equipment is considered adequate with the request for a second projection screen in the room to improve ease of viewing (the audience was then requested to rotate our necks to the right, and then to the left to get the kinks out).
    g. Hotel price: $140-150 was deemed the tipping point for seeking a lower cost venue. The hotel rate will be $130 per night in 2019.
    h. There was strong support for free student registration to increase student participation.

G. Other comments/announcements by Director McGhee:
    a. Industry members have requested a way to support the meeting through a donation. This year snacks have been provided at the registration desk.
    b. Some attendees find a conflict between concurrent sessions for entomology and plant pathology. We could speak to the pathology group about formally joining the entomology group, and consider some mixed sessions.

c. The Rubber Chicken Award will continue. We've added a new award this year, the Golden Apple Award, to recognize novel research and an excellent presentation.
d. Director McGhee said he would work on getting a second screen set up.

Chair Yoshida introduced the first session moderator.

IV. Closing Business Meeting

Chair Yoshida called the closing business meeting to order on January 12, 2017, at 10:03 am.

A. Old Business
   a. Secretary Alston gave a summary report of discussions and decisions from the 2018 Board of Directors' meeting held on January 10 at noon:
      i. The contract with Hilton hotel was renewed for two more years (2019 and 2020). There will be an increase in the room rate of $10 per night ($120 in 2018 increasing to $130 in 2019 and 2020).
      ii. Treasurer Wiman presented the updated budget report. OPDMC is in a good financial position after increasing registration fees. We were low on funds at the close of last year.
      iii. The board discussed instituting a firm cut-off date for abstracts of December 5 in 2019 to allow Chris Sater adequate time to prepare and print the proceedings.
      iv. The board discussed ideas of future keynote speakers. If you have a suggestion, please pass it along to a board member.
      v. The board discussed meeting duration. Director McGhee negotiated the same meeting length for 2019 and 2020: 2.5 days starting Wednesday am and ending Friday late morning. A shorter meeting length will be considered for the next hotel contract period: 2.0 days. The number of papers submitted will dictate the meeting duration needed.
      vi. Student registration was free in 2018; OPDMC will continue with this policy. The board is pleased with the positive response of greater student attendance. Director McGhee will try to add a $0 student registration option in the PayPal registration site next year. The printed proceedings cost will remain the same for all attendees, $10.
   b. Treasurer Wiman presented the final treasurer's report (see report posted at the end of the minutes).

B. New Business
   a. Executive Director McGhee discussed the request by industry members to develop ways for them to be more directly involved, participate and contribute to the meeting. A student travel scholarship fund was suggested as a way for industry donations to help support student participation in the meeting. Director McGhee called for a vote on two separate questions:
      i. Accept industry funds to support a student travel scholarship. The motion was made, seconded and approved.

ii. Establish a committee to create the scholarship fund guidelines and oversee dispersal of funds based on an application review process. The motion was made, seconded, and approved.

A committee was set up to establish the travel scholarship guidelines. The committee will develop the fund management and selection process, they will create a member survey to approve the process, and determine term length of committee members. Volunteers for the committee are:

Melissa Tesche (Chair), Barat Bisabri, Alix Whitener, Betsy Beers, Allison Walston, Teah Smith, and Bob Van Steenwyk.

Chair Yoshida called for any other new business.

Peter Shearer commented that text on slides projected in the wide screen format was small in size and difficult to read. He suggested that OPDMC develop presenter guidelines for PowerPoint slides.

C. Committee Reports:
   a. Nominations: Alan Knight, Chair, gave the report. Rodney Cooper, USDA ARS, Wapato, WA, was nominated as Chair-Elect for 2019, Diane Alston as Secretary, Nik Wiman as Treasurer, Peter McGhee as Executive Director, and Betsy Beers as Program Chair. Call for motions and vote to approve the nominations; all officers were voted in.
   b. 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.
   c. Resolutions: Alix Whitener, Chair, gave the report (but alas, no rapping☹). 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. Chair Yoshida called for nominations for the Rubber Chicken Award.
   a. Broc Zoller nominated Lucia Varela 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”.
   b. Peter McGhee nominated Nik Wiman for fumbling his Mac-produced slideshow even after switching to the Mac computer to show it.
   c. Alan Knight nominated Peter McGhee for always starting the meeting with boring business.

E. Chair Yoshida called for nominations for the Golden Apple Award.
    a. Betsy Beers nominated Brianna Price, OSU (Walton Lab) for an engaging and eloquent presentation that showed video of parasitoids feeding.
    b. Barat Bisabri nominated Alex Whitener, WSU (Beers Lab) for an excellent talk.
    c. Pete McGhee nominated Bob Van Steenwyk for being associated with more talks post-retirement than before retirement.
    d. Chris Adams nominated Chuck Burks for being 2nd author on more talks than anyone.

Chair Yoshida asked the award nominees to leave the room and called for a vote on the Rubber Chicken Award. The vote was strongly in favor of Lucia Varela. Lucia had already departed the meeting. Bob Van Steenwyk will deliver the rubber chicken to her. Chair Yoshida called for a vote on the Golden Apple Award. Brianna Price was a strong winner.

F. Chair Yoshida 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. Chair Yoshida announced next year's meeting dates: January 9-11, 2019 at the Downtown Hilton, Portland.
H. Chair Yoshida passed the gavel to the in-coming Chair Art Agnello, who closed the meeting with the pounding of the gavel at 10:56 am.

Respectfully submitted,
Diane Alston, Secretary
Orchard Pest and Disease Management Conference, January 10-12, 2018

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):

- **Rachel Elkins (2001)**, University of Calif., Clear Lake, for using an overhead projector in a digital age.
- **Jay Brunner (2002)**, Washington State University, Wenatchee, for giving one of the looooongest talks in the history of the WOPDMC (Seriously. His 10-minute talk was an hour).
- **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".

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!

New for 2019 is the Student Travel Scholarship Program, in which industry contributions will be pooled and used to support the travel costs of student recipients to attend and participate in OPDMC.

Industry contributions will be accepted in any amount, and sponsors will be recognized in the following categories: Bronze (up to $250), Silver ($251-$500), 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 poster or talk (award preference given to students presenting 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

2019 Student Travel Scholarship Sponsors

Gold Level

CORTEVA™ agriscience
Agriculture Division of DowDuPont™

FMC

SIR

Silver Level

Arysta LifeScience
Innovation. Agility. Results.

Interested in donating for 2020? See https://opdmc.org/home/scholarships/