Arthropod Pest Management in the Lower San Joaquin Valley

Project No.: **ENTO6.Haviland**

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Summary

Every year we make progress regarding IPM programs for California almond producers. This research project has annually helped guide the almond industry to where it is today by identifying reduced-risk insecticides for NOW, spider mites, and ants; by increasing our understanding of biological control of spider mites; and by documenting the role of mating disruption in IPM programs for NOW. During 2018 we received funding for a Pest Management Alliance project that allowed our mating disruption and other navel orangeworm research to be funded through the Department of Pesticide Regulation (reported separately through DPR) such that we could focus our Almond Board project on spider mite control.

Data in 2018 showed that sixspotted thrips, a key predator of spider mites, is active in the spring (mid-April to mid-May), and again after hull split. Research documented that early-season preventative miticide sprays with abamectin have a negative impact on early-season thrips, but that the thrips are able to recover. No differences in thrips density were seen after hull split in orchards that were or were not sprayed with abamectin in May. The prevalence of sixspotted thrips after hull split serves as a reminder to avoid pesticides that can negatively influence the thrips when spraying for navel orangeworm.

Efforts to develop treatment thresholds for spider mites that take into account captures of thrips was thwarted by very low mite densities that failed to reach treatment thresholds in any of our 100-acre research plots during 2018. A miticide trial in a different almond orchard also had relative low mite pressure, but still was able to identify ten miticides that reduced cumulative mite density over a one-month period compared to the untreated checks or water-only control.

Evaluations of pheromone traps with and without the use of sachets containing phenyl propionate (PPO) showed no benefit to adding PPO to traps where mating disruption is not being used, and significant benefit in orchards where mating disruption was employed. Pheromone traps with PPO provided adequate trap captures to identify flights and assess season-long patterns in NOW adult activity in mating disruption plots. During 2018 we also maintained a 7-acre almond research orchard in Shafter, CA that has been used in 69 different research trials since 2010. From August 2017 until July 2018 we gave 29 extension presentations, two posters, sixteen media interviews, and wrote four extension publications related to integrated pest management in almonds.

Objectives *(300 words max.)*

1. Evaluate seasonal sixspotted thrips abundance and activity patterns in almonds
2. Evaluate the impacts of sixspotted thrips on spider mite populations
3. Develop a trap-based monitoring program for sixspotted thrips that can aide in treatment decisions for spider mites
4. Evaluate the effects of miticides on Pacific spider mite
5. Evaluate the practical use of PPO-based pheromone traps in conjunction with traditional monitoring tools in mating disruption orchards
6. Determine the practical implications of NOW egg captures in mating disruption orchards
7. Maintain a University-based research and demonstration orchard for almond pest management research

Results and Discussion

<u>1. Evaluate seasonal sixspotted thrips abundance and activity patterns in almonds</u>

Sixspotted thrips had two key periods of adult activity in all three experimental orchards (Fig. 1). This included trap captures from mid-April until mid-May, and then again in the fall in response to increases in spider mites during or just after harvest. Comparisons of sixspotted thrips density in the spring in plots that were (Conventional) or were not (IPM) sprayed with abamectin showed reductions in thrips density at Wasco and Lost Hills. This phenomenon was even more significant in Maricopa where the conventional orchard was sprayed with abamectin and a pyrethroid for control of true bugs. Despite the reduction in thrips activity in the spring when abamectin or pyrethroids were used, both conventional and IPM orchards had similar numbers of thrips in the fall. These data document that almond growers should be cautious about early-season use of abamectin or pyrethroids, limiting applications to when spider mites reach treatment thresholds or when leaffooted bug or stink bugs are found at treatable levels. Data also showed significant numbers of sixspotted thrips, sometimes exceeding 200 per trap per week, during harvest. Due to the significant benefit these thrips can provide, growers and PCAs should avoid using insecticides, such as pyrethroids, spinetoram, or abamectin that are known to negatively impact thrips while trying to control navel orangeworm. Other insecticides, such as those containing methoxyfenozide and chlorantraniliprole, are not known to negatively affect sixspotted thrips.

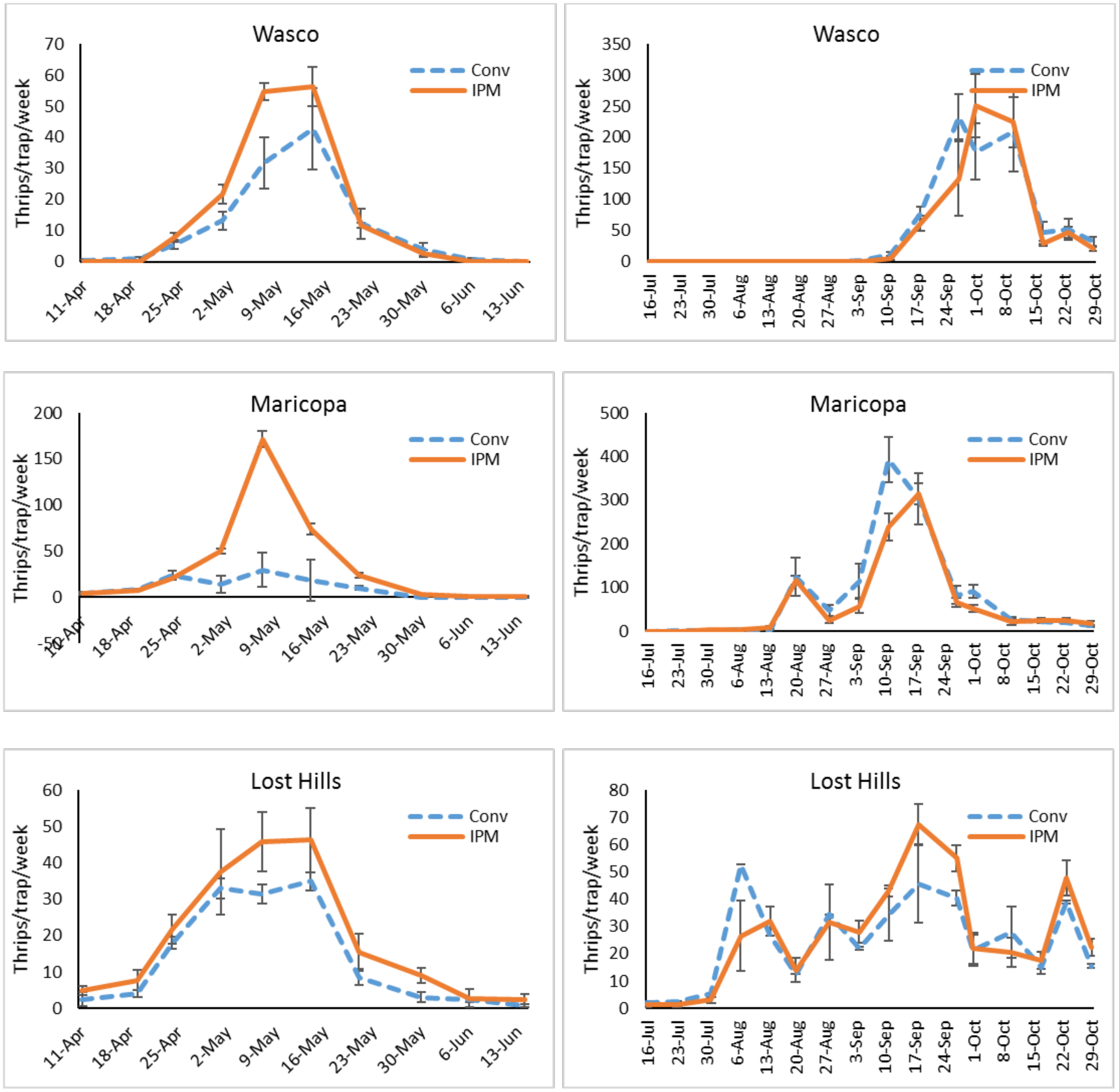

Figure 1. Seasonal captures of sixspotted thrips on yellow sticky cards in three almond orchards in Kern County, 2018

2.

2. Evaluate the impacts of sixspotted thrips on spider mite populations

During 2016 and 2017 we generated provisional guidelines for the density of sixspotted thrips on yellow sticky cards that could be used to justify a ‘no need to treat’ recommendation by growers or PCAs. Our goal in 2018 was to validate those thresholds and further document the impacts of sixspotted thrips on spider mite density. However, 2018 had some of the lowest spider mite densities in Kern County almonds that have been seen in the past decade. Spider mite density at all three experimental orchards was negligible in April and May, and did not exceed 0.5 per leaf for the entire harvest period. This density is approximately 25% of what is considered a treatable level of mites. The good side is that the extremely low mite density was certainly influenced by, if not directly caused by the high number of sixspotted thrips in these same orchards (Fig. 1). However, the mite density was so low that we were unable to generate data needed to quantify cause-effect relationships.

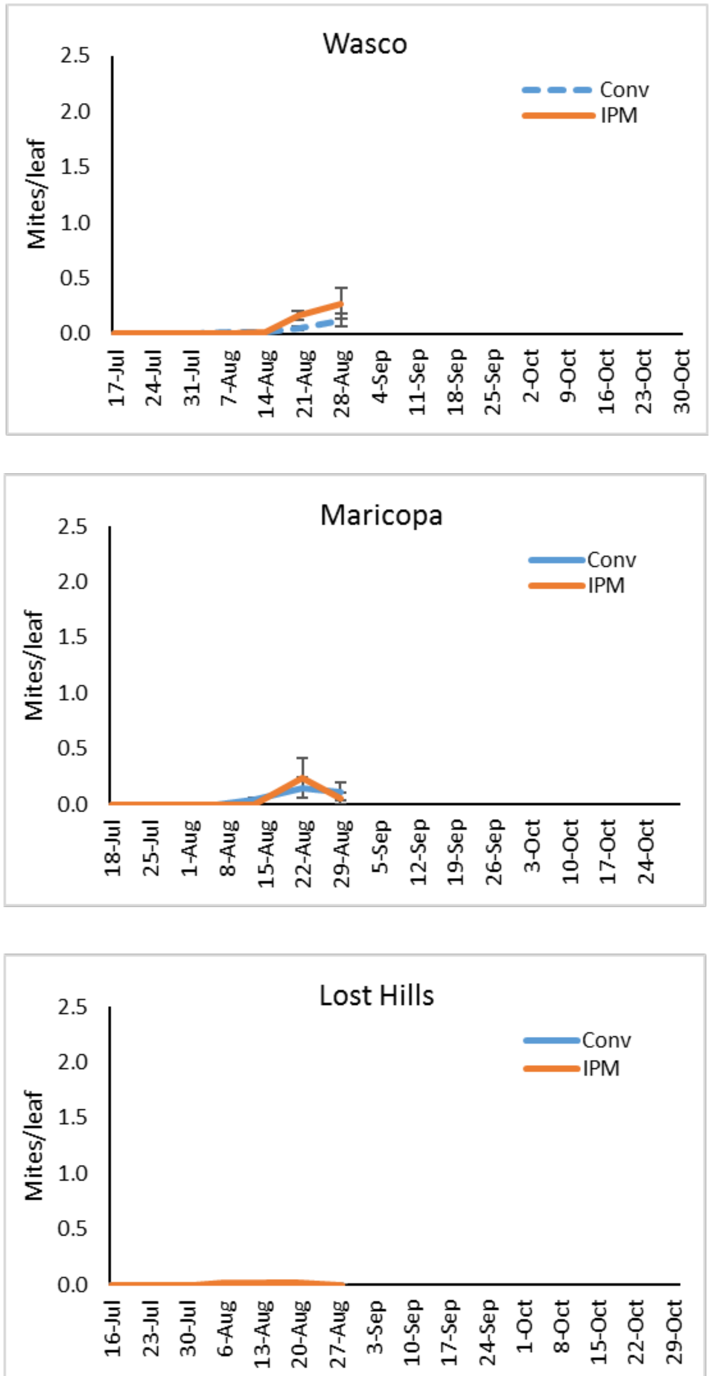

Figure 2. Density of spider mites in three Kern County almond orchards from July through October

3. Develop a trap-based monitoring program for sixspotted thrips that can aide in treatment decisions for spider mites

Our third objective likewise fell victim to a year with extremely low spider mite density. The thrips cooperated (Fig. 1), but the mites did not (Fig. 2). As a result, we can definitively say that yellow strip traps are an effective way to monitor for sixspotted thrips (reported on in our 2017-2018 report to the Almond Board, and confirmed through objective 1 in the current year’s research), but we were unable to determine how to use that information for treatment decisions in a year where treatable levels of mites never occurred. We will continue to work on this research area during the upcoming research season.

4. Evaluate the effects of miticides on Pacific spider mite

There were no significant differences in precounts that ranged from 0.0 to 1.73 mites per leaf. There were no significant differences among treatments 4, 7 and 14 DAT due to relatively low mite densities throughout the orchard as a result of biological control, despite the fact that mite densities were numerically lower in all treatments than the water or untreated checks 14 DAT. By 21 DAT, all treatments significantly reduced mite densities compared to the water check, but were not significantly different than either of the untreated checks. By 27 DAT mite densities in the checks increased to 0.36 to 0.54 mites per leaf. On that date the best treatments were Banter, Envidor, Fujimite, Nealta, Onager Optek, Vigilant, TetraCURB, Biomite and Magister. Treatments that were significantly better than both of the untreated checks included the low rate of Banter, Envidor, Fujimite, Nealta, Onager and Vigilant. All miticides except for Cinnerate, Kanemite and Magester were significantly better than at least one of the untreated checks. By 33 DAT sixspotted thrips overtook the trial and reduced mite densities to less than 0.31 per leaf in all plots with no differences among any treatments (P=0.26). Predation by sixspotted thrips, that prefer to feed on spider mite eggs, caused there to be no significant differences in very low numbers of spider mite eggs across all evaluation dates (Table 2).

When spider mite data across all evaluation dates were combined as cumulative mite days, all miticides resulted in significant reductions in mite density compared to the water check and untreated check 1 (Table 1). Mite densities in all miticide treatments except Envidor were numerically lower than, but statistically equivalent to, the second untreated check. Compared to the second untreated check, mite densities in Envidor plots were numerically reduced yet statistically equivalent.

Table 1. The effects of miticide treatments on the density of Pacific spider mite in almond, Shafter 2018.

		Mean spider mites per leaf							
		Pre	4 DAT	7 DAT	14 DAT	21 DAT	27 DAT	33 DAT	Mite-
Banter	16 fl oz	0.00	0.00	0.00	0.00	0.05ab	0.01a	0.03	0.5ab
Banter	24 fl oz	0.43	0.00	0.00	0.04	0.00a	0.13a-e	0.15	1.5ab
Biomite	0.59 gal	0.05	0.00	0.25	0.00	0.01ab	0.10a-d	0.18	2.5ab
Cinnerate	50 fl oz	0.10	0.23	0.00	0.00	0.03ab	0.51ef	0.03	4.6abc
Envidor	34 fl oz	0.03	0.00	0.00	0.00	0.00a	0.03ab	0.04	0.3a
Fujimite SC	32 fl oz	0.03	0.00	0.00	0.04	0.01ab	0.05ab	0.03	0.7ab
Kanemite	31 fl oz	0.00	0.01	0.01	0.01	0.00a	0.52def	0.00	3.3ab
Magister	32 fl oz	0.05	0.01	0.00	0.13	0.00a	0.14a-f	0.04	1.9ab
Nealta	13.7 fl oz	0.03	0.00	0.00	0.06	0.00a	0.03ab	0.13	1.0ab
Onager Optek	24 fl oz	0.18	0.03	0.04	0.00	0.00a	0.04ab	0.19	1.1ab
TetraCURB	96 fl oz	1.73	0.20	0.06	0.03	0.08ab	0.08abc	0.08	2.8ab
Vigilant	24 fl oz	0.05	0.00	0.00	0.00	0.00a	0.04ab	0.03	0.3ab
415 Oil	1% V/V	0.05	0.00	0.50	0.08	0.00a	0.28b-f	0.10	5.0abc
Water		0.03	0.03	0.95	1.98	0.22c	0.36b-f	0.24	23.0c
UTC 1	-	1.08	1.58	0.64	0.31	0.09abc	0.54f	0.31	18.8c
UTC 2	-	0.00	0.00	0.00	0.46	0.13bc	0.44c-f	0.14	7.1bc
	F	0.81	1.01	0.96	0.96	1.95	2.18	1.28	1.91
	P	0.665	0.465	0.509	0.510	0.043	0.022	0.257	0.048

Means in a column followed by the same letter are not significantly different (P>0.05, Fisher's Protected LSD) after square root (x + 0.5) transformation of the data. Untransformed means are shown.
treatments had 1% 415 oil as a surfactant except 415 Oil, Water Check and Untreated Checks.
-days were calculated adding the average mites per leaf per day for each of the 33 days of the trial.

Table 2. The effects of miticide treatments on the density of Pacific spider mite eggs in almond, Shafter 2018.

	Rate	Mean spider mite eggs per leaf						
		Pre	4DAT	7DAT	14DAT	21DAT	27DAT	33DAT
Banter	16 fl oz	0.00	0.00	0.00	0.00	0.03	0.04	0.04
Banter	24 fl oz	0.75	0.00	0.00	0.00	0.00	0.19	0.24
Biomite	0.59 gal	0.18	0.00	0.29	0.00	0.00	0.03	0.15
Cinnerate	50 fl oz	0.10	0.08	0.00	0.11	0.00	0.14	0.04
Envidor	34 fl oz	0.03	0.00	0.00	0.04	0.00	0.03	0.04
Fujimite SC	32 fl oz	0.03	0.00	0.00	0.13	0.00	0.04	0.10
Kanemite	31 fl oz	0.05	0.03	0.00	0.00	0.00	0.35	0.05
Magister	32 fl oz	0.03	0.00	0.00	0.01	0.00	0.24	0.08
Nealta	13.7 fl oz	0.05	0.00	0.00	0.01	0.00	0.04	0.16
Onager Optek	24 fl oz	0.68	0.00	0.14	0.04	0.00	0.01	0.04
TetraCURB	96 fl oz	10.3	0.23	0.13	0.04	0.20	0.19	0.13
Vigilant	24 fl oz	0.05	0.00	0.00	0.00	0.00	0.00	0.05
415 Oil	1% V/V	1.13	0.00	0.23	0.10	0.00	0.24	0.05
Water		0.38	0.00	1.16	1.06	0.06	0.16	0.09
UTC1	-	1.08	1.23	0.31	0.28	0.02	0.24	0.35
UTC2	-	0.00	0.00	0.05	0.68	0.03	0.48	0.05
	F	0.88	1.01	0.94	0.92	0.99	0.96	0.77
	P	0.5873	0.4594	0.5329	0.5524	0.4778	0.5095	0.7010

Means in a column followed by the same letter are not significantly different (P>0.05, Fisher's Protected LSD) after square root (x + 0.5) transformation of the data. Untransformed means are shown.
treatments had 1% 415 oil as a surfactant except 415 Oil, Water Check and Untreated Checks.

5. Evaluate pheromone trapes with PPO

During 2018 we collected data from 594 pheromone traps with or without PPO. In conventionally managed orchards without mating disruption, captures in pheromone traps with and without PPO were similar from June to July and from August to September (Table 3). In orchards where mating disruption was used, the addition of a PPO sachet increased trap captures from one to nine in June and July, and from one to 83 in August and September. This documents that pheromone + PPO traps have the ability to attract and trap NOW moths in orchards where mating disruption is used.

Table 3. Average NOW captured in pheromone traps with and without PPO sachets during June/July and August/September in paired plots with and without the use of mating disruption in three Kern County almond orchards, 2018.

NOW Management	June to July		August to September	
	Pheromone	Pheromone + PPO	Pheromone	Pheromone + PPO
Conventional	75	22	116	115
Mating disruption	1	9	1	83

Figure 3 shows trap captures throughout the season in an effort to determine if adding PPO to traditional pheromone traps can aid in determining NOW flights. In conventional orchards NOW flights can be seen with and without the PPO, though there appear to be some differences. In particular, in the last two weeks of July and first week of August, pheromone trap captures show an increase in captures (either the end of the second flight or start of the third flight) at the same time that pheromone + PPO traps suggest a lull between flights. Then, in October, pheromone traps did not show much NOW activity while pheromone + PPO traps suggested the presence of a significant fourth flight. The reasons for these discrepancies are not understood, though it could have something to do with the fact that pheromone traps only collect males while the pheromone + PPO trap also collects females. Flight periods of males and females certainly need to overlap for mating to occur, but the start and end times of the flights for each gender are not always the same.

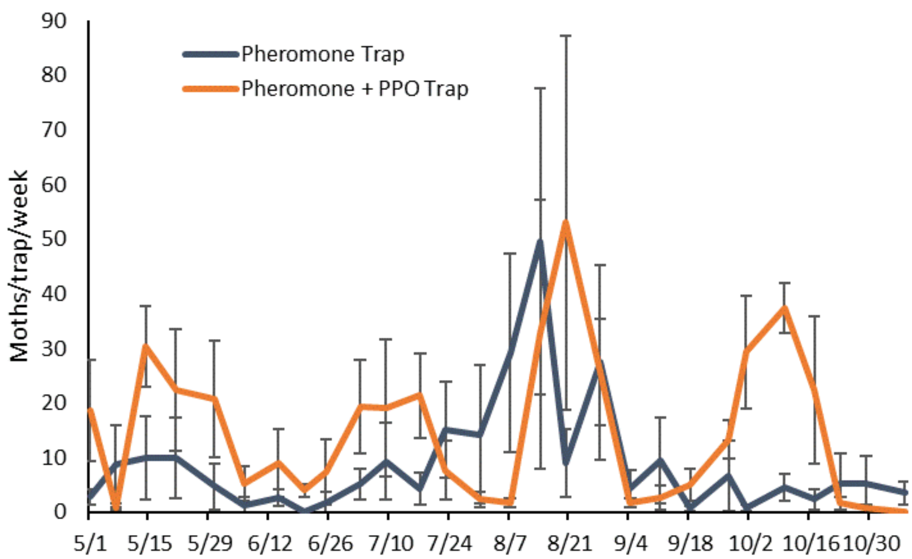

Figure 3. Weekly navel orangeworm captures in pheromone traps with and without PPO in conventionally management orchards <u>without</u> mating disruption.

In contrast to data from conventional orchards, the addition of PPO to pheromone traps made incredible differences in the ability to monitor NOW when mating disruption was used (Fig. 4). As expected, data from pheromone traps showed complete trap shutdown. Traps were valuable if the goal was to show that mating disruption was working, but bad if you want to monitor flights. To the contrary, when PPO was added, all four flights were seen with relative clarity (flight prior to trap placement through May, flight in late June and July, third flight starting in mid-August, and fourth flight from mid-September until mid-October). These data suggest that pheromone traps with PPO sachets can help growers monitor NOW flights in mating disruption orchards in the same way that pheromone traps have been used in conventional orchards.

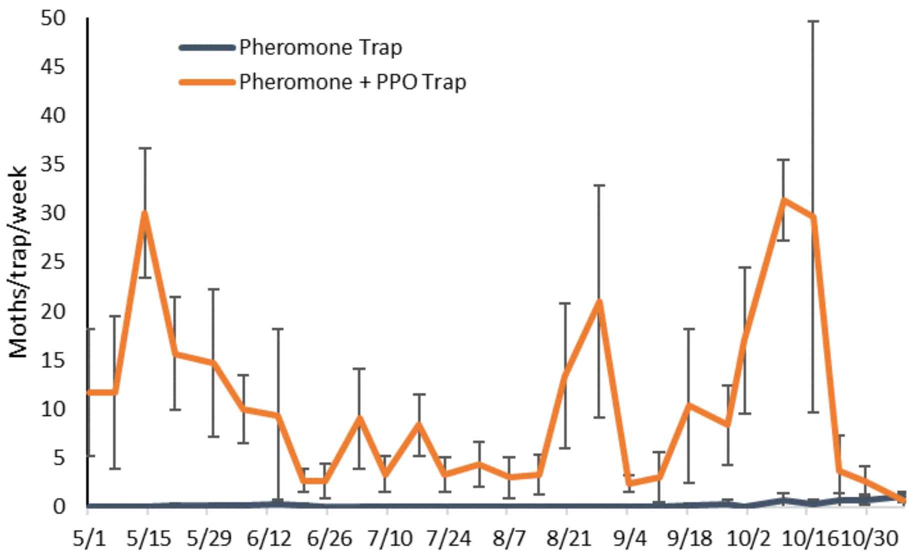

Figure 4. Weekly navel orangeworm captures in pheromone traps with and without PPO in conventionally management orchards <u>with</u> mating disruption.

<u>6. Determine implications of NOW eggs in orchard using mating disruption</u>

During 2018 we collected more than 3,000 egg traps, of which 256 contained eggs. The number of eggs varied greatly from trap to trap and across dates. In total, traps contained 5,957 NOW eggs that resulted in 2,126 NOW larvae after storage for one month (larvae to eggs ratio of 35.7%). Comparisons between larvae to eggs ratios did not reveal any significant differences in the percentages of eggs that were considered viable from April-May, Jun-Sep, or for the entire season (Fig. 5). Therefore, we conclude that growers and PCAs that find eggs on NOW egg traps in orchards using mating disruption should assume that they are just as fertile as eggs found on similar traps where mating disruption is not employed.

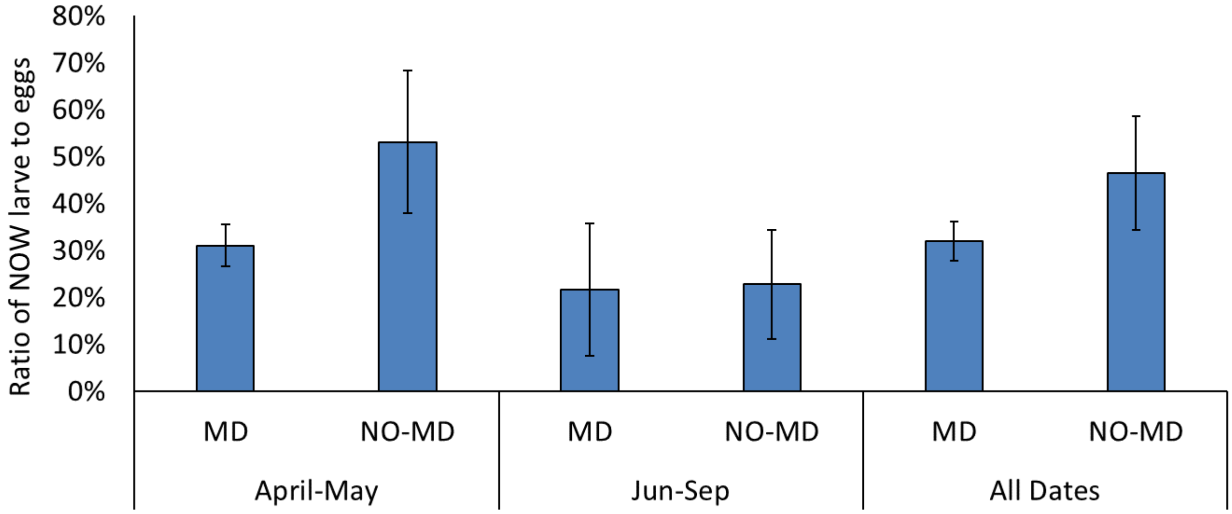

Fig. 5. Viability of eggs on NOW egg traps in orchards with and without mating disruption

7. Maintain a research and demonstration orchard

During 2018 there were five research projects supported by or completed in the research orchard in Shafter that is maintained in part by funding from the Almond Board of California. This included a trial on miticides for control of spider mites, trapping studies for sixspotted thrips and other spider mite predators, a study on predator-prey relationships for spider mites, a study on canker diseases and strategies to manage them, and a trial on the impact of post-harvest irrigation on bloom timing. In total since 2010, this orchard, and a parallel orchard funded by the Almond Board of California at the Westside Research and Extension center through 2013, have hosted or provided support for 69 different research trials.

Outreach Activities (August 2018 to July 2019)

Presentations

9/13/18	Lessons Learned from the Pest Management Alliance Project in Almonds, Kern County Chapter Meeting of the California Association of Pest Control Advisors, Bakersfield, 140
9/25/18	Mating Disruption, Efficacy and Economics, UC Navel Orangeworm Mating Disruption Educational Meeting, Parlier, 40
11/28/18	The Newest on Mite Control for Almonds Kern County Ag Day, Bakersfield, 90
12/5/18	Tools You Can Use for IPM in Almonds, 2018 Almond Industry Conference, Sacramento, 250
12/6/18	IPM Demonstration Project, 2018 Almond Industry Conference, Sacramento, 150
12/7/18	Pest Management Alliance Project Results, UC Almond Workgroup Meeting, Davis, 35
12/13/18	Mating Disruption for Navel Orangeworm in Almonds, Mid Valley Ag Annual Almond Grower Meeting, Modesto, 90
12/13/18	Chlorpyrifos Use in Almonds and Grapes, PAPA Pesticide Compliance Seminar, Fresno, 26
1/9/19	Managing Insect Pests in Nut Crops, 2019 Tree and Vine Educational Seminar, Universal City, 112
1/16/19	Insect Management Update: Gill's Mealybug, Brown Marmorated Stink Bug, and Mating Disruption for Navel Orangeworm, UC Statewide Pistachio Day, Visalia, 310
1/18/19	ID, Biology and Treatment Options for Key Economic Pests of Trees and Vines, Bayer CropSciences Independent PCA Meeting, Monterey, 58
1/22/19	Incorporating Mating Disruption into IPM Programs for Navel Orangeworm in California Almonds, International Organization of Biological Control Conference "Pheromones and Other Semiochemicals in Integrated Production", Lisbon, Portugal, 106
1/30/19	Mite Control in Almonds, North Valley Nut Conference, Orland, 307
2/7/19	Integrated Pest Management of Tree and Vine Pests, Helena Spring Growers Meeting, Bakersfield, 62
2/27/19	Navel Orangeworm: Implementing Mating Disruption as a New Best Management Practice, 2019 American Pistachio Conference, Palm Desert, 306
3/14/19	Managing NOW with Mating Disruption: Is it Right for You?, Fresno-Madera Chapter CAPCA Conference, Fresno, 127
4/11/19	Congratulations, so You Bought a Mating Disruption System, Now What?, 2019 Kern County Almond Day, Bakersfield, 45
4/11/19	Treatment Decisions for Spider Mites, 2019 Kern County Almond Day, Bakersfield, 48
5/9/19	IPM in Almonds and Pistachios, Chowchilla IPM Seminar, Chowchilla, 26
5/29/19	Integrated Pest Management of Almond Pests, California Almond Sustainability Seminar, Buttonwillow, 19
6/5/19	An Effective IPM Approach to Mite Control, Mid Valley Ag Day, Turlock, 180

6/12/19 Mating Disruption for Navel Orangeworm in Pistachios, Primex Grower Appreciation Day, Wasco, 147

6/18/19 Areawide Management of Navel Orangeworm, Navel Orangeworm Summit, Modesto, 200

9/10/19 Integrated Pest Management for Almonds, Kern Chapter CAPCA Fall CE Meeting, Bakersfield, 93

9/10/19 Living in a World without Chlorpyrifos, Kern Chapter CAPCA Fall CE Meeting, Bakersfield, 103

9/12/19 Chlorpyrifos Alternatives, Fresno Madera Chapter CAPCA Conference, Fresno, 120

9/27/19 Top Insects Plaguing California Specialty Crops, Crop Consultant Conference 2019, Visalia, 130

4/1/19 Mighty Spider Mites- Management in Almonds, Pacific Branch Entomological Society of America Conference, San Diego, 38

4/28/19 Demonstration and Implementation of IPM in Almonds in the San Joaquin Valley. Pacific Branch Entomological Society of America Conference, San Diego, 38

Posters

12/5/18 Arthropod Pest Management in the Lower San Joaquin Valley, 2018 Almond Industry Conference, Sacramento, 4-6 Dec 2018

12/5/18 Almond Pest Management Alliance Project, 2018 Almond Industry Conference, Sacramento, 4-6 Dec 2018

Media Interviews

7/16/18 Luke Milliron, Mating Disruption for Navel Orangeworm in Almonds, UC Growing the Valley Podcast

9/26/18 Dennis Pollock, Mating Disruption an Effective Tool Against Navel Orangeworm, Western Farm Press

11/7/18 ABC News Correspondent, The Role of Navel Orangeworm Research in California towards Control of Carob Moth in Australia, ABC News, Australia

11/14/18 Matthew Malcolm, Navel Orangeworm Mating Disruption, California Ag Network

12/4/18 Cecilia Parsons, Biological Control a Win in Almonds, West Coast Nut- Orchard Management Monthly

11/14/18 Patrick Cavanaugh, Sanitation for Navel Orangeworm in Almonds, California Ag Today

12/10/18 Kathy Coatney, Mating Disruption: A Crucial Tool for Nut Growers, West Coast Nut Grower, Jan 2019

1/7/2019 Patrick Cavanaugh, Navel Orangeworm Mating Disruption Decisions, Pacific Nut Producer, Mar 2019, p. 12-14

1/16/19 Phoebe Gordon, Spider Mites in Almonds, Growing the Valley Podcasts, Aug 19, 2019

3/3/19 Carla Curle, Management of Almond Pests with Biocontrol, How We Grow, May 2019

3/24/19 Kyle Kapusta, Springtime Management of Navel Orangeworm, In the Orchard Newsletter, March 2019

6/9/19 Brian German, Managing Late-Season Mites, In the Orchard Newsletter, May 2019
6/10/19 Emma Goss, Innovative Management Techniques for Navel Orangeworm, KBAK Channel 29 News
6/25/19 Kathy Coatney, Expanding your NOW Toolbox, West Coast Nut Producer Magazine
6/26/19 Ashley Knoblauch, Navel Orangeworm Summit, How We Grow, Sept 2019
7/29/19 Patrick Cavanaugh, Navel Orangeworm and Mites Update, California Ag Today

Materials and Methods:

1. Evaluate seasonal sixspotted thrips abundance and activity patterns in almonds.
Yellow strip traps (Great Lakes IPM) were place in three almond orchards in Kern County, with each orchard divided into 100-acre plots that were managed conventionally (preventative abamectin spray in May) or under IPM practices (no preventative treatments) for spider mites. Traps were monitored weekly from April until October for the average number of thrips per card to determine periods of abundance and activity throughout the season.

2. Evaluate the impacts of sixspotted thrips on spider mite populations.
Sixspotted thrips and spider mite density were monitored weekly in each of the six almond plots previously described from April until September. Spider mite density was determined weekly by counting the number of mites on each of 40 leaves per plot. Data were organized to compare increases and decreases in thrips and spider mites in relation to each other, such as thrips populations increasing when food is abundant, and mite density decreasing when thrips are abundant, to draw conclusions about predator-prey relationships.

3. Develop a trap-based monitoring program for sixspotted thrips that can aide in treatment decisions for spider mites.
We made attempts to validate a trap-based monitoring program that used thrips card data to assist in treatment decisions. Unfortunately, none of our research sites in 2018 ever had treatable levels of mites in 2018. This effort will be continued in the upcoming research season.

4. Evaluate the effects of miticides on Pacific spider mite.
We conducted a trial at the Shafter Research Farm to evaluate sixteen miticides against Pacific spider mite. The trial was organized as a randomized complete block design with four blocks of three-tree plots. Treatments were applied on 26 Jul with a hand gun at 150 PSI in 200 gallons per acre of water. Mites were evaluated prior to treatment and 4, 7, 14, 21, 27 and 33 days after treatment. Data were analyzed by ANOVA with means separated by Fisher's Protected LSD after square root transformation of the data.

5. Evaluate pheromone trapes with PPO.
We compared the use of NOW pheromone traps with and without the use of a phenyl propionate (PPO) sachet for six months in 100-acre paired plots (one with and one without the use of mating disruption) at three almond orchards in Kern County. PPO sachets were provided by Shin-Itsu.

6. Determine implications NOW eggs in orchard using mating disruption.
Egg traps were collected weekly from three almond and two pistachio orchards that each contained 40-acre plots with and without the use of mating disruption. Traps containing eggs were returned to the laboratory where eggs were counted and the traps were placed into individual plastic containers on a bed of almond meal. The number of larvae in each container was evaluated after one month.

7. Maintain a research and demonstration orchard.
We completed all of the cultural practices required to maintain a viable 7-acre almond orchard in Shafter, Kern Co., that was used for trials that benefit the almond industry.

Publications

Extension publications

1. Haviland, D., J. Rijal and E. Symmes. Evaluation of Mating Disruption as Part of an IPM Program of Navel Orangeworm in Almonds, CAPCA Advisor, Vo. XXI, No. 5, October 2018, pp 38-42.
2. Haviland, D. R., J. Rijal and E. Symmes. 2019. IPM Advisors Demonstrate Mating Disruption for Key Almond Pest. UC Delivers, June 28, 2019. UC ANR
3. Haviland, D. R. 2019. Organic Spider Mite Control in Deciduous Trees and Vines. Organic Farmer, June/July 2019, pp 22-25
4. Haviland, D., J. Rijal and E. Symmes. 2019. IPM Advisors Demonstrate Mating Disruption for Key Almond Pest. UC Delivers, Posted June 28, 2019. https://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=30619