Insect and Mite Research

Project No.: 12-ENTO7-Zalom

Project Leader: Frank G. Zalom
Department of Entomology
UC Davis
One Shields Avenue
Davis, CA 95616
530.752.3687
fgzalom@ucdavis.edu

Project Cooperators and Personnel:
Franz Niederholzer, UCCE - Sutter/Yuba Counties
David Haviland, UCCE - Kern County
Kelly Hamby, UC Davis

Objectives:

1. Purchase pheromone traps, navel orangeworm (NOW) bait traps, and lures for UC Cooperative Extension Farm Advisors for their ongoing monitoring and extension efforts.
2. Evaluate efficacy at the May treatment timing for less-toxic insecticides against navel orangeworm, and determine effect of field residues on success of NOW eclosion (egg hatch) and newly emerged larvae.
3. Develop baseline dose response for the major miticides used in almond orchards, evaluate susceptibility of field collected spider mite populations to abamectin and other miticides, and begin to determine miticide residual activity against susceptible populations.

Interpretive Summary:

In the 2012-13 funding cycle, our focus included evaluating efficacy and treatment timing for the navel orangeworm (NOW) at the May spray timing and to relate these to navel orangeworm phenology as indicated from monitoring with navel orangeworm egg traps and the new Biolure pheromone traps that are a measure male navel orangeworm flight. Additional studies on navel orangeworm included estimating the residual efficacy of four registered insecticides applied during the spring, and to verify previous studies suggesting that damaged mummy nuts are more likely to be infested by navel orangeworms than previously undamaged nuts. These previous studies related navel orangeworm damage to damage by birds in the field and artificial damage in the lab. Results of the field residue experiment suggest that Brigade residual activity sufficient to prevent infestation was about 2 weeks, Intrepid 4 weeks, Altacor 3 weeks, and Belt 3 weeks. Live larvae were not detected in any of the treated almonds at any of the treatment timings, while an average of 2 percent infestation was detected in the untreated nuts. In the other study, there were highly significant differences in both new navel orangeworm damage and larval infestation in mummies that had previously been damaged by navel orangeworm, with over 3 times more damage and live larvae being recorded in the previously infested nuts. Dose responses for Agri-mek, Acramite and the unregistered miticide Nealta were determined for a susceptible two-spotted spider mite (*T. urticae*) lab colony (to establish a baseline for susceptibility) and a field population that had

been previously treated for at least four seasons with Agri-mek. Dose responses for tow field populations of Pacific mite (*T. pacificus*) were also established.

Materials and Methods:

Objective 1: Monitoring. Each year through this project, trapping supplies are purchased for use by UC Cooperative Extension Farm Advisors to help them monitor the phenological activity of almond insect pests in their counties. The Advisors use the data gathered from these traps to update pest status for local growers and PCA's. Continuing to coordinate regional insect trapping and collaborating with new monitoring research allows for consistency and improvements in this important component of almond IPM. In addition to this standard objective, we were able to obtain some of the new navel orangeworm Biolures from Suterra at the very beginning of the 2013 season and have established 2 sites where we are monitoring the pheromone lures and egg traps for direct comparison. One of the sites (Manteca/Ripon) is also the site of a 'May spray' treatment timing study described later which, together with trapping data generated previously by others who had earlier access to the pheromone lures, will hopefully help identify the 'May spray' timing in degree-days using the pheromone traps.

Objective 2: Navel orangeworm. The 'May spray' timing offers the potential to obtain some level of control of both NOW and peach twig borer (PTB) as these insects have flights that overlap somewhat in many years. The 'May spray' controls the first generation of NOW following spring moth emergence. Females of the first flight lay their eggs on the mummy nuts that remain in the orchards, so the infestation of mummy nuts can be quite high. The current 'May spray' timing recommendation for NOW is 100 degree-days (DD) after the first eggs are laid for 2 consecutive sampling periods on egg traps (Engle and Barnes 1983, Zalom et al. 1998), but this will probably be modified when the relationship between males flights as recorded using the navel orangeworm pheromone is better understood relative to egg hatch as monitored with egg traps. The recommended PTB treatment timing is at 400 degree-days after the first females are captured in pheromone traps (Rice et al. 1982).

The site of the 2012 May navel orangeworm control study was a mature 20 acre almond orchard on near Ripon, CA, but in San Joaquin County. The block had not been dormant treated by the grower. Using the same protocol as proved successful for us in the last 3 years, twenty uninfested Nonpareil nuts saved from the 2011 harvest were hot glued to strands of vegetable mesh during April 2012. They were all deployed at mid-canopy in Nonpareil trees on April 26, the NOW biofix date. There were 18 treatments in all plus a water only control, with 10 mummy strands allocated for each treatment including 20 for the controls. Treatments were timed to the start of NOW oviposition (egg laying) April 26 (0 DD), May 7 (100 NOW DD), or May 14 (400 PTB DD). The products included most of the diamides that are registered or being considered for registration, the IGRs diflubenzuron and methoxyfenozide, Bt and oil, plus the conventional organophosphate Lorsban (chlorpyrifos). All treatments were applied at the equivalent spray volume of 100 gallons per acre (gpa), and any adjuvants included with each treatment are indicated as footnotes to the results table. The nuts were removed from the field on June 25 at 769 NOW DD before the start of the hullsplit flight and handcracked to determine NOW infestation. Arcsine-transformed data were analyzed by one-way ANOVA and treatment means compared by Student's t-test. This study was actually initiated under the previous year's funding, but data were not obtained until after the 2011-12 Annual Report was submitted, so results are being reported now.

Determining 'May spray' treatment timing based on degree-days using egg traps and male pheromone traps is a big issue. This will probably vary from north to south in the state depending on factors that may not be completely known related to temperature. Knowing this, I wish that I had submitted a proposal for 2013-14 funding to pursue this. We have tried to address this to some extent in the field in 2013 by setting up 2 experiments in the Manteca/Ripon orchard where we are currently monitoring both types of traps.

For the first 2013 experiment, 260 strands of surrogate mummies were hung in the orchard when the egg trap monitoring indicated the beginning of the spring navel orangeworm flight (April 16), so that females ovipositing on these mummies or larvae already present prior to the subsequent experimental applications would be exposed to the insecticides as they would in naturally occurring mummies in the orchard. Eight strands each were treated with either chlornitraniliprone (Altacor), flubendiamide (Belt), methoxyfenozide (Intrepid), bifenthrin (Brigade), or spinetoram (Delegate) weekly starting the week that the strands were first deployed (treatment dates were from April 16 through May 21). Twenty strands remained untreated as controls to establish the damage level in the absence of treatment. The number of strands deployed totaled 260 representing 5 treatments X 8 reps X 6 weeks, plus 2 complete reps of untreated control strands. The rates of the insecticides applied were Altacor (4 oz.), Belt (4 oz.), Intrepid (16 oz.), Brigade (16 oz.), and Delegate (7 oz.). All were mixed into the equivalent of 100 gallons per acre, and included the nonionic surfactant, Dyne-amic, at 0.25% v/v. The strands were removed from the trees at 615 NOW degree-days from the date they were deployed and returned to UC Davis, where they were hand-cracked to determine infestation (nuts with larvae or pupae present) and damage (nuts with larvae, pupae or damage present). Data were analyzed by analysis of variance following arcsin transformation, with individual treatments and treatment timing compared to the untreated control and means for treatment timings for each product compared to one another by Students t-test.

The second 2013 experiment was conducted using the same almond strand approach but was intended to provide a better estimate of residual activity as well. A total of 176 strands of almond mummies were used for this experiment. Forty strands were designated for each of the 4 chemicals, and 16 strands for the untreated control. Each week starting April 15, 8 of the 40 strands designated for each chemical treatment were treated and hung within the tree canopy of isolated roadside olive trees, a non-host for navel orangeworm, with no obvious source trees nearby. When the last sets of 8 strands were treated on May 14, all of the strands were transferred to the Manteca/Ripon almond orchard, along with the 16 untreated strands. The strands were left in the almond orchard for 2 weeks (May 29), then returned to the laboratory and held separately by treatment and date until about 600 NOW DD are accumulated to determine infestation. The nuts were hand-cracked to determine infestation at that time. Analysis of variance following arcsin transformation was conducted to determine differences in infestation between treatments (including untreated) on each date. Rates of the insecticides applied were Altacor (4 oz.), Belt (4 oz.), Intrepid (16 oz.), and Brigade (16 oz.). All were mixed into the equivalent of 100 gal per acre, with the nonionic surfactant, Dyne-amic, included at 0.25% v/v. This design effectively provides 6 two-week duration treatment residue periods following each application.

An experiment was conducted to validate that damaged mummy nuts are more likely to attract and host navel orangeworm than are undamaged nuts. Results indicating that bird damaged nuts hosted greater abundance of navel orangeworm and that larvae were more successful on artificially damaged nuts in the laboratory was reported by Hamby et al. 2013. For this experiment, nuts were collected from a heavily-infested site in Fresno County and separated into those that showed overt signs of infestation and those that showed no signs of infestation. A random sample of these infested and uninfested nuts were then placed into a freezer at -12.2^{o}C for 120 days to kill any navel orangeworm larvae present. Ten strands of 20 infested nuts and 20 strands of 20 uninfested nuts were hung in the same orchard used for the previous two experiments on April 15, the start of navel orangeworm oviposition as indicated by egg trap monitoring. One of the infested nuts was lost during the time the stands were deployed, possibly from bird activity. The nuts were removed and hand-cracked at 615 NOW degree-days from the date they were deployed to determine damage and presence of larvae. Data were analyzed by analysis of variance following arcsin transformation, and means separated by Student's t-test.

Objective 3: Spider mite resistance. A number of miticides have been registered on almonds in this century with use of some miticides, particularly abamectin, becoming widespread. The reason for this can be debated, but a debate does not lessen the risk of resistance development. The first step in monitoring for resistance is developing a baseline effective dose for commonly used miticides on a susceptible population. My lab maintains a colony of the two-spotted spider mite, *Tetranychus urticae* that has been in continuous culture and untreated for over 20 years. This colony would be expected to be susceptible to all of the more recently registered miticides. My lab had also maintained a colony of Pacific mite, *Tetranychus pacificus* that was initiated from grapes, but unfortunately the colony was lost prior to the start of this study. We exposed adult females from the two-spotted mite colony to a concentration range of Agri-mek (abamectin), Acramite (bifenezate), and Savey (hexythiazox), to determine LC_{50} and LC_{90} values and slopes using probit analysis. To do this, we transferred 20 adult female mites to leaf discs and then treat the infested leaf discs with a range of concentrations of either Agri-mek or Acramite. After air-drying, the discs were transferred to Petri dishes lined with moistened filter paper where they were held in a growth chamber at 27^{o}C, 75-85% room humidity, and 16:8 photoperiod. There were 5 replicates of each concentration and a water-only control (used to correct for control mortality). Mortality was assessed at 72 hours. This design was repeated with a two-spotted mite population obtained from an almond orchard near Manteca, San Joaquin Co., that had been treated annually with Agri-mek for at least the 4 previous years and with Pacific mite populations obtained from David Haviland's almond plantings at West Side Field Station (Fresno Co.) and Shafter (Kern Co.). These Pacific mite populations had not been treated with an acaricide since the plantings were established.

Results and Discussion:

Objective 1: Monitoring. Each year through this project, trapping supplies are purchased for use by UC Cooperative Extension Farm Advisors to help them monitor the phenological activity of almond insect pests in their counties to update pest status for local growers and PCA's. The trapping supplies are standardized to ensure consistency in data collected over years. For the 2013 season, supplies purchased and distributed included 160 traps of various kinds, 175 pheromone lures for peach twig borer (PTB), San Jose scale (SJS), and oriental fruit moth (OFM), and 3 lbs of NOW bait. Only three Farm Advisors requested supplies this year (an all time low number), and I do not intend to request funds nor supply traps or lures in future years.

Objective 2: Navel Orangeworm. Figure 1 shows the NOW and PTB degree-day accumulations for the Manteca/Ripon site and recommended treatment timings for NOW and PTB. Results are presented in **Table 1**. ANOVA indicated significant treatment differences (*F*=3.1868, df=18, 198). All products significantly reduced nut infestation except for the 2 TriTek oil treatments, the diflubenzuron treatment, and the earlier timings of the Bt product Dipel. There were no differences between the 3 treatment timings for Altacor (chlorantraniliprole) or Belt (flubendiamide).

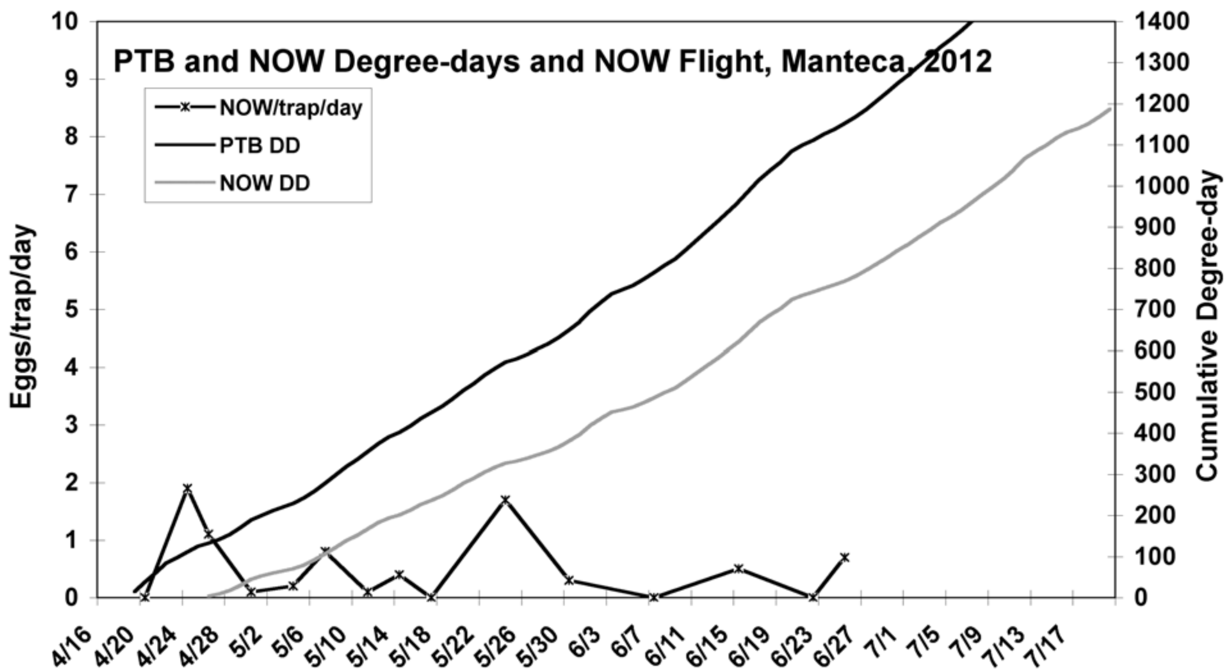

Figure 1. Navel orangeworm and peach twig borer degree-days and navel orangeworm trap count at the Manteca/Ripon site, 2012.

Results for the 2 approaches we used to start to address treatment timing of "May sprays' using the new navel orangeworm Biolure pheromone lure compared to the traditional egg trap are presented on **Table 2** and **Figure 2**. The damage and larval infestation data results had just been obtained at the time of preparing this report so further analysis may be necessary. It was interesting to note that males were captured in the pheromone traps as soon as they were deployed in late March while the first eggs were detected in the egg traps about a month later. However, the peak of male moth capture in the pheromone trap occurred on April 30 while the peak number of eggs recorded on the egg traps was on May 7, only a week apart.

Table 1. Mean (± SD) proportion of NOW infested mummy nutmeats in each treatment, Ripon, 2012.

Treatment	Rate/ac.	Chemical	Spray date	Degree-days	Mean ± SD[1]			
Control					2.7	±	3.2	A
HGW86 *	13.5 oz.	cyazypyr	5/7	109 NOW	0.0	±	0.0	D
HGW86 *	16.9 oz.	cyazypyr	5/7	109 NOW	0.0	±	0.0	D
Altacor *	3 oz.	chlorantraniliprole	5/7	109 NOW	0.0	±	0.0	D
Altacor *	4 oz.	chlorantraniliprole	4/26	0 NOW	0.5	±	1.7	CD
Altacor *	4 oz.	chlorantraniliprole	5/7	109 NOW	0.5	±	1.7	CD
Altacor *	4 oz.	chlorantraniliprole	5/14	402 PTB	0.0	±	0.0	D
Belt *	4 oz.	flubendiamide	4/26	0 NOW	0.0	±	0.0	D
Belt *	4 oz.	flubendiamide	5/7	109 NOW	1.2	±	2.6	BCD
Belt *	4 oz.	flubendiamide	5/14	402 PTB	0.0	±	0.0	D
Tourismo *	10 oz.	flubendiamide & buprofezin	5/7	109 NOW	0.6	±	1.9	CD
Tourismo *	14 oz.	flubendiamide & buprofezin	5/7	109 NOW	0.0	±	0.0	D
Intrepid *	16 oz.	methoxyfenozide	5/7	109 NOW	0.0	±	0.0	D
Dimilin 2L *	12 oz.	diflubenzuron	5/7	109 NOW	2.2	±	2.9	AB
Dipel	1 lb.	Bt	5/7 & 5/17	109 NOW +10 days	1.6	±	2.6	ABC
Dipel	1 lb.	Bt	5/14 & 5/24	402 PTB +10 days	0.0	±	0.0	D
TriTek	1 gal.	mineral oil	5/7 & 5/17	109 NOW +10 days	2.2	±	2.9	AB
TriTek	2 gal.	mineral oil	5/14 & 5/24	402 PTB +10 days	1.2	±	2.4	ABCD
Lorsban*	4 pt.	chlorpyrifos	5/7	109 NOW	0.0	±	0.0	D

[1] ANOVA statistics, F=3.1868, df=18, 198, P<0.0001. Means followed by the same letter do not differ significantly at P=0.05 by Student's t-test following arcsine transformation.
* mixed with Dyne-Amic @ 0.25% v/v

Experiment 1 provides an estimate of treatment success with Altacor, Belt, Intrepid, Brigade, or Delegate at weekly intervals starting the week following the beginning of egg-laying as measured by egg traps. One problem with this method is that we were not sure that oviposition had not actually begun earlier than this time given the extensive male moth captures during April. Results indicated that all treatment timings of all products resulted in less navel orangeworm infestation (F=8.1816, df=30,258, P<0.0001) and damage (F=10.9699, df=30,258, P<0.0001) when compared to the untreated control. In general, the earlier treatment timings had less damage than the later (May 15 and May 21) treatment timings.

Table 2. Infestation and damage of almond mummies treated with different registered insecticides at weekly intervals starting at the initiation of oviposition of the overwintering flight of navel orangeworm at Manteca/Ripon, 2013.

Treatment	Spray date	Rate/ac.	Chemical	Mean ± SD[1] % infestation				Mean ± SD[2] % damage			
Control	n/a	-	-	14.4			A	18.8	±	12.4	A
Altacor	4/16	4 oz.	chlorantraniliprole	0.0	±	0.0	B	0.0	±	0.0	B
Altacor	4/23	4 oz.	chlorantraniliprole	0.0	±	0.0	B	0.0	±	0.0	B
Altacor	4/30	4 oz.	chlorantraniliprole	0.0	±	0.0	B	1.3	±	2.4	B
Altacor	5/7	4 oz.	chlorantraniliprole	0.0	±	0.0	B	0.0	±	0.0	B
Altacor	5/15	4 oz.	chlorantraniliprole	1.4	±	2.5	B	2.9	±	4.2	B
Altacor	5/21	4 oz.	chlorantraniliprole	1.3	±	3.5	B	2.5	±	3.8	B
Belt	4/16	4 oz.	flubendiamide	0.7	±	1.9	B	0.7	±	1.9	B
Belt	4/23	4 oz.	flubendiamide	0.0	±	0.0	B	0.7	±	2.0	B
Belt	4/30	4 oz.	flubendiamide	0.0	±	0.0	B	0.8	±	2.2	B
Belt	5/7	4 oz.	flubendiamide	0.0	±	0.0	B	0.7	±	1.9	B
Belt	5/15	4 oz.	flubendiamide	0.0	±	0.0	B	0.0	±	0.0	B
Belt	5/21	4 oz.	flubendiamide	0.0	±	0.0	B	2.1	±	3.0	B
Intrepid	4/16	16 oz.	methoxyfenozide	0.0	±	0.0	B	0.0	±	0.0	B
Intrepid	4/23	16 oz.	methoxyfenozide	0.0	±	0.0	B	0.0	±	0.0	B
Intrepid	4/30	16 oz.	methoxyfenozide	0.0	±	0.0	B	0.0	±	0.0	B
Intrepid	5/7	16 oz.	methoxyfenozide	0.0	±	0.0	B	0.0	±	0.0	B
Intrepid	5/15	16 oz.	methoxyfenozide	0.0	±	0.0	B	0.0	±	0.0	B
Intrepid	5/21	16 oz.	methoxyfenozide	0.0	±	0.0	B	0.7	±	2.1	B
Brigade	4/16	16 oz.	bifenthrin	0.0	±	0.0	B	1.4	±	2.6	B
Brigade	4/23	16 oz.	bifenthrin	0.7	±	2.0	B	0.7	±	1.9	B
Brigade	4/30	16 oz.	bifenthrin	0.0	±	0.0	B	2.0	±	4.1	B
Brigade	5/7	16 oz.	bifenthrin	3.0	±	4.2	B	3.3	±	3.5	B
Brigade	5/15	16 oz.	bifenthrin	1.7	±	3.3	B	2.8	±	4.2	B
Brigade	5/21	16 oz.	bifenthrin	0.7	±	2.0	B	3.8	±	5.2	B
Delegate	4/16	17 oz.	spinetoram	0.0	±	0.0	B	0.8	±	2.0	B
Delegate	4/23	17 oz.	spinetoram	0.0	±	0.0	B	1.3	±	2.4	B
Delegate	4/30	17 oz.	spinetoram	0.0	±	0.0	B	0.0	±	0.0	B
Delegate	5/7	17 oz.	spinetoram	0.0	±	0.0	B	0.7	±	1.9	B
Delegate	5/15	17 oz.	spinetoram	0.7	±	2.0	B	1.4	±	2.5	B
Delegate	5/21	17 oz.	spinetoram	1.4	±	3.9	B	1.4	±	3.9	B

[1] ANOVA statistics, F=8.1816, df=30,258, P<0.0001. Means followed by the same letter do not differ significantly at P=0.05 by Student's t-test following arcsine transformation.
[2] ANOVA statistics, F=10.9699, df=30,258, P<0.0001. Means followed by the same letter do not differ significantly at P=0.05 by Student's t-test following arcsine transformation.

Experiment 2 provides data to help interpret the residual effect of 4 of these products, Altacor, Belt, Intrepid, and Brigade. The results of this experiment for resulting navel orangeworm damage are provided on **Figure 2**. Unfortunately, because of high variability between replicates, especially in the untreated controls, these results were not statistically different by analysis of variance (F=1.0579, df=20,162, P<0.4005). However, it is relevant to note after which period of time damage was first observed. This period would suggest that Brigade residual activity sufficient to avoid infestation was about 2 weeks, Intrepid 4 weeks, Altacor 3 weeks, and Belt 3 weeks. Live larvae were not detected in any of the treated almonds at any of the treatment timings, while an average of 2 percent infestation was detected in the untreated nuts, a statistically significant difference (F=2.3483, df=20,162, P=0.002).

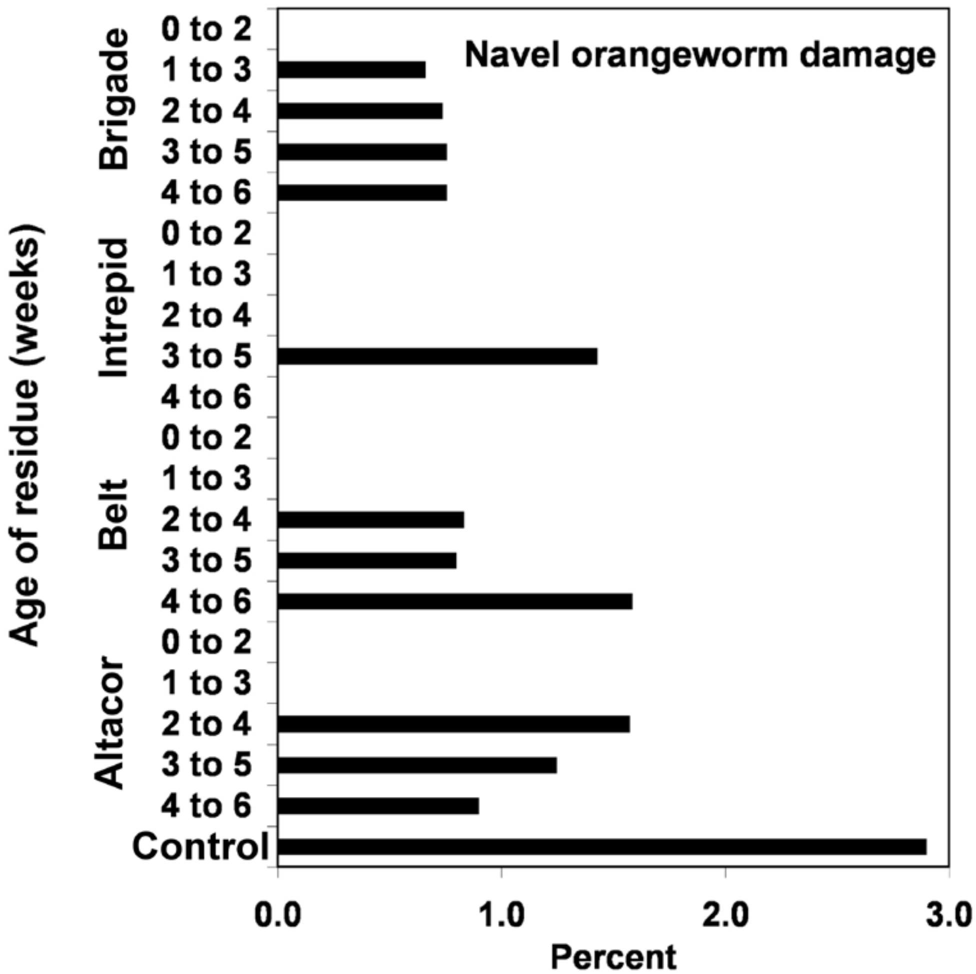

Figure 2. Average percent navel orangeworm damage resulting from nuts pre-treated weekly over a six week period and then simultaneously exposed to navel orangeworm oviposition for a two week period in a commercial almond orchard near Ripon in May 2013.

Table 3 presents the amount of recent damage and percent live larvae found in almond mummy nuts that were infested and not infested prior to deployment in the Manteca/Ripon orchard. There were highly significant differences in both measures of navel orangeworm infestation, with over 3 times more damage and live larvae being recorded in the previously infested nuts. These data support our previous results that suggested that any kind of prior injury to the nuts could increase the success of navel orangeworm infestation.

Table 3. Percent infestation of almond 'mummies' that were previously infested with navel orangeworm larvae and killed, or not infested by navel orangeworm larvae deployed on strands in an almond orchard near Manteca/Ripon, 2013.

	n=	Mean±SE % recent damage[1]	Mean±SE % live larvae or pupae[2]
Uninfested control	20	18.8 ± 12.4	12.0 ± 9.6
Preinfested control	9	62.6 ± 9.9	36.7 ± 15.5

[1] ANOV statistics; F=86.9035, df=1,28, P<0.0001
[2] ANOV statistics; F= 17.2634, df=1,28, P<0.0003

Objective 3: Spider mite resistance. The use of Agri-mek and generic products (and premixes) containing abamectin as well as certain other of these products such as Acramite (soon to be a generic miticide as well), Savey, Fujimite (fenpyroximate), and Zeal (etoxazole) has become widespread with abamectin becoming standard as a preventative spider mite treatment in parts of the San Joaquin Valley. Indeed, the 2010 CDPR pesticide use reports indicate the most widely used miticide on almonds is abamectin with 9889 applications and 734160 acres treated. This is in contrast to 2010 use of the old standard miticide Omite (propargite) for which only 337 applications and 24161 treated acres were reported.

The study of susceptibility of webspinning spider mite populations on almonds is confounded by the presence of 2 different species, the two-spotted spider mite *T. urticae* and the Pacific spider mite *T. pacificus*. These occur symmetrically on occasion, but they tend to be independent of one another possibly due to temperature with *T. urticae* most likely occurring in the cooler areas of the Central Valley and *T. pacificus* in the warmer areas (Marsh et al. 2002). We intended to use susceptible laboratory colonies of both species to establish baseline responses to different concentrations of different miticides, but in the end the *T. pacificus* colony died so we could only establish a true baseline for *T. urticae*. So far we have completed dose responses for Agri-mek, Acramite and are in the process of also completing Savey, but the latter is more difficult since it is a growth regulator affecting fertility so the measure is related to egg hatch and not direct mortality. Dose response for Nealta (cyflumetofen), a new IRAC Class 25 miticide from BASF, was also established. Expected registration for this product on almonds is 2014. Results of probit analysis for the *T. urticae* susceptible colony and a population collected from an almond orchard near Manteca that had been treated with Agri-mek annually for at least the last 4 years are presented on **Table 4**. The ppm for Agri-mek applied at 16 oz per acre in 100 gal is 22.5, and the ppm for Acramite applied at 1 lb. per acre in 100 gal is 600. The laboratory susceptible colony is clearly susceptible to both Agri-mek and Acramite, while the Manteca field population is much more tolerant with LC50s (Lethal Concentration 50%, amount of substance required to kill 50% of test population) for both products at about half the use rate. Dose responses were established for *T. pacificus* populations from David Haviland's untreated almond blocks at both Shafter and West Side Field Station. Susceptibility of both of these *T. pacificus* populations was much lower than the field use rate for both products. We have established and are maintaining a new *T. pacificus* colony from these populations that can be used for future comparisons of field collections of *T. pacificus* populations from other sites.

Table 4. Dose response of different *T. urticae* and *T. pacificus* populations to Agri-mek, Acramite and Nealta with LC50 and LC90 values for each.

Source and *Product*	n=	Slope ± SE	LC50, ppm ai (95% CI)	LC90, ppm ai (95% CI)
Agri-mek				
Lab colony (*T. urticae*)	329	5.528 (±0.899)	0.016 (0.013-0.018)	0.026 (0.022-0.036)
Manteca (*T. urticae*)	656	0.877 (±0.075)	13.5 (8.2-23.5)	391.6 (160.9-1647.6)
Shafter (*T. pacificus*)	287	2.588 (±0.345)	0.063 (0.049-0.081)	0.198 (0.145-0.318)
Westside (*T. pacificus*)	240	4.244 (±0.638)	0.068 (0.057 to 0.083)	0.14 (0.11 to 0.20)
Acramite				
Lab colony (*T. urticae*)	240	3.072 (±0.418)	12.6 (10.3-14.9)	32.8 (26.1-46.6)
Manteca (*T. urticae*)	360	1.997 (±0.199)	141.3 (85.1-229.3)	619.3 (352.6-1801.6)
Shafter (*T. pacificus*)	240	3.846 (±0.540)	4.4 (3.6-5.4)	9.5 (7.5-13.7)
Westside (*T. pacificus*)	287	2.756 (±0.345)	11.4 (6.8-19.6)	33.2 (19.4-116.7)
Nealta (not registered)				
Lab colony (*T. urticae*)	699	1.466 (±0.122)	77.78 (58.39-109.15)	582.24 (342.21-1310.66)
Manteca (*T. urticae*)	320	1.746 (±0.194)	176.22 (91.05-401.21)	955.52 (414.46-12223.22)

Research Effort Recent Publications:

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