Insect and Mite Research

Project No.: **08-ENTO7-Zalom**

Project Leader: Frank G. Zalom
Department of Entomology
University of California, Davis
One Shields Ave.
Davis, CA 95616
(530) 752-3687
fgzalom@ucdavis.edu

Project Cooperators: Franz Niederholzer, University of California Cooperative Extension, Sutter/Yuba Counties
Walter Leal, Department of Entomology, University of California, Davis
Javier Saenz de Cabezon, Department of Entomology, University of California, Davis
Kim Gallagher, Sterling Insectary, Delano, CA

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. Assist in evaluating NOW pheromone blends and formulations and in ten lined June beetle monitoring as necessary in collaboration with other UC researchers.
2. Peach twig borer - evaluate efficacy and treatment timing for registered and candidate insecticides.
3. Dormant spray best management practices (BMPs) – establish efficacy and possible phytotoxicity (from oils) resulting from earlier dormant spray timing, and from use of other mitigation practices.
4. Spider mites – evaluate efficacy of registered and candidate miticides, and determine their specific activity. Continue to evaluate direct and residual effects of pesticides against predatory mites.

Interpretive Summary:

<u>Monitoring supplies and regional trapping</u>

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 insure consistency in data collected over years. For the 2008 season, supplies purchased and distributed included 280 traps of various kinds, 300 pheromone lures for peach twig borer (PTB), SJS, oriental fruit moth, and oriental fruit moth, and 6 lbs of NOW bait. My lab also participates in the development and evaluation of new lures with other almond researchers who solicit our assistance. For example, during the past five years, my lab has helped assist Dr. Walter Leal in his field work to evaluate NOW pheromone blends and formulations, and for monitoring ten lined June beetle populations.

Peach twig borer treatments

An experiment to determine efficacy of registered and candidate insecticides for control of PTB was conducted on third leaf Nonpareil almonds in collaboration with Sutter County CE Farm Advisor, Franz Neiderholzer. All dormant treatments were applied on January 30, 2008. Materials and rates applied per acre were Diazinon (Helena) at 4 pts, Asana (Dupont) 2 EC at 9.6 oz and 12.8 oz, Altacor (Dupont) at 2 oz, 3 oz, and 4 oz, Avaunt (Dupont) at 6 oz, Delegate (Dow) 25 WDG at 1.6 oz, 2.4 oz, and 3.2 oz, Belt (Bayer) 480 SC at 2 oz and 4 oz, with and without oil, Mustang Max EW (FMC) at 4 oz, and Warrior (Syngenta) at 5.12 oz. All dormant sprays except as indicated previously were applied with 4 gal or IAPP 440 oil in 100 gal of water to runoff. An additional treatment consisted of Intrepid (Dow) at 10 oz with Latron B1956 at 0.125% v/v applied at budswell. PTB shoot strikes were evaluated on April 29. All treatments were replicated 6 times. Unfortunately, for the first time since we began working on PTB, we did not obtain useable results from this experiment because of a lack of PTB shoot stirkes in the untreated trees. However, results for Diazinon, Asana, Altacor (rynaxypyr), Avaunt, Delegate, and Warrior applied during the 2007 dormant season are presented in Table 2 (Project 07-ENTO7-Zalom) of our 2007-08 Almond Board of California Final Report available on 2007-08 Final Report CD enclosed with this Proceedings.

Dormant spray best management practices (BMPs)

Earlier dormant spray timing has been one of the most effective methods for mitigating insecticide runoff from orchards in our previous BMP studies. However, there is concern about both the efficacy of the approach against target pests such as PTB, and also possible phytotoxicity from the oils included in the dormant sprays. In 2005-06, Franz Niederholzer and I initiated a study to test the hypothesis that earlier dormant season treatments could be applied effectively without affecting almond bloom. Our results indicated that while the amount of bloom did not seem to be affected, the timing of bloom was affected. The study was repeated in 2006-07, concentrating only on Nonpariel bloom, but with treatments applied as early as mid October. Results presented in Table 3 and Figures 1–4 of our 2007-08 Almond Board of California Final Report (see Project 07-ENTO7-Zalom, on 2007-08 Final Report CD enclosed with this Proceedings) indicated that although PTB shoot strikes were significantly reduced in all of the esfenvalerate and diazinon treatments on all treatment dates when compared to untreated controls (F=17.52, df=16,135, P<0.0001), treatment efficacy was better on both of the later treatment dates than on either the October 18 or November 24 treatment dates. Bloom was most affected by the December 30 treatment when bloom timing was accelerated by as much as 8 days in all treatments containing oil relative to the other treatment timings and untreated controls. For the 2007-08 dormant season, treatments were applied at 4 different timings, November 2, November 26, and December 31, 2007, and January 31, 2008. Treatments were applied to individual Aldrich trees using an air assist sprayer and replicated 8 times. Return bloom and bloom progression on each tree was determined by counting the number of opened flowers per tree from February 18 through March 8 when 94 to 100 percent bloom was recorded. PTB shoot strikes were evaluated on April 29. PTB shoot strikes were very low in 2008, yet significant differences were found in all of the esfenvalerat and diazinon treatments on all treatment dates when compared to untreated controls (F=3.3774, df=14,119, P<0.0002) (Table 1).

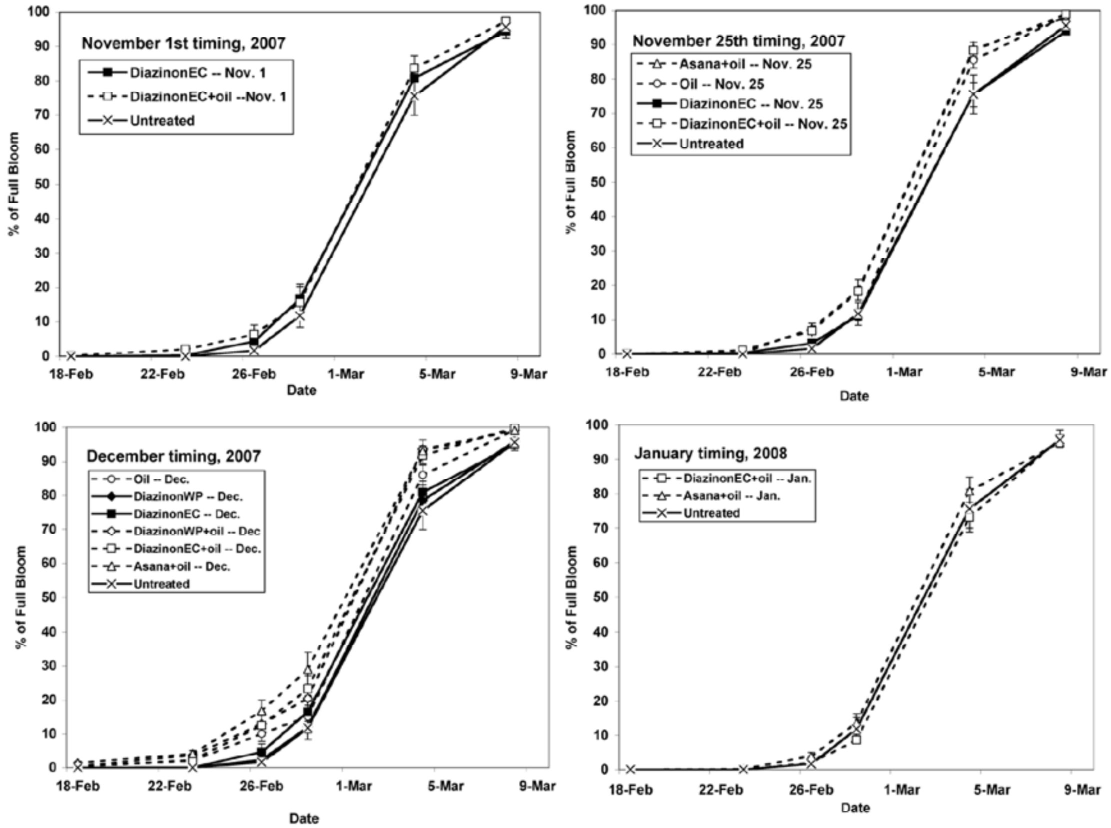
Table 1. Mean (± SE) peach twig borer shoot strikes per tree, 2007-08.

Treatment	Rate (form. / ac.)	Application Date	Mean (± SE) shoot strikes per tree[1]			
Diazinon EC + oil	0.5 gal. + 4 gal.	11/2/07	0.00	±	0.00	c
Diazinon EC	0.5 gal.	11/2/07	0.00	±	0.00	c
Oil	4 gal.	11/26/07	0.88	±	0.30	ab
Asana + oil	9.6 oz. + 4 gal.	11/26/07	0.00	±	0.00	c
Diazinon EC + oil	0.5 gal. + 4 gal.	11/26/07	0.25	±	0.25	c
Diazinon EC	0.5 gal.	11/26/07	0.00	±	0.00	c
Oil	4 gal.	12/31/08	0.50	±	0.27	bc
Diazinon EC + oil	0.5 gal. + 4 gal.	12/31/08	0.00	±	0.00	c
Diazinon EC	0.5 gal.	12/31/08	0.00	±	0.00	c
Diazinon WP + oil	4 lbs. + 4 gal.	12/31/08	0.00	±	0.00	c
Diazinon WP	4 lbs.	12/31/08	0.00	±	0.00	c
Asana + oil	9.6 oz. + 4 gal.	12/31/08	0.00	±	0.00	c
Diazinon EC +oil	0.5 gal. + 4 gal.	1/31/08	0.00	±	0.00	c
Asana + oil	9.6 oz. + 4 gal.	1/31/08	0.13	±	0.13	c
Untreated	na	na	1.13	±	0.58	a

[1] Means followed by the same letter do not differ significantly at (P=0.05) from one another by Fisher's Protected LSD, following SQRT (x + 0.5) transformation.

Unlike 2006 - 2007, there were no significant differences in treatment between treatment dates, but this was likely due to low PTB densities present. As in all of our earlier efficacy studies, no significant PTB control was afforded by the application of oil alone. Results of the return bloom and bloom progression were similar to what we reported in 2006 and 2007. Bloom was accelerated by as much as 6 days in the December treatments containing oil (Figure 1) relative to the other treatment timings and untreated controls, with the primary effect occurring in the first half of the bloom period.

Figure 1. Aldrich bloom date as affected by treatment timing, 2007 - 2008.



<u>Spider mite treatments and non-target effects.</u>

We followed up our detailed laboratory studies of direct and sublethal effects of newer acaricides on predator mites presented in the 2006 - 2007 and 2007 – 2008 Almond Board of California Final Reports by studying their effects on predator mite and spider mite behavior. Behavioral effects of pesticides are seldom considered either from the standpoint of efficacy against target pests, population resurgence, or unintended effects upon beneficial organisms. Some studies have suggested a correlation between pesticide-induced dispersal and spider mite outbreaks, but there has been no study that documents these effects with acaricides registered on almonds. Specifically, we studied the irritant effects of the acaricides fenpyroximate (Fujimite, Nichino America), etoxazole (Zeal, Valent), acequinocyl (Kanemite, Arysta Lifescience), bifenazate (Acramite, Chemtura) and spirodiclofefen (Envidor, Bayer) on adult females of two predatory mites *Galendromus occidentalis* and *Neoseiulus fallacies*, the twospotted spider mite (*Tetranychus urticae*), and the Pacific mite (*T. pacificus*).

Six adult females obtained from colonies maintained in our laboratory were offered a choice between a pesticide-treated leaf disk and an untreated leaf disk by releasing them, one at a time, at the base of an acetate T-bridge that connected the leaf disks. The leaf disks and T-bridge were placed on the surface of wetted filter paper lining a Petri dish. The T-bridge was cleaned with 70% ethanol and then distilled water before and after each use. Mite distribution was recorded after 5 minutes. This choice test was repeated twenty times for each species and acaricide. A control using two untreated leaf disks connected by a T-bridge was used to confirm that mite movement to the leaf disks was random. Arcsine transformed means were compared using a paired-sample *t* test for treatment to determine if the proportion of female mites present on the control versus the pesticide-exposed disk differed significantly from 0.5.

Results of this experiment are presented on Table 2. Twospotted spider mites were repelled by all acaricides applied except for Zeal. Pacific mites were repelled by Envidor and Acramite, but not by the other products. These results are interesting in that they suggest that spider mites that are not killed by the products applied either because they were not contacted by the spray or because they were not exposed to residues for a sufficient period of time to kill them could escape to untreated leaf surfaces and survive an application. Redistribution of the mite population on a tree could also increase the number of potential colonies resulting in a resurgence of the mite population that would encompass a greater area of the tree than before the application. Conversely, irritation and more rapid mite movement could potentially lead to greater control if thorough leaf surface coverage by the spray is achieved. That both spider mite species are not repelled by Zeal is significant in that they would be as likely as not to remain on treated leaf surfaces where they would remain exposed to its residue. *G. occidentalis* was repelled by Envidor, Acramite and Fujimite, and *N. fallacis* by Acramite and Fujimite. Presumably, the ability to sense and avoid treated surfaces would be beneficial to predators that might otherwise be exposed to a toxic pesticide and be killed. These results are useful when considered in light of the drect and sublethal effects of these products reported in Table 10 of our 2006 - 2007 Almond Board of California Final Report and Table 5 of our 2007 - 2008 Almond Board of California Final Report (07-ENTO7-Zalom on CD enclosed with this Proceedings) which showed that the total effects on *G. occidentalis* of Acramite and Kanemite were low and that these products were only slightly persistent (by IOBC standards), that Envidor was slightly harmful and slightly persistent, and that Fujimite and Zeal were harmful and persistent. Interestingly, both predatory mites were highly repelled by Fujimite, with over 90% of those released choosing the untreated leaf disk within 5 minutes, while the predators showed no indication of avoiding Zeal treated leaf surfaces.

Clearly, knowledge of direct, sublethal and indirect (including behavioral responses) of pesticides toward the target pest species and beneficial arthropods are important in making use decisions.

Table 2. Repellent effects of different acaricides on two species of spider mites and two species of predatory mites.

Acaricide	Concentration (ppm)	Species *G. occidentalis*	*N. fallacis*	*T. urticae*	*T. pacificus*
Spirodiclofen	76.20	+	0	+	+
Acequinocyl	158.00	0	0	+	0
Bifenazate	112.75	++	+	+	+
Etoxazole	24.12	0	0	0	0
Fenpyroximate	0.21	++	++	++	0

+ = more than 60 percent of mites on untreated leaf disk
++ = more than 90percent of mites on untreated leaf disk
0 = no significant difference in mite distribution