Insect and Mite Research

Project No.: **07-ENTO7-Zalom**

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Objectives:

1. Purchase pheromone traps, navel orangeworm 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:

Monitoring supplies and regional trapping. 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. For the 2007 season, supplies purchased and distributed to 7 individuals included 744 wing traps and trap liners, 348 San Jose scale (SJS) traps, 50 navel orangeworm (NOW) egg traps, 825 'regular' pheromone lures for peach twig borer (PTB), SJS, oriental fruit moth, and obliquebanded leafroller, 120 'long-life' PTB pheromone lures, and 11 lbs of NOW bait. To insure consistency in data collected over years, we have standardized traps and lures that are utilized. Because insect monitoring is integral to almond IPM, 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 four years, I have assisted in Dr. Walter Leal's field work to evaluate NOW pheromone blends and formulations, and for monitoring ten lined June beetle populations and collecting the beetles for in collaboration with and in support of other UC researchers. Continuing to coordinate regional insect trapping and collaborating with new monitoring research allows for consistency and improvements in this important component of almond IPM.

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. Dormant treatments were applied on January 18, 2007. Delayed dormant/budswell sprays were applied on 1 February. Full bloom sprays were applied on February 28. PTB shoot strikes were evaluated on April 4. All treatments were replicated 8 times with four randomized complete blocks of each treatment placed into each of the 2 treatment rows. All of the dormant and delayed dormant sprays included horticultural mineral oil at 4% vol/vol. Results are presented on Table 1. All products except for Ecotrol resulted in significantly lower shoot strikes relative to the untreated control.

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

		Timing			Mean (± SD) shoot strikes			
Treatment	Rate (formulated)	D	BS	Bl	per tree[1]			
Untreated	NA	X			13.44	±	8.16	A
Diazinon + Oil	4 pts + 4 gal. oil	X			0.25	±	0.71	EFG
Asana + Oil	9.6 oz + 4 gal. oil	X			0.75	±	0.89	EFG
Brigade + Oil	0.5 lb + 4 gal. oil	X			0.00	±	0.00	G
Brigade + Oil	0.5 lb + 2 gal. oil	X			0.00	±	0.00	G
BAS 320 WU I	0.21 lb ai			X	4.25	±	3.62	B
BAS 320 00 I	0.25 lb ai			X	3.50	±	2.27	BC
Baythroid + Oil	2.0 oz + 4 gal. oil	X			0.13	±	0.35	FG
Baythroid + Oil	2.8 oz + 4 gal. oil	X			0.63	±	1.06	EFG
rynaxypyr	4.0 oz	X			0.00	±	0.00	G
rynaxypyr + Oil	3.0 oz + 4 gal oil	X			0.13	±	0.35	FG
rynaxypyr + Oil	4.0 oz + 4 gal oil	X			0.13	±	0.35	FG
Rynaxypyr	3.0 oz			X	0.25	±	0.71	EFG
Rynaxypyr	4.0 oz			X	0.38	±	0.74	EFG
Avaunt + Oil	6 oz + 4 gal oil	X			1.75	±	1.75	CDE
Avaunt	6 oz			X	0.25	±	0.46	EFG
Warrior + Oil	3.0 oz + 4 gal. oil	X			1.88	±	2.80	DEF
zetacypermethrin + Oil	0.025 lb ai + 4 gal. oil	X			0.25	±	0.71	EFG
zetacypermethrin + Oil	0.025 lb ai + 2 gal. oil	X			0.38	±	0.74	EFG
Assail + Oil	5 oz + 4 gal. oil		X		4.38	±	2.26	B
Assail + Oil	8 oz. + 4 gal. oil		X		3.00	±	2.78	BCD
Delegate + Oil	1.6 oz + 4 gal oil	X			0.00	±	0.00	G
Delegate + Oil	2.4 oz + 4 gal. oil	X			0.38	±	0.74	EFG
Delegate 25 + Oil	3.2 oz + 4 gal. oil	X			0.25	±	0.71	EFG
Intrepid + Latron	10 oz. + 0.125% v/v		X		0.88	±	1.36	EFG
Ecotrol EC	3 pts.		X		15.50	±	9.83	A

ANOVA statistics: $F=22.16$, $df=25,190$; $P<0.0001$.

[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.

Dormant spray best management practices (BMPs). Earlier dormant spray timing has been one of the most effective methods for reducing insecticide runoff from orchards in our 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. Treatments applied incuded esfenvalerate (Asana) and horticultural mineral oil, diazinon and horticultural mineral oil, and horticultural mineral oil alone at gallons per acre applied at 4 different timings, October 18, November 24, December 30, 2006, or January 25, 2007. Treatments were applied to individual nonpareil 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 16 through March 8 when 100 percent bloom was recorded. PTB shoot strikes were evaluated on April 4. Although PTB shoot strikes were significantly reduced in all of the esfenvalerat 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 the October or November treatment dates. Table 2 presents the results for the Asana and oil treatments, but similar results were observed for the diazinon treatments. There was no significant PTB control afforded by the oil alone.

Table 2. Mean (± SE) peach twig borer shoot strikes per tree, 2007.

Treatment	Rate (formulated)	Application Date	Mean (± SE) shoot strikes per tree[1]			
Asana + oil	9.6 oz. + 4 gal.	10/18/06	4.38	±	1.28	b
Asana + oil	9.6 oz. + 4 gal.	11/24/06	3.63	±	1.21	b
Asana + oil	9.6 oz. + 4 gal.	12/30/06	0.13	±	0.13	c
Asana + oil	9.6 oz. + 4 gal.	1/25/07	0.00	±	0.00	c
Untreated	NA	NA	12.25	±	1.77	a

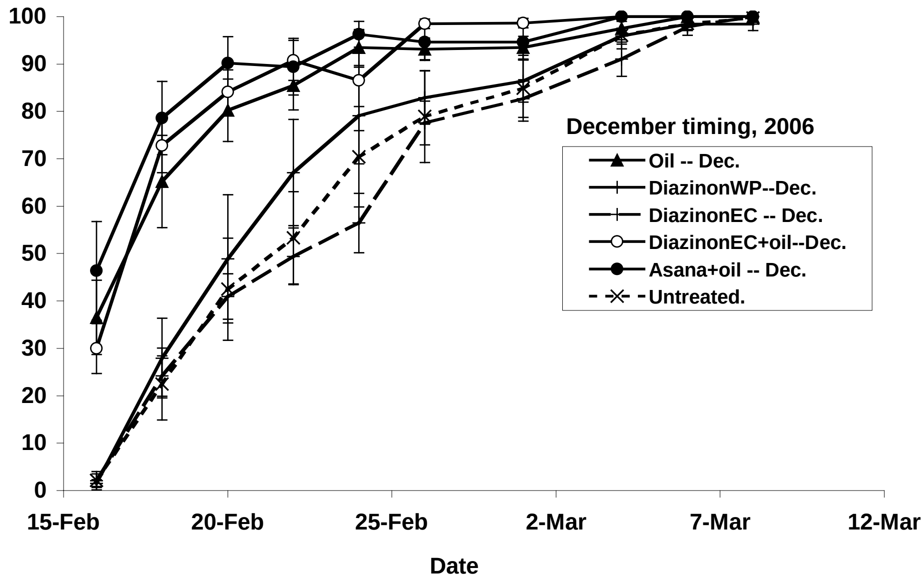
[1] Means followed by the same letter do not differ significantly at (P=0.05) from one another by Fisher's Protected LSD, following SQRT (x + 0.5) transformation.

Results of the return bloom and bloom progression were similar to what we reported in 2006 – bloom was accelerated by as much as 8 days in the December treatments (Figure 1) containing oil relative to the other treatment timings and untreated controls, with the primary effect occurring in the first half of the bloom period.

In 2006, we reported results of experiments using Landguard, an enzyme product from Orica Inc. that is intended to increase the rapidity of organophosphate breakdown. When Landguard was applied to the soil surface after a dormant diazinon application, the resulting concentration of diazinon in the runoff was significantly reduced. We repeated this study in the winter of 2007, and obtained similar results. Diazinon AG500 was applied on February 15, 2007, at a rate of 4 pts/acre in 100 gal of water to 8 replicate plots, and 4 plots remained untreated. Landguard was applied to the soil surface of 4 of the plots at a rate of 1000 g per 1500 L of volume following the diazinon application. Diazinon concentration in runoff captured in our autosampler units 8 days after application indicated levels of diazinon were significant differences between treatments (F=114.721, df=2,11, P<0.0001) with a mean $\pm$ SE of 119.03 $\pm$ 9.36 µg/L to

16.87 ± 4.34 µg/L in the plots treated with Landguard, with a background level of 1.46 + 0.60 µg/L in the untreated plots.

Figure 1. Nonpareil bloom date as affected by December treatment timing, 2006-07.



Spider mite treatments and non-target effects. In 2007, we evaluated a number of miticides for control of twospotted spider mite. The treatments were applied on August 14, and leaves were collected for pretreatment mite counts immediately before the application. Densities averaged 6.8 per leaf at the time of application. The action threshold for webspinning spider mites on almonds is about 4.0 motile mites per leaf. Treatments were applied to runoff using a gas-powered hand gun sprayer at the equivalent volume of 400 gal/acre. Each treatment replicate was a single tree, and each treatment was replicated 4 times in a completely randomized design. Products tested included horticultural mineral oil (Orchex), acequinocyl (Kanemite), bifenezate (Acramite), spiromesefen (Envidor 2SC), fenpyroximate (Fujimite 5EC), and abamectin (Agri-mek). Treatments and application rates are provided on Table 3 along with data for weekly spider mite densities. Mite sampling consisted of removing 10 leaves per tree randomly from around the circumference of each tree, placing the leaves from each tree into a labeled plastic bag, and returning the leaves to the Zalom lab for counting. Using a mite brushing machine, the total number of twospotted spider mite motiles was determined.

Significant (*P*<0.05) differences were observed for all 4 weekly post treatment sampling dates. All products tested reduced spider mite densities except for the horticultural mineral oil applied at 1% v/v on weeks 3 and 4 following application, and Agri-mek plus oil and the 1% and 4% rates of Orchex horticultural mineral oil on the 4th week following application. The oil alone applied at 4% v/v reduced spider mite densities for 3 weeks following its application.

Table 3. Mean (± SD) motile twospotted spider mites per leaf on almonds, 2007 (n=4).

		Mean ± SD twospotted mites per leaflet				
Treatment	Rate (Form/ac)	Aug.14 Pretreat	Aug. 21	Aug. 28	Sept. 4	Sept. 11
Untreated	na	6.8 ± 2.6	5.3 ± 2.1	4.8 ± 2.1	4.5 ± 1.7	3.5 ± 1.3
Envidor	18 oz	5.3 ± 2.1	0.0 ± 0.0*	0.3 ± 0.5*	1.0 ± 1.4*	1.0 ± 0.8*
Envidor + LI7000	18 oz + 0.25% v/v	7.8 ± 2.1	0.0 ± 0.0*	0.0 ± 0.0*	0.5 ± 0.6*	0.8 ± 1.0*
Acramite	1 lb	5.8 ± 2.2	0.5 ± 0.6*	0.8 ± 1.0*	0.8 ± 1.0*	1.5 ± 1.3*
Fujimite + oil	32 oz + 1%	6.5 ± 3.1	0.3 ± 0.5*	0.5 ± 1.0*	0.8 ± 1.0*	1.0 ± 0.8*
Kanemite	31 oz	5.8 ± 2.9	0.0 ± 0.0*	0.5 ± 1.0*	0.8 ± 0.5*	1.3 ± 1.3*
Agri-mek + oil	15.6 oz + 1%	3.8 ± 1.0	1.0 ± 0.8*	0.8 ± 0.5*	1.3 ± 1.5*	1.8 ± 1.3
Orchex	1% v/v	7.3 ± 4.3	3.0 ± 0.8*	3.3 ± 1.0*	5.0 ± 2.2	3.3 ± 1.3
Orchex	4% v/v	8.5 ± 2.9	0.8 ± 1.0*	1.3 ± 1.0*	2.5 ± 1.3*	2.3 ± 1.9

*Means significantly different from untreated control at *P*<0.05 by Student's t-test.
ANOV statistics for each sampling date:

A detailed laboratory study to determine direct and sublethal effects of newer acaricides was conducted in the Zalom laboratory at UC Davis. Complete results are published in the journal *Biological Control* (Saenz de Cabazon Irigaray, F. J., F. G. Zalom, and P. B. Thompson. 2007. Residual toxicity of acaricides to Galendromus occidentalis and Phytoseiulus persimilis reproductive potential. Biol. Contr. 40:153-159), but the most relevant results, which indicate the total effects of the acaricides on the western orchard predator mite, *Galendromus occidentalis* are presented on Table 4.

Table 4. Total effects (E) of acaricide residues on *G. occidentalis* recorded 72 h after exposure to treated strawberry leaflets removed from treated plants in the field on the indicated days after treatment using the labeled dose of formulated products.

	Days after treatment								
Treatment	3	6	10	14	17	24	30	37	IOBC[a]
Bifenazate	100	67	52	0	0	0	0	0	B
Etoxazole	100	100	100	100	100	100	100	100	D
Spiromesifen	100	67	33	0	0	0	0	0	B
Abamectin	60	0	0	0	0	0	0	0	A
Fenpyroximate	100	100	100	100	100	100	100	100	D
Acequinocyl	100	48	30	23	6	0	0	0	B

[a] IOBC categories: A = short lived (<5 d), B = slightly persistent (5-15 d), C = moderately persistent (16-30 d), D = persistent (>30 d).
E (%) = 100% - (100% - M) x R