Efficacy Trials of Insecticides for the Navel Orangeworm

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Navel orangeworm is the most significant insect pest of almonds in California and routinely requires insecticide treatments for its control. Over the past few years, several new insecticides have become available for NOW control, with several others still under development. The objective of this project is to conduct screening trials of these new products to determine which are the best candidates for larger scale field trials and for use in commercial settings.

Methods

During 2010 we conducted two trials that were located in Fresno County in a mature almond orchard at the Kearney Agricultural Center and in a third leaf orchard at the West Side Research and Extension Center. Each trial evaluated the same 14 treatments and an untreated check in a randomized complete block design with four to six replications of single-tree plots. Both trials were sprayed at the initiation of hull split on July 22 or 23, 2010

Table 1. Effects of insecticide treatments on the percentage of almond nuts infested by navel orangeworm.

Treatment/Forumlation[1]	Rate Form. Prod/acre	Parlier		Five Points	
		No. nuts	NOW damage (%)	No. nuts	NOW damage (%)
Tourismo SC	14 fl oz	801	0.39a	1128	0.24a
Belt 480SC	4 fl oz	800	0.58a	1190	0.09a
Delegate 25WG	6.4 oz	808	0.50a	1248	0.32a
Intrepid 2F	16 fl oz	811	0.51a	1167	0.43a
Altacor 35WG	4 oz	846	0.58a	1119	0.45a
HGW86 10SE	13.5 fl oz	798	1.13a	1135	0.07a
Voliam Xpress 1.25ZC	12 fl oz	818	0.23a	1160	0.00a
Proclaim 5SG	4 oz	788	0.88a	1155	0.26a
Danitol 2.4EC	21.3 fl oz	821	1.87a	1210	0.24a
Brigade 10WSB	1 lb	822	1.34a	1148	0.09a
Tourismo SC + Brigade 10WSB	14 fl oz + 1 lb	786	0.13a	1170	0.08a
Athena	13.5 fl oz	823	1.18a	1317	0.05a
Hero EW	11.2 fl oz	637	1.93a	1176	0.00a
Untreated Check	--	812	0.99a	1210	0.09a
		F =	1.35	*F* =	1.50
		P =	0.2261	*P* =	0.1430

[1]Dyne-Amic used as a surfactant at 32 fl oz per 100 gallons.
Means in a column followed by the same letter are not significantly different ($P > 0.05$, Fisher's protected LSD) after arcsin (x) transformation of the data. Untransformed means are shown.

Results

Table 1 shows the effects of NOW treatments on damage at each location. Untreated checks averaged 0.88 and 0.08 percent damage with no significant differences among individual treatments. However, further analysis of data where insecticides were grouped and analyzed by their modes of action revealed significant differences (Table 2). At Parlier, larvicides caused a significant reduction in worm density compared to pyrethroids whereas at West Side pyrethroids resulted in a significant reduction in worm damage compared to larvicides. However, in both cases, the two tank mix products that included both a larvicide and an adulticide had the overall least amount of damage. This suggests that both types of insecticides can be effective, but that treatment timing plays a large role in the effectiveness of single-mode-of-action products compared to those containing both a larvicide and an adulticide.

Table 2. Effects of Mode of Action of insecticides on the percentage of almond nuts infested by navel orangeworm

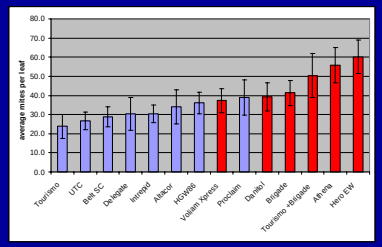
Mode of Action	Insecticides included	NOW damage (% ± SEM)	
		Parlier	Five Points
Larvicide	Diamides (Altacor, Belt, HGW86, Tourismo) Spinosyn (Delegate), Diacylhydrazine (Intrepid), Avermectin (Proclaim)	0.65 ± 0.14ab	0.25 ± 0.06b
Adulticide	Pyrethroids (Athena, Brigade, Danitol, Hero)	1.58 ± 0.38c	0.10 ± 0.05a
Both	Tourismo+Brigade, Voliam Xpress	0.18 ± 0.09a	0.04 ± 0.04a
Untreated Check	Untreated Check	0.99 ± 0.19bc	0.09 ± 0.11 ab
	F, P =	5.65, 0.0021	2.61, 0.0574 *

Means in a column followed by the same letter are not significantly different ($P > 0.05$ or 0.01* Fisher's protected LSD) after arcsin (x) transformation of the data. Untransformed means are shown.

Effects of NOW treatments on Spider Mites

Figure 1 shows the effects of navel orangeworm treatments at hull split at the West Side Research and Extension Center orchard on spider mite densities four weeks later. For comparison purposes, treatments containing pyrethroids are indicated in red compared to treatments without pyrethroids that are indicated in blue.

Figure 1. Affects of treatments for navel orangeworm on the spider mite density approximately 4 weeks after treatment. Bars in red indicate treatments including pyrethroids whereas blue bars indicate either the untreated check or plots treated with non-pyrethroid chemistries.



Establishment of an Almond Research Orchard in Kern County

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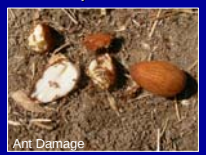
University of California researchers such as Rich Coviello, Mario Viveros, Walt Bentley, Frank Zalom, Brent Holtz, and David Haviland have all played key roles in the screening of new insecticides and acaricides for ants, navel orangeworm, peach twig borer, scales and spider mites.

However, in Kern County, most of these trials have needed tobe conducted in commercial orchards because no research facilities with almonds exist south of the Kearney Agricultural Center. This limits the potential value of these trials due to limitations regarding untreated checks, liabilities and costs of crop destruct, the potential for trials to be oversprayed or harvested by accident, and the coordination of trials with logistics and constraints related to production practices.



Analysis of the costs and benefits of having an entomology research orchard in Kern County led to the conclusion that we should plant and maintain an orchard. Therefore, a 7-acre orchard (Table 1) was planted in 2009 with donations from three industry members for the irrigation system, trees, and wrappers. Ground preparation and an irrigation filter station were supplied by the University of California. Maintenance costs are being covered by a combination of funds from the Almond Board of California and Research Grant Funds obtained by David Haviland.

Table 1. Almond Planting Specifications

- 7 Acres with 720 trees
- 50/50 ratio Nonpareil to Monterey on Nemaguard rootstock
- Spacing 20 ft x 22 ft
- Micro-sprinklers - ability to irrigate Nonpareil and Monterey independently

This research orchard will allow us to conduct multiple research trials annually on insect pests while alleviating many of the previous concerns regarding the use of unregistered insecticides, coordination of our trials with a commercial grower's production practice schedule, and without risk of being oversprayed. It will also allow us to have the ability to improve the quality of the trials through our own production practices, such as those that can promote high levels of insects that can be used for experimentation.

As of summer 2010, the field is fairly uniform and all trees are healthy. In the first two years since planting the orchard has been used for 4 miticide trials and an ant bait trial. In the future the orchard will continue to be used for spider mite and ant bait trials. Beginning in 2011 we will also be able to begin trials on navel orangeworm.

Due to the 50/50 Nonpareil/ Monterey composition of the orchard and number of trees available (700), the opportunity will exist on an annual basis to do multiple trials during both the second and third NOW flights.