Efficacy Trials of Registered and Developmental Insecticides for Navel Orangeworm

Project No.: **09-ENTO8-Haviland/Holtz**

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Objectives:

Develop efficacy data for newly-registered and experimental insecticides against navel orangeworm in almonds

Interpretive Summary:

Navel orangeworm continues to be a significant pest of almonds in California. Many efforts are underway to understand more about navel orangeworm biology, as well as integrated pest management practices such as winter sanitation and mating disruption. The purpose of this project is to evaluate the potential roles of new insecticides that have recently become registered for almonds, or that have the potential to become registered, for their affects on navel orangeworm.

Each year the goal is to conduct two trials in almonds, one of which is in Kern County, and the other of which is in Madera County. Each trial uses four to six replications of single-tree plots to evaluation each of about 20 to 25 insecticides. Trials are typically

conducted in the variety Nonpareil with treatments being applied at the second flight of navel orangeworm at the initiation of hull split. Trials are evaluated in August.

Two trials were conducted in 2008 and two more are underway in 2009. At the time of writing, the field portions of 2009 trials have almost been completed and nuts have been harvested. Nuts will be processed during the fall and early winter to hopefully have data available in time for a poster presentation at the December Almond Industry Conference.

Details from the 2008 trials are included on the 2008-9 Final Reports CD that is included with these proceedings (Project 08-ENTO8-Haviland/Holtz). In those trials we evaluated twenty-one different insecticides. The Madera County trial was conducted in Madera, was sprayed on 24 July, and was harvested on 14 August. Samples were held at room temperature for 10 additional days, were oven-dried to kill any surviving worms, and were evaluated. The Kern Co. trial was located in Shafter, was sprayed on 16 or 17 Jul, and was harvested on 9 September. Nuts were processed through a mini-huller, refrigerated, and evaluated.

Data from the 2008 Final Report are replicated below in Table 1. The Madera site had very high navel orangeworm pressure. The most notable result was the pattern seen of good efficacy of products representing a new mode of action called anthranilic diamides. These included four insecticides using the active ingredients flubendiamide and chlorantraniliprole (Altacor, Belt, Tourismo, and Voliam Xpress). Products with this mode of action affect the ryanodine receptors of worm pests and result in cessation of feeding. These products are considered reduced-risk, are thought to have little impact on natural enemies (with the exception of Voliam Xpress that includes a pyrethroid), and can provide a new tool in resistance management programs for all worm pests in almonds.

Products of other modes of action had mixed results. The pyrethroid Danitol significantly reduced damage to 30.2% compared to 47.2 and 57.8% for the untreated checks, whereas Brigade had damage comparable to the untreated checks at 46.8%. The grower standards Intrepid and Imidan both reduced damage to 30.2 and 34.2%, respectively. Assail has similar good results at 30.2 and 37.2% damage.

Damage in trees treated with other modes of action had variable results and generally fell out towards the middle of the trial in effectiveness. Generally speaking, trees treated with these products had damage that was numerically lower than one or both control plots, that in some cases was statistically equivalent to the best treatments, but that in many cases was also statistically equivalent to one or both of the untreated checks. This was true for the products containing chlorpyrifos (Lorsban 4E and Lorsban Advanced), the spinosyn Delegate, the metaflumizone product Alverde, the emamectin benzoate product Proclaim, and the benzyoylureas Rimon and Dimilin.

In the Kern County trial we evaluated an average of 405 nuts per tree, or 2429 nuts (range of 2,009 to 2,911) per treatment. Average percentage infestation by navel orangeworm ranged from 1.0% to 4.0% with the untreated checks having 1.54 and

2.18% damage. Statistical analysis showed that there were no significant differences between insecticide treatments compared to the untreated checks, nor between the best and worst treatments (*P* = 0.3043).

Table 1. The effects of insecticide treatments for navel orangeworm on the percentage of infested nuts at harvest, 2008. Madera and Kern County Trials.

Treatment	Rate[a] (Madera site, Kern Site)	Surfactant[b] (Madera site, Kern Site)	Percentage Infested Nuts	
			Madera Co. Trial	Kern Co. Trial
Voliam Xpress 1.25ZC	8 fl oz	D, D	29.3 a	2.1 a
Belt 480SC	4 fl oz	R, D	30.0 a	1.6 a
Assail 70WP	2.6 oz	Si, Sy	30.2 a	2.0 a
Intrepid 2F	16 fl oz	I, I	31.8 a	2.4 a
Tourismo SC	13.7 fl oz	I, D	31.8 a	1.0 a
Voliam Xpress 1.25ZC	9 fl oz	D, D	33.7 ab	2.5 a
Danitol 2.4EC	21.3 fl oz	R, I	34.0 abc	1.7 a
Imidan 70W	5.33lb, 5.0lb	-, I	34.2 abc	4.0 a
Altacor	3 oz	I, I	34.3 abc	1.4 a
Dimilin	16 fl oz	Sy, D	36.5 abc	2.5 a
Alverde 2SC	12.56 fl oz	I, I	36.7 abc	1.1 a
Assail 30SG	6 oz	Si, Sy	37.2 abc	2.0 a
Lorsban Advanced	4 pts	-, I	38.3 abcd	2.3 a
Altacor	4 oz	I, I	38.5 abcd	1.4 a
Proclaim	4 oz	D, D	40.0 abcd	1.5 a
Alverde 2SC	16 fl oz	I, I	41.7 abcde	1.7 a
Lorsban 4E	4 pts	-, I	45.8 bcdef	1.6 a
Brigade WSB	1 lb, 2 lb	O, I	46.8 bcdef	1.2 a
Untreated Check 2	-	-, -	47.2 cdef	2.2 a
Delegate 25WG	6.4 oz	I, I	51.3 def	1.7 a
Rimon	12 fl oz	Sy, D	54.0 ef	3.2 a
Untreated Check 1	-	-, -	57.8 f	1.5 a
DiPel 6.4WP	16 oz	R, I	58.8 f	2.1 a
			P<0.0001	P=0.3043

Means in a column followed by the same letter are not significantly different (P>0.05, Fisher's protected LSD).

[a] One rate indicates that the same rate was used at each location. Two rates indicate that the first rate was used at the Madera County trial site and the second rate was used at the Kern County trial site.

[b] D = Dyne-Amic at 48 fl oz, R = R-11 at 48 fl oz, S = Silwet at 24 fl oz, I = Induce at 24 fl oz, Sy = Sylgard at 24 fl oz, O = 415 Oil at 1.5 gal.