Control of Navel Orangeworm (NOW) in Almonds Using Insecticides and Assessing Spray Coverage

Project No.: **11-ENTO11-Siegel/Walse**

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Objectives:

1. Persistence of insecticides on nut surfaces:
   We will combine bioassay with analytical chemistry to establish both the duration of control and rate of degradation of insecticides on almonds.
2. Relative photostability of insecticides:
   We will determine the relative stability of the most commonly used insecticides in almonds using our photolysis chamber. Initially, the stability of these insecticides will be evaluated on glass slides, and once we have perfected this technique, their stability on almonds collected at different times will be assessed.
3. Insecticide penetration into the upper canopy:
   In our previous studies we noted a substantial reduction in the number of droplets per square inch at distances greater than or equal to 12 feet. We have established that the use of two nozzles per vane provides superior coverage compared to a single vane and that engine powered insecticide sprayers provide superior coverage to PTO sprayers in almonds, up to 20 feet. This research will be continued with an emphasis on improving penetration into the canopy.
4. Importance of insecticide coverage of the suture/exposed nut:
   Previous observations suggest that coverage of vulnerable areas on the nut (suture crack, exposed shell) is less important than assumed because NOW larvae wander before becoming established. While wandering, larvae are exposed to insecticide on the hull. Field trials will be conducted to specifically address this issue by covering the suture before spraying and then challenging these nuts with eggs. Larval success, measured by adult emergence, will be contrasted with both unsprayed nuts and regularly sprayed almonds from the same block.

Interpretive Summary:

Experiments are currently underway to meet the objectives listed above. Much of the data will not be available until the end of September or early October, 2012 and will be reported at the Annual Conference. At this point in time, we have focused on the ovicidal/neonate activity and adult activity of the insecticides currently registered for nut crops. The pyrethroids Bifenthrin, Lambda Cy and the insect growth regulator Intrepid have the highest ovicidal/neonate activity in our assays, which employ navel orangeworm eggs pinned on almonds and pistachios in the

field. Narrow spectrum insecticides such as Altacor and Belt also have substantial neonate activity, although they are not as potent as the pyrethroids or Intrepid. However, since their advertised mode of action is through contact and ingestion, the ovicidal/neonate activity demonstrated is an added bonus. Experiments are underway to determine which of these selective insecticides also has adult activity; again, this would be an added bonus. Our research indicates that it is essential to apply these selective/narrow spectrum insecticides early; 3 days early is infinitely better than 3 days late. A consensus is developing among our collaborators and industry representatives that 1% hull split is the preferred time for application to begin; in some circumstances navel orangeworm lay eggs at suture crack. Research is currently underway to document the duration of control of these insecticides in the upper and lower canopy and this issue is closely linked to application efficacy. Coverage can be extended using two nozzles per vane and engine powered spray rigs for tall trees. Our research complements the efforts of other investigators funded by the Almond Board of California who are evaluating drift mitigation and alternative application technologies (See 11.WATER.Giles/Markle).

Materials and Methods:

Spray coverage is evaluated using pinned egg strips containing 50 eggs and spray cards. The strips are collected one day after exposure, placed on diet and incubated for 3 weeks at 80°F. Control egg strips are placed on unsprayed nuts, collected in a similar manner and survival is assessed at 3 weeks. The number of droplets deposited per square inch is calculated from the spray cards.

We evaluate the persistence of insecticides on the nut surfaces by collecting split nuts and bringing them to the laboratory at intervals. They are placed in half-gallon jars and challenged with 200 eggs (4 egg papers containing 50 eggs per paper) or in one-gallon jars containing 400 eggs (eight 50-egg papers). All jars will be incubated at 85°F for 10 weeks and the adults that emerge will be counted. Controls will consist of early split and torn hull almonds collected from unsprayed orchards or treated orchards one day before spraying. This bioassay approach will be paired with the use of analytical chemistry to determine the relationship between insecticide efficacy, measured by the egg challenge, and the amount of insecticide recovered from almond hulls in the field. Insecticide residue on leaf surfaces in the field will also be quantified.

Results and Discussion:

Representative data from the duration of control and coverage trials are reported below for 2011. Similar and new trials are currently underway for 2012.

Fresno County, Nonpareil almonds sprayed on July 20, Belt, July 21, Proclaim, and July 28 Altacor, at 200 gpa and 2 mph

Insecticide	Day after spray	Percent Mortality	Percent Reduction	Eggs
Proclaim (4.8 oz) Abound Flowable (12.8 oz), Onager (24 oz), Britz 415 Supreme Spray Oil (192 oz), Britz 10-12-0 Zn Nutrient buffer (20 oz), ZincMax (20 oz), IronMax (16 oz)	5	99.40	93.15	1,000
Belt (4 oz) Carbomin Zinc 7.5% (20 oz), First Choice Narrow Range 415 Spray Oil (20 oz)	1	98.20	79.44	1,330
Belt (4 oz) Carbomin Zinc 7.5% (20 oz), First Choice Narrow Range 415 Spray Oil (20 oz)	6	98.60	84.01	1,000
Belt (4 oz) Carbomin Zinc 7.5% (20 oz), First Choice Narrow Range 415 Spray Oil (20 oz)	9	97.47	71.58	950
Belt (4 oz) Carbomin Zinc 7.5% (20 oz), First Choice Narrow Range 415 Spray Oil (20 oz)	14	99.28	91.78	1,800
Altacor (4.5 oz) Carbomin Zinc 7.5% (20 oz), First Choice Narrow Range 415 Spray Oil (20 oz)	14	97.33	69.51	3,300
Altacor (4.5 oz) Carbomin Zinc 7.5% (20 oz), First Choice Narrow Range 415 Spray Oil (20 oz)	14	99.83	98.06	600

Fresno County, Nonpareil Almonds

Insecticide	Day after spray	Percent Mortality	Percent Reduction	Eggs
Belt (4 oz) Potassium Nitrate (160 oz), Britz 415 Supreme Spray Oil (256 oz)	1	99.64	94.75	1,400
Altacor (4 oz) Potassium Nitrate (160 oz), Britz 415 Supreme Spray Oil (256 oz)	1	98.60	79.40	1,000
Intrepid (20 oz) Latron B-1956 (2 oz)	14	99.09	86.61	2,200
Intrepid (20 oz) Latron B-1956 (2 oz)	21	99.33	90.19	600

Madera County Nonpareil, sprayed July 21

Insecticide	Day after spray	Percent Mortality	Percent Reduction	Eggs
Intrepid (20 oz)	1	99.60	99.88	1,000
Intrepid (20 oz)	10	99.83	98.67	600
Intrepid (20 oz)	10	98.44	87.85	1,800

Ovicidal and Neonate Activity Almonds, Fresno County

Egg strips (50 eggs per strip) were pinned onto almonds and recovered 24-48 hours later. The strips were laid on bran diet, egg side down, incubated at 80°F, and larvae counted 14-18 days later. Application speed by engine driven sprayer was 2 mph. Two banks used at each position denoted by DB. This assay **does not** assess mortality following ingestion of treated almonds.

Insecticide	**GPA, Spray Rig**	**Height (feet)**	**% Mortality**	**% Reduction**	**Eggs**
Belt 4 oz	Air-O-Fan, 150 gpa, DB	5-7	92.68	67.28	3,550
Intrepid 20 oz	Air-O-Fan, 100 gpa, DB	**Avg. 10-20**	92.68	86.85	4,550
Intrepid 20 oz	Air-O-Fan, 150 gpa, DB	10	97.80	ND	100
Altacor 4.5 oz	Unknown Rig, 200 gpa	5-7	89.79	89.49	1,400
Belt 4 oz		5-7	86.80	86.42	1,750
Belt 4 oz	Air-O-Fan, 150 gpa, DB	5-7	94.53	66.46	1,150
		10	94.50	66.33	100
		Avg. 10-20	88.77	31.22	4,700

Research Effort Recent Publications:
Manuscripts will be written and submitted after this summer's research is completed. Experiments of this intricacy require at least two years of field data.

References Cited:

None