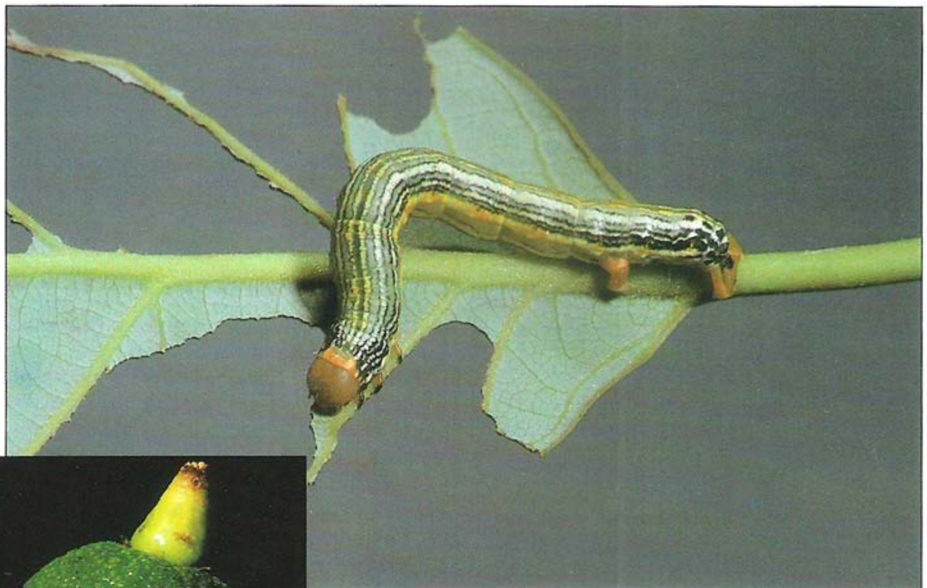

Omnivorous looper larvae can nearly defoliate avocado trees, leaving them vulnerable to sunburn injury. Though damage seldom penetrates the fruit's tough outer skin (left), shoppers may believe otherwise and choose other fruit.

Supplemental chemical control for omnivorous looper on avocados

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Researchers tested four chemicals for omnivorous looper control in avocado orchards. Of the three that proved effective, only two are currently registered for use on bearing avocados in California.

The omnivorous looper, larva of the moth *Sabulodes aegrotata* (Guenee), is a sporadic pest of California's 75,000-acre avocado industry and is normally controlled by natural enemies. The larvae feed on avocado fruit and foliage. Normally, fruit damage is confined to the surface, but it is often severe enough to decrease market value. Omnivorous loopers feeding on foliage can almost completely defoliate the trees, resulting in sunburn of the fruit and the tender twigs. This pest inhabits nearly all avocado groves, but usually is present in low numbers. Most outbreaks have occurred in San Diego County, with less severe problems occurring in Riverside, Ventura, and Santa Barbara counties.

Researchers have investigated various control measures in an attempt to establish an integrated pest management (IPM) program for insect and mite pests of avocados. Their work emphasizes monitoring pest populations and stages of development, and developing control measures that cause the least damage to beneficial organisms. Currently, a widely used method to control the omnivorous looper involves releases of the wasp *Trichogramma platneri* Nagarkatti, which parasitizes the eggs of omnivorous looper and *Amorbia cuneana* (Walsingham), another insect pest of avocados and citrus in California. Synthetic sex pheromones have been developed for both pests to aid in the timing of these releases (*California Agriculture* May-June 1988).

Experimental releases of *T. platneri* have provided approximately 60% control of omnivorous looper eggs (*California Agriculture* November-December 1985). However, no one has clearly demonstrated the ability of *T. platneri* wasps to provide adequate control of the omnivorous looper under commercial conditions. A selective chemical supplement to biological control may be needed.

We conducted five field trials to test insecticides for control of omnivorous looper larvae. Three of the trials used ground application equipment, a handgun operated from a standard orchard-type hydraulic spray rig to give complete coverage of the trees. In the other two trials, chemicals were applied by helicopter. Our results can help growers and pest control advisers select an insecticide or type of application should the need arise.

Ground applications

The first ground trial tested Lannate (methomyl), Orthene (acephate), Dylox (trichlorfon), and Kryocide (cryolite) against mid- to late-instar omnivorous looper larvae. Lannate and Orthene are broad-spectrum insecticides. Lannate is effective on many lepidopterous pests and degrades rapidly, while Orthene controls a wide variety of pests and is less toxic to humans than Lannate. Dylox is a more selective insecticide. Kryocide is a stomach poison that selectively kills phytophagous insects, leaving beneficials relatively unharmed.

Treatments were applied to 6-year-old Hass avocado trees on an 18' × 22' planting in Ventura County. The randomized block design included five single-tree replicates per treatment. Treated trees were sprayed to the point of runoff. Chemical application rates are listed in table 1.

We evaluated the treatments by checking for live omnivorous looper larvae in 30 randomly selected nests. Lannate and Orthene provided good control 5, 6, and 13 days after treatment. Dylox and Kryocide did not.

In the second ground trial, Kryocide and Thuricide were tested against early instar omnivorous looper larvae on 6-year-old Hass avocado trees on a similar 18' × 22' planting in Ventura County. Thuricide (*Bacillus thuringiensis*) is a stomach poison. Coax, a feeding stimulant, was added to the Kryocide treatment. Coax and Gustol, another feeding stimulant, were added to separate Thuricide treatments. Chemical application rates are listed in table 2.

A randomized block experimental design was used, with six single-tree replicates. Replicates were separated by at least one untreated buffer tree. The trees were sprayed to runoff. We evaluated treatments by looking for live larvae on 10 terminal branches per tree. Kryocide performed best, but all three treatments provided adequate control. Results for the two feeding stimulants with Thuricide showed no statistically significant difference.

In the third ground trial, three rates of Orthene and one rate of Kryocide were evaluated for control of late-instar omnivorous looper larvae on 3-year-old Hass avocado trees on an 18'×18' planting in San Diego County. Orthene was tested at the recommended label rate of 1.0 lb active ingredient per acre (ai/acre) and at two lower rates. Kryocide was tested at a rate commonly used for ground applications to other tree crops. Chemical application rates are listed in table 3.

A randomized block experimental design was used with five single-tree replicates. Replicates were separated by at least one untreated buffer tree on all sides. We evaluated the treatments by examining 40 randomly selected omnivorous looper nests per tree for live larvae. The two highest rates of Orthene and Kryocide provided very good control, with no statistically significant difference between any of these treatments. The lowest rate of Orthene was least effective, but still provided adequate control.

Aerial applications

The mountainous terrain common to many avocado groves often makes helicopter-mounted sprayers the most practical means of applying insecticides. In separate trials, we applied Thuricide and Orthene by helicopter to avocado groves in San Diego County.

In an unreplicated trial, we tested Thuricide HPC against early instar omnivorous looper larvae. Three quarts of Thuricide HPC, 1.25 lb of brown sugar, and 12.5 lb of zinc sulfate were applied in 20 gallons of water per acre.

Larval mortality in the treated grove was compared with mortality in a comparable adjacent untreated grove. For the pretreatment sample, we examined ten 6-inch terminals per tree, looking for live larvae. Fifteen days posttreatment we counted in a similar manner, except that the terminals were 18 inches long, with at least one 6-inch lateral branch. Pre- and posttreatment counts were made on 12 randomly selected trees in each grove. Pretreatment counts in the treated and untreated groves averaged 24.3 and 35.2 larvae per tree, respectively. Posttreatment counts in the treated grove averaged 7.8 larvae per tree (68% decrease) compared to 7.0 larvae per tree (80% decrease) in the untreated plot, indicating that the chemical was ineffective.

In the second aerial trial, we applied Orthene 75 SP at 1.0 lb ai/acre to two 20-year-old Hass avocado groves in July, 1982. Pre- and posttreatment samples from both treated and untreated portions of the groves consisted of the looper larvae that fell onto a large white sheet when we shook a large scaffold branch for 15 seconds on each of ten randomly selected trees. Five days posttreatment, our counts showed that Orthene had provided good control of omnivorous looper larvae (table 4).

We observed no phytotoxicity resulting from the use of any of the compounds in any of the ground or aerial trials.

Conclusions

These studies showed that Kryocide and Thuricide controlled omnivorous looper larvae adequately if applied at sufficient concentrations with adequate coverage. Kryocide performed poorly when applied at 8 lb ai/acre, but was effective at 20 ai/acre. Thuricide was effective when applied by ground equipment, but ineffective when applied aerially, probably because of insufficient coverage. Newer strains of *Bacillus thuringiensis* have become commercially available since we conducted these studies, but they have not received adequate field testing against omnivorous looper larvae.

TABLE 1. Insecticides used for omnivorous looper control in Ventura County, January 1980

Treatment	Amount of active ingredient*	Amount of formulation per 100 gal water	$\bar{X}$ no. of larvae per tree sample at two intervals posttreatment: 5 to 6 days	13 days
	lb ai/acre			
Lannate L	1.8	2.0 pts	0.6a†	0.2a
Orthene 75SP	1.0	5.3 oz	1.8a	0.2a
Dylox 80SP	2.0	10.0 oz	26.8b	8.8b
Kryocide 8F	8.0	2.0 pts	34.4b	11.6b
Untreated check	—	—	23.8b	10.4b

* 4 gallons of spray per tree, or 400 gpa at 400 psi.
† Means followed by the same letter are not significantly different at 5% level (DMRT).

TABLE 2. Insecticides used for omnivorous looper control in Ventura County, April 1980

Treatment	Amount of active ingredient*	Amount of formulation per 100 gal water	$\bar{X}$ no. of larvae per tree sample 12 days posttreatment
	lb ai/acre		
Kryocide 8F	8.0	2.0 lb + Coax 10.0 lb	0.7a†
Thurcide HP‡	4.0	10.0 lb + Coax 10.0 lb	5.0b
Thurcide HP‡	4.0	10.0 lb + Gustol 5.0 lb	6.8b
Water	—	—	39.8c
Untreated check	—	—	38.8c

* 4 gallons of spray per tree, or 400 gpa at 400 psi.
† Means followed by the same letter are not significantly different at 5% level (DMRT).
‡ *Bacillus thuringiensis* Berliner16,000 IU/mg.

TABLE 3. Insecticides used for omnivorous looper control in San Diego County, July 1980

Treatment	Amount of active ingredient*	Amount of formulation per 100 gal water	$\bar{X}$ no. of larvae per tree sample 8 days posttreatment
	lb ai/acre		
Orthene 75S	1.0	7.2 oz	0.0a†
Orthene 75S	0.5	3.6 oz	1.2a
Orthene 75S	0.25	1.8 oz	8.6b
Kryocide 96W + Gustol	20.0 + 1.0	108.0 oz + 5.2 oz	2.6ab
Untreated check	—	—	48.2c

* 3 gallons of spray per tree, or 300 gpa at 400 psi.
† Means followed by the same letter are not significantly different at 5% level (DMRT).

TABLE 4. Aerial applications of Orthene 75SP for omnivorous looper control in San Diego County, July 1982

Treatment	Amount of active ingredient	Larvae per 100 trees: Pretreatment	5 days posttreatment	Percentage decrease
	lb ai/acre			
Gillette-Walters grove				
Orthene 75SP*	1.0	403	11	97
Untreated check	—	356	114	68
Stropes-Deavers grove				
Orthene 75SP	1.0	287	6	98
Untreated check	—	331	30	91

* Applied in 25 gallons of water per acre.

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