Controlling ants in almond orchards

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Although ant damage has been identified in the past on nut crops, and some control measures were applied to the soil in the 1950s and 1960s, the damage was generally considered minor until recently. Factors that may have contributed to the apparent increased damage are: increased planting of nut crops, especially almonds, in the southern San Joaquin Valley on previously unirrigated soils; conversion to mechanical harvesting and change in management practices, so that nuts remain on the orchard floor for longer periods; change to nontillage orchard management; and use of drip and sprinkler instead of flood irrigation. The high price paid for quality nuts and the present pricing structure (penalties for damaged nuts) have also influenced the increased interest in ant problems and their control.

After ant penetrates the almond skin, it hollows out the nut.

Jack Kelly Clark

Southern fire ant hill in Colusa County, California.

Two species—the pavement ant and southern fire ant—have been identified as causing major damage to almonds, although other species have been found in orchards and have caused occasional damage.

The pavement ant, *Tetramorium caespitum* (L.), ranges in color from blackish brown to yellowish brown and the body is covered with coarse hairs. Worker ants are 2 to 4.25 mm ($\frac{1}{12}$ to $\frac{1}{6}$ inch) long. The antennae have 12 segments with a 3-segmented antennal club. A pair of short spines is present at the posterior end of the thorax, and the pedicel (small segments of the abdomen behind the thorax) consists of 2 segments. These ants travel in single file in search of food. They usually nest in sandy or loamy soils where the soil temperature is 58° to 82° F.

The southern fire ant, *Solenopsis xyloni* McCook, has a reddish yellow head and thorax with a black abdomen. The workers range widely in size from 1.6 to 6 mm ($\frac{1}{16}$ to $\frac{1}{4}$ inch). This ant has a painful sting (thus the name fire ant), which can cause visible swelling. Characteristic features are a 2-segmented pedicel, 10-segmented antenna, and 2-segmented antennal club. It is found throughout

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Pavement ant (left) and southern fire ant (right) cause most ant damage in almonds, but other species are also involved.

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the San Joaquin and Sacramento valleys and prefers soil temperatures of 70° to 95° F.

The southern fire ant has the widest distribution and is causing the most damage in California almond orchards. Damage by both species of ants appears first as a scraping or peeling of the pellicle or skin of the kernel. The ant usually starts to feed at the base of the nut and then chews into the inner kernel. With a hand lens, mandible marks are visible, appearing as roughened contours in the kernel. No frass or webbing can be seen, although considerable chewings (white, sawdust-like material) might be present. Eventually, the inner kernel, or meat, is completely hollowed out, leaving only parts of the pellicle.

One method of evaluating an ant problem is to collect nut samples throughout the block, hand-crack, and check damage or ask the buyer-processor to evaluate rejects and separate ant damage from other insect damage. About 1,000 nuts from a block is an adequate field sample if collected throughout the orchard.

Potential ant problems can be determined by inspecting the orchard floor for ant hills before harvest. A 7,500-square-foot area is laid out in five representative parts of the orchard. The ant mounds are counted, and damage is estimated that can be expected if no summer chemical treatments are applied for either navel orangeworm or ants (table 1).

Early harvest trials conducted in 1980 where nuts remained on the ground for extended periods indicate that most damage occurs to the nuts after shaking. Damage increases in proportion to the length of time nuts remain on the ground. Damage caused by the southern fire ant increased to 8.5 percent at Tejon, California, over four weeks. An average of 12.5 hills per 7,500 square feet was counted. The pavement ant caused an increase of 5.7 percent damage in the same four-week period at Dayton, California.

TABLE 1. Potential ant damage to almonds if no summer treatments are applied for navel orangeworm or ants

Damage potential	Number of hills*	Damage expected
		%
Low	0-3	<2
Medium	4-10	3-6
High	>10	7+

*Number of ant hills per 7,500 feet, before June 15.

No foliar sprays currently used to control other pests are also registered for ant control in almond orchards; therefore, no specific recommendations can be made. Summer foliar sprays of Guthion, Sevin, or Imidan, applied at hullsplit for navel orangeworm control have suppressed southern fire ants, providing reasonable control. In 1978 and 1979 trials, chemicals used for navel orangeworm gave approximately 83 percent ant control when applied in late June and July.

Observations have shown that ants can still be a major problem where Guthion has been applied as a full-coverage spray in early May. Ant colonies examined after chemical sprays were applied had a greatly reduced worker force, but the queen and the brood remained alive in the nest. These larvae and pupae develop and become active in 4 to 10 weeks, and colony regains full strength in approximately 10 to 12 weeks. Therefore, sprays currently being applied for navel orangeworm suppress ants only seasonally.

In 1980 trials, granular insecticides and also one spray material applied to the ground were effective against the southern fire ant (table 2). Plots were ten trees long by two rows wide, and materials were applied by either a Whirlybird hand-spreader or a 3-gallon pressure sprayer. The treatments were Lorsban, Diazinon, or Sevin granular materials, Lorsban spray, and an untreated check area. The insecticides were applied on July 8 or 29, 1980. Visual ratings were evaluated on strong colonies marked before treatment and then reevaluated on August 7 after treatment. Two hundred nuts were randomly selected

TABLE 2. Ground applications of insecticides for southern fire ant control, Nonpareil almonds, McFarland, California, 1980

Insecticide	Formulated material per acre	Date applied	Visual ratings Aug 7*	New active colonies†	Nut damage‡
					%
Lorsban 15G	20 lb	Jul 8	0.02	2.0	1.1
Lorsban 4EC	1 gal	Jul 8	0.03	1.5	1.1
Diazinon 14G	20 lb	Jul 29	0.07	6.0	1.1
Diazinon 14G	40 lb	Jul 29	0.03	3.0	1.6
Diazinon 14G	20 lb	Jul 8	0.26	2.5	2.6
Sevin 20G	20 lb	Jul 29	0.27	9.0	3.1
Sevin 20G	40 lb	Jul 29	0.54	11.3	5.4
untreated check	...	...	0.60	9.3	7.0
LSD 0.05			0.22	4.3	3.2

*Visual ant colony ratings represent an average of four replicates. Ratings are on a scale of 0 to 1: 0 = no activity; 0.5 = weak colony; 1.0 = strong colony.
†Number of new active colonies counted Apr. 22, 1981, approximately 9 months after treatment.
‡Nuts were shaken Aug. 27, 1980, and remained on the ground for 7 days before damage was rated.

TABLE 3. Ground applications of insecticides for southern fire ant control on Nonpareil almonds, McFarland, California, 1981

Material	Formulated material per acre	Date applied	Visual ratings* Jul 8	Visual ratings* Aug 5	Nut damage†
					%
Lorsban 15G	20 lb	May 13	0.03	0.03	5.9
Lorsban 15G	20 lb	Jul 8		0.10	5.5
Diazinon 14G	20 lb	May 13	0.08	0.08	6.8
Diazinon 14G	20 lb	Jul 8		0.13	7.1
Lorsban 4EC	3 qt	May 13	0.23	0.30	11.6
Lorsban 4EC	3 qt	Jul 8		0.23	7.3
Diazinon 40W	3.5 lb	May 13	0.25	0.18	13.7
Diazinon 40W	3.5 lb	Jul 8		0.20	11.3
Diazinon 40W + Coax	3.5 lb + 2 lb	May 13	0.18	0.20	11.8
untreated check	...	...	0.08	0.74	14.3
LSD 0.05			0.21	0.24	4.1

*Visual ant colony ratings represent an average of four replicates. Ratings are on a scale of 0 to 1: 0 = no activity; 0.5 = weak colony; 1.0 = strong colony.
†Nuts were shaken on Aug 8, 1981 and remained on the ground for 11 days before damage was rated.

Ant hills in almond orchards often appear to be little more than patches of loose soil.

from each plot, hand-cracked, and rated for ant damage.

Lorsban 15G, Lorsban 4EC spray, and Diazinon 14G gave good control of the southern fire ant. Although some of the evaluations showed some reduction of ant activity by Sevin 20G, the effect was not present in the trial when evaluated on April 22, 1981.

Chemical trials were continued in 1981 with Lorsban and Diazinon granules and sprays applied on May 13 and July 8, Diazinon spray plus Coax applied on May 13, and an untreated check. These 1981 trials were conducted as in 1980, except that plots were eight trees long by two trees wide. Five strong colonies per treatment were tagged and observed throughout the season. A random sample of 50 nuts was harvested and rated for nut damage from each tree beside marked colonies.

Visual ratings indicated all materials gave good reduction of ant populations in marked colonies (table 3). Granular applications showed better control than the spray treatments, although the difference was not statistically significant. Nut damage was also higher in the sprayed plots than in the granular treatments.

Diazinon 14G was recently registered (California special local needs registration 24C) for ant control in bearing almonds. None of the other materials are currently registered for ants in almond orchards.

The granular materials applied in these trials appeared to eliminate the entire colony, including the queen. The spray formulations gave temporary control, possibly by reducing the worker force, but not affecting the queen. Therefore, the colony rebounded and caused damage later in the season.

The granular materials should be applied as needed. It is possible that annual applications will not be required. Application to the ground, especially as granular formulations, will minimize effects on nontarget beneficial insects and mites in the orchard.

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In the tropics, polycultures have long been an important component of small-farm agriculture. Farmers with limited resources traditionally intercrop their land to minimize risks and provide a stable source of income and nutrition, while maximizing economic and energy returns using primarily local technology.

Among potential advantages of intercropping systems are weed suppression through shading or natural plant toxins (allelopathy), reduction of insect damage by improving the balance of insect pests and associated natural enemies, better use of available soil nutrients, water conservation, erosion control, and greater productivity per unit of land. The study of such traditional systems has provided information useful as a basis for experimentation on sustainable cropping systems and less resource-intensive management technologies for developed countries.

Monocultural systems predominate in California commercial farms, but some farmers use polycultural arrangements, for example, by interplanting beans, snow peas, and other legumes among established apple, walnut, or almond trees. Some use fava or bell beans as cover crops in apple orchards or produce crops in various mixes, such as pears and grapes, corn and squash, cotton and alfalfa. Many farmers grow vegetables in small gardens for home consumption or sale in roadside stands. In these gardens crops such as tomatoes, hot and sweet peppers, cucumbers, dill, garlic, shallots, onions, cauliflower, cabbage, carrots, beans, squash, flowers, and herbs are intermingled on soil managed through mostly organic techniques.

Such cropping systems have been adopted mainly by trial and error; very little formal research has been conducted to determine whether the combinations are profitable for the farmer with regard to pest and weed control, soil fertility, and productivity, and whether such methods may have smaller or much larger application.

California experiments

During the 1981 growing season, we conducted experiments at three California locations to compare polycultures of collards and green beans (Santa Cruz), brussels sprouts and fava beans (Albany), and corn and cowpeas (Davis) with corresponding monocultures in terms of incidence of pest insects, performance of natural control agents, weed competition, and yield potential. (In these experiments, "polyculture" refers to the simultaneous planting of two crops in the same area at the same densities of each as they would be planted separately in monocultures.) All treatments were replicated three times, and at each site monoculture and polyculture