Compatibility of NOW parasite with commercial sprayers

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To control navel orangeworm (NOW), *Paramyelois transitella* (Walker), larvae in almond orchards, the invasive stage of the insect-parasitic nematode, *Neoaplectana carpocapsae* Weiser, must be deposited inside a moist, newly split almond hull or directly on a NOW adult. Use of the nematode will depend, in part, on its effective distribution into the almonds and its compatibility with conventional commercial spray applicators.

Heat, mechanical injury, and dehydration are the primary concerns in applying *N. carpocapsae* invasive-stage nematodes with commercial delivery systems. We previously observed a water temperature increase of only 1.2° C over a 30-minute period in an Air-O-Fan 375 sprayer. Following 10 minutes of mechanical agitation, nematode viability in samples taken from the tank and at the delivery nozzles was reduced 0.5 and 5.3 percent, respectively.

In subsequent tests, *N. carpocapsae* invasive stages were sprayed through a Myers-Mist three-point hook-up sprayer, with samples captured in 13- by 24-inch plastic bags. Extended survival of *N. carpocapsae* invasive stages in a thick oil wax medium reported by another researcher prompted further investigation with an emulsifiable oil. Nematode suspensions were sprayed with or without a 2 percent volume-to-volume (v/v) concentration of Ortho Volck Supreme Oil Spray at both dilute and concentrate rates (about 450 and 75 gallons per acre, respectively), which are readily handled with conventional spray systems.

No significant difference in nematode mortality was noted between dilute and concentrate applications in water or 2 percent oil spray. Average nematode viability was 99 percent throughout the spray applications, including tank samples taken before and after the test.

Field applications

In the first of two field applications, about 6 million nematodes per tree (about 450 × 10^6 per acre in 6 gallons per tree dilute or 1 gallon per tree concentrate) were applied with a Myers Mity-Mist sprayer at 100 psi. Plots consisted of eight treatments and six replications (each tree was a replication). To avoid temperatures above 33° C, which reportedly can be detrimental to the nematodes, applications were conducted in the evening. Distribution and nematode viability were monitored by two methods (previously described in *California Agriculture,* June 1978), (1) by using sticky discs with 10 NOW adults per disc and one disc per tree inside the upper one-third of the canopy and (2) by placing two NOW larvae within the split hull of almonds in six nuts per tree on the outside midway in the canopy. The sticky discs were collected the next morning and incubated at 26° C for 72 hours before inspection. Larvae in split hulls were collected 72 hours after treatment and inspected for mortality and verification of nematode parasitism.

In the four applications containing nematodes, distribution was greater in the concentrate water and in the dilute water and oil than in the dilute water applications, although no significant difference was determined among these three applications. The low distribution in the 2 percent oil concentrate may be the result of the higher air temperature (34° C) during application.

Adult mortality, except in the concentrate water-oil-nematode application, although not significantly different, appears to be influenced by the addition of oil, or nematodes, or both. In earlier backpack spray applications using 3 × 10^6 nematodes per tree, 60 percent of NOW adults in the sticky disc monitoring system were parasitized. The low incidence of parasitized adults found in this later application probably reflects the difference in the delivery systems used. This technique may still be useful for monitoring possible synergistic responses with future applications of nematodes plus chemical insecticides.

In a second test, nematodes were applied in a 1.5 percent percent Volck oil at a low volume rate of 75 gallons per acre at one-half the previous concentration—about 3 × 10^6 per tree or 225 × 10^6 per acre. The test plot consisted of four rows of Nonpareil almond trees. Each row was 10 trees long and interspaced by one row of Mission variety. Nematode suspensions were applied by helicopter and by a fine-air-carrier ground sprayer at sunrise and at midmorning, respectively. Nematode distribution, as measured by parasitized NOW larvae in baited almonds, was 45.2 and 72.3 percent, respectively, for the helicopter and ground sprayer applica-

Effect of *Neoaplectana carpocapsae* on Navel Orangeworm Adults and Larvae, Fresno, California, 1979

Spray applications*	Tank temperature after application	NOW adults		NOW larvae
		Mortality†	Parasitized	Nematode distribution‡
	°C	%	%	%
Dilute				
water	30	11.7	0.0	0.0
water + oil	34	38.3	0.0	0.0
water + nematodes	31.5	30.0	0.0	22.2
water + oil + nematodes	31.6	36.7	1.7	33.3
Concentrate				
water	34	16.7	0.0	0.0
water + oil	34	31.7	0.0	0.0
water + nematodes	32	25.0	0.0	30.6
water + oil + nematodes	34	16.7	0.0	2.8

*Two percent emulsifiable Volck oil sprays applied at about 2 gallons per acre for both dilute and concentrate applications. Nematodes applied with Myers Mity-Mist sprayer at 100 psi using 6 × 10^6 nematodes per tree in 6 gallons dilute or 1 gallon concentrate per tree.
†Adult mortality monitored by hanging one sticky disc with 10 adults per tree in treatments and control.
‡Nematode distribution monitored by placing two late instar larvae in each of six randomly spaced almonds per tree. Each almond with at least one parasitized larva was considered positive for calculating distribution.

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The nematode parasite of navel orangeworm (NOW) can be applied in oil emulsion spray by either helicopter or conventional ground sprayer. At left are two parasitized NOW larvae inside a newly split almond.

tions. The lower nematode distribution by helicopter was probably due to the drift loss of spray concentration into adjacent nontest almond rows.

Conclusions

In conclusion the invasive stage of *N. carpocapsae* (Mexican strain) appears to be compatible with the conventional spray delivery systems tested. As measured by the baited almond technique, a concentrate application of nematodes in a 1.5 percent oil emulsion appears promising for both helicopter and ground applications, giving nematode distributions of 45.2 and 72.3 percent, respectively.

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