Root-Knot Nematode Control on Kiwifruit (*Actinidia chinensis*) by Chemical Bare-Root Dip

G. S. GRANDISON, Nematologist, Department of Scientific and Industrial Research, Entomology Division, Private Bag, Auckland, New Zealand

ABSTRACT

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Chemical bare-root immersion treatments for control of the northern root-knot nematode (*Meloidogyne hapla*) were investigated on infected 1-yr-old kiwifruit plants (*Actinidia chinensis*). Dormant plants were immersed for 1 hr in 0.1 and 1% a.i. aqueous solutions of carbofuran, chlorine, isazophos, methomyl, oxamyl, parathion, and phenamiphos. The most effective control of *M. hapla* was obtained with 0.1% a.i. phenamiphos with no phytotoxic symptoms.

The increase in area of kiwifruit (*Actinidia chinensis* Planch.) orchards in New Zealand from 190 ha in 1968 to 6,800 ha in 1981 resulted in a wide distribution of planting material. Because kiwifruit is susceptible to the northern root-knot nematode (*Meloidogyne hapla* Chitwood) and because it is desirable to supply growers with the highest quality planting material, a nonphytotoxic chemical treatment was required to meet the demand for nematode-free plants. Dale and van der Mespel in 1972 (1) reported good control with ethoprophos, but since then, several new nematicides have become available. A selection of these was tested and the results are presented.

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MATERIALS AND METHODS

One-year-old kiwifruit (cultivar Hayward) plants heavily infected with *M. hapla* were obtained by planting seedlings in root-knot nematode-infested soil. In July (winter), dormant infested plants were lifted and their roots were washed and immersed in the chemical solutions for 1 hr at room temperature (about 16 C), then allowed to drain.

The chemicals used were 0.1 and 1% a.i. aqueous solutions of carbofuran, chlorine, isazophos, methomyl, oxamyl, parathion, and phenamiphos. Ethoprophos was not used because of its limited availability. Roots immersed in water served as controls. There were five replicates for each treatment with kiwifruit and 10 for tomatoes (*Lycopersicon esculentum* Mill.)

Each plant, together with two tomato seedlings (cultivar Tatura Dwarf), was planted in a planter bag of steam-sterilized soil and grown in the glasshouse for 12 wk at about 23 C. During this period, the kiwifruit plants grew new spring foliage, which enabled such phytotoxic symptoms as leaf edge burning or death of new buds to be assessed.

After 12 wk, the roots were carefully washed and visually assessed for new root-knot galling. A random sample of about 8 g of both old and newly knotted roots from each kiwifruit plant was placed in a misting cabinet to extract *M.*

Table 1. Mean numbers of *M. hapla* juveniles recovered from chemically treated kiwifruit plants (five replicates) and tomatoes (10 replicates) after 12 wk of growth

Treatment	Rate (% a.i.)	*M. hapla* juveniles per gram of root		Phytotoxicity on kiwifruit plants
		Kiwifruit	Tomato	
Isazophos	1.0	0.01 a[z]	2.0	Death
Phenamiphos	1.0	0.04 a	1.4	Nil
Phenamiphos	0.1	0.05 a	1.8	Nil
Oxamyl	1.0	0.1 a	1.4	Moderate
Isazophos	0.1	0.1 ab	1.2	Severe
Methomyl	1.0	0.7 ab	2.0	Nil
Chlorine	1.0	3.0 b	122.0	Nil
Carbofuran	1.0	6.0 bc	2.0	Moderate
Oxamyl	0.1	6.0 bc	1.0	Nil
Carbofuran	0.1	7.0 bc	44.0	Nil
Methomyl	0.1	17.0 bcd	4.0	Nil
Chlorine	0.1	55.0 cd	2,174.0	Nil
Parathion	0.1	154.0 cd	242.0	Moderate
Water	···	164.0 cd	790.0	Nil
Parathion	1.0	202.0 cd	676.0	Severe

[z] Means having the same letter are not significantly different ($P = 0.05$) according to Fisher's least significant difference test on log-transformed data.

hapla juveniles. Microscopic examination of a number of old galls from all treatments for the presence of viable juveniles was performed. Nematodes were extracted from the complete tomato root system in the mist cabinet.

RESULTS AND DISCUSSION

Effective control of *M. hapla* on kiwifruit was obtained with isazophos at 0.1 and 1%, phenamiphos at 0.1 and 1%, oxamyl at 1%, and methomyl at 1% (Table 1). Isazophos treatment at 0.1 and 1%, however, caused severe phytotoxicity and death in some cases; the phytotoxic effect of parathion was moderate to severe, whereas that of oxamyl at 1% was moderate. Also, carbofuran at 1% caused some phytotoxicity. Plants in all other treatments made good growth.

Inspection of the egg masses in the old galls on the kiwifruit roots after 12 wk showed no viable juveniles in the oxamyl, isazophos, and phenamiphos treatments. All other treatments had viable juveniles present. Although both rates of isazophos and oxamyl at 1% showed excellent nematicidal activity, their phytotoxic effects were unacceptable.

To control *M. hapla* in nursery stock, a root-dip for 1 hr in an aqueous solution of 0.1% a.i. phenamiphos at about 16 C can therefore be recommended.

ACKNOWLEDGMENT

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LITERATURE CITED

1. Dale, P. S., and van der Mespel, G. J. 1972. Control of root-knot nematodes on Chinese Gooseberry (Kiwifruit), *Actinidia chinensis*, by chemical bare-root dip. Plant Dis. Rep. 56:850-851.