EFFECTS OF PREPLANT AND POSTPLANT NEMATICIDES ON POPULATIONS OF NEMATODES IN THE SOIL AND ON GROWTH OF FRUIT TREES IN THE NIAGARA PENINSULA

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Abstract

Preplant, tree-row, fumigation of Vineland fine sandy loam nrovided good control of the root-lesion nematode, Pratylenchus penetrans, in the soil around peach trees for at least 2 years. The same treatments controlled the pin nematode, Paratylenchus sp., for only 1 year. Vorlex at 112 l/ha appeared to be the most effective preplant treatment and should be practical in orchards where other crops are not being interplanted. Though postplant applications of Nemagon reduced numbers of root-lesion nematodes around established peach trees, they did not result in any promotion of growth, indicating that this treatment might not be practical in the Niagara Peninsula.

Introduction

The root-lesion nematode, Pratylenchus penetrans Cobb 1917, is one of the important orqanisms associated with peach replant problems (1, 7, 8, 9) and with decline of peach trees in established orchards. Also it is a primary parasite of apple (12) and has damaged tree fruit crops on liqhter soils in New York State (11).

The pin nematode, Paratylenchus curvitatus v.d. Linde 1938, is believed to be responsible for most of the decline of apple orchards in the Hudson Valley (10). Thouqh pin nematodes, Paratylenchus spp., are quite prevalent in the orchard soils of the Niagara peninsula it has not been determined if these nematodes are of economic importance. Mountain and Boyce (8) suqgested that pin nematodes may affect mainly the longevity and productivity of peach trees.

Preplant nematicides control the root-lesion nematode, Pratylenchus penetrans Cobb 1917, and promote growth of peach trees in Fox sandy loam (8). Such treatments also reduce replant problems of apple and cherry on lighter soils and trees in treated soil have a faster growth rate than those in non-treated soil (4). Preplant soil fumigation did not promote growth of peach seedlings in Vineland fine sandy loam in the qreenhouse (8), but did promote the growth of nursery stock of apple, cherry, pear and plum in the field (2).

The postplant nematicide, Nemaqon (1,2-dibromo-3-chloropropane) improved the qrowth and/or yield of peaches and apples in established orchards (10,13). However growth was promoted in only 31% of trials with postplant applications of Nemagon in established orchards of peach, nrune or walnut in California (3).

This report outlines the effects of preplant and postplant nematicides on the numbers of root-lesion and pin nematodes in Vineland fine sandy loam and subsequently on growth of orchard trees.

Materials and methods

Preplant treatments

Experiment 1 (Table 1) with peaches was conducted in a former peach orchard (trees removed 2 months before treatment) that averaged 700 root-lesion and 500 pin nematodes/0.45 kq soil prior to treatment. Vorlex (1,3-dichloropropene and related C_3 hydrocarbons 80%; methylisothiocynnate, 20%) was applied at 34, 112 and 220 l/ha in the tree row. The fumigant was injected 15-20 *cm* deep in bands 2.4 m wide with a spring tooth fumigation rig in November 1968. The soil was sealed immediately and left undisturbed until spring. The check plots were treated similarly but no chemical was applied. Each plot consisted of four peach (Prunus persica (L.) Batsch cv. Babvqold 7) trees. The treatments were replicated at least twice and arranqed at random in the orchard. Planting holes were drilled in the middle of the treated bands and the trees were planted in April 1969.

Experiment 2 (Table 1) with apples was also conducted in a former peach orchard from which trees had been removed 2 months before the treatment. The population densities prior to treatment were about 1750 root-lesion and 1140 pin nematodes/0.45 kg soil.

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Table 1. Effects of pre-plant nematicides on numbers of root-lesion and pin nematodes in the soil and on the growth of fruit trees

Expt. no. and crop	Treatment and rate (l/ha)*	No. of nematodes/0.45 kg soil at end of 2 seasons of growth		Increase in trunk x-section area (cm^2)			% Larger than check trees after two seasons
		Root-lesion	Pin	1st season	2nd season	Total	
1 Peach	Check	2130†	1900				
	Vorlex, 34	650	4770				14
	Vorlex, 112	25	2070				47
	Vorlex, 220	300	1550				32
2 Apple	Check	130a§	80a	3.33a	3.67 b	7.00 b	
	Telone, 72	20b	40a	3.77a	4.60ab	8.37ab	20
	Vorlex, 34	30b	70a	4.03a	5.40a	9.43ab	35
	Vorlex, 112	2b	40a	3.73a	5.90a	9.60a	38
	Vorlex, 220	2b	3a	3.53a	4.67ab	8.20ab	17

* Tree row application; multiply by 2.5 to obtain the actual broadcast rate.

† Data not analyzed because of varying number of replications for the treatments.

§ Means followed by the same letter are not significantly different at P = 0.05 (Duncan's Multiple Range Test).

In November 1970, Telone (1,3-dichloropropene and related chlorinated C. hydrocarbons) at 72 l/ha and Vorlex at 34, 112, and 220 l/ha were applied as described for experiment 1. Each plot contained four apple (Malus pumila Mill. cv. Scotia) trees planted in April 1971. Treatments were replicated three times and arranged in a randomized block design.

Postplant treatments

Experiment 1 (Table 2) was conducted with 10-year-old sweet cherry trees (Prunus avium L. cv. Heidelfingen). Prior to treatment there were 1000 root-lesion and 100 pin nematodes/0.45 kg soil. On May 20, 1968, the orchard was shallow disked and Nemagon 130 EC (1,2-dibromo-3-chloropropane, 1.3 kg ai/l) was applied at 33.7 l ai/ha with a spring tooth fumigation rig. The nematicide was injected 13-15 cm deep in bands 2.4 m wide, as close to the trunks as possible on the row sides of the trees. The soil surface was sealed, straw mulch was spread under the trees, and the soil was then left undisturbed. Ten, single-tree replicates per treatment were randomized throughout the orchard.

Experiment 2 (Table 2) was established in a 2-year-old peach orchard containing five rows of cultivar Babygold and three rows of cultivar Sunhaven. The population densities prior to treatment were 1500 root-lesion and 1300 pin nematodes/0.45 kg soil. On June 4, 1968, Nemagon 130 EC was applied at 33.7 and 22.5 l ai/ha to freshly disked soil, as in experiment 1. However, the application of the lower rate of Nemagon was repeated in early June of 1969. In 1968 the check plots were treated similarly to the nematicide plots but chemical was not applied. In 1969 only the plots that received the chemical (22.5 l ai/ha treatment) were shanked but all plots were disked and sealed. The treatments were applied across the rows and replicated six times in a randomized block design.

Experiment 3 (Table 2) was established in a 3-year-old peach orchard, cultivar Royalvee, having population densities of 400 root-lesion and 1200 pin nematodes/0.45 kg soil. On June 22, 1970, Nemagon 130 EC was applied at 33.7 l ai/ha, as described for experiment 1, and Nemagon 25% G (1,2-dibromo-3-chloropropane, 25% ai) was applied at 73 kg ai/ha. The granular formulation was applied with a hand-operated cyclone seeder to a similar area to that treated with Nemagon 130 EC and incorporated to a depth of 13-15 cm by disking. Corresponding checks were used for each type of application and all plots were sealed by rolling. Seven replications of each treatment, four trees per replicate, were arranged in a randomized block design.

All experimental sites were situated on Vineland fine sandy loam. Soil samples for

Table 2. Effects of a postplant, fumigant-type nematicide on numbers of root-lesion and pin nematodes in soil around established fruit trees

Expt. no. and crop†	Treatment and rate (l ai/ha)††	Number§ of nematodes/0.45 kg soil							
		Root lesion				Pin			
		Growing seasons after treatment				Growing seasons after treatment			
		1	2	3	4	1	2	3	4
1 Sweet cherry	Check	560 **	830 **	2030 **	3380 **	290 *	1400	320	1320 *
	Nemagon 130 EC (33.7)	180	160	330	580	20	30*	70*	300
2 Peach	Check	1170a	2450a	1750a		800a	4040a	2420a	
	Nemagon 130 EC (22.5)¶	510 b	970 b	920a		180 b	490 c	1200a	
	Nemagon 130 EC (33.7)	410 b	870 b	2000a		190 b	1370 b	5040a	
3 Peach	Check - shanked & rolled	820a	650a			3060a	4950ab		
	Nemaqon 130 EC (33.7) injected & rolled	15 b	110 b			0 c	570 c		
	Check - disked & rolled	690a	310ab			3090a	6170a		
	Nemaqon 10G (73) disked & rolled	360ab	190 b			300 b	2300 b		

† Expt. 1, 10-year-old trees; Expts.2 and 3, 4-year-old trees.

†† Tree row application; multiply by 1.25 to obtain the actual broadcast rate.

§ Expt. 1, means followed by ** are significantly different at P = 0.01, * at P = 0.05. Expts. 2 and 3, means followed by the same letter are not significantly different at P = 0.05 (Duncan's Multiple Range Test).

¶ Nemaqon was injected at 22.5 1 ai/ha in June 1968 and repeated in June 1969.

nematode counts were taken from the drip-line areas at time of treatment and thereafter annually in November. Nematodes were extracted from the soil by the modified Baermann pan technique (13) and nematode counts were transformed to log (x + 200) before statistical analyses. Tree measurements were taken either at plantinq time, or when the postplant nematicides were applied. Subsequent measurements were made in December of each year, except for experiment 1 (Table 1) where the trees were measured only after the second growing season.

In all experiments the cultural practices, except for nematinide treatments, were those of the cooperators. In preplant experiment 2 (Table 1) and in postplant experiments 2 and 3 (Table 2) the conventional cultural practice of clean cultivation until July 1 followed bv a mowed weed cover for the remainder of the growinq season was used. In preplant experiment 1 (Table 1) the between-row areas were interplanted with potatoes in 1969 and 1970; weed cover was allowed to grow around the trees.

Results

Preplant treatments

In experiment 1 (Table 1), Vorlex at 112 l/ha seemed to be the best treatment in terms of nematode control and growth response of peach trees.

In experiment 2 (Table 1), tne number of nematodes in the area planted to apples declined considerably, irrespective of treatment, durinq the two years following planting. At the end of the second growing season there were fewer root-lesion nematodes in the treated plots than in the check plots (Table 1). With pin nematodes, however, there were no significant differences between treatments after two seasons. None of the chemical treatments promoted tree qrowth in the first qrowinq season and Vorlex at 112 l/ha was the only traatment to qive a significant increase relative to the check in the second season.

Postplant treatments

In experiment 1 (Table 2), Nemaqon at 33.7 l ai/ha controlled root-lesion and pin nematodes in the soil around 10-year-old sweet cherry trees for four years.

Experiments 2 and 3 (Table 2) showed that 33.7 l ai/ha (exneriments 2 and 3) controlled both root-lesion and pin nematodes around peach trees for two growing seasons. Two applications of Nemaqon at 22.5 l ai/ha did not result in any siqnificant improvement in nematode control over a sinqle application of 33.7 l ai/ha. Nemaqon 25 G at 73 kq ai/ha did not reduce numbers of root-lesion nematodes below those of the corresponding check but it did reduce the numbers of pin nematodes.

The injection of Nemaqon 12-15 cm deen with a spring tooth fumigator apparently did not cause any damaqe to feeder roots nor did it affect tree qrowth. None of the nostplant nematicide treatments resulted in promotion of tree qrowth so data are not presented.

Discussion

Preplant, tree-row, fumiqation of Vineland fine sandy loam can provide qood control of root-lesion nematodes in the soil for at least two years but seems to control pin nematodes for only one growing season (Table 1, experiment 2). Mountain and Boyce (8) have reported that pin nematodes increase rapidly in fumiqated soils in peach orchards durinq the second growing season.

Both apple and peach showed improved growth on Vineland fine sandy loam treated with preplant nematicides. The present data show that, in terms of nematode control and growth response, a tree-row application of Vorlex at 112 l/ha, should be effective. Furthermore, since the numbers of P. penetrans increase very slowly in fumiqated soil in peach orchards (8) and since the rate of increase can be reduced further by qood weed control practices and the use of proper cover crops (5,6), tree-row fumiqation should be as effective as broadcast fumiqation for growers who are not interplantinq with other crops.

Postplant applications of Nemaqon can provide nematode control up to four years after treatment in sweet cherry (Table 2, experiment 1). However it appears that the normal cultural practice of usinq a weed cover crop in peach orchards may shorten the period to two years (Table 2, experiment 2) in orchards with very high densities of weeds. It is also possible that peach is a more suitable host than sweet cherry.

In aqreement with other studies (8,3) postplant applications of Nemaqon failed to enhance tree qrowth. Perhaps a yield response would occur with bearinq trees treated with a postplant nematicide. However, it appears that postplant applications of Nemaqon on tree fruit crops generally are not practical on the Vineland fine sandy loam soils in the Niagara Peninsula. The use of a postplant nematicide may be more beneficial on Fox sandy loams, such as those in the tree fruit growinq areas of Essex and Norfolk counties. Because of the smaller amount of available water in these coarser soils, the trees would be subjected to qreater moisture stress and would be less tolerant of nematode damage than trees on the Vineland fine sandy loam (14).

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