Effects of Some Nitrogenous Materials and Wetting Agents on Survival in Soil of Lesion, Stylet, and Lance Nematodes

P. M. Miller

Department of Plant Pathology and Botany, The Connecticut Agricultural Experiment Station, New Haven 06504.
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ABSTRACT

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Urea at 1.0 and 0.2 g/kg of soil was toxic to lesion nematodes (*Pratylenchus penetrans*), stylet nematodes (*Tylenchorhynchus dubius*), and lance nematodes (*Hoplolaimus* spp.). Chitin at 1.5 and 4.5 g/kg of soil and collagen at 4.5 g/kg of soil reduced nematode populations nearly 75%. Casein or casamino acids at 8 g/kg of soil were toxic to these three nematodes. Tween-20 at 1.0 and 0.3 ml/kg increased populations of lance nematodes, but reduced numbers of stylet and meadow nematodes. Surfactant-F at 1 ml/kg of soil increased populations of stylet nematodes, but decreased populations of meadow nematodes; at rates of 0.3 and 0.1 mg/kg of soil, however, it reduced populations of all three nematodes. Other treatments affected only one or two of the three nematodes.

Additional key words: Pratylenchus penetrans, Hoplolaimus, Tylenchorhynchus.

Organic matter added to the soil reduces populations of plant parasitic nematodes (1, 2, 4, 5, 6). Miller et al. (4) found ammonia toxic to *Heterodera tabacum,* and Walker et al. (6) found ammonia toxic to *Pratylenchus penetrans*. This report describes the results of further studies of the effects of several organic and inorganic nitrogen sources and some wetting agents on survival in soil of the lesion nematode (*P. penetrans*), the stylet nematode (*Tylenchorhynchus dubius*), and the lance nematode (*Hoplolaimus* spp.).

Soil infested with *P. penetrans* was mixed with an equal volume of soil infested with *T. dubius* and *Hoplolaimus* spp. to provide populations of the three parasitic nematodes.

Treatments and rates are listed in Tables 1 and 2, and all rates given are for 1 kg of soil. Mycelial wastes are the residues from the commercial production of antibiotics and some organic acids. The wetting agents and lower rates of nitrogenous materials were diluted with 100 ml of water before they each were mixed with 500 g of soil. Higher rates of the nitrogenous materials were mixed directly with 1 kg of soil and then 100 ml of water was added to the mixture. All soil mixtures were placed separately in styrofoam cups which held 500 g of soil. Treatments were stored for 3 weeks in a greenhouse and watered every 2 days.

Four samples of 100 g each then were taken from each treatment and nematodes were removed from the soil by the sugar flotation method (3). In a successive test, 150 g of infested soil was placed in small styrofoam cups stored in the greenhouse. Treatments were replicated four times. Nematodes were extracted after 3 weeks. The following concentrations (g/kg) of nitrogenous materials reduced the population of lance nematodes by more than 90%: collagen 4.5, powdered milk 8.0, soluble fertilizer 0.1, and urea 0.2 and 1.0. Except for bone meal 0.5 and 2.0 g, all other additives reduced the population of lance nematodes by 50 to 90%. Bone meal at 2.0 g/kg appeared to increase the number of lance nematodes. The effects of the nitrogenous materials on the nematode populations are given in Table 1.

The following nitrogenous treatments reduced the population of stylet nematodes by more than 90%: casein 8.0 (g/kg); and urea 0.2 and 1.0. The following reduced it by 50 to 90%: $Ca(NO_3)_2$ 0.3; casamino acids 8.0; casein 0.5, 2.0, and 8.0; chitin 1.5 and 4.5; collagen 4.5; mycelial wastes 1.0 and 3.0; and peptone 8.0. The other nitrogenous treatments did not reduce the population of stylet nematodes by more than 50%. Bone meal 0.5 g/kg and soluble fertilizer 0.1 g/kg appeared to increase the number of stylet nematodes.

The following nitrogenous treatments reduced the population of lesion nematodes by more than 90% (g/kg); $Ca(NO_3)_2$ 0.3; casamino acids 8.0; casein 0.5 and 8.0; powdered milk 8.0; and urea 0.2 and 1.0. The following reduced it by 50 to 90% (g/kg); bone, casein 2.0; chitin 1.5 and 4.5; collagen 1.5 and 4.5; mycelial wastes 3.0; and powdered milk 2.0. Other treatments did not reduce the population of meadow nematodes by more than 50%. Bone meal 0.5 g/kg and soluble fertilizer 0.1 g/kg appeared to increase the number of meadow nematodes.

The following (ml/100 ml water) when added to 1 kg of soil reduced lance nematode populations more than 50%: Triton B-1956 (0.3 and 1.0 ml); Biofilm (0.3 and 1.0 ml); and Surfactant-F (0.1 and 0.3 ml). Lance nematode populations increased in response to additions of Tween-20 (0.1 and 1.0 ml/100 ml) and Biofilm (0.1 ml/100 ml).

Additions to 1 kg of soil of Biofilm (1.0 ml/100 ml), Surfactant-F (0.1 and 1.0 ml/100 ml), and Triton B-1956 (0.1 and 0.3 ml/100 ml) decreased populations of stylet nematodes more than 50%. Tween-20 (1.0 and 0.3 ml/100 ml), Triton B-1956 (1.0 ml/100 ml), and Surfactant-F (0.3 and 0.1 ml/100 ml) decreased lesion nematode populations more than 50%. Biofilm (0.1 ml/100 ml) increased the number of recoverable lesion nematodes.

DISCUSSION

Susceptibility of nematodes to injury by soil additives appears related to whether the nematodes enter roots or remain in the soil. Lesion nematodes which reside mainly inside the roots and lance nematodes which reside part of

TABLE 1. Effects of organic and inorganic nitrogenous additives on the survival of lance nematodes, stylet nematodes, and lesion nematodes in soil

Treatment		Nematodes extracted from soil[a]		
Material	Rate (g/kg)	Lance (no./100 g soil)	Stylet (no./100 g soil)	Lesion (no./100 g soil)
No additive	...	55 w[b]	169 w	61 y
Bone meal	0.5	31 wy	208 w	93 w
	2.0	38 w	153 w	43 x
	8.0	22 x	120 x	42 x
$Ca(NO_3)_2$	0.3	21 x	35 y	0 z
Casein	0.5	21 x	36 y	0 z
	2.0	12 xy	38 y	8 yz
	8.0	9 y	14 z	0 z
Chitin	1.5[c]	15 xy	47 y	9 yz
	4.5[c]	6 y	47 y	13 y
Collagen	1.5	69 x	101 x	12 y
	4.5[c]	4 y	35 y	28 xy
Mycelial waste	1.0	17 xy	69 xy	53 x
	3.0	12 y	57 xy	8 yz
Peptone	0.5	28 x	129 x	45 x
	2.0	18 xy	121 x	31 xy
	8.0	19 xy	53 xy	33 xy
Casamino acids	0.5	23 x	98 y	33 xy
	2.0	15 xy	75 x	23 y
	8.0	13 y	48 y	18 y
Powdered milk	0.5	24 x	189 w	38 x
	2.0	13 y	159 w	17 y
	8.0	3 z	108 x	0 z
Soluble fertilizer[d]	0.1	0 z	193 w	93 x
Urea	0.2	0 z	5 z	2 z
	1.0	0 z	7 z	0 z

[a]Average of four replicates in each of two tests. Extraction was by a sugar flotation technique.
[b]Means followed by different letters differ significantly ($P = 0.05$) according to Duncan's multiple range test.
[c]High populations of saprophytic nematodes.
[d]Rapid-Gro 23-17-9

TABLE 2. Effects of four wetting agents on survival of lance nematodes, stylet nematodes, and lesion nematodes in soil

Treatment		Nematodes extracted from soil[a]		
Material	Rate (ml/kg)	Lance (no./100 g soil)	Stylet (no./100 g soil)	Lesion (no./100 g soil)
Biofilm	0.1	62 x[b]	107 x	48 x
	0.3[c]	25 y	73 x	43 x
	1.0	10 y	58 x	82 w
Surfactant-F	0.1	15 y	35 y	18 y
	0.3	12 y	47 xy	17 y
	1.0	38 xy	189 w	21 y
Triton B-1956	0.1	29 y	31 y	43 x
	0.3	23 y	52 x	53 x
	1.0	25 y	78 x	13 xy
Tween-20	0.1[c]	85 x	28 y	45 x
	0.3[c]	43 x	38 y	6 z
	1.0[c]	95 w	30 y	3 z
No additive	0	78 w	134 w	44 x

[a]Average of four replicates in each of two tests.
[b]Means followed by different letters differ significantly ($P = 0.05$) according to Duncan's multiple range test.
[c]High populations of saprophytic nematodes.

the time in the roots, were more susceptible to injury by soil additives than stylet nematodes which reside entirely in the soil. Thus stylet nematodes apparently have adjusted to the enzymes or other organic chemicals released during natural decay in the soil of organic matter. Patrick and co-workers found chemicals toxic to nematodes were released during decay of rye in soil (5). Lance and lesion nematodes residing in roots at least part of the time have become adapted to substances in the roots, but are less resistant to enzymes and substances released in the soil during decay of organic matter in the soil.

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