

# Pathogenicity and Control of Nematodes Affecting Sunflower in North Central Florida

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## ABSTRACT

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In 1978, two sunflower (*Helianthus annuus*) field trials were conducted, one in early spring and the other in late summer. Soil in the spring trial was infested with *Belonolaimus longicaudatus*, *Trichodorus christiei*, *Meloidogyne incognita*, and *Pratylenchus brachyurus* and was treated with the soil fumigant DD at 67 kg a.i./ha. The treatment did not significantly increase sunflower yield but reduced populations of all nematodes except *T. christiei*. Soil in the summer test was infested with *M. incognita*, *T. christiei*, and *Pratylenchus zaei* and was treated with aldicarb, carbofuran, or fenamiphos at 3.0 kg a.i./ha. Aldicarb significantly increased seed yields, whereas fenamiphos was phytotoxic and reduced plant emergence. All nematicide treatments reduced populations of one or more of the three nematode species. Most plant-parasitic nematodes in both tests reproduced well on sunflower.

Several reports have indicated the presence of plant-parasitic nematodes in or around the roots of sunflower (*Helianthus annuus* L.) (1,3,6,10). Reproduction and damage caused by nematodes to sunflower and the use of chemical control on this crop, however, have received little attention (5,9). In Florida, nematodes are important pests of agronomic crops. With the introduction of oilseed sunflower production in the north-central portion of the state, an understanding of the role of plant-parasitic nematodes in the culture of this crop was needed. The purposes of this study were to identify nematodes that would reproduce on sunflower, determine the extent to which they might affect yield, and assess the feasibility of using chemical nematicides to control nematodes on this crop.

## MATERIALS AND METHODS

**Spring test.** Soil at the test site was Arredondo fine sand (92% sand, 4% silt,

4% clay) naturally infested with *Meloidogyne incognita* (Kofoid and White) Chitwood, *Pratylenchus brachyurus* (Godfrey) Filip. and Sch.-Stek., *Trichodorus christiei* Allen, and *Belonolaimus longicaudatus* Rau. Treatment with the soil fumigant DD and untreated controls served as main plots, and two sunflower cultivars, Interstate 891 and Sun Hi 304, were the subplots. On 25 February 1978, DD was applied in-row at 67 kg a.i./ha with dual chisels spaced 25 cm apart and to a depth of 20 cm. Nine days after fumigation, seeds of the two cultivars were planted into plots containing two rows 91 cm apart and 6.1 m long. Each treatment was replicated eight times, and recommended cultural practices, including irrigation, were used.

Soil samples for nematode analysis were taken before planting and at harvest. Ten soil cores were taken 20 cm deep in-row from each plot and composited, and a 250-cm<sup>3</sup> subsample was processed by a modified centrifugation sugar-flotation technique (4). At harvest, 5–10 g of roots was collected from two plants in each plot. Roots were chopped in a blender and placed on a Baermann funnel for 24 hr. Sunflower head, stem diameter, and seed yield were taken from 3.6 m of row in each plot 98 days after planting. Plant stem diameter was measured 1 m above the soil line. Seed yields were adjusted to represent seed production at 10% moisture.

**Summer test.** Soil was Lakeland fine sand (93% sand, 4% silt, and 3% clay) that had been cropped to corn immediately before the test and that contained populations of *M. incognita*, *P. zaei* Graham, and *T. christiei*. Treatments included a control and granular formulations of aldicarb, carbofuran, and fenamiphos. The nematicides were applied in a 20-cm band over the seed row during planting on 11 August 1978. An additional fenamiphos treatment was placed in the seed furrow. All materials were applied at a net rate of 3.0 kg a.i./ha.

Seeds of sunflower cultivar Sungro 380 were planted in 91-cm-wide rows and in plots with two rows 7.1 m long. Five treatments replicated six times were placed in a randomized complete block design. Recommended cultural practices, including irrigation, were followed. Soil samples for nematode analysis were collected from the control plots at planting and from all plots 66 days after planting. Eight cores, 30 cm deep, were collected from each plot. The soil was well mixed, and a 250-cm<sup>3</sup> subsample was processed by centrifugation. Plant emergence data were collected 19 days after planting. Vigor ratings were made on a scale of 0–5 (0 = poorest plant growth, 5 = best plant growth) after 25 days. Sunflower seed heads were harvested from 4.6 m of row in each plot 103 days after planting, and seed yield was recorded as in the spring test.

## RESULTS

Spring fumigation significantly reduced populations of *M. incognita* and *P. brachyurus* in the plant roots, but cultivars did not affect root populations of these two nematodes (Table 1). Soil populations of the plant-parasitic nematodes were affected by the DD treatment. Populations of *M. incognita*, *P. brachyurus*, and *B. longicaudatus* were significantly reduced by DD, whereas *T. christiei* numbers were significantly increased in the fumigated plots. More *M. incognita* larvae were found in soil around roots of Sun Hi 304 cultivar than

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**Table 1.** Plant-parasitic nematodes from two sunflower cultivars 98 days after planting in soil treated with fumigant DD and in untreated soil<sup>y</sup>

Cultivar Treatment	Roots		Soil			
	<i>Meloidogyne incognita</i>	<i>Pratylenchus brachyurus</i>	<i>Meloidogyne incognita</i>	<i>Pratylenchus brachyurus</i>	<i>Belonolaimus longicaudatus</i>	<i>Trichodorus christiei</i>
Interstate 891						
DD	21 a <sup>z</sup>	23 a	22 a	17 a	7 a	224 b
Control	56 b	50 b	51 c	47 b	30 b	142 a
Sun Hi 304						
DD	10 a	4 a	38 b	5 a	1 a	187 b
Control	77 b	49 b	130 d	44 b	23 b	93 a

<sup>y</sup> At planting, there were 120 *M. incognita*, 18 *P. brachyurus*, 1 *B. longicaudatus*, and 7 *T. christiei* per 250 cm<sup>3</sup> of soil.

<sup>z</sup> Column means followed by the same letter are not significantly different ( $P=0.05$ ) according to Duncan's multiple range test.

**Table 2.** Nematode populations and growth and yield of sunflowers treated with three nematicides<sup>w</sup>

Treatment	Application method	Nematodes per 250 cm <sup>3</sup> of soil <sup>x</sup>			Stand count	Plant vigor <sup>y</sup>	Yield (kg/ha)
		<i>Meloidogyne incognita</i>	<i>Pratylenchus zeae</i>	<i>Trichodorus christiei</i>			
Aldicarb	20 cm band	135 b <sup>z</sup>	15 a	2 b	94 a	3.7 b	2,202 a
Carbofuran	20 cm band	448 a	22 a	4 b	94 a	4.8 a	2,044 ab
Fenamiphos	20 cm band	154 b	12 a	2 b	72 b	3.2 b	2,012 ab
Control	...	636 a	33 a	13 a	98 a	3.3 b	1,897 b
Fenamiphos	In-furrow	162 b	21 a	4 b	24 c	2.2 c	1,208 c

<sup>w</sup> Treatments applied and seeds planted 11 August 1978; stand count was taken at 19 days, plant vigor rating at 25 days, nematode samples at 66 days, and final yields at 103 days after planting.

<sup>x</sup> Nematode population densities at planting were 204 *M. incognita*, 46 *P. zeae*, and 10 *T. christiei* per 250 cm<sup>3</sup> of soil.

<sup>y</sup> Vigor ratings were made on a scale of 0-5: 0 = dead plants and 5 = excellent plant growth.

<sup>z</sup> Column means followed by the same letter are not significantly different ( $P=0.05$ ) according to Duncan's multiple range test.

of Interstate 891, but populations of the remaining three nematode species were not affected. Interstate 891 produced significantly higher yield and head and stem diameter, whereas DD treatment did not affect plant growth of the two cultivars.

**Summer test.** All nematicide treatments except carbofuran significantly reduced populations of *M. incognita* (Table 2). Although nematicide treatments significantly reduced populations of *T. christiei*, numbers of *P. zeae* were not different among the treatments. The two fenamiphos treatments resulted in less plant emergence than other treatments. The emerged plants were stunted and showed slight marginal necrosis on the first two true leaves. Sunflower plants treated with carbofuran exhibited significantly higher vigor ratings. Only the aldicarb treatment resulted in significantly higher seed yields than the control plot; lowest yields were found in the in-furrow fenamiphos treatment.

## DISCUSSION

Fumigation with DD reduced soil populations of three of the four nematode

species, but the treatment increased *T. christiei* numbers. Population increases of *T. christiei* after fumigation have been reported (7,8), however; they may be related to the absence of competitive organisms in the soil. In this test, the four nematode species, particularly *B. longicaudatus* and *T. christiei*, appeared to reproduce well on sunflower.

Although initial nematode densities were high, application of DD did not improve yield of sunflower in the spring test. Cool soil temperatures in the early spring may have allowed the plant to become established before nematodes became fully active or reproduced very rapidly. Higher yields of Interstate 891 than of Sun Hi 304 were apparently caused by inherent differences in plant vigor rather than by differential susceptibility to nematodes. Interstate 891 is an agronomically more vigorous plant than Sun Hi 304. However, soil populations of *M. incognita* were greater from Sun Hi 304 than from Interstate 891. Further tests will be necessary to determine whether these differences were real.

The summer test confirmed and extended results from the earlier test.

Data and field observations of galled roots indicated that *M. incognita* reproduced well on sunflower and was the prominent nematode associated with yield reduction. Populations of *T. christiei* after 66 days were lower than those found at planting. This nematode reproduced well on sunflower in the spring test and also in greenhouse studies (Rich, unpublished). It is suggested that the decline in numbers of *T. christiei* was a function of factors other than host plant. The relative involvement of *P. zeae* could not be accurately determined because of the low numbers recovered, possibly as a result of the extraction technique used.

Under these test conditions, sunflower appeared tolerant to parasitism by *M. incognita*, *B. longicaudatus*, and *T. christiei*. Although these nematodes reproduced well on sunflower, little yield reduction was observed. The apparent plant tolerance may be caused, in part, by the extensive root system of sunflower that gives it a high drought tolerance (2). Further studies should be made, but nematicides may be of less value in this crop than in some of the other agronomic crops of north Florida (9). Sunflower was more sensitive to fenamiphos than to other nematicides tested in these experiments, and that compound seems to be particularly unlikely to benefit this crop.

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