EFFECT OF FUMIGANT AND NONFUMIGANT NEMATICIDES ON PLANT NEMATODE POPULATIONS AND YIELD OF SWEET CORN PRODUCED ON A FINE SANDY SOIL IN FLORIDA[1]

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ABSTRACT

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A 3-yr study was conducted on Myakka fine sand in which soil fumigant nematicides (EDB, 1,3-D, and metam-sodium) and nonfumigant nematicides (aldoxycarb, carbofuran, ethoprop, fenamiphos, oxamyl, and terbufos) were tested for their efficacy in reducing injury from *Belonolaimus longicaudatus* and *Hoplolaimus galeatus* and increasing yield on sweet corn (*Zea mays* var. *saccharata*). All of the soil fumigants significantly reduced populations of both *B. longicaudatus* and *H. galeatus* and significantly increased yields of the sweet corn. Of the nonfumigants, aldoxycarb, fenamiphos, and terbufos consistently gave a significant reduction of *B. longicaudatus* populations, but carbofuran, ethoprop, and oxamyl did not. None of the nonfumigants were effective for reducing populations of *H. galeatus*. However, in most instances, sweet corn yields were not significantly different for fumigant and nonfumigant nematicides and all were significantly higher than the untreated checks.

Additional key words: Belonolaimus longicaudatus, Hoplolaimus galeatus, Zea mays var. saccharata, chemical control.

RESUMEN

Rhoades, H. L. 1985. Efecto de los nematicidas fumigantes y no-fumigantes en las poblaciones de los nematodos parasíticos y rendimientos del maíz dulce producidos en suelos de arena fina en la Florida. Nematropica 15:127-134.

Un estudio de tres años fue conducido en suelos Myakka arena fina en los cuales nematicidas fumigantes (EDB, 1,3-D, y metam-sodium) y no-fumigantes (aldoxycarb, carbofuran, ethoprop, fenamiphos, oxamyl y terbufos) fueron probados para determinar su eficiencia en reducir el daño causado por *Belonolaimus longicaudatus* y *Hoplolaimus galeatus* y aumentar los rendimientos del maíz dulce (*Zea mays* var *saccharata*). Todos los nematicidas fumigantes redujeron significativamente las poblaciones de ambos *B. longicaudatus* y *H. galeatus* y aumentaron significativamente los rendimientos del maíz dulce. Entre los no-fumigantes, aldoxycarb, fenamiphos y terbufos redujeron consistentemente las poblaciones de *B. longicaudatus* pero el carbofuran, el ethropop y el oxamyl no lo hicieron. Nînguno de los nematicidas no-fumigantes fueron efectivos para reducir las poblaciones de *H. galeatus*. Sin embargo, en la mayoria de los casos los rendimientos del

maíz dulce no fueron significativamente diferentes cuando de usaron nematicidas fumigantes o no-fumigantes, pero todos fueron significativamente mas altos que los de las lotes testigos no tratados.
Palabras claves adicionales: Belonolaimus longicaudatus, Hoplolaimus galeatus, Zea mays var. saccharata, control químico.

INTRODUCTION

Sweet corn (*Zea mays* var. *saccharata*) is one of the most extensively produced vegetable crops in Florida. Approximately 22,350 ha were harvested in the 1983-84 growing season, having a total value of nearly 61 million dollars (2). In fine sandy soils, where approximately 25-30% of the production occurs, the sting nematode, *Belonolaimus longicaudatus* Rau, is often a severe pest of sweet corn (1). Other nematodes such as the stubby-root nematode, *Paratrichodorus christiei* (Allen) Siddiqi, and the lance nematode, *Hoplolaimus galeatus* (Cobb) Sher, are also frequently present and cause some injury, but the majority of the injury is normally caused by *B. longicaudatus* (6).

Both fumigant and nonfumigant nematicides have been used for controlling plant nematodes on sweet corn in the past. However, the recent loss of several of the soil fumigants because of ground water contamination and health hazards has led to more extensive use of the granular nonfumigant nematicides. Many of these have been found to be effective in reducing populations of *B. longicaudatus* and increasing yields of sweet corn (4,5,6), but are less effective in controlling *H. galeatus* (6) which occurs extensively on sweet corn. Since some growers prefer to use soil fumigants, there has been an increased interest in using those remaining on the market. For example, sodium N-methyldithiocarbamate (metam-sodium), a multi-purpose soil fumigant generally used in seed-bed operations and on high profit crops to control nematodes, weeds, insects, and diseases, is now being reexamined for possibly more extensive use in field operations. The purpose of these studies was to compare the efficacy of several soil fumigants and nonfumigants for reducing populations of plant-parasitic nematodes and increasing yields of sweet corn in the fine sandy soils of central Florida.

MATERIALS AND METHODS

Three experiments (1983, 1984, and 1985) were conducted at the Central Florida Research and Education Center on Myakka fine sand (% composition = sand 92.2, silt 5.7, clay 2.1) naturally infested with high populations of the sting nematode *B. longicaudatus,* and the lance nematode *H. galeatus.* Other plant nematodes consistently present in low and variable numbers were *P. christiei* and *Meloidogyne incognita* (Kofoid and White) Chitwood; however, their presence appeared to have little or no effect on experimental results. The experimental design was a randomized complete block with five replicates. Each plot consisted of two rows spaced 76 cm apart and 12.2 m long.

Soil fumigants used in the experiments for comparison with the nonfumigants were ethylene-dibromide (EDB) in 1983 (before its banning by the U. S. Environmental Protection Agency), 1,3-dichloropropene (1,3-D) in 1984, and metam-sodium and 1,3-D in 1985. EDB and 1,3-D were injected with a hand injector as a single line of injections spaced 25 cm apart and 17-18 cm deep in-the-row at the rate of 14 L/ha and 56 L/ha, respectively. Metam-sodium was injected in the same manner but with 2 lines of injections 30 cm apart per row and application rates of 140 and 280 L/ha. The soil fumigants were applied 2 wks before planting except in 1984 when 1,3-D was applied only one day before planting to determine its phytotoxicity when applied close to planting.

Nonfumigant nematicides that were applied in one or more of the experiments included aldoxycarb, carbofuran, ethoprop, fenamiphos, oxamyl, and terbufos. Granular formulations of carbofuran, ethoprop, fenamiphos, and terbufos were applied in a 38-cm band in-the-row and incorporated 5-8 cm deep with rotary spiked wheels, whereas liquid formulations of aldoxycarb and oxamyl were sprayed in the same width band and incorporated in the same manner. The nonfumigants were applied either the day before or on the same day of planting the sweet corn. 'Gold Cup' sweet corn was planted in early March in all three experiments. Stand counts for determining possible phytotoxicity were made approximately 2 wks after planting. Normal cultural practices that are recommended for the area were followed throughout the growing season, and the marketable sized ears of sweet corn were harvested during mid-May. Soil samples consisting of five 2.5 x 18-cm cores were taken from the plant row 1-2 wks before harvest and processed by a centrifugal flotation technique (3) for determining nematode populations.

RESULTS AND DISCUSSION

In 1983 there was no evidence of phytotoxicity from any of the nematicides, and there were no significant differences in early plant populations (Table 1). There was a distinct improvement in plant growth and vigor within a few days after plant emergence in all plots treated with nematicides, and this difference became more pronounced as the season progressed. Plants in check plots soon became stunted and many died as the season progressed. Remaining plants in check plots

Table 1. Effects of fumigant and nonfumigant nematicides on nematode populations, plant stand, and yield of sweet corn. 1983 experiment.

Treatment	Application rate	Plant population[y]	Nematode populations[z]		Marketable ears/plot	Average ear wt (g)	Yield (kg/ha)
			BL	HG			
Control	—	49	203	400	34	209	4048
EDB	14 L/ha	60	18	21	102	263	15406
Fenamiphos	2.24 kg/ha	55	4	233	86	259	12839
"	3.36 "	54	13	244	103	263	15406
Carbofuran	2.24 "	48	227	359	74	249	10784
"	3.36 "	54	248	676	76	263	11297
Terbufos	2.24 "	55	4	374	94	272	14379
"	3.36 "	54	21	260	105	281	16433
Ethoprop	2.24 "	56	241	617	79	254	11574
"	3.36 "	53	262	400	82	259	12016
Oxamyl	2.24 "	60	194	512	84	254	11812
"	3.36 "	53	159	517	87	263	12839
LSD 0.05		NS	57	184	24	32	3595

[y]Number of plants per plot (190 ft^2) 2 wks after planting.
[z]Average number of *Belonolaimus longicaudatus* (BL) and *Hoplolaimus galeatus* (HG) extracted from 100 cm^3 of soil at harvest.

had greatly reduced root systems with typical *B. longicaudatus* injury symtoms of discoloration, lesions, and stubby roots (1). Yields were extremely low and significantly less than in all nematicide treatments. Number of harvested ears and ear weight were also significantly less. Populations of *B. longicaudatus* were significantly less just before crop harvest in plots treated with EDB, fenamiphos, and terbufos. There was not a significant reduction of this nematode in plots treated with carbofuran, ethoprop, and oxamyl; however, yields were only slightly lower for these treatments than for those with the greater reductions of the nematode populations. Only the soil fumigant EDB was effective in reducing populations of *H. galeatus*; however, yield increases for EDB were no greater than for some of the other treatments that did not reduce populations of *H. galeatus*.

In 1984, check plots were again seriously damaged by *B. longicaudatus*, and yield from these plots was significantly less than for all nematicide treatments (Table 2). The soil fumigant 1,3-D was phytotoxic and reduced germination because of a waiting period of only one day between application and planting. However, this material provided good control of *B. longicaudatus* and *H. galeatus*. All nematicides but oxamyl significantly reduced *B. longicaudatus* populations. Although yields were slightly lower for oxamyl than the other treatments, they were still significantly higher than the check. As in 1983, reduction of *B. longicaudatus* was less for carbofuran and ethoprop than the other nonfumigants, but yields were essentially as high as that of the other treatments.

In 1985, check plots were again seriously injured and practically no yield was obtained (Table 3). All nematicides reduced *B. longicaudatus* populations and significantly increased yields. The soil fumigant 1,3-D was applied 2 wks before planting in this experiment, and no phytotoxicity occurred as it did in 1984 when only a one day waiting period occurred. As in the 1984 experiment, 1,3-D gave excellent control of both *B. longicaudatus* and *H. galeatus*. The soil fumigant metam-sodium gave somewhat less reduction of both of these nematodes than 1,3-D; however, yields were nearly the same. The performance of the nonfumigants was essentially the same as in previous years. Carbofuran and oxamyl again gave less reduction of *B. longicaudatus* than the other nematicides, and all of the nonfumigants failed to give much control of *H. galeatus*. Nevertheless, yields were essentially the same in all nematicide treatments.

The results from these experiments show that all of the nematicides used were effective in reducing injury from *B. longicaudatus* and increasing yields of sweet corn. In general, carbofuran, ethoprop, and oxamyl

Table 2. Effects of fumigant and nonfumigant nematicides on nematode populations, plant stand, and yield of sweet corn. 1984 experiment.

Treatment	Application rate	Plant population[y]	Nematode populations[z] BL	Nematode populations[z] HG	Marketable ears/plot	Average ear wt (g)	Yield (kg/ha)
Control	—	84	217	315	43	196	4981
1,3-D	56 L/ha	52	32	6	80	245	10733
Fenamiphos	2.24 kg/ha	87	30	249	94	224	12068
"	3.36 "	91	26	203	120	231	15816
Carbofuran	2.24 "	91	81	279	101	225	12941
"	3.36 "	93	83	180	124	224	15765
Terbufos	2.24 "	98	17	210	117	220	14533
"	3.36 "	95	25	244	116	214	14070
Ethoprop	2.24 "	91	83	343	116	216	14276
"	3.36 "	95	55	215	113	213	13608
Oxamyl	2.24 "	88	191	317	79	199	9038
"	3.36 "	91	187	344	94	210	11246
Aldoxycarb	2.24 "	92	53	376	119	253	16998
"	3.36 "	92	33	312	122	235	16279
LSD 0.05		12	52	129	26	43	3184

[y]Number of plants per plot (190 ft^2) 2 wks after planting.
[z]Average number of *Belonolaimus longicaudatus* (BL) and *Hoplolaimus galeatus* (HG) extracted from 100 cm^3 of soil at harvest.

Table 3. Effects of fumigant and nonfumigant nematicides on nematode populations, plant stand, and yield of sweet corn. 1985 experiment.

Treatment	Application rate	Plant population[y]	Nematode populations[z] BL	HG	Marketable ears/plot	Average ear wt (g)	Yield (kg/ha)
Control	—	56	298	103	11	243	1448
1,3-D	56 L/ha	82	5	2	120	269	18353
Metam-sodium	140 "	78	128	38	102	266	15621
" "	280 "	83	79	10	119	285	19195
Fenamiphos	2.24 kg/ha	79	30	103	101	269	15375
"	3.36 "	74	29	75	108	270	16463
Carbofuran	2.24 "	79	105	62	117	259	16999
"	3.36 "	74	55	70	103	274	16012
Terbufos	2.24 "	73	33	96	122	255	17788
"	3.36 "	73	8	59	111	259	16402
Ethoprop	2.24 "	77	59	97	104	266	15683
"	3.36 "	78	49	105	112	267	17008
Oxamyl	2.24 "	84	116	111	114	272	17583
"	3.36 "	82	73	85	104	277	16505
Aldoxycarb	2.24 "	79	57	45	110	278	17285
"	3.36 "	76	53	83	105	277	16608
LSD 0.05		8	53	51	23	16	3487

[y]Number of plants per plot (190 ft^2) 2 wks after planting.
[z]Average number of *Belonolaimus longicaudatus* (BL) and *Hoplolaimus galeatus* (HG) extracted from 100 cm^3 of soil at harvest.

were less effective than the other nematicides for reducing populations of *B. longicaudatus*, yet yields were increased approximately the same for these materials indicating that protection had been rendered to the crop. The soil fumigants gave better control of *H. galeatus* than the nonfumigants, but yields were about the same indicating that this nematode caused little or no injury to the sweet corn in these experiments. Since many of the chemicals in these tests also possess insecticidal properties, increased plant growth and yield may have been due in part to the control of soil insects.

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