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EVALUATION OF NEMATICIDES AND METHODS OF THEIR APPLICATION FOR CONTROL OF NEMATODES ON FIELD CORN [EVALUACION DE NEMATICIDAS Y METODOS DE APLICACION PARA CONTROLAR LOS NEMATODOS EN EL MAIZ]

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ABSTRACT

Soil fumigants and nonvolatile nematicides increased growth and yield of field corn *(Zea mays* L.) over that of control plots in a 2-yr study. Nematicide treatments increased average yields by 28% in 1977 and 58% in 1978. Increases in yield were related to control of *Belonolaimus longicaudatus.* Application of phenamiphos, carbofuran, aldicarb, and oxamyl in a 38-cm band incorporated with rotary wheels just prior to planting controlled *B. longicaudatus* better than applying the chemicals in a 25-cm band in front of the press wheel or in the seed furrow with the planter. However, grain yields were not significantly different between treatments.
Key Words: chemical control, nematicides, methods of application, sting nematode, stubby-root nematode, lance nematode.

INTRODUCTION

In 1968, Rhoades (5) reported that sting nematodes could be economically controlled on field corn with low rates of several organophosphate and carbamate nematicides incorporated in 38-cm band row treatments just prior to planting. Johnson and Dickson (3) confirmed these results in 1973. The list of these materials effective for controlling this nematode on field corn was expanded in 1978 (6). In 1974, Dickson and Johnson (1) demonstrated that several of these materials banded behind the planter opening disks and incorporated only by the soil movement and press wheel action was as effective as preplant-incorporated treatments.

This report describes results of experiments designed to compare the efficacy of additional nonfumigant nematicides developed in recent years and three different

methods of application. The soil fumigants, DBCP, and EDB, were included in 1977 and 1978, respectively, for comparison.

MATERIALS AND METHODS

An experiment was conducted in 1977 and 1978 at Sanford, Florida, on Delray fine sand infested with the sting nematode, *Belonolaimus longicaudatus,* Rau, 1958, as the primary nematode pest. Low populations of stubby-root, *Paratrichodorus christiei,* (Allen, 1957) Siddiqi, 1973, and lance, *Hoplolaimus galeatus* (Cobb, 1913) Filipjev and Sch. Stekhoven, 1941, nematodes were also present. The experimental design was a randomized complete block with five replicates. Each plot consisted of two rows (76 cm apart) 12.2 m long. Granular formulations of organophosphate and carbamate nematicides and or insecticides used were: 1) ethyl 4-(methylthio)-m-tolyl isopropylphosphormamidate (phenamiphos); 2) 0, 0-diethyl 0-[p-(methylsulfinyl) phenyl] phosphorothioate (fensulfothion); 3) 0-ethyl, S,S-dipropyl phosphorodithioare (ethoprop); 4) 2,3-dihydro-2, 2-dimethyl-7-benzofuranyl methylcarbamate (carbofuran); 5) 2-methyl-2-(methylthio) propionaldehyde 0-(methylcarbamoyl) oxime (aldicarb); 6) methyl N', N'-dimethyl-N-[(methylcarbamoyl) oxy] -1-thiooxamimidate (oxamyl); 7) 0-[5-chloro-1-(1-methylethyl)-1H-1, 2, 4-triazol-3-yl] 0,0-diethyl phosphorothioate (CGA-12223); 8) diethyl 1, 3-dithiethane-2-ylidenephosphoramidate (AC 64,475); and 9) S-(1, 1-dimethylethyl) thiomethyl 0,0-diethyl phosphorodithioate (terbufos).

The soil fumigants, 1,2-dibromo-3-chloropropane (DBCP) and 1,2-dibromoethane (EDB), were included in the 1977 and 1978 experiments, respectively.

The granular materials were all applied at 2.2 kg a.i./ha in 38-cm bands and incorporated 5-8 cm deep with spiked, rotary wheels just prior to planting as one treatment. In addition, phenamiphos, carbofuran, ethoprop, and oxamyl were applied at the same rate with the planter in 25-cm bands in front of the press wheel and in the seed furrow, as separate treatments. DBCP (10 kg/ha) and EDB (18 kg/ha) were injected with a single chisel at a depth of 15-18 cm below the row one day before planting.

'Asgrow RX 132' hybrid field corn was planted on March 30, 1977, and March 21, 1978. Stand counts were made 2 weeks after planting to determine possible phytotoxicity. Normal cultural practices for corn production were used throughout the growing season and the grain was harvested on July 28, 1977, and July 19, 1978. Grain yields were converted to the equivalent of No. 2 corn (15.5% moisture) by drying a sample of 10 ears from each plot. Soil samples, made up of five 18-cm deep cores per plot, were taken 10 wks after planting and processed by a centrifugal-flotation technique (2) for nematode population determination. Population levels of the sting nematode were recorded in 1977 and 1978 and population levels of the lance and stubby-root nematode were recorded in 1977 and 1978, respectively.

RESULTS AND DISCUSSION

Increased plant growth and vigor were evident within a few days after plant emergence in plots treated with nematicides. This difference continued to increase during early growth in areas of heavy sting nematode infestation until treated plots had dark green, vigorous plants with thick stalks, whereas check plots had small, stunted plants that wilted in the heat of the day (Fig. 1). None of the nematicides reduced plant populations significantly (Tables 1, 2) and there was no evidence of phytotoxicity symptoms.

Grain yields were higher in all nematicide treatment plots than in check plots both

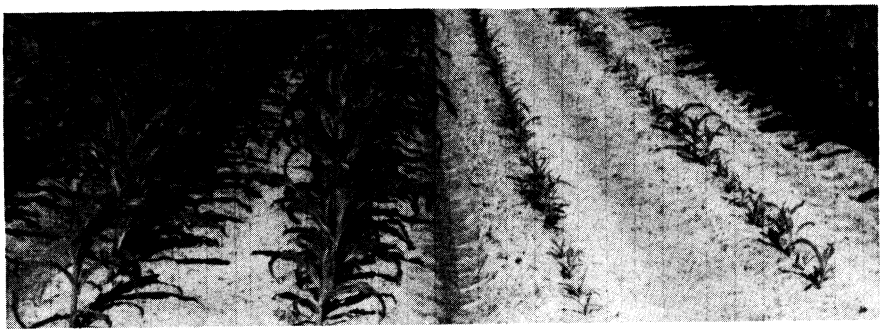

Figure 1. Effect of aldicarb on growth of field corn in soil heavily infested with sting nematodes. Left two rows treated with 2.24 kg/ha; right two rows untreated.

Table 1. Effect of nematicides on nematode populations, plant populations and yield of field corn, 1977.

Treatment[1]	Application method	Plant population[2]	No. nematodes/100 cc soil Sting	Lance	Yield (hl/ha)
Check	- - -	92	301	90	101
DBCP	Chisel	90	57	8	125
Phenamiphos	38-cm band	95	2	55	136
Phenamiphos	25-cm band	91	34	24	122
Phenamiphos	Seed furrow	96	130	60	132
Carbofuran	38-cm band	97	235	53	131
Carbofuran	25-cm band	95	267	75	135
Carbofuran	Seed furrow	93	265	77	122
Aldicarb	38-cm band	93	54	89	133
Aldicarb	25-cm band	94	114	134	130
Aldicarb	Seed furrow	96	70	63	138
Oxamyl	38-cm band	92	98	25	138
Oxamyl	25-cm band	94	175	65	135
Oxamyl	Seed furrow	92	150	91	130
Ethoprop	38-cm band	97	122	56	129
Fensulfothion	38-cm band	99	94	102	122
AC-64475	38-cm band	100	49	68	124
CGA-12223	38-cm band	99	64	48	131

[1]DBCP was applied at 10 kg ai./ha and all other chemicals were applied at 2.2 kg a.i./ha.
[2]Average number of plants per plot (17.7m^2).

years with yield increases averaging 28% (range of 21-37%) in 1977 and 58% (range of 38-88%) in 1978. Yield increases were not significant in 1977 due to high variablity in sting nematode populations among replicates but all treatment yields were significantly higher than check plots in 1978.

Figure 1. Effect of aldicarb on growth of field corn in soil heavily infested with sting nematodes. Left two rows treated with 2.24 kg/ha; right two rows untreated.

Table 2. Effect of nematicides on nematode populations, plant populations, and yield of field corn, 1978.

Treatment[1]	Application method	Plant population[2]	No. nematodes/100 cc soil Sting	Stubby-root	Yield (hl/ha)
Check	- - -	103	409	122	76
EDB	Chisel	96	71	119	125
Phenamiphos	38-cm band	110	0	83	117
Phenamiphos	25-cm band	104	26	63	112
Phenamiphos	Seed furrow	103	111	66	116
Carbofuran	38-cm band	111	109	135	121
Carbofuran	25-cm band	111	156	119	116
Carbofuran	Seed furrow	110	211	116	117
Aldicarb	38-cm band	113	4	91	127
Aldicarb	25-cm band	108	33	70	114
Aldicarb	Seed furrow	105	43	75	113
Oxamyl	38-cm band	106	119	102	113
Oxamyl	25-cm band	104	132	104	117
Oxamyl	Seed furrow	99	98	105	121
Ethoprop	38-cm band	110	113	111	105
Fensulfothion	38-cm band	101	117	74	132
AC-64475	38-cm band	114	9	81	127
CGA-12223	38-cm band	110	67	68	121
Terbufos	38-cm band	115	10	58	143
LSD (p:05):		9			25
LSD (p:01):		12			35

[1]DBCP was applied at 10 kg a.i./ha and all other chemicals were applied at 2.2 kg a.i./ha.
[2]Average number of plants per plot (17.7 m^2).

Both soil fumigants, DBCP and EDB, provided good control of the sting nematodes. In addition, DBCP gave good control of lance nematodes in 1977, whereas the nonvolatile materials provided relatively poor control of this nematode. Nevertheless, yield increases were just as high for the nonvolatile materials demonstrating that the sting nematode was the major pest present. EDB gave poor control of the stubby-root nematode in 1978. However, the rapid return of this nematode following the use of certain soil fumigants was demonstrated by Perry (4) and is a well known phenomenon. Of the nonvolatile materials, terbufos, phenamiphos, and CGA-12223 provided the best control of stubby-root nematodes, but yield increases were very similar to the other treatments demonstrating again that the sting nematode was the primary pest involved.

Based on the average number of sting nematodes present at sampling time, the 38-cm preplant incorporated band provided the best control of the three methods of applying granular phenamiphos, carbofuran, aldicarb, and oxamyl. The next best control was provided by the 25-cm band applied in front of the press wheel during the planting operation, except for oxamyl in which case seed furrow application provided

slightly better control. In spite of higher average sting nematode populations following seed furrow application, yield increases were essentially the same for this treatment indicating that root protection was sufficient during early growth for the plants to become established and withstand the attack of the nematodes during plant maturation. These findings could be of considerable economic importance for corn producers since less equipment and fewer field operations would be required if the nematicides are applied as a part of the planting operation.

Since many chemicals in these tests also possess insecticidal properties, increased plant growth and yield may have been due in part to the control of insects. Terbufos, presently labeled only as a soil insecticide provided surprisingly good nematode control and the yield obtained for this treatment was the highest in the experiment. Nematicidal properties of this material should greatly increase its usefulness as a pesticide.

RESUMEN

En un estudio de dos años de duración el uso de nematicidas fumigantes y otros no volátiles resultó en un aumento en el crecimiento y el rendimiento de maíz común *(Zea mays* L). Tratamientos con nematicidas aumentaron la producción en un promedio de 28% en 1977 y 58% en 1978. Los aumentos en rendimiento estuvieron relacionados con el combate de *Belonolaimus longicaudatus.* La aplicación de fenamifos, carbofurán, aldicarb, y oxamil en una franja de 38 cms incorporados con escarificadoras rotatorias un momento antes de la siembra resultó en mejor control de *B. longicaudatus* que la aplicación de los nematicidas en una franja de 25 cms delante de la rueda empacadora o en la sementera con la sembradora. Sin embargo, las diferencias en rendimiento entre los diferentes tratamientos no fueron significativas.

Claves: combate químico, nematicidas, métodos de aplicación, nematodo de escobilla radicular.

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