EFFECTS OF CHEMICALS AND PLASTIC MULCH ON NEMATODE POPULATIONS AND YIELD OF TOMATO [LOS EFFECTOS DE QUIMICOS Y CUBERTURA PLASTICA SOBRE LAS POBLACIONES DE NEMATODOS Y LA PRODUCCION DE TOMATE]

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ABSTRACT

In a field experiment, comparisons were made of D-D, DD-MENCS, Bunema, Oxamyl, Phenamiphos and DBCP for the control of plant parasitic nematodes and their effect on yield of tomato. Examination of soil samples from each experimental plot 2 mos after planting showed that the nematicides significantly reduced populations of *Pratylenchus zeae, Helicotylenchus dihystera, Rotylenchulus reniformis, Tylenchorhynchus* sp., *Criconemoides* sp. and *Meloidogyne incognita*. The use of black plastic film as a mulch did not enhance nematode control by the nematicides although good week control was achieved. Fruit yield was not significantly increased by the nematicides, with or without plastic mulch, and compound x mulch interaction had no significant effect. No compound showed any evidence of being phytotoxic.

INTRODUCTION

The importance of plant parasitic nematodes in vegetable crop production in Trinidad has already been shown by previous workers (1, 7, 11, 12, 13). The practices of crop rotation, flooding, fallowing and "shifting cultivation" to prevent the multiplication of nematodes are becoming uneconomical and other means of control must be found.

The effects of plastic mulch on plant nematode populations with other biotic factors have recently been investigated in Trinidad (10). In experiments on chemical control, several compounds have shown good to excellent nematicidal properties (11,12). However, since these chemicals are expensive and difficult to apply, the use of plastic mulch is being considered to permit usage of lower nematicide dosages. The beneficial effects of plastic mulch and soil fumigants on soil borne plant pathogens and crop yield have been reported by other workers (8,9).

The purpose of this study was to investigate the effects of plastic mulch and different chemicals on nematode populations and yield of tomato.

MATERIALS AND METHODS

The investigations were carried out on River Estate sandy clay loam soil located at the University Field Station. A typical particle size analysis for the 15 to 17 cm depth of soil was 55% sand (0.2 - 0.05 mm), 27% silt (0.05 - 0.002mm) and 23% clay (0.002 mm). The soil had a pH of 4.5 and a cation exchange capacity

of 8 mequiv./100 g soil. The site selected was infested naturally with *Pratylenchus zeae* Graham, 1951; *Helicotylenchus dihystera* (Cobb, 1893) Sher, 1961; *Meloidogyne incognita* (Kofoid & White, 1919) Chitwood, 1949; *Rotylenchulus reniformis* Linford & Oliveira, 1940; *Tylenchorhynchus* sp. and *Criconemoides* sp. Also present in lesser numbers were *Aphelenchus avenae* Bastian, 1865, *Xiphinema* sp. and *Tylenchus* sp. at concentrations of 38, 16 and 53 nematodes per 200 cm^3 soil, respectively.

The chemicals evaluated, their compositions and rates ai/ha were as follows: D-D(1-3-dichloropropane - 1,2-dichloropropane) 280 liters; DD-MENCS (80% D-D & 20% methyl isothiocyanate) 100 liters; Bunema (40% potassium N-hydroxymethyl-N-methyldithiocarbamate) 224 liters; 908g/3785 ml formulation Oxamyl (methyl-N,N-dimethyl-N-[(methylcarbamoyl) oxy]-1-thiooxamimadate) 1.7 kg; Phenamiphos 5% G (ethyl-4-(methylthio)-m-tolyl isopropylphosphoramidate) 11.2 kg; DBCP 75% EC (1,2-dibromo-3-chloropropane and other halogenated hydrocarbons) 22 liters.

All chemicals except Oxamyl and Phenamiphos were injected 15 to 18 cm deep at loci 20 cm apart in each plot by means of a Shell hand-gun. Injection holes were closed by pressing with the heel. Oxamyl was applied as a bare root-dip for 30 min at the time of transplanting and subsequently as a foliage spray at intervals of 10, 24, and 35 days after transplanting. Phenamiphos was spread about 25 cm wide-in-the-row on the soil surface and incorporated with a rototiller 10 to 12 cm deep.

Immediately after application of the chemicals, 2.5 T/ha of 13-13-20 NPK fertilizer were banded 30 cm from each side of the plant row. A 0.038 mm thick black plastic film was then stretched to cover ½ of each plot, the edges of the plastic being held down with soil. Two wks after soil injection, 8 cm diameter holes spaced 0.5 m apart were cut in the plastic film and 4-wk old tomato seedlings (cv Floradel) raised in a steamed soil mixture, were planted through the holes 1 wk later.

The design used was a randomized latin-square with the 7 different chemicals replicated 7 times. Each plot was split in half to accommodate the black plastic mulch treatment. This corresponds to a design described by Cochran and Cox (3) as "a latin square design with sub-unit treatments in strips." Each main plot was 13 m x 0.9 m. Soil samples for nematode assay were taken from each plot with a 1.5 cm borer to a depth of 15 to 17 cm, 2 mos after transplanting (2, 3, 5). Each sample was collected from around the plant roots in 40 locations within the plot. A sub-sample of 200 cm^3 was processed by modified Cobb's decanting and sieving method (6). Duplicate samples consisting of 10% of each nematode suspension recovered were examined under the stereo-microscope and generic counts made. Specific identification was done under the compound microscope.

Foliage pesticides were applied weekly and weeding was done as needed; all plants were staked. The crop was watered by natural rainfall and supplemented occasionally by overhead sprinkler irrigation. Yield data were recorded for each plot and an analysis of variance as described above was performed. Logarithmic transformation of nematode population density was used to stabilize variance. Unless otherwise stated, all differences referred to in the test were significant at the 5% level of probability or lower.

RESULTS AND DISCUSSION

Results showed differences in the effectiveness of the nematicides tested (without plastic mulch) in reducing the population of *Pratylenchus zeae, H. dihystera, R. reniformis, Tylenchorhynchus* sp., *Criconemoides* sp. and *M. incognita* at the 2-mo sampling date (Table 1). Duncan's multiple range test on the transformed data showed that, when compared with the control, *M. incognita* and *H. dihystera* were significantly reduced by all nematicides except Bunema. *Pratylenchus zeae* was significantly reduced only in D-D and DD-MENCS treated soil and *R. reniformis* was significantly reduced by all other nematicides except Bunema and DD-MENCS. In a previous test, DD-MENCS applied at a much higher dosage was more effective in controlling the nematode populations than DBCP applied at half the present rate (11). It should be pointed out that the transformed data on *R. reniformis* and *Criconemoides* sp. on which the Analysis of Variance was performed, showed significantly lower mean numbers for DBCP than for DD-MENCS and Bunema, but the tabulated means calculated directly from the original data could not bring out this variance in nematode counts.

The use of plastic mulch did not enhance control by nematicides (Table 1). Nematode populations were higher in most plastic covered plots with treatments and controls.

In the mulched plots all the nematicide treatments showed yields of marketable fruit 8.8 to 27% higher than the control. However, there were no significant yield differences amongst the nematicide treatments, with or without mulch. Tomato plants under plastic mulch have also been reported to support higher nematode concentration without stunting, wilting or having reduced yields (8,9).

It is known that soil moisture stress can influence the nematode population density and plant growth. However, in this study, the effect of soil moisture on the nematode populations and plants during the growing season was not determined. Yield response could also be altered where proper adjustments of ammonium fertilizers are not made to mitigate the effect of retarded nitrification following soil fumigation with DD-MENCS and other compounds (8,9). It is conceivable, therefore, that part of the yield response in the nematicidal treatments resulted from one or more of these factors or probably a combination of several other factors (2,8).

Plastic covered plots were free from weeds except for nutgrass, *Cyperus rotundus* L. which grew through the plastic. A similar effect has been reported by other workers (5). Two weedings were necessary to keep the unmulched plots free from weeds. In a previous test, DD-MENCS applied in an overall method at higher dosages gave excellent weed control without the use of plastic mulch (11).

Although DD-MENCS is known to be effective in controlling a number of soilborne disease organisms, there was no evidence of root damage by any other soilborne plant pathogen. No phytotoxicity was observed with any of the chemicals. Further studies are needed to evaluate the effects of fumigants and plastic mulch on crop yield under different soil conditions.

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Table 1. Effects of chemicals with (+) and without (−) plastic on yield of tomato and nematode population per 200 cm^3 soil sample (mean number of 7 replicates).

TREATMENTS Rate/ha (ai)	Marketable Yield MT (Metric tons)/ ha		NEMATODE POPULATIONS 0 AND 2 MONTHS AFTER TRANSPLANTING																	
			Pratylenchus zeae			*Helicotylenchus dihystera*			*Rotylenchulus reniformis*			*Tylenchorhynchus* sp.			*Criconemoides* sp.			*Meloidogyne incognita*	
			0[1]	2		0	2		0	2		0	2		0	2		0	2	
	+	−		+	−		+	−		+	−		+	−		+	−		+	−
CONTROL	32.47	38.03	15	150ab[2]	55b	90	1315bc	611d	1800	6465	5899d	130	95b	62ab	15	110bc	175cd	400	465d	386c
D-D 280 liter	41.26	43.05	-	60a	15a	-	570abc	144bc	-	1070	379a	-	45ab	60ab	-	10a	13a	-	125bc	34a
DD-MENCS 100 liter	39.82	39.65	-	230b	17a	-	625abc	175bc	-	4180	2451bcd	-	50ab	106b	-	50b	13a	-	250cd	95b
BUNEMA 224 liter	40.18	34.08	-	225b	66b	-	1590c	559cd	-	4525	3641cd	-	45ab	77b	-	85bc	69bc	-	220bcd	136bc
OXAMYL 1.7 kg	35.34	36.95	-	185b	76b	-	245a	86ab	-	2210	1109abc	-	20a	39a	-	195c	201d	-	125bc	55ab
PHENAMIPHOS 5% G 11.2 kg	37.67	37.13	-	190b	31ab	-	415ab	71a	-	3625	869ab	-	50ab	23a	-	65b	111cd	-	75ab	37a
DBCP 75% EC 22 liter	37.85	36.24	-	95ab	55b	-	335a	104ab	-	2090	2692ab	-	50ab	88ab	-	70b	83b	-	30a	81ab

(1) Initial population density before application of the chemicals.

(2) Means in columns flanked by a letter in common do not differ significantly (P = 0.05). No letter indicates non-significance.

RESUMEN

En un experimento de campo se compararon los nematicidas de D-D, Vorlex, Bunema, Oxamyl, Phenamiphos y DBCP para el control de nemátodos parasíticos y la producción de tomate. El examen de muestras de suelo de cada parcela del terreno experimental después de 2 meses demostró que los tratamientos redujeron significativamente las poblaciones de *Pratylenchus zeae, Helicotylenchus dihystera, Rotylenchulus reniformis, Tylenchorhynchus* sp., *Criconemoides* sp. y *Meloidogyne incognita.* El uso de una cubertura de plástico negra para proteger las plantas no mejoró el control de los nematodos en los tratamientos pero dió buen control de las malezas. Los tratamientos con y sin cubertura no aumentaron la producción de tomate y dieron una interacción insignificante entre los nematicidas y el plástico. No se registró acción fitotóxica en ninguno de los tratamientos.

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CONTROL OF *PRATYLENCHUS BRACHYURUS* IN ROUGH LEMON SEEDLINGS WITH DOWCO 275 (DIETHYL-FLUORO-PYRIDYL-PHOSPHOROTHIOATE[1/] [CONTROL DE *PRATYLENCHUS BRACHYURUS* EN LIMON RUGACEO CON DOWCO 275 (DIETIL-FLUORO-PIRIDIL-FOSFOROTIOATO)]

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ABSTRACT

Soil amendment with Dowco 275 (0-0 diethyl 0-(6-fluoro-2 pyridyl) phosphorothioate) granules at rates of 5.6 to 22.4 kg/ha (a.i.) around 2-yr-old potted rough lemon (*Citrus jambhiri* Lush.) seedlings in the greenhouse gave significant control of *Pratylenchus brachyurus* and increased top growth of the plants. Beneficial effects of treatment occurred at all but the lowest rates used. The 5.6 and 11.2 kg/ha rates resulted in 19 to 27% and 43 to 54% increase in height and weight

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