RELATION BETWEEN THE METHOD OF INCORPORATION OF SYSTEMIC NEMATICIDES INTO SOIL AND THEIR EFFECTIVENESS AGAINST ROOT-KNOT NEMATODE ON PEANUTS [RELACION ENTRE EL METODO DE INCORPORACION EN EL SUELO PARA NEMATICIDAS SISTEMICOS Y LA EFFECTIVIDAD CONTRA EL NEMATODO NODULADOR DEL MANI].

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ABSTRACT

The influence of the method of incorporation into soil on the effectiveness of systemic nematicides was studied in a peanut field of sandy loam infested with *Meloidogyne arenaria* (Neal) Chitwood. Granular formulations of phenamiphos (Nemacur 15G), aldicarb (Temik 15G) or oxamyl (Vydate 10G) were applied to Florunner peanuts at planting time at a rate of 3.4 kg a.i./ha in a 36-cm band. Treatments for each nematicide included no incorporation, shallow (2.5-5 cm) incorporation by means of spring-activated scratchers, and deep incorporation by disking (10-14 cm) or rototilling (20 cm). In a 1977 experiment with phenamiphos yield response was best in plots where the nematicide was not incorporated or where it was only scratched-in. Results from a 1978 experiment with phenamiphos, aldicarb, and oxamyl indicated that application of the nematicides resulted in significantly increased yields regardless of method of incorporation. Control of *Meloidogyne arenaria* in the 1977 and 1978 seasons with the nematicides was not as good as that obtained with soil injections of the fumigant DBCP (9.35 L/ha), although yield responses from the 1978 experiment were as good as that obtained with the fumigant that year. Our data suggest that deep (10-20 cm) incorporation of systemic nematicides into soil is not a prerequisite for effectiveness against *Meloidogyne arenaria* on peanuts.
Key words: Nematode control, groundnut, root-knot nematodes, Arachis hypogaea, organophosphates, carbamates, insecticides.

INTRODUCTION

Systemic nematicides have been available for use on peanuts *(Arachis hypogaea)* for almost a decade. In the past a great amount of research effort has been devoted to determining the relative effectiveness of these materials against nematodes parasitic of the crop (2, 7, 12). However, in spite of the considerable amount of knowledge accumulated on the use of systemics in peanuts their acceptance by farmers for use in this crop has been limited. Part of the reason for this situation has been the higher cost of effective doses of systemics in comparison with cheaper available fumigants. Thus, traditionally, peanut farmers in Alabama and other southeastern states of the USA relied on the use of DBCP for control of the major nematode parasites of peanuts, the root-knot nematodes, *Meloidogyne arenaria* (Neal) Chitwood, and *M. hapla* Chitwood (4). The use of DBCP provided an inexpensive ($15-20/ha) and effective means of controlling the pests. Recently, DBCP was eliminated for use on peanuts because of its effect on human health (1). Besides their higher cost (US$ 30-35/ha) systemic nematicides required new equipment for application and it was believed that their thorough incorporation into soil was a prerequisite for maximal effectiveness against nematodes (4). Incorporation into soil required extra operations at planting that seriously impaired use of systemics on peanuts. Since no data were available on the influence of various methods of incorporation into soil on the effectiveness of systemic nematicides, we conducted field studies on the subject.

MATERIALS AND METHODS

Experiments with representative nematicides were conducted during the 1977 and 1978 peanut seasons in a field in the vicinity of Tumbleton, Alabama which was heavily infested (ca 40-50 larvae/50 cm^3) soil with *M. arenaria*. The field had been under continuous peanut culture for 5 years.

Each plot in the experiments consisted of two 91-cm-rows 10 m long. The soil was a sandy loam with a pH of 6.0 and organic matter content less than 1%. All experiments were conducted using the Florunner variety of peanuts.

In a first experiment in 1977 the effectiveness of 3 different methods of incorporation of nematicides was studied with a granular formulation of phenamiphos (Nemacur 15G). The nematicide was applied at planting time in a 36-cm band at a rate of 3.4 Kg of active ingredients (a.i.)/ha. Phenamiphos was either left on the soil surface, lightly incorporated to a depth of 3-4 cm by means of spring-activated "scratchers", or incorporated to a depth of 10-14 cm by a single pass of a disk.

The experiment in 1978 included granular formulations of aldicarb (Temik 15G) and oxamyl (Vydate 10G) in addition to phenamiphos. All nematicides were applied at a rate of 3.4 Kg a.i./ha in a 36-cm band. The experiment studied for each nematicide the methods of incorporation tested in 1977 and included an additional treatment in which the nematicides were rototilled to a depth of 20 cm.

Every treatment in each experiment was represented by 8 plots arranged in a randomized complete block design. Each experiment contained treatments with no nematicides and a treatment with the recommended 9.35L/ha of DBCP (Fumazone 86E) to serve as a positive control. Control of peanut leafspot and weeds was attained following recommended practices for South Alabama (4) and the cultivar used was Florunner. Soil samples for nematode analysis were collected just prior to harvest during the first week of September to coincide with the period of maximal population development (6). Each sample consisted of soil cores 2.5 cm in diameter obtained from the root zone to a depth of 15-20 cm along the center of each plot to provide a total of 15-18 cores/plot. The cores from each plot were composited and a 50 cm^3 subsample was used to extract nematodes following the molasses flotation sieving technique (9, 11).

The relative appearance of plots was determined in mid-August each year using a subjective scale which ranged from a value of 1, representing plots with plants showing poorest growth in the field, to a value of 5 assigned to plots with plants showing the best growth.

The effect of nematicide-treatments on the incidence of Southern blight *(Sclerotium rolfsii)* was determined in 1977 in mid-August by counting the number of disease loci per plot. A locus is an area which consisted of 30 cm or less of row with diseased peanuts. (10). Because of the dry conditions prevailing in the 1978 season the level of Southern blight was not severe enough to be estimated by the disease locus method, instead a subjective disease evaluation was utilized. The evaluation followed a scale where 1 represented plots free of Southern blight and 5 represented the maximal level of the disease prevailing in the field. Peanut yield was determined every year at maturity from the entire plots.

Statistical analysis: All data were analyzed following standard procedures for analysis of variance, and, differences between means were evaluated for significance with the least significant difference test (13). Unless otherwise specified all differences mentioned in the text were significant to the 5% or lower level of probability.

RESULTS AND DISCUSSION

Nemacur lightly incorporated by scratching was the only treatment with phenamiphos that significantly reduced numbers of *Meloidogyne arenaria* larvae in the 1977 experiment (Table 1); the most effective reduction in la. al numbers was obtained with DBCP. All nematicide treatments improved plot appearance and reduced the incidence of Southern blight. The appearance of plots in which Nemacur was disked in was inferior to those of the other two Nemacur treatments and to that of DBCP treated plots. Yield response was significantly above the control in all plots receiving nematicide; yield was highest in plots with DBCP and lowest in those in which Nemacur was incorporated by disking. The yield difference between the other two Nemacur treatments was not significant.

All nematicide treatments resulted in increased yields above the control in the 1978 test (Table 2). Yield differences between treatments with phenamiphos, aldicarb or oxamyl were not significant; also, differences between methods of incorporation for

Table 1. Relation between the method of phenamiphos (Nemacur 15G) incorporation into soil, control of Meloidgyne arenaria, plot appearance, incidence of Southern blight (Sclerotium rolfsii) and yield of Florunner peanuts.

Treatments	Rate (kg a.i./ha)	Method of Incorpora-tion	M. arenaria (larvae/ $50cm^3$ soil)	Subjective[y] Appearance	Disease[z] (loci/ plot)	Yield (kg/ha)
Nemacur 15G	3.4	Surface	62	4.4	2.1	2883
Nemacur 15G	3.4	Disked	64	3.4	1.7	2462
Nemacur 15G	3.4	Scratched	43	4.4	1.0	3147
DBCP 86EC	9.35 L/ha		15	4.4	1.7	4186
Control			78	2.0	9.7	1641
		LSD (P=0.05)	10	0.74	3.8	192
		LSD (P=0.01)	13	0.88	5.1	255

x All figures are averages of 8 plot replications.

y Subjective appearance of plants in plots based on a scale where 1 = poorest and 5 = excellent.

z Locus = a diseased area consists of 30 cm or less of row length.

Table 2. Relation between the method of incorporation of three nematicides and control of Meloidogyne arenaria, subjective appearance of plants in plots, incidence of Southern blight (Sclerotium rolfsii) and yield of Florunner peanuts.

Treatment	Method of Incorporation	M. arenaria (larvae/50cm^3 soil)	Subjective[y] Appearance	Disease[z] Rate	Yield (kg/ha)
Nemacur 15G	Surface	54.5	4.50	2.25	3092
	Disked	63.6	4.37	2.25	3285
	Scratched	85.75	4.50	2.37	3097
	Rototilled	58.62	4.50	2.70	3114
Temik 15G	Surface	52.12	4.18	2.43	3309
	Disked	39.87	4.31	2.12	3249
	Scratched	65.50	4.25	2.12	3358
	Rototilled	24.12	4.50	2.12	3087
Vydate 10G	Surface	63.87	4.37	2.50	3298
	Disked	28.75	4.31	2.12	3255
	Scratched	70.25	4.43	2.25	2880
	Rototilled	51.62	4.37	1.87	3065
DBCP		10.25	4.43	2.25	3440
Control		87.75	4.25	4.25	2577
	LSD (P=0.05)	49	1.11	0.83	461
	LSD (P=0.01)	65	1.47	0.10	613

x All figures are averages of 8 plot replications.

y Subjective appearance of plants in plots based on a scale where 1 = poorest and 5 = excellent.

z Based on a scale where 1 = no disease and 5 = plots with severely diseased plants.

each nematicide were not significant. Significant reductions in the number of larvae of *Meloidogyne arenaria* in soil was only attained with DBCP and with aldicarb when rototilled and with oxamyl disked into the soil.

Yield increases obtained in the present study after treatment with systemic nematicides were not always related to significant declines in numbers of larvae of root-knot nematode in soil, as was always the case in plots that received the fumigant nematicide. We interpret this phenomenon to be the result perhaps of less efficient killing of the parasites by the systemics and also perhaps to inhibition of feeding by the larvae in systemic treated plots. This would explain the higher number of larvae found in soils treated with the systemic nematicides and also the yield increases obtained from these same plots. Differences in the subjective appearance of plots were not significant, a reflection of the drier conditions prevailing during the evaluation period which made it difficult to determine differences in plant appearance between plots. All nematicide treatments significantly reduced the incidence of Southern blight *(S. rolfsii)* in the 1978 experiments; however, differences for this variable between nematicide treatments were not significant. Reduction of the incidence of Southern blight by nematicide treatment would indicate that in the root-knot nematode-*S. rolfsii* complex in peanuts the nematode component is the major disease-determining factor. Results indicate that the commonly assumed requirement (4) of thorough incorporation of systemic granular nematicides into soil to obtain maximal nematode control and peanut yield response is not necessary. These findings agree with those of Rhoades (8) and Dickson (3) which indicated that systemic nematicides can be used effectively for control of nematodes on corn with minimal incorporation into soil. Our results also agree with those from other workers on the use of systemics in banana fields where these materials are applied with minimal or no incorporation into soil (5). Our results thus indicate that, for the 3 systemic nematicides of the study, practical methods of application and incorporation for effective use are feasible and within the present equipment capabilities of peanut farmers.

RESUMEN

Se estudió la influencia del método de incorporación en el suelo sobre la efectividad de nematicidas sistémicos en un campo de maní con un limo arenoso infestado por *Meloidogyne arenaria* (Neal) Chitwood. Se aplicaron preparaciones granulares de fenamifos (Nemacur 15G), aldicarb (Temik 15G), o oxamil (Vydate 10G) durante la siembra de maní Florunner a razón de 3.4 Kg a.i./ha en una franja de 36 cms. Los tratamientos para cada nematicida fueron: no incorporación, incorporación superficial (2.5-cm) por medio de escarificadores activados por resortes, incorporación profunda por medio de discos (10-14 cms) o por arado rotatorio (20 cms). En un experimento con fenamifos durante la campaña de 1977 el rendimiento de maní fue significativamente superior en las parcelas donde el nematicida no se incorporó o sólo superficialmente. Los resultados de un experimento con fenamifos, aldicarb y oxamil durante la campaña de 1978 señalaron que la aplicación de los nematicidas resultó en aumentos significativos de rendimientos sin importar el método de incorporación utilizado. El grado de combate de *M. arenaria* durante las dos campañas no fue tan bueno como el obtenido con inyección al suelo del fumigante DBCP (9.35 L/ha) aunque los aumentos en rendimiento obtenidos en el experimento de 1978 fueron equivalentes al obtenido con el fumigante. Nuestros datos indican que la incorporación profunda (10-20 cm) en el suelo de nematicidas sistémicos no es necesaria para obtener efectividad contra *M. arenaria* en mani.
Claves: combate de nematodos, cacahuete, nematodos noduladores, Arachis hypogaea, carbamatos, nematicidas fosforados, insecticidas.

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EFECTO DE *HELICOTYLENCHUS JOJUTLENSIS* SOBRE PASTO HONDURAS Y MAIZ [EFFECT OF *HELICOTYLENCHUS JOJUTLENSIS* ON HONDURAS GRASS AND CORN]. Emma Zavaleta-Mejía y Carlos Sosa-Moss, Rama de Fitopatología, Colegio de Postgraduados, Chapingo Méx. México.

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RESUMEN

Se realizaron pruebas para conocer el efecto de *Helicotylenchus jojutlensis* en pasto Honduras bajo condiciones de campo y en maíz (variedad H-412), bajo condiciones de invernadero. *H. jojutlensis* redujo significativamente (alrededor del 65%) el desarrollo del pasto Honduras; en maíz, los resultados obtenidos no fueron concluyentes, ya que al parecer el efecto patogénico de *H. jojutlensis* fúe enmascarado por el efecto negativo (sobre el desarrollo de las plantas) del suelo esterilizado en autoclave que se utilizó en el experimento.

Claves: Zea mays, nematodos espiraliformes, patogenicidad, Isophorus unisetus.

INTRODUCCION

En México el género *Helicotylenchus* tiene una distribución muy amplia y se le ha encontrado asociado con un gran número de cultivos (2, 6, 7, 9, 11, 12, 13, 14); no obstante, se han realizado muy pocos estudios con objeto de conocer la patogenicidad y daños que causan las especies de este género (10). Fué por esta razón que se decidió realizar el presente estudio con *H. jojutlensis,* especie que fué encontrada prácticamente en cultivo puro bajo condiciones naturales, en el municipio de Jojutla, Estado de Morelos, México. Las pruebas se realizaron bajo condiciones de campo en pasto Honduras y de invernadero en maíz.

MATERIALES Y METODOS

1. Experimentos en Campo. Se realizaron dos experimentos en un terreno con más de 5 años de monocultivo con pasto Honduras, *Isophorus unisetus* (Presl.) Schlecht.,