EFFECTS OF APPLICATION TIME OF ETHYLENE DIBROMIDE AND PHENAMIPHOS ON NEMATODES, SOUTHERN STEM ROT, THRIPS, AND YIELD OF PEANUTS.

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ABSTRACT

Minton, N.A., D.K. Bell, and A.S. Csinos. 1982. Effects of application time of ethylene dibromide and phenamiphos on nematodes, southern stem rot, thrips, and yields of peanuts. Nematropica 12: 21-32.

Phenamiphos at 2.8 kg ai/ha applied at planting, and phenamiphos at 1.1 and 2.8 kg ai/ha and ethylene dibromide at 17.9 and 35.8 kg ai/ha applied postplant increased peanut yields significantly ($P = 0.05$) over the control. Phenamiphos at 1.1 and 2.8 kg ai/ha applied postplant to plots treated at planting with phenamiphos at 1.1 kg ai/ha increased yields significantly as did phenamiphos 2.8 kg ai/ha applied postplant to plots treated at planting with ethylene dibromide at 17.9 kg ai/ha. No treatment applied after planting increased yields in plots that had been treated at planting with phenamiphos at 2.8 kg ai/ha or ethylene dibromide at 35.8 kg ai/ha. Peanut yields were negatively correlated ($P = 0.01$) with root-knot indices ($r = -0.47$), soil populations of *Meloidogyne arenaria* (Neal) Chitwood larvae ($r = -0.24$), and southern stem rot ($r = -0.33$). *Additional key words: Sclerotium rolfsii, Frankliniella spp., nematicides, chemical control, pest management, Arachis hypogaea, Macroposthonia ornata.*

RESUMEN

Minton, N.A., D.K. Bell, y A.S. Csinos. 1982. Efecto del tiempo de la aplicación de bibromuro de etileno y de fenamifos sobre los nematodos, la podredumbre blanca del tallo, los pulgones y el rendimiento del maní. Nematropica 12: 21-32.

Las aplicaciones de fenamifos durante la siembra en dosis de 2.8 kg i.a./ha, y después de la siembra a razón de 1.1 y 2.8 kg i.a./ha así como las de bibromuro de etileno (BDE) durante la postsiembra en dosis de 17.9 y

Mention of a pesticide herein neither constitutes a recommendation nor implies registration under FIFRA.

35.8 kg i.a./ha, resultaron en aumentos significativos (P = 0.05) en rendimientos sobre los obtenidos con el tratamiento testigo. La aplicación de fenamifos a 1.1 y 2.8 kg i.a./ha después de la siembra a parcelas ya tratadas durante la siembra con 1.1 kg i.a./ha de fenamifos o con 17.9 kg i.a./ha de BDE también resultó en aumentos significativos en rendimiento. Ningún tratamiento de postsiembra resultó en aumentos significativos de rendimiento cuando se efectuó sobre parcelas previamente tratadas durante la siembra con fenamifos a 2.8 kg i.a./ha o con BDE a 35.8 kg i.a./ha. Los rendimientos de maní estuvieron correlacionados negativamente (P = 0.01) con los índices de nodulación (r = 0.47), las poblaciones de larvas de *Meloidogyne arenaria* (Neal) Chitwood (r = 0.24) y el grado de incidencia de la podredumbre blanca de los tallos (r = 0.33).
Palabras claves adicionales: Sclerotium rolfsii, Frankliniella spp., nematicidas, combate químico, manejo de plagas, Macroposthonia ornata.

INTRODUCTION

Comparisons of nematicides applied to peanuts, *Arachis hypogaea L.*, at planting with an additional application at pegging have been made. In Oklahoma (3) in soil infested with *Pratylenchus brachyurus* (Godfrey) Goodey, peanut yields were greater in plots treated with nematicides at planting and at pegging time than when treated only at planting. In Florida (2) yields of peanuts from plots that were infested with *Meloidogyne arenaria* (Neal) Chitwood and treated with nematicides at planting and at pegging time were greater than yields from plots treated only at planting; DBCP at planting plus aldicarb at pegging was the most effective treatment. Researchers in Alabama (9) indicated that ethylene dibromide, alone or combined with chloropicrin, applied at planting of Florunner peanuts was as effective for nematode control as applications at planting plus at midbloom. In Georgia (5) in plots where yields were increased significantly with at-planting nematicide treatments, postplant treatments of nematicides or nematicides plus a fungicide did not further increase yields. However, postplant applications of ethoprop and phenamiphos alone or combined with pentachloronitrobenzene applied to plots that did not receive a nematicde treatment at planting increased yields.

Previously, DBCP had been used extensively for nematode control on peanuts. The recent withdrawal of this material for use on peanuts by the Environmental Protection Agency (1) has created the need to find new materials or methods of applying old materials that provide control equal to or superior to that obtained with DBCP. Ethylene dibromide, recently approved for the use on peanuts at planting, and phenamiphos are two of the most effective nematicides now available to control *M. arenaria* on peanuts. There are no reports of these materials being used as at-planting-postplant combination treatments. This article presents the effects of these nematicides applied at planting and/or postplant on peanut yield, nematode populations, incidence of *Sclerotium rolfsii* Sacc. (southern stem rot) and damage due to thrips. Preliminary results have been published (6).

MATERIALS AND METHODS

This study was conducted during 1979 and 1980 on a loamy sand infested with *M. arenaria, Macroposthonia ornata* (Raski) de Grisse and Loof, and *Sclerotium rolfsii.* The experimental design was a split plot replicated five times. The whole-plot and subplot treatments consisted of at-planting and postplant treatments, respectively. Two rates each of ethylene dibromide and phenamiphos comprised the whole-plot and subplot treatments. Subplots were 7.6 m long planted with two rows of Florunner peanuts spaced 0.9 m apart.

The seedbed was prepared to a depth of 25 cm with a moldboard plow. Fertilizer and lime were applied as recommended for peanut production in Georgia. The rows were marked and benefin herbicide (1.3 kg ai/ha) was applied broadcast. The at-planting treatments were applied and seeds were planted 23 April 1979 and 1 May 1980. Phenamiphos at 1.1 kg ai/ha was applied in the planting furrow, and phenamiphos at 2.8 kg ai/ha was applied in a 46-cm band and incorporated 5-8 cm deep with a power driven rototiller. Ethylene dibromide at 17.9 and 35.8 kg ai/ha was injected 20 cm deep by using two chisels per row spaced 25 cm apart. Phenamiphos at 1.1 and 2.8 kg ai/ha and ethylene dibromide at 17.9 and 35.8 kg ai/ha were applied post-plant. In 1979 phenamiphos was applied on 30 May and ethylene dibromide on 4 June. In 1980 phenamiphos was applied on 23 June and ethylene dibromide on 27 June.

The herbicides alachlor (3.4 kg ai/ha) and naptalam (3.4 kg ai/ha) plus dinoseb (1.7 kg ai/ha) were applied after planting on 3 May 1979 and 12 May 1980. Bentazon (3.4 kg ai/ha) was also applied on 21 May 1980. Gypsum (calcium sulfate) was applied at 700 kg/ha each year during the early bloom stage. Chlorothalonil and sulfur were used for foliar disease control and methomyl and monocrotophos for control of insects. Rainfall was inadequate for maximum peanut production both years which resulted in applying approximately 3.8 cm of irrigation water one time in 1979 and six times in 1980.

Ten 2.5-cm diam cores of soil for nematode assays were taken from the 0 to 20-cm depth from each plot on 7 September 1979 and 23 September 1980. The soil in each sample was thoroughly mixed, and the nematodes were extracted from 150 cm^3 by the centrifuge-sugar-flotation method (4). Damage due to thrips (*Frankliniella* sp.) was evaluated on 9 June 1980 by examining ten leaves per plot at random and counting damaged leaflets. These counts were converted to percentage of damaged leaflets.

The plants were harvested on 19 September 1979 and 2 October 1980. Roots and pods of 10 plants from each plot were rated for severity of root-knot galling immediately after digging; ratings were based on a 1-5 scale.

The number of southern stem rot loci per 15.2 m of row was recorded within 12 hours after digging using the methods of Rodriguez-Kabana et al. (8). Data were subjected to analysis of variance, Duncan's multiple range test, and stepwise regression analysis (7).

RESULTS

Peanut yields were greater for plots treated with phenamiphos at 2.8 kg ai/ha at planting than those receiving other at-planting treatments (Table 1). All postplant treatments applied to plots that did not receive a treatment at planting increased yields. Also, plots that received ethylene dibromide at 35.8 kg ai/ha postplant and no treatment at planting yielded more peanuts than those that received ethylene dibromide at 17.9 kg ai/ha. None of the postplant treatments applied to plots treated at planting with phenamiphos at 2.8 kg ai/ha and ethylene dibromide at 35.8 kg ai/ha increased yields over the at-planting treatments. Conversely, phenamiphos at 1.1 and 2.8 kg ai/ha applied postplant to plots treated at planting with phenamiphos at 1.1 kg ai/ha increased yields. Also, phenamiphos at 2.8 kg ai/ha applied postplant to plots treated at planting with ethylene dibromide at 17.9 kg ai/ha increased yields. All postplant treatments except ethylene dibromide at 17.9 kg ai/ha increased average yields, and phenamiphos treatments at 1.1 and 2.8 kg ai/ha were superior to the ethylene dibromide treatments at 17.9 kg ai/ha.

Root-knot indices were reduced in all plots that received only at-planting treatments (Table 2). Phenamiphos at 2.8 kg ai/ha and ethylene dibromide at 35.8 kg ai/ha were more effective for nematode control than ethylene dibromide at 17.9 kg ai/ha. Also, root-knot indices were reduced in all plots that received only postplant treatments; and both rates of phenamiphos were more effective than either rate of ethylene dibromide. Root-knot indices were reduced in all plots that received postplant treatments compared with plots that received only ethylene dibromide at 17.9 kg ai/ha at planting. Also, all postplant treatments except ethylene dibromide at 17.9 kg ai/ha reduced root-knot indices compared with plots that received only phenamiphos at 1.1 kg ai/ha. None of the postplant treatments applied to plots treated at planting with phenamiphos at 2.8 kg ai/ha, and ethylene dibromide at 35.8 kg ai/ha decreased root-knot indices. Average root-knot indices were reduced by all treatments applied at planting and postplant. Stepwise regression analysis indicated that 22% of the yield variation was attributable to root-knot nematodes as estimated by root-knot indices.

Of the at-plant treatments, only ethylene dibromide at 35.8 kg ai/ha reduced the numbers of *M. arenaria* larvae in the soil (Table 3). In plots that received no treatment at planting, numbers of *M. arenaria* were not reduced by any postplant treatment. No postplant treatment applied to plots treated at planting with phenamiphos at 2.8 kg ai/ha, and ethylene dibromide at 35.8 kg ai/ha reduced *M. arenaria* larvae. However, phenamiphos at 2.8 kg ai/ha

Table 1. Effects of nematicides applied at planting and postplant on peanut yields (kg/ha, 2-yr average).[z]

At-planting treatments (kg ai/ha)	Postplant treatments (kg ai/ha)					
	Control	Phenamiphos		Ethylene Dibromide		Average
		1.1	2.8	17.9	35.8	
Control	4156 b	4835 a	4807 a	4443 a	4872 a	4622 a
Phenamiphos 1.1	4389 b	4882 a	5016 a	4660 a	4663 a	4723 a
Phenamiphos 2.8	5050 a	5046 a	5043 a	4810 a	4930 a	4976 a
Ethylene dibromide 17.9	4521 b	4910 a	5088 a	4866 a	4686 a	4814 a
Ethylene dibromide 35.8	4635 b	4816 a	4750 a	4742 a	4836 a	4756 a
Average	4551	4898	4941	4706	4797	

[z] Data in columns followed by the same letter and data in rows underscored by the same line are not significantly different (P = 0.05) according to Duncan's multiple range test.

Table 2. Effects of nematicides applied to peanuts at planting and postplant on root-knot indices (2-yr average.)[y,z]

At-planting treatments (kg ai/ha)	Postplant treatments (kg ai/ha)					
	Control	Phenamiphos		Ethylene dibromide		Average
		1.1	2.8	17.9	35.8	
Control	3.5 a	2.6 a	2.3 a	3.1 a	3.0 a	2.9 a
Phenamiphos 1.1	2.8 bc	2.2 a	2.1 a	2.6 a	2.4 b	2.4 b
Phenamiphos 2.8	2.2 c	2.2 a	2.2 a	2.4 b	2.2 b	2.3 b
Ethylene dibromide 17.9	3.0 b	2.4 a	2.1 a	2.6 a	2.4 b	2.5 b
Ethylene dibromide 35.8	2.5 c	2.2 a	2.1 a	2.4 b	2.2 b	2.3 b
Average	2.8	2.3	2.2	2.6	2.5	

[y] Ratings based on 1-5 scale: 1 = no galling, 2 = 1-25, 3 = 26-50, 4 = 51-75 and 5 = 76-100% of root system galled.

[z] Data in columns followed by the same letter and data in rows underscored by the same line are not significantly different (P = 0.05) according to Duncan's multiple range test.

Table 3. Effects of nematicides applied to peanuts at planting and postplant on populations of *Meloidogyne arenaria* larvae (2-yr average).[z]

At-planting treatments (kg ai/ha)	Postplant treatments (kg ai/ha)					
	Control	Phenamiphos		Ethylene dibromide		Average
		1.1	2.8	17.9	35.8	
	---Number larvae/150 cm^3 soil---					
Control	372 a	309 a	226 a	494 a	303 a	341 a
Phenamiphos 1.1	407 a	240 a	87 a	337 ab	243 a	263 ab
Phenamiphos 2.8	227 ab	107 a	179 a	126 bc	132 a	154 bc
Ethylene dibromide 17.9	318 a	96 a	134 a	194 b	155 a	179 bc
Ethylene dibromide 35.8	70 b	105 a	63 a	63 c	103 a	81 c
Average	279	171	138	243	187	

[z] Data in columns followed by the same letter and data in rows underscored by the same line are not significantly different (P = 0.05) according to Duncan's multiple range test.

Table 4. Effects of nematicides applied to peanuts at planting and postplant on populations of *Macroposthonia ornata* (2-yr average)[z].

At-planting treatments (kg ai/ha)	Postplant treatments (kg ai/ha)					
	Control	Phenamiphos		Ethylene dibromide		Average
		1.1	2.8	17.9	35.8	
	---Number nematodes/150 cm^3 soil---					
Control	211 a	126 a	144 a	397 a	329 a	241 ab
Phenamiphos 1.1	211 a	146 a	79 a	273 ac	312 a	204 ab
Phenamiphos 2.8	198 a	87 a	133 a	186 bc	359 a	193 ab
Ethylene dibromide 17.9	353 a	178 a	191 a	346 ab	261 a	266 a
Ethylene dibromide 35.8	273 a	132 a	72 a	106 c	145 a	146 b
Average	250	134	124	261	281	

[z] Data in columns followed by the same letter and data in rows underscored by the same line are not significantly different (P = 0.05) according to Duncan's multiple range test.

Table 5. The effects on the incidence of southern stem rot of peanuts of nematicides applied at planting and postplant (2 year average).

At-planting treatments (kg ai/ha)	Postplant treatments (kg ai/ha)[z]					
	Control	Phenamiphos		Ethylene dibromide		Average
		1.1	2.8	17.9	35.8	
	Number of infection loci/15.2 m of row					
Control	1.8 a	2.7 a	2.0 a	1.8 a	1.4 a	1.9 b
Phenamiphos 1.1	3.7 a	3.9 a	4.9 a	4.6 a	3.4 a	4.1 a
Phenamiphos 2.8	2.0 a	3.8 a	3.2 a	2.1 a	2.8 a	2.8 ab
Ethylene dibromide 17.9	2.2 a	2.8 a	2.7 a	3.2 a	2.9 a	2.8 ab
Ethylene dibromide 35.8	3.2 a	3.7 a	5.6 a	5.3 a	4.3 a	4.4 a
Average	2.6	3.4	3.7	3.4	3.0	

[z] Data in columns followed by the same letter are not significantly different (P = 0.05) according to Duncan's multiple range test.

applied to plots treated at planting with phenamiphos at 1.1 kg ai/ha; and phenamiphos at 1.1 kg ai/ha applied to plots treated at planting with ethylene dibromide at 17.9 kg ai/ha reduced *M. arenaria* larvae.

Populations of *M. ornata* were not reduced by any treatment applied at planting or postplant to plots that received no other treatment (Table 4). None of the postplant treatments applied to plots treated at planting with phenamiphos at 2.8 kg ai/ha or ethylene dibromide at 17.9 or 35.8 kg ai/ha reduced populations of *M. ornata.* However, phenamiphos applied postplant at 2.8 kg ai/ha to plots treated at planting with phenamiphos at 1.1 kg ai/ha reduced populations of *M. ornata.* No treatment applied at planting reduced the average population levels of *M. ornata.*, but average population levels of *M. ornata.* were reduced by phenamiphos applied postplant at 1.1 and 2.8 kg ai/ha. *M. ornata.* did not influence variation in yield according to stepwise regression analysis.

The incidence of southern stem rot was $<$5.7 loci/15.2 m of row in all plots, and differences among treatments were not significant (Table 5). However, the average number of loci per 15.2 m of row was significantly greater in plots treated at planting with phenamiphos at 1.1 kg ai/ha and ethylene dibromide at 35.8 kg ai/ha than in control plots. Stepwise regression analysis indicated that only 12% of the yield variation was attributable to southern stem rot.

Low to moderate levels of thrips infestations were present in 1979, but no evaluation of damage was made. In 1980 the level of infestation was greater and damage was evaluated. The data reflect only the effects of the at-planting treatments because the major thrips damage occurred early in the growing season, and evaluations were made before the postplant treatments were applied. Both rates of phenamiphos reduced thrips damage in all plots that received the at-planting treatments (data not shown). Differences between the two rates of phenamiphos were not significant. Thrips did not influence the variation in yield according to stepwise regression analysis.

Peanut yields were negatively correled (P = 0.01) with root-knot indices (r = 0.47), numbers of *M. arenaria* larvae in the soil (r = 0.24), and southern stem rot loci (r = 0.33). *M. arenaria* larvae counts were positively correlated (P = 0.01) with root-knot indices (r = 0.64).

CONCLUSIONS

A greater portion of yield differences was attributed to *M. arenaria* than to southern stem rot. Even though the incidence of southern stem rot was relatively low and no significant differences occurred among treatments, yields were affected to some extent by this disease. The indication of a higher incidence of southern stem rot for the average of all plots treated with phenamiphos at 1.1 kg ai/ha, and ethylene dibromide at 35.8 kg ai/ha may warrant further investigation. The relatively high yields produced in the 1980 plots that received postplant treatments, but no treatment at planting are indicative that thrips did not cause appreciable yield reductions. However, thrips damage was significantly reduced with both rates of phenamiphos when applied at planting. Even though phenamiphos at 1.1 kg ai/ha applied in the seed furrow controlled thrips, this treatment did not adequately control nematodes or increase yields.

These data indicate that where moderate levels of *M. arenaria* are present, phenamiphos and ethylene dibromide applied postplant may reduce nematode populations and increase peanut yields if control measures are not applied to the crop at planting or if applied and control is inadequate. The data also indicate that when adequate nematode control is obtained with at-planting treatments, application of additional nematicides postplant is not profitable. Minton and Bell in Georgia (5) and Rodriguez-Kabana et al. (9) in Alabama obtained similar results with different combinations of materials. Conversely, Dickson and Waites (2) in Florida and Jackson and Sturgeon (3) in Oklahoma working with still other combinations of materials obtained appreciable yield increase with postplant treatments following at-planting treatments. These differences in results may be related to different nematodes and infestation levels, the chemicals tested, methods of application, and perhaps other ecological and climatological factors.

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