Evaluation of Systemic and Nonsystemic Pesticides for Insect and Nematode Control in Peanuts[1]

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ABSTRACT

Carbofuran, aldicarb, disulfoton, AC 64,475 (diethyl 1,3-dithiethane-2-ylidenephosphoramidate), AC 64,475 plus phorate and fensulfothion plus disulfoton controlled thrips effectively in all tests where included. Fensulfothion, Nemacur® (ethyl 4-methylthio-m-tolyl isopropylphos - phoramidate), and oxamyl gave a lower level of control or less consistent control than the above materials. Control by all other materials was only mediocre or ineffective. Damage by lesser cornstalk borers was not reduced by any treatment. Carbofuran completely controlled leafhoppers in one experiment whereas no other material significantly controlled them. None of the pesticides tested controlled corn earworm and rednecked peanutworm. All chemicals gave some measure of nematode control. Significant nematode control usually increased yields. Although thrips control was obtained, most of the increase in yield was attributed to nematode control. Yields from plots treated with DBCP, which did not control any insect, were usually among the highest.

Additional key words: Insecticide, nematicide, *Arachis hypogaea*.

Certain carbamate and organophosphorous pesticides control both insects and nematodes. Most materials have been evaluated either as insecticides or as nematicides, but few multiple evaluations have been made. Multiple-pest evaluation for crop performance is, perhaps, more reliable because under field conditions, insects and nematodes often attack the same plants. To assign all the increase in growth and crop yield to the control of one pest may lead to erroneous conclusions.

Systemic and nonsystemic pesticides used in the southern United States to control thrips has variably affected peanut yields. Poos and coworkers (17, 18, 19), working with nonsystemic materials, reported that the effects of thrips control on yield were inconsistent. Arant (1), using nonsystemic materials, and Arthur and coworkers (2, 3), using both systemic and nonsystemic materials, reported no increase in yields after thrips control. Morgan et al. (14), using both systemics and nonsystemics, reduced numbers of thrips but did not increase the rate of plant growth, flower production or yield. Leuck et al. (11) found no significant correlation between thrips abundance on various varieties and breeding lines of peanuts and yield. However, Eden and Brogden (8), using systemic insecticides, obtained increased yields in 3 of 5-years' experimentation.

Some of the carbamate and organophosphorous compounds have shown much promise as soil nematicides on several crops. Higher rates are usually applied when nematode, rather than insect, control is the primary benefit sought. Nematode control and increased yields of peanuts (22), soybeans (21), cotton (4), tobacco (5, 15) and sweetpotato (10) have been obtained when these crops were planted in soil treated with certain of these materials. Foliar applications of oxamyl to several plants have controlled various soil nematodes (7, 12, 16, 20).

Howe and Miller (9) evaluated demeton for multiple pest control on peanuts and found that damage by thrips, potato leafhopper, southern corn rootworm, and northern root-knot nematode was reduced, but yield was not increased. Smith (23) reported good thrips control and some nematode control with 1 lb a.i./acre of carbofuran, phorate, disulfoton, and aldicarb. For thrips control, effects of combinations of systemic insecticides plus nematicides were comparable to effects of the insecticides alone. Thrips control did not result in increased yields. Although differences were not significant ($P = 0.05$), the nematicidal effects of DBCP and prophos alone increased yields over those of the untreated control. Northern root-knot nematodes were controlled most effectively by combinations of carbofuran plus DBCP and carbofuran plus prophos. Miller and Kring (13) reported control of nematodes and certain insects on potato with soil application of carbofuran, aldicarb, Dansanit , and disulfoton. Chalfant and Johnson (6) controlled nematodes, beet army worms, and thrips on southern peas with systemics.

This paper reports the effects of several carbamate and organophosphorous compounds on insect and nematode control and yield of peanuts.

Materials and Methods

The following chemicals having insecticidal or nematicidal properties or both were evaluated: carbofuran, aldicarb, fensulfothion, Nemacur® (ethyl 4-(methylthio)-m - tolyl isopropylphosphoramidate), fensulfothion plus disulfoton, disulfoton, ethoprop, Tirpate® (2,4-dimethyl-2-formyl-1,3-dithiolane oxime, methylcarbamate), oxamyl, AC 64,475 (diethyl 1,3-dithiethane-2-ylidenephosphoramidate), and AC 64,475 plus phorate. DBCP was included in all tests as a standard. All materials were applied on the basis of linear meters per hectare calculated on 0.9-meter row spacing. DBCP was injected to a depth of 20 cm with one knife per row. Granules were applied with a Demco® or Gandy® applicator, and liquid nonfumigant materials were applied to the soil with a sprinkler can or to the foliage with a pressurized knapsack sprayer. Materials were incorporated into the soil 10-15 cm deep with a power-driven rototiller.

The experimental design was a randomized complete-block, replicated four times. All experimental units consisted of two 15.2-m rows, except the 1973 experiment, which consisted of two 7.6-m rows. Fertilizer and cul-

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tural practices recommended for commercial peanut production were used. 'Starr', 'Florigiant', and 'Florunner' peanuts were used.

The pesticides were evaluated for the control of thrips **Frankliniella** spp., lesser cornstalk borer **Elasmopalpus lignosellus** (Zeller), leafhoppers Empoasca spp., corn earworm **Heliothis zea** (Boddie), rednecked peanutworm **Stegasta bosqueela** (Chambers), lesion nematodes **Pratylenchus brachyurus** (Godfrey, 1929) Filip & Sch. Stek., 1941, ring nematodes **Criconemoides** spp., northern root-knot nematode **Meloidogyne hapla** Chitwood, 1949.

To measure thrips damage, 10 leaves/plot were examined at random, and the damaged leaflets were counted. These counts were converted to percentage of damaged leaflets. To score leafhopper damage, the least and most severely affected leaves were rated 0 and 3, respectively. When present, corn earworm and rednecked peanutworm counts were made by examining 10 plant terminals per plot. The number of terminals infested by each species of insect was determined by microscopic examination. At harvest, 100 pods/plot were examined for soil insect damage and reported in percentage of damaged pods. Soil samples collected from the root zone were assayed for nematodes. Where root-knot nematodes were present, 10 plants/plot were rated for galls at harvest, by a scale of 1 - 5, with 1 = no galls and 5 = most severe galling. When lesion nematodes were present, 50 peanut pods were collected for lesion ratings and nematode assays. Pods were rated by a scale of 1 - 3 or 1 - 5 with 1 = no lesions and 3 or 5 = greatest number of lesions. Shell samples (5 g) were fragmented in a food blender and incubated in a moist chamber for recovery of lesion nematodes. At maturity, the peanuts were removed from the soil with a tractor-mounted digger-shaker and allowed to cure in windrows in the field. The nuts were then picked with a peanut combine.

Eight tests were conducted, two per year for three years (1969-71) and one per year for two years (1972-73). Tests were duplicated in different locations during 1969-71. Materials, rates and methods of application were changed from year to year (Tables 1-6).

1969 Experiments: Tift County.—This experiment was conducted on a Tifton sandy loam soil infested with lesion and ring nematodes. Chemicals were applied April 15. Starr peanuts were planted April 18 and harvested August 19.

Worth County.—The test site was a Norfolk sandy loam soil infested with the northern root-knot nematode and ring nematodes. Chemicals were applied April 16, and Florigiant peanuts were planted April 21 and harvested September 10.

1970 Experiments: Tift County.—This experiment was located in the field adjacent to the 1969 Tift County test area. and the soil was infested with the same nematodes. Chemicals were applied April 20-21, and Starr peanuts were planted April 24 and harvested August 17.

Calhoun County.—Norfolk-Tifton-Rains soil infested with the peanut root-knot and ring nematodes was used. Chemicals were applied April 30. Florigiant peanuts were planted May 1 and harvested September 2.

1971 Experiments: Tift County.—This experiment was conducted on a Tifton sandy loam infested with the northern root-knot and ring nematodes. Rains interfered with chemical applications and planting. Oxamyl was

Table 1. Controlof insects and nematodes on Starr peanuts in a Tifton sandy loam infested with the lesion and ring nematodes, Tift County, 1969[a].

Material and formulation	Dosage (kg a.i./ha)	Method of application[b/]	Thrips damage (%)[c/]	Ring nematodes (no./150 cc soil)[d/]	Lesion nematodes (no./g shell)[e/]	Pod lesion index (1-5)[f/]	Yield (kg/ha)
Carbofuran 10G	3.4	A	0.8 a	206 a	178 ab	1.5 a	3,221 d
Aldicarb 10G	3.4	A	1.0 a	141 a	47 ab	1.8 ab	2,982 cd
Fensulfothion 15G	3.4	A	2.3 a	247 a	35 ab	1.5 a	2,808 a-c
Fensulfothion 720g/liter	6.7	A	4.0 a	78 a	6 a	1.5 a	2,859 bc
Nemacur 15G	2.8	A	5.0 a	182 a	117 ab	2.3 ab	3,132 cd
Disulfoton 720g/liter	6.7	B	6.0 a	246 a	1,838 c	3.5 cd	2,948 cd
DBCP 1,452g/liter	10.1	C	15.0 b	181 a	127 ab	2.5 ab	3,226 d
Ethoprop 10G	3.4	A	17.3 b	48 a	437 b	2.8 bc	2,824 a-c
Control		D	17.3 b	146 a	2,280 c	4.3 d	2,586 ab

a/ Means in column with letters in common are homogeneous (p = 0.05 by Duncan's multiple range test).

b/ A = chemical applied on surface of soil in 45-cm band and incorporated with a power-driven rototiller;
B = chemical applied broadcast on surface of soil and incorporated with a power-driven rototiller; C = injected 20 cm deep with single chisel per row; D = rototilled.

c/ Counts made 52 days after planting.

d/ Counts made 41 days after planting. Data transformed to $\sqrt{n + 0.5}$ for statistical analysis; converted data presented.

e/ Counts made at harvest. Data transformed to $\sqrt{n + 0.5}$ for statistical analysis, converted data presented.

f/ 1-5 scale: 1 = no lesions, 5 = severe lesions.

applied April 13, DBCP, April 26; and all other chemicals April 21. Florunner peanuts were planted May 5 and harvested September 9.

Calhoun County.—This experiment was located in the field adjacent to the 1970 Calhoun County test area, and the soil was infested with the same species of nematodes. Chemicals were applied May 6-7, but rain delayed planting of Florunner peanuts until May 12. They were harvested September 13.

1972 Experiment: Tift County.—This experiment was conducted on a Tifton sandy loam soil infested with the peanut root-knot and ring nematodes. Chemicals were applied April 16-19, and Starr peanuts planted April 24 and harvested August 24.

1973 Experiment: Tift County.—The same area was used for the 1973 experiment as in 1972. Chemicals were applied May 7-8, and Florunner peanuts were planted May 10 and harvested August 30.

Results and Discussion

1969 Experiments.—Thrips damage was significantly less in all chemical treatments than in the control in both tests, with the exception of DBCP and ethoprop (Tables 1, 2). Thrips damage from DBCP and ethoprop treated plots in the Tift County test was about the same as that in the control. Lesser cornstalk borers were numerous only in the Worth County experiment, but differences were not significant at the 5% level (these data are not shown). In the Tift County experiment, lesion nematodes in the peanut shells and pod lesion indices were reduced by all materials except disulfoton. Ring nematodes were significantly reduced in tht Worth County experiment by all materials except aldicarb and disulfoton, but root-knot indices were reduced by only carbofuran, ethoprop and DBCP. Root-knot larvae in the soil at the time of the assay were too few to be meaningful (these data are not shown). Yields were significantly increased in both experiments by carbofuran, Nemacur®, and DBCP. Yields were also increased significantly by aldicarb and disulfoton in the Tift County experiment and by ethoprop in the Worth County experiment. In the Tift County evperiment, there were significant correlations between lesion nematodes in the shells and pod lesion indices and yield ($r = -0.45/r = -0.38$). A high positive correlation was shown between number of nematodes recovered from the shell and pod lesion index ($r=0.77$). There were also significant correlations between ring nematodes and root-knot indices and yield in the Worth County experiment $r = -0.57/r = -0.46$). Thrips damage was not significantly correlated to yield in either experiment. Therefore, yield differences appear to be more closely related to nematode than to insect control.

1970 Experiments.—Thrips damage was significantly reduced by all materials except DBCP and

Table 2. Control of insects and nematodes on Florigiant peanuts in a Norfolk sandy loam infested with the northern root-knot and ring nematodes, Worth County, 1969[a].

Material and formulation	Dosage (kg a.i./ha)	Method of application[b/]	Thrips damage (%)[c/]	Ring nematodes (no./150 cc soil)[d/]	Root-knot index (1-5)[e/]	Yield (kg/ha)
Fensulfothion 720g/liter	6.7	A	1.3 a	104 a	1.2 ab	2,365 ab
Carbofuran 10G	3.4	B	1.5 a	346 a	1.1 a	2,769 bc
Aldicarb 10G	3.4	B	2.0 a	1,693 b	1.3 ab	2,542 a-c
Fensulfothion 15G	3.4	B	2.5 a	97 a	1.4 ab	2,510 a-c
Disulfoton 720g/liter	6.7	A	2.8 a	1,102 b	1.9 c-d	2,262 ab
Nemacur 15G	2.8	B	3.3 a	227 a	1.3 ab	2,757 bc
DBCP 1,452g/liter	10.1	C	13.3 b	90 a	1.0 a	3,157 c
Ethoprop 10G	3.4	B	14.8 b	229 a	1.1 a	2,581 bc
Control		D	24.0 c	1,527 b	1.8 b-d	1,913 a

a/ Means in column with letters in common are homogeneous ($p = 0.05$ by Duncan's multiple range test).

b/ A = chemical applied broadcast on surface of soil and incorporated with a power-driven rototiller;

B = chemical applied on surface of soil in 45-cm band and incorporated with a power-driven rototiller;

C = chemical injected 20 cm deep with single chisel per row; D = rototilled.

c/ Counts made 50 days after planting.

d/ Counts made 87 days after planting. Data transformed to $\sqrt{n + 0.5}$ for statistical analysis; converted data presented.

e/ 1-5 scale: 1 = no galling, 5 = severe galling.

ethoprop in the Calhoun County experiment (Table 4), whereas only carbofuran (3.4 and 5.6 kg a.i./ha), aldicarb, and fensulfothion reduced the damage significantly in the Tift County experiment (Table 3). Lesser cornstalk borers were numerous only in the Calhoun County experiment, but differences were not significant (these data are not shown). In the Tift County eyperiment, ring nematodes were significantly reduced by carbofuran (5.6 kg a.i./ha) and fensulfothion. Lesion nematodes in shells were reduced by all materials, except DBCP, Nemacur®, and ethoprop. Also, pod lesion indices were reduced by all materials, except DBCP and ethoprop. In the Calhoun County experiment at time of sampling, none of the materials had reduced the ring nematodes and root-knot larvae in the soil. However, all materials except carbofuran (3.4 and 5.6 kg a.i./ha), aldicarb, and ethoprop significantly reduced root-knot indices. None of the materials significantly increased peanut yields in the Tift County experiment, but all treatments except aldicarb and ethoprop resulted in significant increases in Calhoun County. In the Tift County experiment, significant correlations occurred between ring nematodes and yield ($r = -0.70$).

In the Calhoun County experiment root-knot indices and ring nematodes were significantly correlated with yield ($r = -0.71/r = -0.41$). Thrips were not significantly correlated with yields in either experiment. Yields, as in the previous year, were more closely related to nematode than thrips damage.

1971 Experiments.—Thrips damage was significantly reduced by carbofuran (3.4 and 5.6 kg a.i./ha), Nemacur®, and aldicarb in both experiments and by oxamyl and fensulfothion in the Calhoun County experiment (Tables 5, 6).

Leafhopper damage occurred in the Tift County experiment. Sixty-seven percent of the foliage on control plants was affected whereas none was damaged on carbofuran treated plants. No other material gave significant control (these data are not shown).

In the Tift County experiment, carbofuran (5.6 kg a.i./ha) and DBCP significantly reduced ring nematodes, and all materials except aldicarb and fensulfothion reduced root-knot indices. In the Calhoun County experiment, carbofuran (5.6 kg a.i./ha) and DBCP significantly reduced ring nematodes. Root-knot larvae were significantly reduced by 3.4 and 5.6 kg a.i./ha of carbofuran and by Nemacur®, and root-knot indices were reduced by all materials except aldicarb, fensulfothion, and ethoprop. Yields in the Tift County experiment were significantly increased by only carbofuran 5.6 a.i./ha, whereas all materials except fen-

Table 3. Control of insects and nematodes on Starr peanuts in a Tifton sandy loam infested with lesion and ring nematodes, Tift County, 1970[a].

Material and formulation	Dosage (kg a.i./ha)	Method of application[b]	Thrips damage (%)[c]	Ring nematodes (no./150 cc soil)[d]	Lesion nematodes (no./g shell)	Pod lesion index (1-3)[e]	Yield (kg/ha)
Carbofuran 10G	5.6	A	5.5 a	29 a	2 ab	1.7 ab	3,934 bc
Carbofuran 10G	3.4	A	5.5 a	132 a-d	6 ab	1.5 ab	3,898 bc
Aldicarb 10G	3.4	A	5.5 a	231 cd	9 ab	1.5 ab	3,578 b
Fensulfothion 720g/liter	6.7	A	8.2 ab	64 ab	0 a	1.3 a	3,802 bc
Tirpate 10G	4.5	A	11.5 a-c	88 a-d	1 a	1.3 a	3,770 bc
Oxamyl 10G	4.5	A	11.8 a-c	110 a-d	5 ab	1.5 ab	3,086 a
DBCP 1,452g/liter	10.1	B	11.8 a-c	77 a-c	50 bc	2.3 bc	3,761 bc
Nemacur 15G	2.8	A	12.0 a-c	193 b-d	49 bc	1.8 ab	3,674 b
Ethoprop 10G	3.4	A	14.3 bc	108 a-d	118 c	2.5 cd	4,203 c
Control		C	15.8 c	234 cd	68 c	2.6 cd	3,759 bc

a/ Means in column with letters in common are homogeneous (p = 0.05 by Duncan's multiple range test).

b/ A = chemical applied on surface of soil in 45-cm band and incorporated with power-driven rototiller; B = chemical injected 20 cm deep with single chisel per row; C = rototilled.

c/ Counts made 45 days after planting.

d/ Counts made 69 days after planting. Data transformed to $\sqrt{n + 0.5}$ for statistical analysis; converted data presented.

e/ 1-3 scale: 1 = no lesions, 3 = severe lesions.

Table 4. Control of insects and nematodes on Florigiant peanuts in a Norfolk-Tifton-Rains soil infested with the peanut root-knot and ring nematodes, Calhoun County, 1970[a].

Material and formulation	Dosage (kg a.i./ha)	Method of application[b/]	Thrips damage (%)[c/]	Ring nematodes (no./150 cc soil)[d/]	Root-knot larvae (no./150 cc soil)[d/]	Root-knot index (1-5)[e/]	Yield (kg/ha)
Carbofuran 10G	5.6	A	6.7 a	10 a	30 a-c	2.1 ab	2,563 b
Fensulfothion 720g/liter	6.7	A	9.2 ab	31 ab	125 c	1.9 a	2,456 b
Oxamyl 10G	4.5	A	10.3 ab	17 ab	6 ab	2.0 a	2,733 b
Aldicarb 10G	3.4	A	18.0 a-c	92 b	42 a-c	2.7 ab	2,319 ab
Carbofuran 10G	3.4	A	18.8 a-c	24 ab	23 a-c	2.4 ab	2,426 b
Nemacur 15G	2.8	A	24.3 bc	27 ab	106 bc	1.9 a	2,504 b
Tirpate 10G	4.5	A	29.0 cd	36 ab	17 a-c	2.0 a	2,689 b
Ethoprop 10G	3.4	A	41.5 de	34 ab	66 a-c	2.7 ab	2,075 ab
Control		B	46.8 e	46 ab	14 a-c	3.3 b	1,520 a
DBCP 1,452g/liter	10.1	C	51.8 e	8 a	2 a	1.9 a	2,670 b

a/ Means in column with letters in common are homogeneous ($p = 0.05$ by Duncan's multiple range test).

b/ A = chemical applied on surface of soil in 45-cm band and incorporated with power-driven rototiller; B = rototilled; C = chemical injected 20 cm deep with single chisel per row.

c/ Counts made 40 days after planting.

d/ Counts made 57 days after planting. Data transformed to $\sqrt{n + 0.5}$ for statistical analysis; converted data presented.

e/ 1-5 scale: 1 = no galling, 5 = severe galling.

sulfothion and ethoprop increased yields in the Calhoun County experiment.

In the Tift County experiment correlations were significant for root-knot larvae and root-knot indices and yield ($r = -0.38/r = -0.38$). Correlations were significant for root-knot larvae and root-knot indices and yield ($r = -0.62/r = -0.54$) and also for thrips damage and yield ($r = -0.40$) in the Calhoun County experiment. Yields in the Tift County experiment were probably more closely related to nematode than to thrips damage. However, both nematodes and thrips apparently caused measurable yield reductions in the Calhoun County experiment.

1972 Experiment.—In Tift County in 1972, thrips damage was significantly reduced by all materials except ethoprop, fensulfothion, and DBCP (Table 7). Corn earworm and rednecked peanutworm infestation ranged from 40 to 60% and 12 to 32%, respectively. However, differences were not signifficant. Lesser cornstalk borers were not numerous enough to evaluate. Ring nematodes were significantly reduced by all materials except fensulfothion whereas root-knot larvae and root-knot indices were not significantly reduced by any materials. Although large numerical differences occurred in favor of some of the materials, the failure to obtain significantly fewer root-knot larvae and lower root-knot indices resulted from the variability of nematode distribution. Yields were likewise affected by nematode distribution variability. DBCP was the only treatment that resulted in significantly more peanuts than the control. However, the two carbofuran treatments at the 5.6 kg a.i./ha rate produced about 600 kg/ha more than control.

Root-knot larvae, root-knot indices, and ring nematodes were significantly correlated with yield ($r = -0.51/r = -0.61/r = -0.36$). Percentage of sound mature kernels was significantly correlated with yield and root-knot indices ($r = 0.31/r = -0.40$).

1973 Experiment.—In Tift County in 1973, all materials except DBCP, Nemacur®, oxamyl, and DBCP plus oxamyl significantly reduced thrips damage (Table 8). Ring nematodes were not significantly reduced by any material. Root-knot larval populations were reduced significantly by carbofuran at 9.0 kg a.i./ha, and root-knot indices were reduced by AC 64,475, AC 64,475 plus phorate, and Nemacur®. All materials except Nemacur® and carbofuran at 9.0 and 5.6 kg a.i./ha, respectively, increased yields significantly.

Root-knot indices, dead plants and percentage of sound mature kernels were significantly correlated with yield ($r = -0.43/r = -0.52/r = 0.69$).

Table 5. Control of insects and nematodes on Florunner peanuts in a Tifton sandy loam infested with the northern root-knot and ring nematodes, Tift County, 1971[a].

Material and formulation	Dosage (kg a.i./ha)	Method of application[b/]	Thrips damage (%)[c/]	Ring nematodes (no. /150 cc soil)[d/]	Root-knot larvae (no. /150 cc soil)[d/]	Root-knot index (1-5)[e/]	Yield (kg/ha)
Carbofuran 10G	3.4	A	7.0 a	686 ab	84 a-c	1.2 ab	3,358 a
Aldicarb 10G	6.7	B	8.8 a	1,474 a	262 a-c	2.2 bc	3,403 a
Carbofuran 10G	5.6	A	10.0 ab	309 a	4 a	1.0 a	4,064 b
Nemacur 15G	2.3	A	34.5 c	841 bc	275 bc	1.4 ab	3,293 a
Oxamyl 10G	3.4	A	40.8 cd	1,505 c	158 a-c	1.3 ab	3,386 a
Fensulfothion 720 g/liter	2.3	A	43.8 cd	800 bc	324 c	1.8 a-c	2,984 a
Ethoprop 10G	3.4	A	51.3 cd	1,102 bc	306 c	1.4 ab	3,094 a
Tirpate 10G	4.5	A	56.3 cd	1,108 bc	198 a-c	1.5 ab	3,546 ab
DBCP 1,452 g/liter	10.1	C	62.0 d	292 a	9 ab	1.3 ab	3,070 a
Control		D	63.3 d	924 bc	210 a-c	2.7 c	3,370 a

a/ Means in column with letters in common are homogeneous ($p = 0.05$ by Duncan's multiple range test).

b/ A = chemical applied on surface of soil in 45-cm band and incorporated with a power-driven rototiller; B = chemical applied broadcast on soil surface and incorporated with a power-driven rototiller; C = chemical injected 20 cm deep with single chisel per row; D = rototilled.

c/ Counts made 44 days after planting.

d/ Counts made 104 days after planting. Data transformed to $\sqrt{n + 0.5}$ for statistical analysis; converted data presented.

e/ 1-5 scale: 1 = no galling, 5 = severe galling.

Table 6. Control of insects and nematodes on Florunner peanuts in a Norfolk-Tifton-Rains soil infested with the peanut root-knot and ring nematodes, Calhoun County, 1971[a].

Material and formulation	Dosage (kg a.i./ha)	Method of application[b/]	Thrips damage (%)[c/]	Ring nematodes (no./150 cc soil)[d/]	Root-knot larvae (no./150 cc soil)[d/]	Root-knot index (1-5)[e/]	Yield (kg/ha)
Carbofuran 10G	5.6	A	7.0 a	82 a	84 a	2.9 a-c	3,142 e
Carbofuran 10G	3.4	A	8.8 a	259 a-c	106 a	3.1 a-c	2,733 de
Aldicarb 10G	6.7	B	22.5 ab	1,089 e	533 a-c	4.2 cd	2,432 b-e
Oxamyl 10G	3.4	A	36.3 b	299 a-d	171 ab	2.9 a-c	2,871 de
Nemacur 15G	2.3	A	38.8 b	285 a-d	121 a	2.1 a	2,939 de
Fensulfothion 720g/liter	2.3	A	40.0 b	515 cd	1,218 c	4.8 d	1,782 ab
Tirpate 10G	4.5	A	72.5 c	702 de	353 ab	3.3 a-c	2,786 de
Ethoprop 10G	3.4	A	78.3 c	458 b-d	660 bc	3.8 b-d	2,331 a-d
DBCP 1,452g/liter	10.1	C	87.0 c	148 ab	148 ab	2.6 ab	2,522 c-e
Control		D	92.0 c	484 cd	650 bc	4.7 d	1,645 a

a/ Means in column with letters in common are homogeneous ($p = 0.05$ by Duncan's multiple range test).

b/ A = chemicals applied on surface of soil in 45-cm band and incorporated with a power-driven rototiller; B = chemical applied broadcast on soil surface and incorporated with a power-driven rototiller; C = chemical injected 20 cm deep with a single chisel per row; D = rototilled.

c/ Counts made 34 days after planting.

d/ Counts made 98 days after planting. Data transformed to $\sqrt{n + 0.5}$ for statistical analysis; converted data presented.

e/ 1-5 scale: 1 = no galling, 5 = severe galling.

Table 7. Control of insects and nematodes on Starr peanuts in Norfolk sandy loam infested with the peanut root-knot and ring nematodes, Tift County, 1972[a].

Material and formulation	Dosage (kg a.i./ha)	Method of application[b/]	Thrips damage (%)[c/]	Ring nematodes (no. /150 cc soil)[d/]	Root-knot larvae (no. /150 cc soil)[d/]	Root-knot index (1-5)[e/]	Yield (kg/ha)
Carbofuran 480 g/liter	6.7	A	5.6 a	86 ab	28 a	1.8 ab	2,781 ab
Carbofuran 480 g/liter	5.6	B	6.9 a	94 ab	90 a	1.6 a	2,923 ab
Nemacur 360 g/liter	5.6	A	9.4 ab	264 ab	150 ab	2.9 a-c	2,806 ab
Fensulfothion + disulfoton 7.5+7.5G	3.4	C	10.0 ab	732 c	198 ab	3.6 c	2,192 a
Carbofuran 10G	5.6	D	12.5 a-c	92 ab	34 a	2.2 a-c	2,948 ab
Nemacur 15G	2.8	D	15.6 a-c	200 ab	192 ab	2.2 a-c	2,744 ab
Ethoprop 10G	5.6	E	28.8 a-d	227 ab	374 b	3.3 a-c	2,350 a
Fensulfothion 15G	5.6	F	29.4 a-d	436 ab	226 ab	2.6 a-c	2,554 ab
Ethoprop 10G	3.4	D	35.0 b-d	305 ab	179 ab	2.8 a-c	2,744 ab
Ethoprop 720 g/liter	5.6	A	36.9 cd	316 ab	216 ab	3.6 c	2,342 a
Control		G	47.5 de	706 c	203 ab	3.2 a-c	2,350 a
DBCP 1,452 g/liter	10.1	G	62.5 e	42 a	30 a	1.6 a	3,123 b

a/ Means in column with letters in common are homogeneous (p = 0.05 by Duncan's multiple range test).

b/ A = nematicide mixed with balan, sprayed broadcast on surface of soil and incorporated with power-driven rototiller; B = nematicide sprayed on surface of soil in 45-cm band and incorporated; C = nematicide applied in seed furrow at planting; D = nematicide applied on surface of soil in 45-cm band and incorporated with power-driven rototiller; E = nematicide applied 3.4 kg on surface of soil in 45-cm band at planting and incorporated with power-driven rototiller, and 67 days after planting applied nematicide 2.2 kg in 45-cm band with no incorporation; F = same as E except 4.5 kg applied at planting, and 1.1 kg applied 67 days after planting; G = rototilled; H = nematicide injected 20 cm deep with single chisel per row.

c/ Counts made 45 days after planting.

d/ Counts made 95 days after planting.

e/ 1-5 scale: 1 = no galling, 5 = severe galling.

Table 8. Control of insects and nematodes on Florunner peanuts in a Tifton sandy loam infested with the peanut root-knot and ring nematodes, Tift County, 1973[a].

Material and formulation	Dosage (kg a.i./ha)	Method of application[b/]	Thrips damage (%)[c/]	Ring nematodes (no./150 cc soil)[c/]	Root-knot larvae (no./150 cc soil)[c/]	Root-knot index (1-5)[d/]	Yield (kg/ha)
Carbofuran 10G	3.4	A	0.0 a	28 a	325 bc	4.0 bc	2,553 bc
Disulfoton 15G	6.7	B	0.6 a	40 a	446 e	3.8 bc	2,464 bc
AC 64,475 15G + phorate 15G	0.7 1.1	A C	4.4 a	36 a	146 bc	2.8 ab	2,976 cd
AC 64,475 15G	1.1	A	5.6 a	18 a	241 bc	2.8 ab	2,634 bc
Oxamyl 10G + oxamyl 240g/liter	0.6 1.1	C D	31.9 b	8 a	372 bc	3.8 bc	2,802 b-d
Carbofuran 480g/liter	9.0	B	38.1 b	8 a	96 a	4.3 c	2,008 ab
Carbofuran 10G	5.6	A	40.0 bc	20 a	144 bc	4.3 c	2,057 ab
DBCP 1,452g/liter	10.1	E	65.0 cd	22 a	164 b-d	3.5 a-c	3,058 cd
Nemacur 360g/liter	4.5	D	70.0 de	24 a	434 d-e	2.3 a	2,065 ab
Oxamyl 240g/liter	1.1	D	80.6 de	22 a	448 e	4.0 bc	2,602 bc
DBCP 1,452g/liter + oxamyl 240g/liter	10.1 1.1	E D	85.0 de	12 a	224 b-e	3.5 ac	3,602 d
Control		F	85.0 de	14 a	408 c-e	4.8 c	1,391 a

a/ Means in column with letters in common are homogeneous (p = 0.05 by Duncan's multiple range test).

b/ A = chemical applied on surface of soil in 45-cm band and incorporated with power-driven rototiller; B = chemical applied broadcast on surface of soil and incorporated with power-driven rototiller; C = chemical applied in seed furrow at planting; D = chemical applied as foliar spray beginning 41 days after planting and continued every 2 wk until 4 applications were made; E = chemical injected 20 cm deep with single chisel per row; F = rototilled.

c/ Counts made 28 days after planting.

d/ 1-5 scale: 1 = no galling, 5 = severe galling.

Root-knot indices were also significantly correlated with percentage of sound mature kernels and dead plant indices (r = -0.36/r = 0.51) (dead plant indices not shown). *Sclerotium rolfsii* Sacc. appeared to be the major cause of plant death. Further, these data suggest that root-knot nematodes may have contributed to the severity of *S. rolfsii.*

Conclusions

Carbofuran, aldicarb, disulfoton, AC 64,475, AC 64,475 plus phorate, and fensulfothion plus disulfoton gave excellent thrips control in all tests where included. Fensulfothion, Nemacur and oxamyl gave a lower level of control or less consistent control than the above materials. Control by all other materials was only moderate or ineffective. All chemicals gave some measure of nematode control in one or more experiments. Significant nematode control usually resulted in increased yields. Conversely, thrips control usually was not correlated with increased yields. There was a correlation between thrips control and yield in only one test in eight. Other leaf-feeding or soil insects were either not controlled by any chemical used, or if so, control did not appear to affect peanut yields. Yields of plots treated with DBCP, which did not control any insect, were usually among the highest. Therefore, in most instances, the major portion of the increased yield was attributed to nematode control. These data suggest that thrips reduce yields significantly only when extreme damage occurs.

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