EFFECTS OF FALLOWING, SUMMER COVER CROPS, AND FENAMIPHOS ON NEMATODE POPULATIONS AND YIELDS IN A CABBAGE-FIELD CORN ROTATION IN FLORIDA[1]

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ABSTRACT

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In a field experiment on Myakka fine sand, high populations of *Belonolaimus longicaudatus* and *Hoplolaimus galeatus* and a moderate population of *Paratrichodorus christiei* developed on a summer cover crop of sorghum-sudangrass hybrid (*Sorghum bicolor* X *S. sudanense*). Populations of *B. longicaudatus* increased moderately on cowpea (*Vigna unguiculata*) but populations of *H. galeatus* and *P. christiei* did not increase on this crop. Populations of *B. longicaudatus* and *H. galeatus* did not increase on hairy indigo (*Indigofera hirsuta*) and joint verch (*Aeschynomene americana*) but a moderate increase of *P. christiei* occurred on both. No increase in nematode numbers was found in fallow plots, but a moderate population of *H. galeatus* persisted during 3 months of fallowing. In-row applications of 2.24 kg ai/ha of fenamiphos significantly increased the yield of the first crop (cabbage) following sorghum-sudangrass but not following the other cover crops or fallowing. Yields of the second crop in the rotation (field corn) were significantly higher where fenamiphos was applied to both crops in the rotation than where none was applied following the cover crops of sorghum-sudangrass and cowpea but not for hairy indigo, joint vetch, or fallowing. A single application of fenamiphos applied to either cabbage or corn increased corn yields significantly only after sorghum-sudangrass.
Additional key words: Indigofera hirsuta, Aeschynomene americana, Vigna unguiculata, Sorghum bicolor X S. sudanense, Belonolaimus longicaudatus, Hoplolaimus galeatus, Paratrichodorus christiei, cowpea, sorghum-sudangrass, hairy indigo, joint vetch, nematicide, nematode management.

RESUMEN

Rhoades, H. L. 1984. Efectos del barbecho limpio, cosechas de covertura de verano y fenamifos en las poblaciones de nematodos y los rendimientos de una rotación col-maíz de campo en Florida. Nematropica 14:131-138.

En experimentos de campo en arena fina Myakka, en una cosecha de verano de un hibrido de millo-hierba del sudán (*Sorghum bicolor* X *S. sudanense*) se desarollaron poblaciones altas de *Belonolaimus longicaudatus* y *Hoplolaimus galeatus* y una pob-

lación moderada de *Paratrichodorus christiei*. Las poblaciones de *B. longicaudatus* aumentaron moderadamente en el frijol de vaca (*Vigna unguiculata*) pero no así las poblaciones de *H. galeatus* y *P. christiei*. Las poblaciones de *B. longicaudatus* y *H. galeatus* no aumentaron en el añil (*Indigofera hirsuta*) y tamarindillo (*Aeschynomene americana*), pero en ambas cosechas tuvo lugar un aumento moderado de *P. christiei*. El número de nematodos no aumentó en los lotes en barbecho limpio pero una población moderada de *H. galeatus* persistió durante 3 meses bajo esas condiciones. Las aplicaciones de fenamifos a 2.24 kg ai/ha aumentaron significativamente los rendimientos de la col (primera cosecha de la rotación) a continuación del millo-hierba del sudán pero no después de las otras cosechas de covertura o el barbecho limpio. Los rendimientos del maíz de campo (segunda cosecha de la rotación) fueron significativamente más altos cuando el fenamifos fue aplicado a las dos cosechas de la rotación (col y maíz de campo) a continuación de la covertura de millo-hierba del sudan y frijol de vaca, que cuando no se aplicó el fenamifos a la col y el maíz de campo a continuación de las coverturas de añil y tamarindillo y del barbecho limpio. Una sola aplicación de fenamifos tanto a la col como al maíz de campo aumentaron significativamente los rendimientos del maíz de campo solamente a continuación de la covetura de millo-hierba del sudán.

Palabras claves adicionales: Indigofera hirsuta, Aeschynomene americana, Vigna unguiculata, Sorghum biocolor X S. sudanenese, Belonolaimus longicaudatus, Hoplolaimus galeatus, Paratrichodorus christiei, frijol de vaca, millo-hierba del sudan, añil, tamarindillo, nematicida, manejo de los nematodos.

INTRODUCTION

With the recent loss of some of the most extensively used soil fumigants due to action by the U. S. Environmental Protection Agency, and since few new nematicides are currently being registered in the United States, control of plant nematodes by nonchemical methods is becoming more important. One of the most common nonchemical methods used by Florida vegetable growers is summer fallowing. This practice has been shown to be effective in reducing plant nematode populations (1, 3, 7), but is considered to be destructive to soil fertility and physical properties and is not normally recommended by soil scientists. Earlier studies (4, 8) have shown the usefulness of hairy indigo (*Indigofera hirsuta* L.) to reduce populations of *Belonolaimus longicaudatus* Rau, and *Meloidogyne incognita* (Kofoid and White) Chitwood, and only minimal increases in yields of vegetable crops were obtained from the use of a nematicide after this crop. One study also showed joint vetch (*Aeschynomene americana* L.) was not a suitable host of *B. longicaudatus, M. incognita, Dolichodorus heterocephalus* Cobb, and *Hoplolaimus galeatus* (Cobb) Sher (5). The objective of this experiment was to determine the effect of several summer cover crops and fenamiphos on nematode populations and subsequent crop yields of cabbage (*Brassica oleracea* L.) and field corn (*Zea mays* L.).

MATERIALS AND METHODS

The experiment was conducted at Sanford, Florida, U.S.A., on Myakka fine sand (% composition = sand 92.2, silt 5.7, clay 2.1) naturally infested with the sting nematode, *B. longicaudatus,* the lance nematode, *H. galeatus,* and the stubby-root nematode, *Paratrichodorus christiei* (Allen) Siddiqi. Four summer cover crops and soil fallow were included in a randomized complete block design replicated 5 times. Plot size was 6.1 m X 12.2 m. The cover crops were hairy indigo, joint vetch, sorghum-sudangrass hybrid (*Sorghum bicolor* X *S. sudanense* [Piper] Stapf 'Grazer A'), and cowpea (*Vigna unguiculata* [L.] Walp. 'California Blackeye #5'). The cover crop plots were seeded with 8 rows 75 cm apart on 16 June 1982. Residual fertilizer from applications made on the previous winter vegetable crops served to maintain the summer cover crops. Normal cultivation plus hand hoeing kept the crops essentially weed free. Fallow plots were disked periodically to prevent weed growth. The crops were mowed and the soil plowed in late September in preparation for planting cabbage. After final soil preparation on 8 November, half (4 rows) of each plot was treated with 2.24 kg ai/ha of granular fenamiphos applied as 38-cm bands in-the-row and incorporated 5-8 cm deep with rotary cultivators. On 10 November, 'Gourmet' cabbage was transplanted in the plots. Subsequent fertilization and cultural practices were normal for the area and the cabbage was harvested twice (26 January and 7 February 1983). After soil preparation on 4 April, the plots were again split with 2 rows of each 4-row plot receiving 2.24 kg ai/ha of fenamiphos as on the previous crop of cabbage. The plots then were planted with Asgrow's 'RX 114' hybrid field corn. Subsequent fertilization and cultural practices were normal for the area, and the corn was harvested on 3 August.

Soil samples consisting of five 2.5 cm X 15 cm cores were taken for nematode population determination from the summer cover crops just before mowing on 22 September 1982, and 10 wks after planting the cabbage and corn. Nematodes were removed from the soil by a centrifugal-flotation technique (2).

RESULTS AND DISCUSSION

Highest populations of *B. longicaudatus* were found following the sorghum-sudangrass cover crop, with lower populations in descending order in cowpea, fallow, joint vetch, and hairy indigo (Table 1). Apparently, *H. galeatus* increased only on sorghum-sudangrass since populations were higher following this crop but were essentially the same after cowpea, hairy indigo, and joint vetch as in fallow plots. This nematode

Table 1. Nematode populations following growth of cover crops and fallowing.[z]

Treatment	Plant nematode populations/100 cm^3 soil		
	Belonolaimus longicaudatus	*Hoplolaimus galeatus*	*Paratrichodorus christiei*
Fallow	2	58	9
Sorghum-sudangrass	256	166	42
Cowpea	18	44	11
Hairy indigo	0	62	50
Joint vetch	1	50	32

[z]Soil samples were taken 14 wks after planting.

persists for long periods of time in the absence of a host plant. Populations of *P. christiei* were considerably higher after sorghum-sudangrass, hairy indigo, and joint vetch than after cowpea or fallowing, indicating these three crops had served as hosts.

Fenamiphos greatly reduced populations of *B. longicaudatus* and significantly increased the yield of cabbage following sorghum-sudangrass (Table 2). As reported earlier (6), this nematicide had little effect on *H. galeatus,* but populations of *P. christiei* were less in treated than in untreated plots in every case. However, the populations of *H. galeatus* and *P. christiei* apparently were too low to have an effect since yields were essentially the same for treated and untreated plots, except where *B. longicaudatus* was present in high numbers.

The application of fenamiphos on both cabbage and field corn or a single application on either crop reduced *B. longicaudatus* populations in field corn (Table 3). This material was particularly effective in reducing high populations that had built up in plots planted previously with sorghum-sudangrass, and yields from those plots were significantly higher than from untreated plots. Application of fenamiphos to both crops increased corn yields significantly over untreated plots previously planted to sorghum-sudangrass and cowpea but not hairy indigo, joint vetch, or fallowing. A single application of fenamiphos increased corn yields only after the sorghum-sudangrass, and this occurred whether the nematicide was applied to the cabbage or the corn. Populations of *H. galeatus* were low on the corn and apparently did not affect yields. *P. christiei* populations had increased, but since populations had been low following the previous crop of cabbage, the corn probably was able to establish large root systems before injurious populations developed.

Table 2. Effect of fenamiphos on nematode populations and yield of first crop (cabbage) following summer cover crops.[z]

Cover crop	Fenamiphos (kg ai/ha)	Nematode populations/100 cm³ soil			Cabbage yield (quintals/ha)
		Belonolaimus longicaudatus	*Hoplolaimus galeatus*	*Paratrichodorus christiei*	
None (fallow)	—	4	33	49	524
" (")	2.24	1	36	11	565
Sorghum-sudangrass	—	129	118	29	411
" "	2.24	37	108	12	575
Cowpea	—	21	54	58	550
"	2.24	6	18	21	601
Hairy indigo	—	0	11	124	580
" "	2.24	0	22	34	632
Joint vetch	—	1	4	91	591
" "	2.24	0	19	6	632
LSD 0.05		37	74	38	87
LSD 0.01		50	99	51	118

[z]Soil samples were taken 10 wks after planting cabbage.

Table 3. Effect of fenamiphos on nematode populations and yield of second crop (corn) following summer cover crops.[z]

Cover crop	Fenamiphos (kg ai/ha)		Nematode populations/100 cm³ soil			Corn yield (q/ha)
	First crop (cabbage)	Second crop (corn)	*Belonolaimus longicaudatus*	*Hoplolaimus galeatus*	*Paratrichodorus christiei*	
None (fallow)	2.24	2.24	0	0	87	125
" (")	2.24	—	6	5	92	115
" (")	—	2.24	4	5	129	120
" (")	—	—	56	3	186	109
Sorghum-sudangrass	2.24	2.24	6	13	83	115
" "	2.24	—	85	22	148	108
" "	—	2.24	46	7	202	107
" "	—	—	512	26	190	66
Cowpea	2.24	2.24	3	11	124	125
"	2.24	—	66	0	144	118
"	—	2.24	0	6	110	115
"	—	—	187	12	134	104
Hairy indigo	2.24	2.24	2	0	123	120
" "	2.24	—	4	2	244	113
" "	—	2.24	0	4	218	114
" "	—	—	17	1	331	105
Joint vetch	2.24	2.24	0	5	207	123
" "	2.24	—	0	10	171	123
" "	—	2.24	9	4	137	120
" "	—	—	19	0	244	108
LSD 0.05			20	11	63	17
LSD 0.01			27	15	86	23

[z]Soil samples were taken 10 wks after planting corn.

Data from this experiment showed that fallowing and cover crops of hairy indigo and joint vetch were effective in preventing increase of *B. longicaudatus* populations, whereas sorghum-sudangrass greatly increased populations that significantly reduced yields of subsequent crops of cabbage and corn. Populations of *H. galeatus* and *P. christiei* were also increased by sorghum-sudangress, but apparently these nematodes had little or no effect on subsequent crop yields. Cowpea did not increase populations of *H. galeatus* and *P. christiei* but maintained an intermediate population of *B. longicaudatus* which continued to develop to an injurious level on succeeding crops. Since legumes such as hairy indigo and joint vetch add large quantities of nitrogen and organic matter in addition to resisting build up of certain important nematode species, they appear to be valuable crops that could be used in crop rotation to aid in the management of plant nematodes. Although fallowing is beneficial for reducing nematodes, its deleterious effect on soil physical properties and organic matter content should be considered before it is used.

LITERATURE CITED

1. GODFREY, G. H. 1947. A practical control for nematodes. Proc. Second Ann. Lower Rio Grande Valley Citrus and Vegetable Institute. 1947:143-149.
2. JENKINS, W. R. 1964. A rapid centrifugal-flotation technique for separating nematodes from soil. Plant Dis. Reptr. 48:692.
3. RHOADES, H. L. 1964. Effect of fallowing and flooding on root knot in peat soil. Plant Dis. Reptr. 48:303-306.
4. RHOADES, H. L. 1976. Effect of *Indigofera hirsuta* on *Belonolaimus longicaudatus, Meloidogyne incognita,* and *M. javanica* and subsequent crop yields. Plant Dis. Reptr. 60:384-386.
5. RHOADES, H. L. 1980. Relative susceptibility of *Tagetes patula* and *Aeschynomene americana* to plant nematodes in Florida. Nematropica 10:116-120.
6. RHOADES, H. L. 1980. Influence of nematicides and methods of their application on growth and yield of cabbage in sting nematode infested soil. Proc. Fla. State Hort. Soc. 93:246-247.
7. RHOADES, H. L. 1982. Effect of temperature on survival of *Meloidogyne incognita* in flooded and fallow muck soil. Nematropica 12: 33-37.
8. RHOADES, H. L. 1983. Effects of cover crops and fallowing on

populations of *Belonolaimus longicaudatus* and *Meloidogyne incognita* and subsequent crop yields. Nematropica 13:9-16.

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