RELATIVE SUSCEPTIBILITY OF *TAGETES PATULA* AND *AESCHYNOMENE AMERICANA* TO PLANT NEMATODES IN FLORIDA. [SUSCEPTIBILIDAD RELATIVA DE *TAGETES PATULA* Y *AESCHYNOMENE AMERICANA* A LOS NEMATODOS FITOPARASITOS DE LA FLORIDA].

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ABSTRACT

Experiments were conducted in the greenhouse and field to evaluate *Tagetes patula* (marigold) and *Aeschynomene americana* (jointvetch) as possible nematode-reducing cover crop plants in Florida. In the greenhouse, high populations of *Belonolaimus longicaudatus. Dolichodorus heterocephalus,* and *Paratrichodorus christiei* developed on marigold, but only a slight increase of *Hoplolaimus galeatus* occurred. There was no increase of *Meloidogyne incognita. Belonolaimus longicaudatus, D. heterocephalus,* and *H. galeatus* did not build up on jointvetch but *P. christiei* increased to relatively high populations. Jointvetch exhibited a high degree of resistance to *M. incognita* although a few small galls developed on the roots and egg laying females were present. In a field experiment where *B. longicaudatus* was present, high populations of this nematode developed on marigold but remained low on jointvetch. Snapbean yield subsequent to the growth of jointvetch was equivalent to that following soil fallow but yield following marigold was 34% less than following fallow. Applying 2.8 kg/ha in-the-row of phenamiphos following marigold increased snapbean yield 57%, but following fallow and jointvetch increased yield only 7 and 14%, respectively.
Key Words: Jointvetch, marigold, phenamiphos, Belonolaimus longicaudatus, Dolichodorus heterocephalus, Hoplolaimus galeatus, Meloidogyne incognita, Paratrichodorus christiei.

INTRODUCTION

In recent years, there has been a renewed interest in the potential use of nematode-resistant cover crops to reduce nematode losses One of the most widely investigated plants for this purpose has been marigold *(Tagetes* spp.). As early as 1938, Tyler (9) reported that 29 marigold varieties had a high degree of resistance to root-knot and in 1941, Steiner (8) found that root-knot larvae entered roots of *Tagetes* freely but failed to develop to sexual maturity. Sixteen years later, Oostenbrink et al. (7) reported that the population levels of *Pratylenchus penetrans* and *P. pratensis* were reduced 90% when *T. patula* was grown (equivalent to reductions obtained by fallowing land). Since those early papers, many other researchers (1, 2, 3, 4, 6, 10) have demonstrated that marigolds are effective for reducing plant nematode populations. Reported effects vary among *Tagetes* species and varieties and among nematode genera and species. Of the many nematode genera tested, *Pratylenchus* and *Meloidogyne* appear to be affected the most, but several others have also been reported to be reduced (3, 6, 7). Good et al. (3) working in Georgia found that *T. minuta* effectively reduced populations of *Belonolaimus longicaudatus, Trichodorus christiei, Xiphinema americanum,* and *Criconemoides ornatum,* as well as *Pratylenchus brachyurus, Meloidogyne incognita,* and *M. javanica.*

Greenhouse and field experiments were conducted in 1979 to determine the effect of *Tagetes patula* and *Aeschynomene americana* (jointvetch), a legume used as a summer annual forage or cover crop in recent years, on some of the more important nematode pests of vegetables in Florida.

MATERIALS AND METHODS

Greenhouse experiment.- This experiment was conducted in 15-cm pots of steam sterilized Myakka fine sand. The pots were seeded separately to jointvetch *(Aeschynomene americana* L.), 'Rusty Red' marigold *(Tagetes patula* L.), sorghum-sudangrass hybrid *(Sorghum bicolor* (L.) x *S. sudanense* (Piper) Stapf), and 'Pointsett' cucumber *(Cucumis sativus* L.). Sorghum-sudangrass is an excellent host of many of the ectoparasitic nematodes found in Florida and cucumber is an excellent host of root-knot nematodes. When the seedlings were 2-3 cm high, they were thinned to three per pot and 100 hand-picked specimens each of sting nematodes, *Belonolaimus longicaudatus* Rau, 1958, awl nematodes, *Dolichodorus heterocephalus* Cobb, 1914, lance nematodes, *Hoplolaimus galeatus* (Cobb, 1913) Sher, 1961, and stubby-root nematodes. *Paratrichodorus christiei* (Allen, 1957) Siddiqi, 1973, were added separately to four pots of jointvetch, sorghum-sudangrass, and marigold. Five grams of cucumber roots heavily galled by root-knot *Meloidogyne incognita* (Kofoid & White, 1919) Chitwood, 1949) were added to four pots of jointvetch, marigold, and cucumber. Twelve weeks after inoculation, soil samples were removed from the pots and processed by a centrifugal-flotation technique (5) for determining population levels of the ectoparasitic nematodes. Roots were examined for degree of galling for determining suitability as a host for *M. incognita.*

Field experiment.- The field plot trial was conducted during the summer and fall of 1979 on Myakka fine sand at Sanford, Florida. The soil was naturally infested with *B. longicaudatus, H. galeatus,* and *P. christiei.* The experimental design was a randomized complete block with five replicates. Plot size was 4.6 m x 12.2 m. Cover crops included were marigold, jointvetch, and sorghum-sudangrass hybrid. Summer fallow, a common pest management practice used in central Florida to reduce plant pests before planting fall and winter vegetable crops, was used as a standard. The cover crops were seeded on June 26, 1979. Plots consisted of three 1.5 m wide beds, each planted with three rows spaced 38 cm apart. Fertilizer was applied preplant and postplant in adequate quantities for proper growth. Both cultivation and hand hoeing were used to prevent weed growth in the cover crops. Fallowing consisted of periodic disking to prevent plant growth.

The cover crops were mowed on September 7 and all plots plowed on Septemer 13. On September 25, phenamiphos (ethyl 3-methyl-4- (methylthio) phenyl(1-methylethyl)phosphoramidate) was applied in half of each plot at the rate of 2.8 kg/ha in-the-row in 38-cm bands incorporated 5-8 cm deep with spiked rotary wheels. 'Bountiful' snapbeans *(Phaseolus vulgaris* L.) were then seeded in all plots. Normal cultural practices were followed and the snapbeans were harvested on November 15.

Soil samples, each consisting of six random cores 16-18 cm deep from each plot, were collected on September 4 prior to mowing the cover crop and on November 16 when the snapbeans were at harvest stage.

RESULTS AND DISCUSSION

Greenhouse experiment. - Host suitability of the various plants to the plant nematodes used in the test is shown in Table 1. High populations of sting, awl, and stubby-root, and moderate populations of lance nematodes built up on sorghum-

Table 1. Effect of cover crops on nematode populations in greenhouse pots.

Crop	Ectoparasitic Nematode Populations[x]				
	Sting	Awl	Lance	Stubby-root	Root-knot index[y]
Sorghum-sundangrass	336	71	31	83	---
Jointvetch	0	3	2	116	2
Marigold	948	207	10	72	1
Cucumber	---	---	---	---	4

[x]Average number of nematodes extracted from 100 cm^3 of soil 12 weeks after pots were infested with 100 nematodes each.
[y]Based on an index of 1 (no galling) to 5 (severe galling). Pots were inoculated with 5 g of galled roots 12 weeks prior to the indexing.

sudangrass confirming that it is a good host for these nematodes. It was not tested for its effect on root-knot.

Jointvetch appeared to be a non-host of sting and either a very poor or non-host of awl and lance nematodes. Only a few small galls were found as compared to heavy galling of cucumber indicating considerable resistance to *M. incognita.* Upon dissecting the galls, however, fully developed egg laying females were found, thus, demonstrating that some root-knot nematodes would probably persist on this crop.

Marigold was an excellent host of sting, awl, and stubby-root and enabled the build up of high populations of these nematodes. Apparently some reproduction of lance nematodes had occurred but results were inconclusive since the population was still at a relatively low level. No galling was found on the roots from pots originally infested with root-knot nematode indicating that *T. patula* is a non-host of *M. incognita.*

Field experiment.- Population levels of nematodes subsequent to growth of the cover crops and fallowing are presented in Table 2. Sting populations built up to high levels following sorghum-sudangrass and marigold but were very low following jointvetch and fallow. Since the population following jointvetch was essentially the same as for fallowing, it would appear that this crop is not a host of this nematode; consequently, verifying the results obtained in the greenhouse experiment. Lance nematode populations were still at a relatively high level in fallow plots demonstrating that this nematode is able to persist for a considerable period in the absence of a plant host. Some increase in population occurred on sorghum-sudangrass and marigold but

Table 2. Nematode populations following cover crops in field plots.

Treatment	Nematode populations[x]		
	Sting	Lance	Stubby-root
Fallow	7	85	6
Sorghum-sundangrass	311	114	30
Jointvetch	6	65	18
Marigold	279	95	14

[x]Average number of nematodes extracted from 100 cm^3 of soil at end of cover crop period.

Table 3. Effect of phenamiphos on nematode populations and yield of snapbeans subsequent to cover crops.

	Nematode Populations[x]			
Treatment	Sting	Lance	Stubby-root	Snapbean yield (quintals/ha)
Fallow	29	41	12	103
Fallow + Phenamiphos[y]	4	61	7	100
Sorghum-sundangrass	292	80	13	73
Sorghum + Phenamiphos	19	82	8	103
Jointvetch	25	49	34	101
Jointvetch + Phenamiphos	2	48	22	115
Marigold	266	40	13	77
Marigold + Phenamiphos	18	67	7	121
LSD .05				29
.01				33

[x]Average number of nematodes extracted from 100 cm^3 of soil taken from snapbeans at harvest time.
[y]Phenamiphos applied at 2.8 kg/ha in-the-row.

not on jointvetch. Although stubby-root populations were relatively low, they were somewhat higher following all of the cover crops than in fallow plots, demonstrating that all were hosts and confirming results obtained in the greenhouse trial.

Data obtained from snapbeans planted subsequent to fallowing and the cover crops are presented in Table 3. Sting nematode populations remained high in plots previously planted to sorghum-sudangrass and marigold and although some increase occurred on the beans following jointvetch and soil fallow, populations were still relatively low when the beans were harvested. Populations of lance nematodes appeared to have actually declined during growth of the beans indicating that they are a poor host or that other factors preventing population increase were involved. Stubby-root populations were essentially unchanged, also indicating that snapbeans are a poor host or that other factors were operating to prevent population buildup.

Phenamiphos greatly reduced sting and stubby-root nematode populations but had little effect on the lance nematode. Following sorghum-sudangrass and marigold, both of which had built up high populations of the sting nematode, the application of phenamiphos increased yield 41 and 57%, respectively, over the untreated plots of these crops. Snapbean yields following fallow and jointvetch without the application of a nematicide were essentially the same and yields were increased only 7 and 15%, respectively, by phenamiphos.

The results of these tests confirmed earlier reports that marigold is a non-host of *M. incognita*. However, since sting, awl, and stubby-root, all important plant nematodes in Florida, increased rapidly on this plant, it should not be recommended for nematode control in most instances. Since populations of sting, awl, and lance nematodes disappeared or remained at low levels on jointvetch, and considerable resistance to *M. incognita* was exhibited; it would appear that this cover crop may be useful in controlling these nematodes. However, since it is a good host of *P. christiei*, the effect of this nematode in the overall cropping plan would have to be considered. The addition of nitrogen and organic matter from a legume such as jointvetch should also be an important factor in its consideration. Although fallowing is beneficial for reducing nematodes, its deleterious effect on soil physical properties and organic matter content are factors to be considered.

RESUMEN

Se efectuaron experimentos de invernadero y de campo para determinar el valor de *Tagetes patula* (maravilla) y *Aeschynomene americana* (tamarindillo) como cultivos para reducir los nematodos en la Florida. En el invernadero se observaron altas poblaciones de *Belonolaimus longicaudatus, Dolichodorus heterocephalus*, y *Paratrichodorus christieie* desarrollándose en maravilla pero sólo se observó un ligero aumento de *Hoplolaimus galeatus* y ningún aumento de *Meloidogyne incognita* en esa planta. *Belonolaimus longicaudatus, D. heterocephalus,* y *H. galeatus* no aumentaron en tamarindillo pero *P. christiei* si llegó a desarrollar altas poblaciones. El tamarindillo exhibió un alto grado de resistencia a *M. incognita* aunque se encontraron pequeñas agallas en las raíces y también hembras con huevos. En un experimento de campo con *B. longicaudatus* se registraron altas poblaciones del nematodo en maravilla pero bajas con tamarindillo. El rendimiento de habichuelas en un cultivo subsequente al de tamarindillo, fue equivalente al obtenido seguido un período de barbecho, pero el rendimiento de habichuela después del cultivo de maravilla fue sólo 34% del obtenido seguido el período de barbecho. La aplicación de fenamifos a 2.8 kg/ha en el surco después de maravilla resultó en un aumento en la producción de habichuela de 57% pero sólo de 7 y 14% respectivemente, cuando se efectuó la aplicación en terrenos que previamente estaban en barbecho o con tamarindillo.
Claves: Tamarindillo, maravilla, fenamifos, Belonolaimus longicaudatus, Dolichordorus heterocephalus, Hoplolaimus galeatus, Meloidogyne incognita, Paratrichodorus christiei, control biológico.

LITERATURE CITED

1. Belcher, J. V., and R. S. Hussey. 1977. Plant Dis. Reptr. 61: 525-528; *2.* Daulton, R. A. C., and R. F. Curtis. 1963. Nematologica 9:357-362; *3.* Good, J. M., N. A. Minton, and C. A. Jaworski. 1965. Phytopathology 55:1026-1030; *4.* Hackney, R. W., and O. J. Dickerson. 1975. J. Nematol. 7:84-90; *5.* Jenkins, W. R. 1964. Plant Dis. Reptr. 48:692; *6.* Omidvar, A. M. 1962. Nematologica 7:62-64; *7.* Oostenbrink M., M. Kuiper, and J. J. s'Jacob. 1957. Nematologica Suppl. 2:424-433; *8.* Steiner, G. 1941. Biol. Soc. Washington Proc. 54:31-34; *9.* Tyler, J. 1938. Plant Dis. Reptr. Suppl. 109:133-151; 10. Varma, M. K., H. C. Sharma, and V. N. Pathak. 1978. Plant Dis. Reptr. 62:274-275.