COMPARISON OF FENAMIPHOS AND *ARTHROBOTRYS AMEROSPORA* FOR CONTROLLING PLANT NEMATODES IN CENTRAL FLORIDA[1]

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ABSTRACT

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In field trials on Myakka fine sand in central Florida, fenamiphos applied at 2.24 kg ai/ha significantly reduced populations of *Belonolaimus longicaudatus* Rau and *Paratrichodorus christiei* Siddiqi, and significantly increased early growth and subsequent grain yield of field corn (*Zea mays* L.). In the same experiment, a commercial preparation of the nematode-trapping fungus, *Arthrobotrys amerospora* Schenck, Kendrick, & Pramer, applied as a liquid concentrate at 4 and 8 ml (containing 10^5-10^6 colony forming units per ml), or the equivalent of granular formulation, per 305 m of row failed to affect nematode populations or plant growth and yield. Similar results were obtained on okra [*Abelmoschus esculentus* (L.) Moench.] on which fenamiphos significantly suppressed populations of *P. christiei* and lessened root galling caused by *Meloidogyne incognita,* whereas *A. amerospora* failed to affect nematode populations. Similarly, root galling and growth of soybean [*Glycine max* (L.) Merr.] was not affected by *A. amerospora* under greenhouse conditions.
Additional key words: Belonolaimus longicaudatus, Hoplolaimus galeatus, Paratrichodorus christiei, Meloidogyne incognita, nematicide, nematode-trapping fungus, biological control.

RESUMEN

Rhoades, H. L. 1985. Comparación del fenamifós y del *Arthrobotrys amerospora* para controlar los nematodos parasíticos de las plantas en la región central de la Florida. Nematropica 15:1-7.

En pruebas de campo en suelos de arena fina Myakka en la región central de la Florida, el fenamifós aplicado a 2.24 kg ia/ha redujo significativamente las poblaciones de *Belonolaimus longicaudatus* Rau y *Paratrichodorus christiei* Siddiqi, y aumentó significativamente el crecimiento inicial y el subsequente rendimiento de granos del maíz de campo (*Zea mays* L.). En el mismo experimento una preparación comercial del hongo "atrapador de nematodos" *Arthrobotrys amerospora* Schenck, Kendrick, y Pramer, aplicado a un surco de 305 m de largo en forma de líquido concentrado a 4 y 8 ml (conteniendo 10^5-10^6 unidades formadoras de colonias por ml), o su equivalente en formulación granulada, falló en afectar las poblaciones de nematodos y el crecimiento y rendimiento del maíz. Resultados similares fueron obtenidos en el quimbombó [*Abelmoschus esculentus* (L.) Moench] donde el fenamifós redujo significativamente las poblaciones de *P. christiei* y disminuyó los nodulos de las racies causados por *Meloidogyne incognita* y el *A. amerospora*

falló en afectar las poblaciones de nematodos. Similarmente, los nódulos de las raices y el crecimiento del frijol de soya [*Glycine max* (L.) Merr.] no fueron afectados por *A. amerospora* bajo condiciones de invernadero.
Palabras claves adicionales: Belonolaimus longicaudatus, Hoplolaimus galeatus, Paratrichodorus christiei, Meloidogyne incognita, nematicida, hongo atrapador de nematodos, control biológico.

INTRODUCTION

Many attempts have been made to use predatory fungi to control plant-parasitic nematodes beginning with the classical work of Linford (4) and Linford *et al.* (5). These workers added chopped, green pineapple tops to nematode-infested soil in pots and at a later date estimated nematode population densities and fungal activity. Their results indicated that the treatment stimulated a rapid increase in the number of free-living nematodes and the subsequent development of predaceous fungi. The predaceous fungi reduced the total nematode populations to less than the original level. In later experiments, Linford and Yap (6) added five different species of predaceous fungi to soil in which pineapple plants were grown. Results indicated that *Arthrobotrys oligospora, A. musiformis, Dactylaria thaumasia,* and *Dactylella ellipsospora* had only a slight beneficial effect. Similar types of results have been found by many workers (2). Barron (1) and Sayre (8) reported that, in general, little or no beneficial results are obtained by adding only predatory fungi to soil. If, however, such fungi are added with significant amounts of organic matter, beneficial effects may be obtained.

In 1981, Scudder (unpublished data), working with soybeans at Sanford, Florida, obtained greatly increased growth and yield and a decrease of root galling by root-knot nematodes in plots to which he added an experimental preparation of a combination of *Arthrobotrys amerospora* Schenck, Kendrick, & Pramer, and the nitrogen-fixing bacterium, *Rhizobium japonicum* (Kirchner) Buchanan. The increase in yield was much greater than for *R. japonicum* alone. These promising results stimulated interest in conducting experiments to determine the effect of *A. amerospora* on some of the highly injurious nematodes in the fine sandy soils of central Florida.

MATERIALS AND METHODS

One greenhouse and three field trials were conducted at the Central Florida Research and Education Center, Sanford, Florida, to compare the efficacy of *A. amerospora* and fenamiphos for controlling plant nematodes in central Florida. The experimental preparations of *A. amerospora* were provided by Agricultural Laboratories of Columbus, Ohio.

Field trials

One of the field trials was on field corn (*Zea mays* L.) and two were on okra [*Abelmoschus esculentus* (L.) Moench.] during the spring and summer, respectively, of 1982. All were of randomized complete block design with 5 replicates and were conducted on Myakka fine sand in fields previously cropped to winter vegetables. Plot size was 1.52 m (2 rows) X 11.58 m. Plant-parasitic nematode species present in the corn test were: sting, *Belonolaimus longicaudatus* Rau; lance, *Hoplolaimus galeatus* Cobb; and stubby-root, *Paratrichodorus christiei* Siddiqi. Those present in the okra tests were: *B. longicaudatus, H. galeatus, P. christiei,* and the root-knot nematode, *Meloidogyne incognita* (Kofoid & White) Chitwood. Prior to planting, the seed furrows were opened 2-3 cm and liquid and granular formulations of *A. amerospora* applied in the furrows at the recommended rate (4 ml/305 m of row of liquid concentrate containing 10^5-10^6 colony forming units/ml or the equivalent of granules). A hand sprayer was calibrated to apply the liquid formulation and a Planet-Junior® planter was modified to apply the granules in the furrow. Immediately after the fungus was applied, 'Clemson Spineless' okra and Asgrow's 'RX 114' hybrid corn were seeded and the furrows closed with a Planet-Junior planter. Fenamiphos (15% granules) was applied at 2.24 kg/ha as a 38-cm in-row band and incorporated 5-8 cm just prior to planting the crops. Cultural practices for the crops were normal for central Florida. Soil samples of 10 random cores (2.5 x 17.5 cm) were removed from within the rows 10 wk after planting and the ectoparasitic nematode populations removed by centrifugal-flotation (3), identified, and counted. At 12 wk, 8 plants were dug at random from each okra plot and the roots indexed for root-knot nematode galling using a rating index of 1=no galling to 5=severe galling. Yields of okra were not determined; however, height measurements of corn plants were taken at 6 wk, and at maturity, the grain was harvested and yields determined.

Greenhouse trial

The experiment was conducted in 15-cm pots containing 1600 cm^3 of sterilized Myakka fine sand. It was arranged in randomized complete blocks replicated 5 times. Five grams of finely chopped okra roots galled by *M. incognita* were mixed into the top 5 cm of soil in all pots receiving this treatment. The nitrogen fixing bacterium *Rhizobium japonicum* (recommended rate of 10^4 colony forming units per seed) and *A. amerospora* (recommended rate or 5 times the recommended rate) also were mixed into the top 5 cm of soil. Ten seeds of 'UFV-1' soybean [*Glycine max* (L.) Merr.] were planted in each pot and the plants thinned to four after

Table 1. Effect of fenamiphos and *Arthrobotrys amerospora* on nematode populations and growth and yield of field corn.

Treatment	Rate[x]	Nematode Populations[y] BL	HG	PC	Plant height[z]	Gain yield (kg/ha)
Control	—	197	258	57	32.5	4328
A. amerospora (granules)	1X	160	221	51	37.1	3638
A. amerospora (granules)	2X	201	186	57	38.1	3763
A. amerospora (liquid)	2X	282	214	50	29.7	3450
Fenamiphos	2.24 kg/ha	21	220	4	45.0	6774
LSD 0.05		163	N.S.	44	6.1	1756

[x]1X rate equals 68 g of granules or 4 ml of liquid per 305 m of row.
[y]Average number of *Belonolaimus longicaudatus* (BL), *Hoplolaimus galeatus* (HG), and *Paratrichodorus christiei* (PC) extracted from 100 cm^3 of soil.
[z]Plant height in cm 6 wk after planting.

germination. The study was terminated after 6 wk and plant weight and root-knot galling recorded.

RESULTS AND DISCUSSION

Field trials

In the experiment with field corn, neither liquid nor granular formulations of *A. amerospora* affected populations of *B. longicaudatus, H. galeatus,* and *P. christiei,* or plant growth and grain yield (Table 1). Fenamiphos, however, significantly suppressed populations of *B. longicaudatus* and *P. christiei,* and both early plant growth and grain yield were significantly increased. As has been reported previously (7), fenamiphos did not suppress populations of *H. galeatus.*

In experiments with okra as a host, populations of *B. longicaudatus* were very low in both tests with no significant differences due to treatment (Table 2). As in the experiment on field corn, there was no effect on *H. galeatus* by *A. amerospora* or fenamiphos. Populations of *P. christiei* were suppressed significantly in Test 1 and were considerably lower (although not significantly) in fenamiphos-treated plots in Test 2. Populations of *P. christiei* were not suppressed by *A. amerospora.* Root galling by *M. incognita* was significantly reduced by fenamiphos in both tests but was unaffected by *A. amerospora.*

Table 2. Effect of fenamiphos and *Arthrobotrys amerospora* on nematodes attacking okra.

Treatment	Rate[x]	Nematode populations[y]			Root-knot index[z]
		BL	HG	PC	
Test 1					
Control	—	17	231	129	3.90
A. amerospora (granules)	1X	16	253	169	3.97
A. amerospora (granules)	2X	13	241	135	4.04
A. amerospora (liquid)	1X	17	194	88	4.00
Fenamiphos	2.24 kg/ha	4	215	43	2.50
LSD 0.05		NS	NS	76	0.70
Test 2					
Control	—	3	11	96	2.90
A. amerospora (granules)	1X	10	17	134	3.07
A. amerospora (granules)	2X	1	10	122	2.93
A. amerospora (granules)	5X	4	13	85	3.13
A. amerospora (granules)	10X	5	7	81	2.87
A. amerospora (liquid)	10X	2	11	85	2.90
Fenamiphos	2.24 kg/ha	2	10	35	1.50
LSD 0.05		NS	NS	NS	0.66

[x]1X rate equals 68 g of granules or 4 ml of liquid per 305 m of row.
[y]Average numbers of *Belonolaimus longicaudatus* (BL), *Hoplolaimus galeatus* (HG), and *Paratrichodorus christiei* (PC), extracted from 100 cm^3 of soil.
[z]Based on an index of 1=no galling to 5=severe galling.

Greenhouse trial

Galling of soybean roots by *M. incognita* was essentially the same in all treatments containing the nematode (Table 3). The addition of *A. amerospora, R. japonicum,* or a combination of the two had no significant effects on the nematode population or plant growth.

These experiments demonstrated that *A. amerospora* added to a typical central Florida fine sand did not suppress populations of *B. longicaudatus, H. galeatus, P. christiei,* or *M. incognita,* whereas fenamiphos effectively reduced populations of all these nematodes but *H. galeatus.* However, since these trials lasted for only one growing season, the possibility of long-term control from *A. amerospora* cannot be ruled out.

Table 3. Effect of *Rhizobium japonicum* and *Arthrobotrys amerospora* on growth of soybean plants and galling of the roots when grown in soil infested with *Meloidogyne incognita.*

Treatment	Root-knot index[y]	Plant weight (g)
Control	1.00	157
M. incognita[x]	2.88	93
R. japonicum	1.00	177
R. japonicum + *M. incognita*	2.88	90
A. amerospora (1X rate) + *M. incognita*	2.75	81
R. japonicum + *A. amerospora* (1X rate) + *M. incognia*	2.75	92
R. japonicum + *A. amerospora* (5X rate) + *M. incognita*	2.88	81
LSD 0.05	0.46	19

[x]*M. incognita* infestations consisted of 5 g of heavily galled okra roots added to each pot. *R. japonicum* was added at the rate recommended by Agricultural Laboratories. *A. amerospora* was added at the recommended rate (1X) and five times that (5X).
[y]Based on an index of 1=no galling to 5=severe galling.

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