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INFLUENCE OF SUMMER MANAGEMENT STRATEGIES ON NEMATODE POPULATIONS IN A SUBTROPICAL AGROECOSYSTEM[1]

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ABSTRACT

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During 1980 and 1981 nematode populations were compared before and after eight different summer management strategies on land used for autumn and winter vegetable production in south Florida. The various strategies assessed were: summer fallow; cover cropping with maize (*Zea mays* L.) or sorghum (*Sorghum bicolor* L.); maintenance of uniform weed cover of *Parthenium hysterophorus* L., *Phyllanthus carolinensis* Walt., or *Cyperus esculentus* L.; or maintenance of weed cover consisting of mixtures of these weeds and other plant species. Populations of *Rotylenchulus reniformis* Linford & Oliveira increased to high levels on the broadleaf weed species grown, reaching the highest levels in plots containing *P. hysterophorus* alone or in combination with other weed species. Populations were maintained on summer cover crops of maize or sorghum but declined under summer fallow. Populations of *Quinisulcius acutus* (Allen) Siddiqi and *Helicotylenchus dihystera* (Cobb) Sher increased under all strategies except fallow. Populations of *Q. acutus* following sorghum were significantly ($P=0.05$) greater than those achieved following most other management strategies.

Additional key words: maize, sorghum, fallow, weed hosts, Rotylenchulus reniformis, Quinisulcius acutus, Helicotylenchus dihystera, Cyperus esculentus, Parthenium hysterophorus, Phyllanthus carolinensis.

RESUMEN

McSorley, R., y J. L. Parrado. 1983. Influencia de manejos estratégicos de verano en las poblaciones de los nematodes en un sistema ecológico agrícola subtropical. Nematrópica 13:1-8.

Durante 1980 y 1981 las poblaciones de nematodos del suelo fueron comparadas antes y después de ocho diferentes manejos estratégicos efectuados durante el verano en terrenos del Sur de la Florida usados en el otono e invierno para la producción de vegetales. Las estrategias evaluadas fueron: barbecho de verano; cosecha de covertura con maíz (*Zea mays* L.) o millo (*Sorghum bicolor* L.) y mantenimiento de una covertura uniforme de las hierbas, *Parthenium hysterophorus* L., *Phyllanthus carolinensis* Walt., y *Cyperus esculentus* o de mezclas de estas y otras especies de plantas. La población de *Rotylenchulus reniformis* Linford & Oliveira aumentó a niveles altos, en todas las especies de hierbas de hoja ancha en crecimiento, alcanzando el más alto nivel

en los lotes de *P. hysterophorus* solo o en combinación con otras especies de hierbas. Las poblaciones de nematodos se mantuvieron en los lotes de covertura de verano de maíz y millo pero declinaron en los lotes bajo barbecho de verano. Las poblaciones de *Quinisulcius acutus* (Allen) Siddiqi y *Helicotylenchus dihystera* (Cobb) Sher aumentaron en todas los tratamientos exceptuando el barbecho de verano. Las poblaciones de *Q. acutus* en los lotes de millo fueron significativamente (P=0.05) mayores que aquellas obtenidas en la mayoría de los demás manejos estratégicos ensayados.
Palabras claves adicionales: maiz, millo, barbecho, hierbas hospederas, Rotylenchulus reniformis, Quinisulcius acutus, Helicotylenchus dihystera, Cyperus esculentus, Parthenium hysterophorus, Phyllanthus carolinensis.

INTRODUCTION

Rotylenchulus reniformis Linford & Oliveira is widely distributed in the tropics and has a wide host range, including many vegetable crops (2, 5, 8, 9). It is a very common nematode in south Florida, where various species of vegetable crops can be damaged by it during the long production season which extends from September to May. Vegetable crops are not usually grown during the rainy summer months, hence it may be possible to reduce *R. reniformis* populations by various land management strategies during this time. For example, the use of summer cover crops can have a marked influence on nematode populations (12), as can fallow or weed control programs (11). Summer cover crops of maize (*Zea mays* L.) or sorghum (*Sorghum bicolor* L.) are frequently planted in south Florida. In a few sites, the land is maintained in a fallow condition by discing. But the most common land management strategy is to temporarily surrender the field to summer weed growth.

Since maize and sorghum are reported to show immunity or resistance to *R. reniformis* (2, 9), growing these crops may decrease populations of this nematode. Field populations of *R. reniformis* following sorghum have been shown to be much lower than those following cotton, a known host (13). In the Philippines, populations in monocultures of corn or sorghum were similar to levels in fallowed plots (3).

Little information exists on the influence of common weed species in south Florida on nematode populations. Common weeds in cultivated fields include *Cyperus esculentus* L., *Parthenium hysterophorus* L., and *Phyllanthus carolinensis* Walt. The objective of this study was to compare the impact of several different summer management strategies on populations of *R. reniformis* and other common nematodes. These strategies include fallow, cover cropping with maize or sorghum, or maintenance of a weed cover through the summer months.

MATERIALS AND METHODS

This experiment was performed in each of two successive summers, 1980 and 1981, and conditions were very similar in both years. In each year of the study, the test site was a Rockdale fine sandy loam soil with pH = 7.8 which had been planted to snap bean (*Phaseolus vulgaris* L., 'Sprite') in the previous spring and which was to be planted again to that crop in the autumn. In each test, the experimental design was a randomized complete block with eight treatments and five replications, and each plot was a 3.0m x 3.0m square. The experimental sites were disced and prepared for planting in early June of each year and no herbicides were used. Plant-parasitic nematodes were sampled in mid-June, prior to planting, by using a hand trowel to collect soil to a depth of 15 cm from 10 locations within each plot. Soil from each plot was composited to form a single sample which was passed through a 4mm sieve to remove rock, and a 100 cm^3 subsample was then processed for nematodes by decanting and sieving, followed by suspension of the residues in modified Baermann funnels (1, 4). Treatments consisting of various summer management strategies were imposed on the individual plots immediately after the preplant nematode samples were collected. The eight treatments were as follows:

1. Maize. In mid-June, the maize hybrid 'Pioneer X304C' was machine-planted in four rows, each 0.92m apart. Plots were fertilized with 224 kg/ha of a 7-14-14 fertilizer at planting, and the distance between plants in the row was 7-10 cm. Plots were maintained free of weeds by frequent hand weeding.
2. Sorghum. Conditions for planting the sorghum-sudangrass hybrid 'Redlan x Greenleaf' were similar to those described for maize, except that the distance between plants in the row was 3-5 cm.
3. Fallow. These plots were maintained in a fallow condition by discing the entire plot at monthly intervals.
4. *Cyperus esculentus.* In this treatment, all weeds other than yellow nut-grass, *C. esculentus,* were removed by hand weeding immediately after germination.
5. *Phyllanthus carolinensis.* Plots consisting of *P. carolinensis* were established by hand weeding of other species.
6. *Parthenium hysterophorus.* Seedlings of all weeds other than Santa Maria, *P. hysterophorus,* were removed from the treatment to establish plots of this common weed species.
7. Mixed Weed Species. This treatment consisted of a mixture of all weed species which grew naturally in the plots, and was not weeded during the summer. Composition of the plots in this treat-

ment was assessed in late September of each year by rating the percentage of ground covered by each weed species, using a modification of a disease rating scale (6), such that 1=0% of ground covered; 2=0-3%; 3=3-6%; 4=6-12%; 5=12-25%; 6=25-50%; 7=50-75%; 8=75-88%; 9=88-94%; 10=94-97%; 11=97-100%; 12=100% of ground covered. The composition of these plots during 1980 and 1981 is shown (Table 1). *P. hysterophorus* was very common in these plots in both years.

8. Broadleaf Weeds. Selective weeding was used to establish plots of broadleaf weeds other than *P. carolinensis* and *P. hysterophorus*. Seedlings of these two species were removed from the plots along with seedlings of *C. esculentus* and grasses. The composition of these plots in each season is shown (Table 1).

All plots were mowed on approximately October 1 of each year and rototilled twice during early October. Plots were rototilled again prior to fall planting. A nematode sample was collected from each plot shortly after the last rototilling but prior to the planting of snap bean. Dates of these samples were November 5, 1980, and October 16, 1981.

RESULTS

Besides *R. reniformis, Quinisulcius acutus* (Allen) Siddiqi and *Helicotylenchus dihystera* (Cobb) Sher were also common in both tests. Preplant densities of all nematodes were lower in 1980 than in 1981, and no significant (P=0.05) differences among treatments existed in the preplant samples (Table 2). Numerous differences in *R. reniformis* populations existed in the postharvest samples, depending on the summer management strategy used. Highest populations were found in plots of *P. hysterophorus* and plots of mixed weed species. Results of these two strategies were similar because the plots of mixed weeds contained high levels of *P. hysterophorus* (Table 1). Postplant levels of *R. reniformis* greatly increased over preplant levels in all four strategies in which broadleaf weeds were involved. Populations declined in fallow plots and were generally maintained on maize and sorghum, showing only slight increases or decreases. Results with *C. esculentus* were inconsistent and intermediate.

Quinisulcius acutus showed significantly (P=0.05) higher postplant populations after sorghum than under most other strategies, which were usually similar. *Helicotylenchus dihystera* populations showed much variability and few clear patterns. Both of these nematodes increased in all strategies other than fallow.

Table 1. Composition of plots maintained in mixed weed species or broadleaf weed species, September 1980 and September 1981.

Weed species	Horsfall-Barratt Rating[x]			
	Mixed weed species plots		Broadleaf weed plots	
	1980	1981	1980	1981
Parthenium hysterophorus L.	5.6	7.6	1.6	1.4
Phyllanthus carolinensis Walt.	1.0	4.0	1.0	1.6
Chamaesyce prostrata (Ait.) Small	6.6	2.0	7.6	4.2
Amaranthus spinosus L.	1.0	1.4	2.8	3.4
Bidens pilosa L.	1.2	1.0	1.0	4.4
Chamaesyce spp.	1.0	1.0	1.0	1.2
Cyperus esculentus L.	1.2	1.6	1.0	1.2
Phaseolus lathyroides (L.) Urb.	1.4	1.6	2.6	1.8
Poinsettia spp.	1.0	1.0	1.0	1.2
Portulaca oleracea L.	1.0	1.0	1.0	3.6
Richardia scabra St. Hil.	1.0	1.0	3.4	1.0
Rottboellia exaltata L. f.	4.8	2.6	1.0	1.2
Sida acuta Burm.	1.4	1.2	2.4	1.8
Sonchus oleraceus L.	1.0	1.0	1.0	1.6

[x]Percent of ground covered by each weed species where 1=0% of ground covered; 2=0-3%, 3=3-6%; 4=6-12%; 5=12-25%; 6=25-50%; 7=50-75%; 8=75-88%; 9=88-94%; 10=94-97%; 11=97-100%; 12=100% of ground covered. Figures in table are means of five replications.

DISCUSSION

It is apparent from the results of this study that allowing broadleaf weed species to grow on vegetable land over the summer off-season would be likely to build up *R. reniformis* populations. Maize or sorghum maintained *R. reniformis* levels and did not show the declines observed elsewhere when these crops were double-cropped (3). It may be that the length of the summer off-season in south Florida (4 months) is not long enough to result in a population drop following one crop of a nonhost. However, to extend the maize or sorghum summer cover crop into a successive crop in the fall would not be economically practical in this region due to the lost opportunity to plant a more profitable vegetable crop. Fallowing did reduce populations somewhat and could significantly alter *R. reniformis* populations compared to allowing broadleaf weed

Table 2. Preplant and postharvest numbers of three nematode species under eight different summer management strategies, 1980-81.

Summer management strategy	Nematodes per 100 cm^3 of soil[x]			
	1980		1981	
	Preplant	Postharvest	Preplant	Postharvest
	Rotylenchulus reniformis			
Fallow	40 n.s.	25 a	207 n.s.	22 a
Maize	34	49 ab	157	171 abc
Sorghum	48	63 abc	174	89 ab
C. esculentus	29	132 bcd	215	77 ab
Broadleaf Weeds[y]	53	202 de	133	140 abc
P. carolinensis	38	154 cde	111	297 bc
P. hysterophorus	61	236 e	167	316 c
Mixed Weed Species	41	248 e	121	384 c
	Quinisulcius acutus			
Fallow	8 n.s.	7 a	47 n.s.	13 a
C. esculentus	9	24 ab	33	49 a
P. carolinensis	10	14 a	18	108 a
Broadleaf Weeds[y]	19	27 ab	13	98 a
Mixed Weed Species	14	29 ab	21	96 a
Maize	9	13 a	18	129 ab
P. hysterophorus	9	43 b	14	54 a
Sorghum	10	51 c	45	221 b
	Helicotylenchus dihystera			
Fallow	11 n.s.	3 a	22 n.s.	7 a
P. hysterophorus	3	29 ab	33	126 ab
P. carolinensis	13	47 abc	33	92 ab
Broadleaf Weeds[y]	4	57 bc	40	126 ab
Maize	12	43 abc	21	130 b
C. esculentus	12	85 c	28	77 ab
Mixed Weed Species	7	88 c	11	96 ab
Sorghum	6	89 c	37	81 ab

[x]Mean of five replications. For each nematode species, means in columns followed by the same letter are not significantly (P=0.05) different, according to Duncan's New Multiple Range Test (n.s.=no significant differences).

[y]Except *P. carolinensis* and *P. hysterophorus*.

species such as *P. hysterophorus* to grow on the land. However, fallowing should not be performed indiscriminately, but should be weighed against fuel costs, magnitude of the nematode populations, and the possibility of increased leaching of soil nutrients.

Any oversummering strategy must consider the dynamics of all nematide species involved in the system. On Rockdale soils of south Florida where the common species are *R. reniformis, Q. acutus,* and *H. dihystera,* maize or sorghum may be satisfactory to maintain *R. reniformis* populations without substantial increases. Buildup of *Q. acutus* or *H. dihystera* is of little consequence in this agroecosystem since these nematodes cause little damage to the vegetable crops that are commonly grown, such as snap bean (10, 14). *Meloidogyne* spp. are more likely to maintain themselves on weed species than on maize or sorghum. Cover cropping with a monocotyledonous species such as sorghum could lead to serious problems if *Belonolaimus longicaudatus* Rau or other nematodes that build up on sorghum (7) are present, however. Finally, the effect of high nematode populations on the cover crop itself should not be overlooked if a commercial harvest of the cover crop is planned.

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