Nematode Population Levels on Vegetable Crops Following Two Winter Cover Crops

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ABSTRACT

Population densities of plant-parasitic nematodes were compared on cowpea *(Vigna unguiculata)*, yellow squash *(Cucurbita pepo)*, okra *(Hibiscus esculentus)*, bush bean *(Phaseolus vulgaris)*, and sweetpotato *(Ipomoea batatas)* following a winter cover crop of rye *(Secale cereale)* or crimson clover *(Trifolium incarnatum)*, in a field test in north-central Florida. Nematode levels showed few differences among the five vegetable crops. Numbers of ring nematodes *(Criconemella* spp.) and the root-knot nematodes *(Meloidogyne incognita)* were greater following clover than following rye, but the stubby-root nematode *(Paratrichodorus minor)* was more common on one sampling date on vegetable crops that followed rye. Yields of all vegetable crops except sweetpotato were lower ($P<0.05$) following clover. Results demonstrate the efficacy and advantage of a suitable winter cover crop for lowering densities of a key nematode pest and improving yields of susceptible vegetable crops grown in rotation.

INTRODUCTION

Plant-parasitic nematodes cause problems on a variety of crops grown in the southeastern United States (Christie, 1959; Riggs, 1982). Nematode problems are often rather site-specific, and the rise and fall of nematode populations in a site depends on the crops grown. Therefore crop rotation (Johnson, 1982; McSorley and Duncan, 1995; McSorley and Gallaher, 1992; 1993; 1994; Trivedi and Barker, 1986) and use of winter cover crops (McSorley, 1996; McSorley and Gallaher, 1992) have been important methods for managing plant-parasitic nematodes.

These practices have been applicable in north-central Florida (McSorley, 1996; McSorley and Gallaher, 1992; 1993; 1994), particularly against the root-knot nematode, *Meloidogyne incognita*, which is the key nematode pest in many cropping systems in the region (McSorley and Gallaher, 1992). The objectives of the research presented here were to demonstrate the effects of two winter cover crops on population levels or root-knot and other nematodes and their buildup in subsequent susceptible vegetable crops.

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MATERIALS AND METHODS

This research was conducted at the University of Florida Green Acres Agronomy Research Farm in Alachua County on an Arredondo fine sand (92% sand, 4% silt, 4% clay). In November 1995, adjacent sites were planted with cover crops of either crimson clover *(Trifolium incarnatum* cv. Dixie) or rye *(Secale cereale* cv. Wrens Abruzzi). Cover crops were killed by application of labelled rates of gramoxone (Paraquat) plus non toxic surfactant. Vegetable crops were planted on 18 April with an in-row subsoil no-tillage planter. At each site, five different vegetable crops were planted in a randomized complete block design with four replications: cowpea *(Vigna unguiculata* cv White Acre), squash *(Cucurbita pepo* cv. Yellow Crookneck), okra *(Hibiscus esculentus* cv. Clernson Spineless), bean *(Phaseolus vulgaris* cv. Blue Lake), and sweetpotato *(Ipomoea batatas* cv. Georgia Red). Sweetpotato slips were hand planted into previously formed in-row subsoil no-tillage rows. Individual plots consisted of four rows, 10 ft long. Plots were irrigated with sprinklers as needed, and fertilized with 48 lb N, 16 lb P, and 32 lb K/a on 22 April and an additional 75 lb n/a on 14 May. Weeds were controlled by one post direct application of gramoxone and by hand. Cowpeas were harvested on 29 May; okra and beans were harvested twice, on 29 May and 17 June; squash was harvested four times between 29 May and 17 June; and sweetpotato was harvested on 2 October. For each harvest, marketable fresh weight in a 1.0-m^2 area was measured.

All plots were sampled for nematodes on 25 April and 28 June. Each nematode sample consisted of six cores of soil (2.5-cm diameter x 20 cm deep) collected in a systematic pattern and then combined into a plastic bag for transport. In the laboratory, a 100-cm^3 soil subsample was removed for nematode extraction using a modified sieving and centrifugation procedure (Jenkins, 1964). Extracted nematodes were identified and counted under an inverted microscope. Data were analyzed by an analysis of variance for a split-plot design with cover crops (sites) as main plots and vegetable crops as subplots, followed by Duncan's multiple-range test to compare means among vegetable crops.

RESULTS AND DISCUSSION

Because the rye and clover crops were maintained in separate but adjacent sites, differences between these treatments could be due to site factors other than cover crop. Nevertheless, the main difference between these two sites was the cover crops; other factors were similar in both sites.

Four different kinds of plant-parasitic nematodes occurred in these sites, and all were affected by cover crop (Table 1). Ring and root-knot nematodes were more abundant following clover than rye, but numbers of stubby-root nematodes on 28 June were greater in the site following rye. Except for root-knot nematodes on 28 June, nematode numbers were not affected (at $P \leq 0.10$) by the vegetable crops present (Table 1).

Root-knot nematodes are important pests of vegetable crops in Florida (McSorley, 1996; McSorley et al., 1994; McSorley and Gallaher, 1992), and their numbers were not detectable in April following rye. Even in June, numbers in plots following rye were only half as great as numbers following clover. Yields of four vegetable crops were lower ($P \leq 0.05$) following clover than after rye (Table 2), and attributed to damage from root-knot nematodes. Sweetpotato yields were low and highly variable. These data demonstrate the advantage of a winter rye cover crop over crimson clover for reduction of root-knot nematode levels, and confirm other studies in which graminaceous cover crops were more effective than legumes for this purpose (McSorley, 1996; McSorley and Gallaher, 1992).

Although a rye cover crop appeared to be useful for reducing root-knot nematode numbers and improving yields of vegetable crops high numbers of nematodes had built up on the vegetable crops by 28 June, even in the site which had the rye cover crop (Table 2). Root-knot nematode population levels recover quickly once a susceptible vegetable crop is planted. A similar resurgence of root-knot nematodes was also observed on eggplant *(Solanum melongena)* (McSorley et al., 1994). Thus, the benefits of the crop rotation lasted only a single vegetable season, so that another nematode-suppressive cover crop or rotation crop would be needed before a susceptible vegetable crop could be grown again. Nevertheless, the use of winter cover crops to manipulate population levels of root-knot nematodes is a relatively convenient and inexpensive method for managing these pests and improving crop production. Additional research is needed to identify a wider range of crops and cultivars useful for this purpose.

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Table 1. Nematode population densities on vegetable crops following winter cover crops of crimson clover or rye.

Vegetable crop	Nematodes per 100 cm³ soil				
	25 April		28 June		
	Clover	Rye	Clover	Rye	Mean
	Ring nematodes, *Criconemella* spp.				
Cowpea	92	34	251	78	
Squash	100	29	413	77	
Okra	40	30	262	80	
Bean	88	33	275	104	
sweetpotato	51	28	403	279	
Mean	74	31**	321	124**	
	Root-hot nematode, *Meloidogyne incognita*				
Cowpea	76	0	480	372	426 abc†
Squash	52	0	110	366	238 bc
Okra	31	0	990	374	682 ab
Bean	59	0	1220	381	800 a
sweetpotato	26	0	234	30	132 c
Mean	49	0**	607	305*	
	Stubby-root nematode, *Paratrichodorus minor*				
Cowpea	10	3	6	15	
Squash	8	9	6	62	
Okra	12	6	15	52	
Bean	3	5	20	26	
sweetpotato	3	5	14	32	
Mean	9	6@	12	38**	
	Lesion nematodes, *Pratylenchus* spp.				
Cowpea	1.0	1.2	1.2	0.5	
Squash	0.5	1.2	2.0	1.0	
Okra	0.5	1.2	3.0	4.8	
Bean	0.5	3.0	5.8	3.5	
sweetpotato	0	0.2	0.8	1.8	
Mean	0.5	1.4*	2.6	2.3	

**,*,@ indicate significant differences from clover at $P \leq 0.01$, $P \leq 0.05$, and $P \leq 0.10$, respectively.

†Means in column followed by the same letter are not different ($P \leq 0.10$), according to Duncan's multiple-range test

Table 2. Yields of vegetable crops following winter cover crops of crimson clover or *rye*.

Vegetable crop	Fresh weight (g per m^2)	
	Clover	Rye
Cowpea	215	658**
Squash	1276	4525*
Okra	13	439*
Bean	0	522**
sweetpotato	0	635†

**,* indicate significant differences from clover at $P \leq 0.01$ and $P \leq 0.05$, respectively.
†Highly variable, not different from clover at $P \leq 0.10$.