The Ring Nematode, *Criconemoides ornatus*, on Peach and Centipede Grass[1]

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Abstract: Criconemoides ornatus at 500, 1,000, and 10,000 specimens per 15-cm pot containing 1,500 cc of soil was not pathogenic or parasitic on 'Lovell' peach. The number of nematodes recovered was always less than the inoculum. Inocula of 1,000 and 10,000 specimens were pathogenic to centipede grass, but the 500 inoculum level was not. The number of nematodes recovered from parasitized centipede grass was considerably higher than the inoculum. *Key Words: Criconemoides ornatus,* Ring nematode, Peach, Centipede grass, Parasitism, Pathogenicity.

Ring nematodes, *Criconemoides* spp., are generally considered to be obligate parasites even though pathogenicity has been demonstrated on only a few species of plants. Various authors (1, 5, 6, 9, 10, 17) have reported species of *Criconemoides* associated with peach. Lownsbery (9) reported populations of *C. xenoplax* on 'S-37' and 'Lovell' peach rootstocks in Merced County, California, but was unable to prove pathogenicity in controlled tests. In every case the number of specimens declined during his experiments. Later, Lownsbery (10) showed that 'S-37' and 'Lovell' peach are poor hosts for *C. xenoplax*, and were not injured by population levels as high as any found in the Merced County peach orchards. Hung and Jenkins (6) reported large numbers of *C. curvatum* present in 79% of the peach orchards surveyed in New Jersey. In greenhouse and laboratory tests, they reported that *C. curvatum* caused extensive lesions and pits on peach roots. Under nonsterile conditions, the pits and lesions were invaded by other microorganisms which caused a general discoloration and low vigor of the root system. They also found that treatments with nematicides in replanted orchards reduced tree loss and resulted in greater tree growth. They concluded that peach tree decline is a complex involving nematodes and one or more cultural or other disease factors.

Several workers (2, 3, 4, 13, 16) have reported ring nematodes associated with injury to centipede grass, but pathogenicity has not been proved. Johnson and Powell (8) reported large population increases of *C. lobatum* on centipede grass in greenhouse experiments. In every case the weight of the grass from inoculated plants was less than from uninoculated plants, but the differences were not statistically significant. Johnson (7) showed that *C. ornatus* reduced the growth of several bermudagrass varieties, but differences from uninoculated controls were statistically significant in only one case.

Species of *Criconemoides* associated with turfgrasses in Florida appear to be highly successful plant parasites since large populations develop before severe injury results. The present experiments were designed to determine parasitism and pathogenicity of *C. ornatus* to peach and centipede grass.

MATERIALS AND METHODS

The soil used in all experiments was Arredondo fine sand collected from the Florida Agr. Exp. Sta. farm, Gainesville, Florida; it

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was thoroughly mixed, 1,500 cc placed in 15-cm clay pots, and autoclaved 1 hr at 18 psi.

One source of nematode inoculum was from an experimental centipede grass plot at the Horticultural Unit, Florida Agr. Exp. Sta. near Gainesville. Fifty specimens isolated from this plot were transferred to each of several 15-cm pots of autoclaved soil along with unrooted sprigs of centipede grass, and maintained in a greenhouse for 5 months. Specimens from these pots were used as one source of inoculum.

The other inoculum source was isolated and used directly from zoysiagrass (*Zoysia matrella* Merrill) growing on the University of Florida campus.

Four treatments, consisting of 0, 500, 1,000, and 10,000 specimens of *C. ornatus* per pot, were each replicated 10 times for both peach and centipede grass. The inocula were equivalent to 0.3, 0.6, and 6 *C. ornatus* per cc of soil, respectively. Specimens for the 500 and 1,000 levels were obtained from the centipede grass colonies by the Seinhorst elutriator technique (14) and hand-picking the recovered specimens. The nematodes for the 10,000-specimen level of inoculation was recovered from the zoysiagrass by the centrifugal-flotation technique as modified by Miller (12). Stylet-bearing nematodes other than *C. ornatus* were removed, and the remaining specimens, mostly *C. ornatus*, were suspended in sufficient water to obtain the desired uniform dilution.

'Lovell' peach *Prunus persica* (L.) Batsch. seedlings 11–15 cm tall and grown in steamed vermiculite were pruned extensively so that only a few leaves, less than 3 cm of branched roots, and 5 cm of main roots remained.

Centipede grass *Eremochloa ophiuroides* (Munro) Hack cuttings with at least 3 internodes were rooted in autoclaved soil for 3–5 days before inoculation. Only those with roots 5–8 cm long were used in the experiment.

Inoculations on centipede grass and peach were made by pouring water suspensions of the nematodes into a hole made in the soil contained in the 15-cm pots. Roots of the transplants were placed in the same hole, covered with soil, and watered in. The uninoculated controls were transplanted and watered only.

The pots, placed on inverted saucers, were randomly arranged on a greenhouse bench, and watered as necessary for good plant growth. Fifty ml of liquid fertilizer composed of 8 g of ammonium sulphate and 1.6 g of potassium sulphate/l were added to each pot at intervals of 4 weeks. Greenhouse temperatures ranged from 22–29 C.

PEACH: The experiment with peach was initiated on March 6, 1965, and terminated on July 15, 1965. On May 2 (57 days) and July 6, 1965 (118 days) the height of each plant was measured and recorded, and above-ground growth characteristics were noted. After 131 days the plants were removed from the pots and soil separated from the roots. Some of the roots were examined with the aid of a dissecting microscope to determine symptoms of injury. The plants were dried at 70 C for 3 days, and dry weights of both tops and roots were individually recorded. The soil was thoroughly mixed, and two 100-cc samples from each pot were processed by the centrifugal-flotation technique (12). The nematodes recovered were counted, and the total number of nematodes per plot was calculated.

CENTIPEDE GRASS: This experiment was initiated on May 9, 1965, and terminated on October 16, 1965. Centipede grass was observed periodically for symptoms of nematode injury. Stolon lengths were measured 54 days after inoculation. At 54, 84, and 114 days after inoculation, the stolons were

TABLE 1. Dry weights of the tops and roots and numbers of *Criconemoides ornatus* recovered from peach plants 131 days after inoculation.

No. specimens in inoculum	Dry weight (g)[a]		No. specimens recovered/pot
	Tops	Roots	
Control	8.72	4.82	0
500	8.61	4.87	64
1,000	8.66	4.98	127
10,000	8.68	4.93	785

[a] Differences not significant. Each figure is the mean of 10 replicates.

clipped, dried at 70 C for 3 days, and weighed. After 159 days the plants were removed from the soil and the tops separated from the roots. The roots were washed in running water and examined with the aid of a dissecting microscope. Dry weights of tops and roots then were determined as described above. The soil was mixed thoroughly and a 100-cc sample from each pot was processed by the centrifugal-flotation technique (12). Nematodes were counted, and the number per pot was computed.

RESULTS

PEACH: No differences in plant height or dry weight of tops and roots of the inoculated and uninoculated peach plants were observed at any time (Table 1). Careful examination of the root systems on termination of the experiment revealed no visible damage by *C. ornatus*. The number of nematode specimens recovered from each replicate at the end of the experiment was in every case considerably fewer than the number introduced (Table 1). The specimens were transparent and either moribund or dead.

CENTIPEDE GRASS: Soon after the experiment began, growth of the centipede grass was less in pots which received 10,000 ring nematodes than in other treatments. Stolon lengths 54 days after inoculation were shortest in treatments which received 10,000 nematodes (Table 2). Dry weights of tops of

TABLE 2. Stolon lengths and dry weights of the tops and roots of centipede grass, and numbers of *Criconemoides ornatus* recovered 159 days after inoculation.

No. specimens in inoculum	Length of stolons (cm) after 54 days	Total dry wt. (g)		No. specimens recovered/pot
		Tops	Roots	
Control	27.2[a]	5.95[a]	2.66[a]	0
500	34.2[a]	6.13[a]	2.47[a]	213,900
1,000	31.6[a]	4.81[b]	2.05[ab]	199,350
10,000	16.4[b]	4.39[b]	1.70[bc]	73,300
Significance level†	1%	1%	5%	

† Treatment means having the same superscript letter are not significantly different. Each figure is the mean of 10 replicates.

control plants and those inoculated with 500 nematodes were significantly greater than those of plants inoculated with 1,000 and 10,000 specimens. No significance occurred between weights of plants inoculated with 1,000 and 10,000 specimens.

Root systems of plants inoculated with 10,000 nematodes were much discolored and reduced in size compared to the controls; those of plants inoculated with 500 or 1,000 nematodes exhibited much less discoloration and size reduction. Substantiating the observations of Streu *et al.* (15) and Hung and Jenkins (6), we also observed *C. ornatus* deeply embedded in the cortical tissue and doubt that this species can be strictly classed as an ectoparasite.

DISCUSSION

Growth of peach plants inoculated with *C. ornatus* was no different than growth of uninoculated plants. The number of nematodes recovered was always fewer than the number used as inoculum, and those recovered were transparent and either moribund or dead. We conclude, therefore, that under the conditions of our experiment, *C. ornatus* is neither pathogenic nor parasitic on 'Lovell' peach. If no feeding occurred on peach,

then some of the nematodes lived 131 days (end of test) upon stored food. Since Lownsbery (10) showed that 'S-37' and 'Lovell' peach were not injured by *C. xenoplax*, in his experiments, we showed that 'Lovell' peach is not a host of *C. ornatus*, and Hung and Jenkins (6) showed that *C. curvatum* caused extensive pits and lesions on peach, it would appear that different species of *Criconemoides* differ in pathogenicity to peach.

Growth of centipede grass was retarded by population levels of 10,000 and 1,000 *C. ornatus* per 15-cm pot. The lower inoculation level of 500 nematodes apparently stimulated growth as measured by dry weights of tops and roots; this parallels the finding of Madamba, Sasser and Nelson (11) that low to moderate numbers of *Meloidogyne* stimulated growth of some plants. Our data show that *C. ornatus* is a pathogen to centipede grass. The 1,000-specimen level (0.6/cc of soil) is found in almost every sample of centipede grass examined in Florida. The 10,000-specimen level (6/cc of soil) and above is found frequently. From these data, it seems apparent that centipede grass in Florida is endemically infected and usually damaged to some extent by ring nematodes, but that large populations must be present before extensive damage occurs.

Terminal populations of *C. ornatus* on centipede grass inoculated with 500 and 1,000 specimens were much greater than those inoculated with 10,000 nematodes (Table 2). Possibly the plants in soil infested with 500 and 1,000 nematodes became established sooner and grew faster than those inoculated with 10,000 nematodes. Thus, with a larger root system and more feeding sites, the population could increase rapidly. With 10,000 nematodes per pot the root growth may have been limited from the beginning thereby reducing the number of feeding sites. Under such conditions many of the inoculum specimens may have died of starvation, and thus reproduction would have been diminished.

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