Population Behavior of *Meloidogyne graminis* in Field-grown 'Tifgreen' Bermudagrass[1]

C. W. LAUGHLIN AND A. S. WILLIAMS[2]

Abstract: The vertical distribution and overwintering potential of *Meloidogyne graminis* on field-grown *Cynodon* sp (var. 'Tifgreen' bermudagrass) was measured. Total populations of *M. graminis* were found to be lowest in March and highest in May. Larvae were most abundant in the top 5-cm of soil during periods favoring bermudagrass growth and least numerous during periods of host dormancy. Throughout the year, more than 50% of the nematodes recovered each month were in roots within the top 5-cm of the soil profile. Both eggs and larvae of *M. graminis* overwinter in eastern Virginia. *Key Words:* Root-knot nematodes, Vertical distribution, Overwintering potential, *Cynodon* sp.

The distribution of plant parasitic nematodes in the soil profile has been correlated with depth of host roots (3, 10), moisture and temperature gradients (8), location and sampling dates (1, 6).

In the present field study the seasonal fluctuation in vertical distribution and overwintering potential of *Meloidogyne graminis* (Sledge & Golden) Whitehead, on 'Tifgreen' bermudagrass in Virginia was investigated.

MATERIALS AND METHODS

A 3 × 3-m area at the Tidewater Experiment Station, Holland, Virginia was sterilized with methyl bromide, fertilized with 560 kg/ha 10-10-10 fertilizer and limed to *p*H 6.5. The fertilizer and lime were incorporated into the sandy loam soil to a 15-cm depth. An aluminum bordering material was placed around a 1.8 × 2.7 m section within the sterilized area. On June 20, 1967, this plot was planted with stolons of 'Tifgreen' bermudagrass previously rooted in the greenhouse. A suspension of *M. graminis* larvae (100,000/7.5 liters) was sprinkled uniformly over the 4.9 m^2 area. The infested stolons were covered with sterilized soil and watered. The plot was irrigated daily during the first two weeks. No other maintenance practices were followed throughout the investigation.

Three replicate soil samples were taken at monthly intervals from August 1967 through July 1968. These samples were dug by hand with a 10.2-cm diam core cutter to a depth of 15-cm. The profile of each soil core was divided into three 5-cm zones from top to bottom. A 250-cc soil sample was collected from each zone, and nematodes were extracted using a modified centrifugal-flotation technique (9). A 0.5-g root sample was collected from each zone, washed with tap water, stained with acid fuchsin in 1:1 mixture of absolute alcohol and glacial acetic acid, cleared in chloral hydrate solution, and examined under the microscope. Observed population densities were recorded.

A bioassay technique was used to determine the infectivity of winter survival stages of *M. graminis*. A single egg mass from each zone was placed near the root of a 'Tifgreen' bermudagrass sprig growing in a 100 cc plastic tube. In other tubes, bermudagrass

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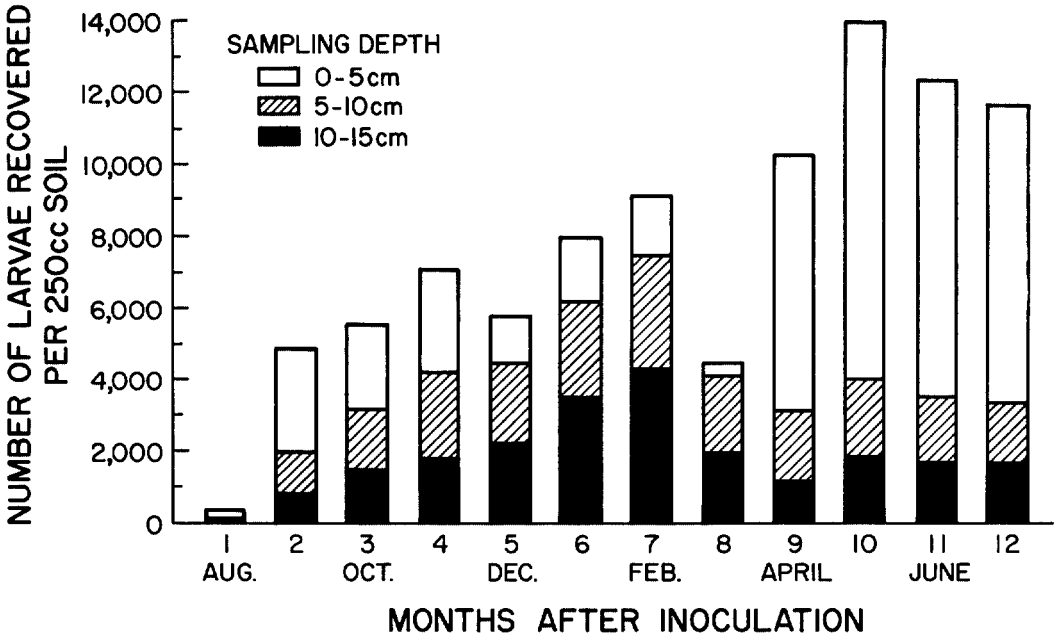

FIG. 1. Distribution of *Meloidogyne graminis* larvae recovered from around 'Tifgreen' bermudagrass roots growing in a sandy loam soil at Holland, Virginia. Monthly samples were taken at three depths from August 1967 to July 1968.

roots were inoculated with 100 larvae extracted from each profile sample. The plants were maintained at 27 C for 21 days, at which time the roots were washed free of soil, stained, and the number of nematodes in 0.5g of root recorded.

RESULTS AND DISCUSSION

The number of *M. graminis* larvae and adults recovered from various soil depths throughout the year is tabulated in Fig. 1 and 2. The highest population density of *M. graminis* larvae was observed in May, and the lowest, in March (Fig. 1). August data represent the initial population and are not indicative of general trends. In September, October, and November larvae were most abundant in the top 5-cm of soil, and least prevalent at the 10–15 cm depth. The number of *M. graminis* larvae recovered in the top 5-cm of soil from December through March was lower than the number recovered from either of the other two sampling depths. Larval densities decreased in the 10–15 cm depth from January to April. The highest number of *M. graminis* found in the roots was observed in June, and the lowest number in March (Fig. 2). Throughout the study more than 50% of the nematodes recovered each month were within roots in the top 5 cm of the soil profile. The lowest number of nematodes was recovered from roots in the 10–15 cm zone.

Rapid increases in field densities of *M. graminis* occurred during periods of rapid root growth when the food supply probably exceeded maintenance requirements, supports recent work in nematode population dynamics. Seinhorst (7) described the rate of increase of plant parasitic nematodes as density dependent, i.e. the amount of food necessary per unit of time is proportional to

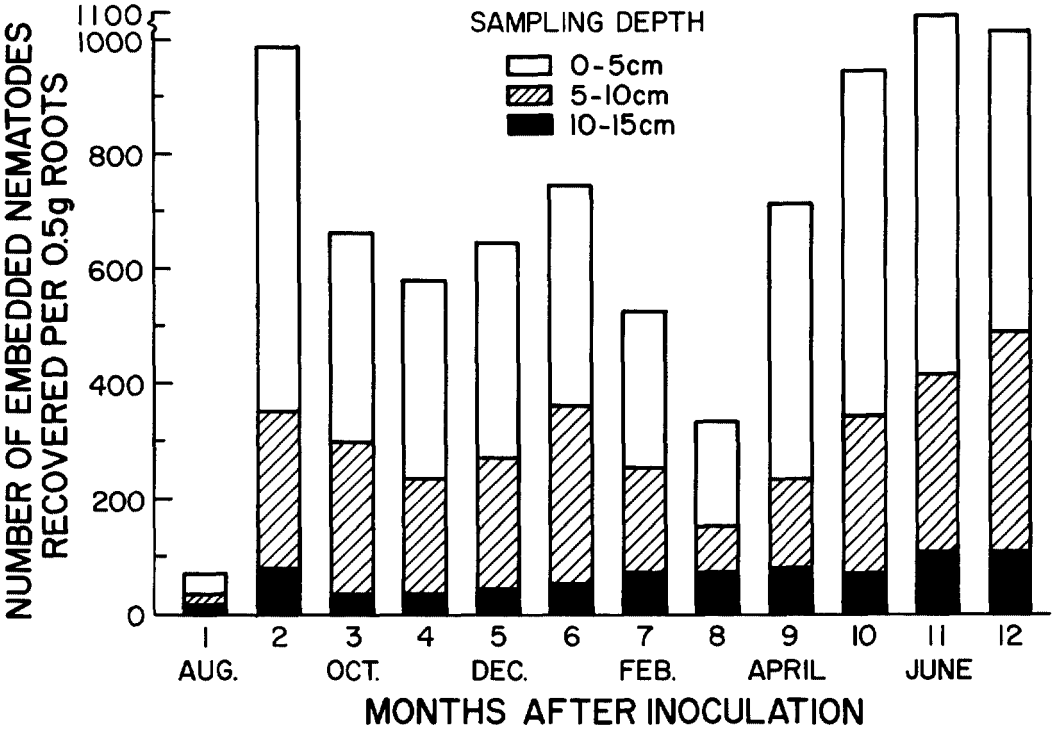

FIG. 2. *Meloidogyne graminis* recovered from roots of 'Tifgreen' bermudagrass growing in a sandy loam soil at Holland, Virginia. Monthly samples were taken at three depths from August 1967 to July 1968.

population size. Jones, *et al.* (2) suggested that final nematode population densities were independent of the initial population size, and that the growth of the root system determined the size of the population supported on the roots. The decrease in the number of *M. graminis* found in roots following a fall maximum may be attributed either to reduced nematode activity at lower soil temperatures, changes in the suitability and activity of the host roots related to dormancy, or a combination of both factors.

This field study supported laboratory studies which showed *M. graminis* invasion was greatest in bermudagrass roots growing in the top 5-cm of the soil profile and decreased with increased depth (5). This apparent increase in larval activity in the upper soil profile may be attributed to environmental factors. The laboratory studies eliminated soil moisture, porosity, texture, and *p*H as soil variables influencing *M. graminis* activity in the upper soil profile, but gas exchanges at varying soil depths could have a marked effect on nematode ingress. Evidence suggests that root exudates are associated with the orientation of nematodes to roots (4). Root exudates from newly emerged adventitious roots from the crown region of bermudagrass may exert a greater influence on nematode activity than roots deeper in the soil.

The bioassay showed no difference in the infectivity of nematodes which survived, either as egg masses or larvae, in each profile zone from October through April (Table 1).

TABLE 1. The infectivity of *Meloidogyne graminis* overwintering stages recovered from 'Tifgreen' bermudagrass roots and associated sandy loam soil collected at Holland, Virginia. Monthly samples were taken at three depths from October, 1967 to April 1968.

	Recovery depth (cm)					
	0–5		5–10		10–15	
Month	Eggs[1]	Larvae[2]	Eggs[1]	Larvae[2]	Eggs[1]	Larvae[2]
October	24a[3]	35 b	21a	27a	18a	31a
November	32a	38 b	19a	34a	24a	35a
December	21a	28 b	28a	39a	19a	37a
January	29a	19ab	31a	24a	23a	24a
February	26a	25 b	15a	33a	21a	39a
March	18a	9a	31a	27a	23a	29a
April	32a	38 b	24a	36a	23a	30a

[1] One egg mass used as inoculum.
[2] 100 larvae in inoculum.
[3] Mean value of three replications. Column means with the same letter are not significantly different ($P = 0.05$) according to Duncan's Multiple Range Test.

With a single exception, larvae from these zones during this period demonstrated no difference in ability to penetrate host roots. The ingression of larvae collected from the top profile zone in March was noticeably lower.

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