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Notes: Differences Among Nematode Populations In Tall Fescue Pastures In North, Central, And South Alabama

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DIFFERENCES AMONG NEMATODE POPULATIONS IN TALL FESCUE PASTURES IN NORTH, CENTRAL, AND SOUTH ALABAMA[1]

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Abstract

Surveys of nematode populations in tall fescue (*Festuca arundinacea* Schreb.) pastures in north, central, and south Alabama in 1982 and 1983 showed significant differences in frequency of occurrence of many nematode species by geographical region. Although nematode damage has been implicated in the poor adaptation of tall fescue to the sandy soils of the extreme Southeast, many plant parasitic nematode species occurred in low frequency in south Alabama pastures. There were significant differences in the frequency of occurrence of *Paratrichodorus christiei* (Allen) Siddiqi by region. This nematode occurred with relatively high frequency in south Alabama in both years. There were no differences in the frequency of occurrence of *Helicotylenchus* spp. [principally *Helicotylenchus* dihystera (Cobb) Sher]. However, *Helicotylenchus* spp. occurred with high frequency and in high numbers in all three geographical areas.

Additional index words: **Persistence, *Aphelenchus, Festuca arundinacea, Helicotylenchus* (principally), *Heterodera, Hoplolaimus, Meloidogyne, Paratrichodorus, Paratylenchus Pratylenchus, Tylenchorhynchus, Xiphinema.***

TALL fescue (*Festuca arundinacea* Schreb.) is not well adapted to sandy, droughty soils (1) that make up a sizable portion of the extreme southeastern United States. Yet, from a plant breeder's viewpoint, tall fescue probably has more potential for being adapted to that area than any other cool season grass species. In a comparison of tall fescue, orchard grass (*Dactylis glomerata* L.), and bromegrass (*Bromus inermis* Leyss.) conducted in southern Alabama, only tall fescue survived for more than 1 year (4).

Hoveland et al. (5) demonstrated that nematodes destroyed tall fescue roots at depths beyond 10 cm in a fine sandy loam soil in central Alabama. In tests comparing untreated plots with nematicide treated plots, they showed that nematode susceptibility contributed significantly to tall fescue's poor performance on sandy soils. Root pruning by nematodes contributed to drought susceptibility by restricting the grass roots to a shallow layer of soil. They concluded that breeding for host plant resistance to nematodes will be necessary to extend the geographical range of tall fescue southward.

Little information is available regarding the geographic distribution of nematode species parasitic to tall fescue. Hoveland et al. (5) identified *Hopolaimus galeatus* (Cobb) Thorne, *Telenchorhynchus claytonia* Steiner, and possibly *Paratrichodorus christiei* (Allen) Siddigi as being important factors in limiting tall fescue yield and persistence, but only at one location in central Alabama. Numerous other nematodes have also been reported to infect tall fescue (2,3).

If breeding for nematode resistance will indeed be necessary to extend the geographical range of tall fescue southward (5), it is necessary that the nematodes be identified which infect a wide cross section of tall fescue stands in the sandy coastal plain soils of the Deep South. The objectives of this study were to identify the nematodes in tall fescue pastures in south Alabama where tall fescue is not adapted, and to compare those populations with nematode populations in tall fescue pastures in north and central Alabama where tall fescue is better adapted.

Materials and Methods

Nematodes were surveyed in 10, 7, and 13 tall fescue pastures in north, central, and south Alabama, respectively, in 1982 and 1983. Each pasture was subdivided into approximately 2-ha sites which were the experimental units in this study. A total of 28, 19, and 40 sites, respectively, were sampled 1 Mar. to 22 Apr. 1982 and 27, 17, and 42 sites, respectively, were sampled 19 Jan. to 18 Feb. 1983. Approximately 75 8 to 10 cm deep soil-root cores were taken directly under tall fescue plants at random in each site using a 2.5-cm diam soil probe. Cores were composited, mixed well, and analyzed in the lab. Nematodes in root and soil fractions were counted using the incubation technique described by Rodriguez-Kabana and Pope (7).

A bionomial data set was made for each year with individual nematodes either being present (=1) or absent (=0) in each site. A modified F test for binomial data outlined by Li with

$$F' = (\text{among sample mean square})/[\bar{Y}\ (1-\bar{Y})]$$

and $\bar{Y}$ = overall mean (6) was used to test for differences between the frequency of occurrence of each nematode species in north, central, and south Alabama.

Results and Discussion

Mean nematode counts and standard errors are shown for north, central, and south Alabama in Tables 1 and 2. Variation in numbers was considerable between sites. There were higher numbers of *Helicotylenchus* spp. [principally *Helicotylenchus dihystera* (Cobb) Sher] than any other nematode in soil samples from both years.

Since the numbers of individual nematodes of each species are variable and would be expected to fluctuate seasonally in a study such as this, it is more meaningful to look at the frequency of occurrence in a region. The frequencies of occurrence of 10 nematodes and the F′ statistic used to determine dif-

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Table 1. Mean populations and standard errors of ten nematodes in tall fescue pastures in north, central, and south Alabama in 1982.

	Soil samples						Root samples					
	North		Central		South		North		Central		South	
Nematode genera	no./100 cm³ soil	SE	no./100 cm³ soil	SE	no./100 cm³ soil	SE	no./5 g roots	SE	no./5 g roots	SE	no./5 g roots	SE
Aphelenchus	0.2	±0.1	0.6	±0.3	0.0	±0.0	0.0	±0.0	0.0	±0.0	0.02	±0.01
Helicotylenchus	7.9	±1.6	5.4	±0.9	11.5	±2.6	0.3	±0.2	1.4	±0.4	1.9	±0.3
Heterodera	0.0	±0.0	0.0	±0.0	0.0	±0.0	0.0	±0.0	0.0	±0.0	0.0	±0.0
Hoplolaimus	1.3	±0.5	0.5	±0.4	0.0	±0.0	0.8	±0.4	0.08	±0.08	0.0	±0.0
Meloidogyne	0.0	±0.0	0.0	±0.0	0.2	±0.1	0.0	±0.0	0.0	±0.0	0.0	±0.0
Paratrichodorus	0.1	±0.1	4.3	±1.2	5.9	±0.9	0.0	±0.0	0.0	±0.0	0.0	±0.0
Paratylenchus	2.3	±1.1	0.2	±0.2	0.04	±0.04	0.6	±0.4	0.0	±0.0	0.0	±0.0
Pratylenchus	0.2	±0.1	0.08	±0.08	0.04	±0.03	0.07	±0.07	0.0	±0.0	0.07	±0.05
Tylenchorhynchus	3.0	±1.0	1.3	±1.0	0.0	±0.0	0.0	±0.0	0.0	±0.0	0.0	±0.0
Xiphinema	0.8	±0.2	2.6	±0.8	2.2	±0.6	0.1	±0.0	0.08	±0.08	0.0	±0.0

Table 2. Mean populations and standard errors of ten nematodes in tall fescue pastures in north, central, and south Alabama in 1983.

	Soil samples						Root samples					
	North		Central		South		North		Central		South	
Nematode genera	no./100 cm³ soil	SE	no./100 cm³ soil	SE	no./100 cm³ soil	SE	no./5 g roots	SE	no./5 g roots	SE	no./5 g roots	SE
Aphelenchus	2.0	±0.5	0.4	±0.3	0.02	±0.02	0.0	±0.0	0.0	±0.0	0.0	±0.0
Helicotylenchus	11.9	±2.1	10.0	±1.4	5.6	±1.0	0.3	±0.2	3.1	±1.5	0.9	±0.3
Heterodera	0.8	±0.3	0.0	±0.0	0.0	±0.0	0.3	±0.3	0.0	±0.0	0.0	±0.0
Hoplolaimus	3.7	±1.2	1.4	±0.8	0.2	±0.2	0.7	±0.3	0.3	±0.3	0.0	±0.0
Meloidogyne	0.0	±0.0	2.0	±1.0	0.04	±0.04	0.0	±0.0	0.0	±0.0	0.0	±0.0
Paratrichodorus	0.6	±0.3	4.9	±1.5	3.6	±0.8	0.0	±0.0	0.0	±0.0	0.05	±0.03
Paratylenchus	5.0	±3.9	0.0	±0.0	0.0	±0.0	1.1	±0.7	0.0	±0.0	0.0	±0.0
Pratylenchus	1.9	±0.7	0.7	±0.4	0.6	±0.4	0.03	±0.03	0.1	±0.1	0.0	±0.0
Tylenchorhynchus	7.0	±2.2	0.2	±0.2	0.3	±0.3	0.0	±0.0	0.0	±0.0	0.0	±0.0
Xiphinema	1.1	±0.4	5.5	±1.4	4.6	±1.3	0.03	±0.03	0.0	±0.0	0.0	±0.0

Table 3. F′ values and the frequency of occurrence of ten nematodes in tall fescue pastures in north, central, and south Alabama in 1982.

	Root samples				Soil samples			
Nematode genera	North	Central	South	F′†	North	Central	South	F′
	freq.‡				freq.			
Aphelenchus	0	0	0	0.59	14	26	0	5.15*
Helicotylenchus	21	58	78	10.50*	75	95	90	2.30
Heterodera	0	0	0	--	0	0	0	--
Hoplolaimus	18	5	0	4.14*	25	11	0	5.55*
Meloidogyne	0	0	0	--	0	0	15	3.79*
Paratrichodorus	0	0	0	--	11	68	85	19.19*
Paratylenchus	11	0	0	3.27*	32	16	3	5.70*
Pratylenchus	4	0	5	0.48	11	5	5	0.47
Tylenchorhynchus	0	0	0	--	39	21	0	9.03*
Xiphinema	7	5	0	1.38	46	74	45	2.35

* Significant at P = 0.05.
† F′ value is undefined [F′ = (0/0)].
‡ freq. = (number sites in which nematode occurred)/(number sites sampled).

Table 4. F′ values and the frequency of occurrence of ten nematodes in tall fescue pastures in north, central, and south Alabama in 1983.

	Root samples				Soil samples			
Nematode genera	North	Central	South	F′†	North	Central	South	F′
	freq.‡				freq.			
Aphelenchus	0	0	0	-	48	18	2	10.88*
Helicotylenchus	15	53	29	6.18*	74	88	60	2.54
Heterodera	4	0	0	1.11	19	0	0	5.80*
Hoplolaimus	19	12	0	3.95*	33	24	2	6.19*
Meloidogyne	0	0	0	--	0	29	2	8.29*
Paratrichodorus	0	0	7	1.63	26	71	55	5.00*
Paratylenchus	7	0	0	2.24	11	0	0	3.40*
Pratylenchus	4	6	0	1.09	26	24	5	2.54
Tylenchorhynchus	0	0	0	--	48	12	2	11.70*
Xiphinema	4	0	0	1.11	30	78	52	4.67*

* Significant at P = 0.05.
† F′ value is undefined [F′ = (0/0)].
‡ freq. = (number sites in which nematode occurred/number sites sampled).

ferences between north, central, and south Alabama are shown in Tables 3 and 4.

There were significant differences between regions for *Helicotylenchus* spp. and *Hoplolaimus* spp. in root samples in both years, and for *Paratylenchus* spp. in root samples in 1982. Species of *Hoplolaimus* and *Paratylenchus* were not found in root samples in south Alabama. *Helicotylenchus* spp. tended to occur with lowest frequency in north Alabama.

In soil samples, significant differences between geographical regions are shown for the frequency of occurrence of many of the nematodes. However, in most cases where significant differences were shown, the lowest frequencies occurred in south Alabama. Differences were found between geographical regions for *P. christiei* in both years with the lowest frequencies tending to occur in north Alabama. A significant difference between geographical areas for *Xiphinema* in soil samples was shown only in 1983. In both years, it occurred in moderate frequencies in south Alabama. Other potentially damaging nematodes, with the exception of *Helicotylenchus* spp., did not occur in high enough frequencies in south Alabama to be of apparent concern.

In soil samples, frequency of occurrence of *Helicotylenchus* spp. was not significantly different between regions. However, these were shown to occur with high frequencies in all three regions. Since these nematodes occur quite commonly in high numbers under tall fescue, they may affect the adaptation of tall fescue to southern Alabama because the effects of root damage may be much more severe in the sandy soil of southern Alabama than in the heavier textured soils of central and northern Alabama.

Of the nematodes suggested by Hoveland et al. (5) as being important on tall fescue, only *P. christiei* was found with relatively high frequency in southern Alabama. *T. claytoni* and *Hoplolaimus* spp. were rarely found in the southern Alabama sites. In our studies, *Helicotylenchus* spp. and *P. christiei*, and possibly *Xiphinema* spp., appeared to be the most important in the sandy soils of the Deep South. Therefore, any breeding project to select for nematode resistance in order to extend the southern range of tall fescue should be directed at these species.

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