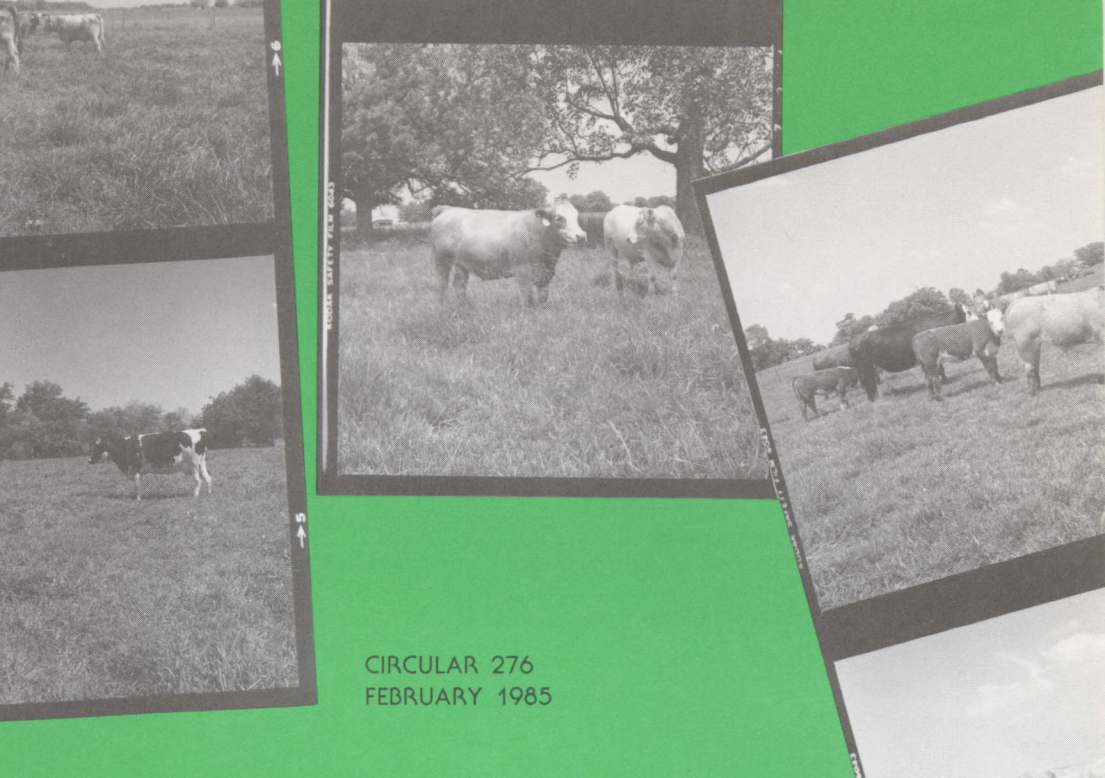

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Regional Differences in Nematode Populations of Tall Fescue Pastures in Alabama

ALABAMA AGRICULTURAL EXPERIMENT STATION
GALE A. BUCHANAN, DIRECTOR

AUBURN UNIVERSITY
AUBURN UNIVERSITY, ALABAMA

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Regional Differences in Nematode Populations of Tall Fescue Pastures in Alabama

J. F. PEDERSEN and R. RODRIGUEZ-KABANA[1]

TALL FESCUE (*Festuca arundinacea* Schreb.) is commonly grown throughout central and north Alabama. However, it is not well adapted to the sandy, droughty soils found in the southern portion of this State, and in much of the extreme Southeastern United States (*1*). From a plant breeder's viewpoint, tall fescue probably has more potential for being adapted to that area than any other cool-season perennial grass species. In a south Alabama comparison of tall fescue, orchardgrass (*Dactylis glomerata* L.), and bromegrass (*Bromus inermis* Leyss.), only tall fescue survived for more than one year (*4*).

Hoveland et al. (*5*) demonstrated that nematodes destroyed tall fescue roots at depths below 4 inches in a fine sandy loam soil in central Alabama. Their test comparing untreated plots with nematicide-treated plots showed that nematode susceptibility contributed significantly to tall fescue's poor performance in sandy soils. Damage to roots by nematodes contributed to drought susceptibility by restricting the fescue roots to a shallow layer of soil. They concluded that breeding for host plant resistance to nematodes would 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 lance (*Hopolaimus galeatus* (Cobb) Thorne), stunt (*Tylenchorhynchus claytoni* Steiner), and possibly stubby root (*Paratrichodorus christiei* (Allen) Siddiqi) nematodes

[1] Respectively, Assistant Professor of Agronomy and Soils; and Professor of Botany, Plant Pathology, and Microbiology.

TABLE 1. SEVERAL NEMATODE GENERA AND THEIR COMMON NAMES

Scientific name	Common name
Aphelenchus	—
Helicotylenchus	Spiral
Heterodera	Cyst
Hoplolaimus	Lance
Meloidogyne	Root knot
Paratrichodorus	Stubby root
Paratylenchus	Pin
Pratylenchus	Meadow
Tylenchorhynchus	Stunt
Xiphinema	—

as being important factors 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*). The scientific and common names of several nematodes associated with tall fescue are shown in table 1.

If breeding for nematode resistance will indeed be necessary to extend the geographical range of tall fescue southward (*5*), identification of the nematodes which commonly infect tall fescue stands in Coastal Plain soils of the Deep South is necessary. The objectives of this study were to identify the nematodes which infect tall fescue in south Alabama, 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

Two nematode surveys were conducted. The first was a preliminary roadside collection. In November 1981, two samples each were obtained in 19 south Alabama counties. One other south Alabama county was included with one sample only. Samples consisted of an entire fescue plant with approximately 6 inches of its roots and the surrounding soil intact. These were dug with a spade and were stored in plastic bags for transportation to the laboratory. The nematodes present in the root and soil fractions were counted using the incubation technique of Rodriguez-Kabana and Pope (*7*). The frequency of occurrence, mean number of each species of nematode identified, and its standard error were calculated for the 39 sites sampled.

The second survey was conducted so that differences in nematode populations in Alabama tall fescue pastures located in different portions of the State could be detected. 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 5-acre sites which were the experimental units in this study. A total of 28, 19, and 40 sites, respectively, were sampled March 1 to April 22, 1982, and 27, 17, and 42 sites, respectively, were sampled January 19 to February 18, 1983. Approximately 75 soil-root cores were taken 3-4 inches deep directly under tall fescue plants at random in each site using a 1-inch diameter soil probe. Cores were composited, mixed well, and analyzed in the lab. Nematodes in root and soil fractions were counted as above.

A binomial 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

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

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

Roadside Survey

In contrast to the information collected by Hoveland et al. (*5*) in central Alabama, spiral (*Helicotylenchus* spp.) nematodes occurred at higher frequencies and in higher numbers than did any other plant parasitic nematode in the south Alabama roadside collection, table 2. Although inconclusive, this indicated that plant parasitic nematodes were found in tall fescue in south Alabama and that the nematode populations were different from those found in the central portion of the State. Therefore, a study to determine differences in nematode populations in tall fescue pastures in north, central, and south Alabama was initiated.

TABLE 2. FREQUENCY OF OCCURRENCE, MEAN NUMBERS, AND STANDARD ERRORS OF 10 NEMATODES FOUND IN 20 SOUTH ALABAMA COUNTIES IN 1981

Nematode	Frequency		No. per 100 cm^3 soil	SE	No. per 5 g roots	SE
	In Soil	In roots				
	Pct.	*Pct.*				
Aphelenchus	3	3	0.8	±0.8	0.01	±0.01
Spiral	77	67	28.7	±8.5	7.3	±1.9
Cyst	0	0	.0	—	.0	—
Lance	0	0	.0	—	.0	—
Root knot	8	5	.4	± .3	.2	± .1
Stubby root	0	0	.0	—	.0	—
Pin	3	3	.4	± .4	.4	± .4
Meadow	0	3	.0	—	.1	± .1
Stunt	0	3	.0	—	.03	± .03
Xiphinema	0	0	.0	—	.0	—

Comparison of North, Central, and South Alabama Pastures

Mean nematode counts and standard errors are shown for north, central, and south Alabama in tables 3 and 4. Variation in numbers was considerable among sites. Again, there were higher numbers of spiral 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 differences among north, central, and south Alabama are shown in tables 5 and 6.

There were differences among regions for spiral and lance nematodes in root samples in both years, and for pin nematodes (*Paratylenchus* spp.) in root samples in 1982. Lance and pin nematodes were not found in root samples in south Alabama. Spiral nematodes tended to occur with lowest frequency in north Alabama.

In soil samples, differences among geographical regions are shown for the frequency of occurrence of many of the nematodes. In most cases where differences were shown, however, the lowest frequencies occurred in south Alabama. Differences were found among geographical regions for stubby root nematodes in both years with the lowest frequencies tending to occur in north Alabama. A difference among geographical areas for *Xiphinema* in soil samples was shown only

TABLE 3. MEAN POPULATIONS AND STANDARD ERRORS OF 10 NEMATODES IN TALL FESCUE PASTURES IN NORTH, CENTRAL, AND SOUTH ALABAMA IN 1982

Nematode	Soil samples						Root samples					
	North		Central		South		North		Central		South	
	No. per 100 cm^3 soil	SE	No. per 100 cm^3 soil	SE	No. per 100 cm^3 soil	SE	No. per 5 g roots	SE	No. per 5 g roots	SE	No. per 5 g roots	SE
Aphelenchus	0.2	±0.1	0.6	±0.3	.0	—	.0	—	.0	—	0.02	±0.01
Spiral	7.9	±1.6	5.4	± .9	11.5	±2.6	.3	±.2	1.4	± .4	1.9	± .3
Cyst	.0	—	.0	—	.0	—	.0	—	.0	—	.0	—
Lance	1.3	± .5	.5	± .4	.0	—	.8	±.4	.08	±.08	.0	—
Root knot	.0	—	.0	—	.2	± .1	.0	—	.0	—	.0	—
Stubby root	.1	± .1	4.3	±1.2	5.9	± .9	.0	—	.0	—	.0	—
Pin	2.3	±1.1	.2	± .2	.04	± .04	.6	±.4	.0	—	.0	—
Meadow	.2	± .1	.08	± .08	.04	± .03	.07	±.07	.0	—	.07	± .05
Stunt	3.0	±1.0	1.3	±1.0	.0	± .0	.0	—	.0	—	.0	—
Xiphinema	.8	± .2	2.6	± .8	2.2	± .6	.1	—	.08	±.08	.0	—

TABLE 4. MEAN POPULATIONS AND STANDARD ERRORS OF 10 NEMATODES IN TALL FESCUE PASTURES IN NORTH, CENTRAL, AND SOUTH ALABAMA IN 1983

Nematode	Soil samples						Root samples					
	North		Central		South		North		Central		South	
	No. per 100 cm^3 soil	SE	No. per 100 cm^3 soil	SE	No. per 100 cm^3 soil	SE	No. per 5 g roots	SE	No. per 5 g roots	SE	No. per 5 g roots	SE
Aphelenchus	2.0	±0.5	0.4	±0.3	0.02	±0.02	.0	—	.0	—	.0	—
Spiral	11.9	±2.1	10.0	±1.4	5.6	±1.0	.3	±0.2	3.1	±1.5	.9	±.3
Cyst	.8	± .3	.0	—	.0	—	.3	± .3	.0	—	.0	—
Lance	3.7	±1.2	1.4	± .8	.2	± .2	.7	± .3	.3	± .3	.0	—
Root knot	.0	—	2.0	±1.0	.04	± .04	.0	—	.0	—	.0	—
Stubby root	.6	± .3	4.9	±1.5	3.6	± .8	.0	—	.0	—	.05	±.03
Pin	5.0	±3.9	.0	—	.0	—	1.1	± .7	.0	—	.0	—
Meadow	1.9	± .7	.7	± .4	.6	± .4	.03	± .03	.1	± .1	.0	—
Stunt	7.0	±2.2	.2	± .2	.3	± .3	.0	—	.0	—	.0	—
Xiphinema	1.1	± .4	5.5	±1.4	4.6	±1.3	.03	± .03	.0	—	.0	—

TABLE 5. F′ VALUES AND THE FREQUENCY OF OCCURRENCE OF 10 NEMATODES IN TALL FESCUE PASTURES IN NORTH, CENTRAL, AND SOUTH ALABAMA IN 1982[1]

Nematode	Frequency in root samples				Frequency in soil samples			
	North	Central	South	F′	North	Central	South	F′
Aphelenchus	0	0	0	0.59	14	26	0	5.15*
Spiral	21	58	78	10.50*	75	95	90	2.30
Cyst	0	0	0	—	0	0	0	—
Lance	18	5	0	4.14*	25	11	0	5.55*
Root knot	0	0	0	—	0	0	15	3.79*
Stubby root	0	0	0	—	11	68	85	19.19*
Pin	11	0	0	3.27*	32	16	3	5.70*
Meadow	4	0	5	.48	11	5	5	.47
Stunt	0	0	0	—	39	21	0	9.03*
Xiphinema	7	5	0	1.38	46	74	45	2.35

* Significant at P = .05.

[1] Frequency = $\frac{\text{number sites in which nematode occurred}}{\text{number sites sampled}}$; F′ value is undefined ($F' = \frac{0}{0}$).

in 1983. In both years, it occurred in moderate frequencies in south Alabama. Other potentially damaging nematodes, with the exception of spiral nematodes, did not occur in high enough frequencies in south Alabama to be of apparent concern.

In soil samples, frequency of occurrence of spiral nematodes was not different among 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

TABLE 6. F′ VALUES AND THE FREQUENCY OF OCCURRENCE OF 10 NEMATODES IN TALL FESCUE PASTURES IN NORTH, CENTRAL, AND SOUTH ALABAMA IN 1983[1]

Nematode	Frequency in root samples				Frequency in soil samples			
	North	Central	South	F′	North	Central	South	F′
Aphelenchus	0	0	0	—	48	18	2	10.88*
Spiral	15	53	29	6.18*	74	88	60	2.54
Cyst	4	0	0	1.11	19	0	0	5.80*
Lance	19	12	0	3.95*	33	24	2	6.19*
Root knot	0	0	0	—	0	29	2	8.29*
Stubby root	0	0	7	1.63	26	71	55	5.00*
Pin	7	0	0	2.24	11	0	0	3.40*
Meadow	4	6	0	1.09	26	24	5	2.54
Stunt	0	0	0	—	48	12	2	11.70*
Xiphinema	4	0	0	1.11	30	78	52	4.67*

* Significant at P = .05.

[1] Frequency = $\frac{\text{number sites in which nematode occurred}}{\text{number sites sampled}}$; F′ value is undefined ($F' = \frac{0}{0}$).

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 stubby root was found with relatively high frequency in southern Alabama. Stunt and lance nematodes were rarely found in the southern Alabama sites. In the current studies, spiral and stubby root nematodes, and possibly *Xiphinema* spp., appeared to be the most important in the Coastal Plain soils. It appears that these data much more accurately reflect the true nematode populations found in the different areas of Alabama because of the large number of sites and the large number of cores that were composited as a sample from each site.

Therefore, it would appear that any breeding project to select for nematode resistance to extend the southern range of tall fescue should be directed at spiral, stubby root, and *Xiphinema* nematodes. However, the association of these nematodes with tall fescue does not in itself demonstrate that they cause any detrimental effects to tall fescue. Further research will be required to demonstrate that tall fescue's lack of adaptation to the sandy, droughty soils of the extreme Southeastern United States is directly attributable to these nematodes.

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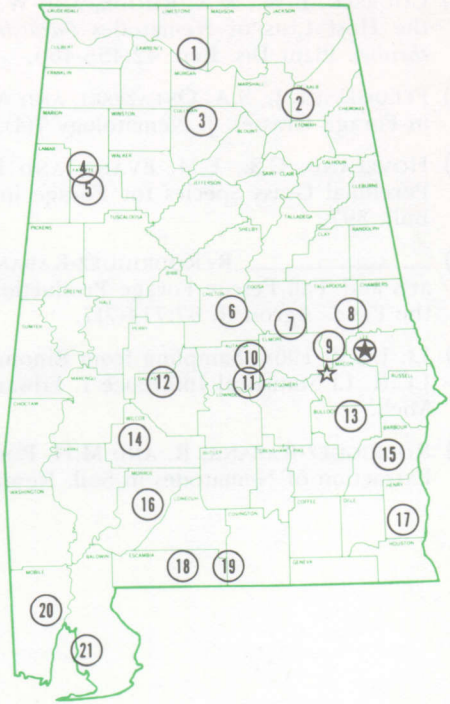

Research Unit Identification

★ Main Agricultural Experiment Station, Auburn.
☆ E. V. Smith Research Center, Shorter.

1. Tennessee Valley Substation, Belle Mina.
2. Sand Mountain Substation, Crossville.
3. North Alabama Horticulture Substation, Cullman.
4. Upper Coastal Plain Substation, Winfield.
5. Forestry Unit, Fayette County.
6. Chilton Area Horticulture Substation, Clanton.
7. Forestry Unit, Coosa County.
8. Piedmont Substation, Camp Hill.
9. Plant Breeding Unit, Tallassee.
10. Forestry Unit, Autauga County.
11. Prattville Experiment Field, Prattville.
12. Black Belt Substation, Marion Junction.
13. The Turnipseed-Ikenberry Place, Union Springs.
14. Lower Coastal Plain Substation, Camden.
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16. Monroeville Experiment Field, Monroeville.
17. Wiregrass Substation, Headland.
18. Brewton Experiment Field, Brewton.
19. Solon Dixon Forestry Education Center, Covington and Escambia counties.
20. Ornamental Horticulture Substation, Spring Hill.
21. Gulf Coast Substation, Fairhope.