HOST EFFICIENCY OF BERMUDAGRASS TO *MELOIDOGYNE INCOGNITA* AND *MELOIDOGYNE ARENARIA*†

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ABSTRACT

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Host efficiencies of ten hay and pasture bermudagrasses (*Cynodon dactylon*) for the four *Meloidogyne incognita* host races and three *M. arenaria* race 2 populations were determined in the greenhouse. Rooted stem cuttings were inoculated with 1 500 nematode eggs, then grown for 60 days, when eggs were extracted from roots and counted. The cultivars Coastal, Coastcross-1, Grazer, and Tifton 44 were resistant to all populations of both nematode species. The cultivars Alicia, Lancaster, and Tifton 78 were resistant to all populations of *M. arenaria* race 2, but in some cases supported significant reproduction by races 3 and 4 of *M. incognita*. The cultivars Calley and Maddox were susceptible to all races of *M. incognita* and all populations of *M. arenaria* race 2 except for one population of *M. arenaria* from North Carolina, which reproduced poorly or none on Calley. A common bermudagrass genotype was resistant to races 2 and 3 of *M. incognita* and resistant to all populations of *M. arenaria* race 2.

Key words: bermudagrass, *Cynodon dactylon, Meloidogyne arenaria, Meloidogyne incognita*, resistance, root-knot nematode.

RESUMEN

Windham, G. L., y G. E. Brink. 1991. Capacidad hospedadora del pasto bermuda a *Meloidogyne incognita* y *M. arenaria*. Nematrópica 21:89–96.

Se determinó bajo condiciones de invernadero la capacidad hospedadora de 10 cultivares de pasto bermuda (*Cynodon dactylon*) utilizados para heno y pasto a las cuatro razas de *Meloidogyne incognita* y a tres poblaciones de la raza 2 de *M. arenaria*. Esquejes de tallo fueron inoculados con 1 500 huevos. Después de 60 días, los huevos fueron extraídos de las raíces y contados. Los cultivares Coastal, Coastcross-1, Grazer, y Tifton 44 fueron resistentes a todas las poblaciones de ambas especies. Los cultivares Alicia, Lancaster, y Tifton 78 fueron resistentes a todas las poblaciones de *M. arenaria* raza 2, aunque en algunos casos, mostraron reproducción significativa de las razas 3 y 4 de *M. incognita*. Los cultivares Calley y Maddox fueron susceptibles a todas las razas de *M. incognita* y a todas las poblaciones de *M. arenaria* raza 2, excepto a una población de *M. arenaria* de Carolina del Norte, que se reprodujo mal en Calley. Un genotipo común de pasto bermuda fue

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resistente a las razas 2 y 3 de *M. incognita* y resistente a todas las poblaciones de *M. arenaria* raza 2.

Palabras clave: Cynodon dactylon, Meloidogyne arenaria, Meloidogyne incognita, nematodo de las agallas, pasto bermuda, resistencia.

INTRODUCTION

Bermudagrass (*Cynodon dactylon* (L.) Pers.) can be used in rotation with crops susceptible to root-knot nematodes (*Meloidogyne* spp.) to reduce nematode populations below damaging levels (3,8). An annual rotation with bermudagrass cv. Coastal, for example, reduced nematode populations sufficiently to allow certified vegetable transplants to be grown from seed year after year in fields infested with *M. incognita* (Kofoid and White) Chitwood (3). Coastal bermudagrass has been used in rotations with tobacco (*Nicotiana tabacum* L.) to reduce black shank in fields infested with root-knot nematodes and *Phytophthora parasitica* var. *nicotianae* (Breda de Haan) Tucker (8). Resistant bermudagrasses also improve the growth of the forage legume annual lespedeza (*Lespedeza striata* (Thunb.) H. & A.) when grown together in soil infested with root-knot nematodes (4). This crop and clovers (*Trifolium* spp.) are excellent hosts for root-knot nematodes and can suffer appreciable damage when grown in infested soil (10,13,22). Nematicide application usually is not economically or environmentally feasible and no *Trifolium* cultivar is available with root-knot nematode resistance (17,18). Crop rotation with resistant bermudagrass may be a practical alternative.

Several bermudagrass cultivars have shown good resistance to isolated populations of certain *Meloidogyne* spp. The cultivars Coastal and Coastcross-1 were resistant to *M. incognita, M. arenaria* (Neal) Chitwood, *M. javanica* (Treub) Chitwood, and *M. hapla* Chitwood (1,3). The cultivar Tifton 44 was resistant to *M. incognita* and a mixed population of *Meloidogyne* spp. (1). However, the host status of bermudagrass to the four host races of *M. incognita* and to the two host races of *M. arenaria* is not known, nor is the extent to which resistance may vary among populations within a host race. The objective of our study was to compare the host efficiency of bermudagrasses adapted for hay and pasture production in the southeastern United States to the four *M. incognita* host races (20) and to three populations of *M. arenaria* race 2 (20).

MATERIALS AND METHODS

Four populations of *M. incognita* representing the four host races and three populations of *M. arenaria* race 2 were selected. *Meloidogyne incognita* populations MS-9 (race 1), MS-8 (race 2), and MS-6 (race 3), and *M. arenaria* race 2 populations MS-7 and MS-17 were collected in Mississippi by S. C. Bost, University of Tennessee. North Carolina populations NC-1 (*M. incognita* race 4) and NC-2 (*M. arenaria* race 2) were collected by K. R. Barker, North Carolina State University. Inoculum was increased on *Lycopersicon esculentum* Mill. cv. Floradel. After 8-10 weeks, eggs were collected from tomato roots using NaOCl (11).

The hay and pasture bermudagrasses evaluated included the cultivars Alicia, Callie, Coastal, Coastcross-1, Grazer, Lancaster, Maddox, Tifton 44, and Tifton 78, and a common bermudagrass genotype collected in Mississippi. Stem cuttings were rooted in Super Cell Cone-tainers (a plastic cone tapering from 3.75 cm to a blunt point at the bottom; Ray Leach Cone-tainer Nursery, Canby, Oregon, U.S.A.) in a methyl bromide-sterilized mixture of sandy loam soil and river sand. The particle composition of the mixture was 80% sand, 6% clay, and 14% silt.

Bermudagrass cuttings were inoculated by pipetting a water suspension containing 1 500 eggs of the appropriate nematode population into each Cone-tainer 30 days after starting the cuttings. Plants inoculated with *M. incognita* and *M. arenaria* were placed in greenhouses maintained at 32 ± 1 C and 29 ± 3 C, respectively. After 60 days, roots were washed free of soil, weighed, and cut into 1-cm segments. Eggs were extracted from each root system using NaOCl (11). Oostenbrink's R factor (RF = final egg number/initial egg number) (16) and the number of eggs per gram of fresh root (EGR) were determined for each Cone-tainer.

A separate experiment was conducted for each nematode species. Each experiment included 10 replications of each cultivar × population combination in a randomized complete-block design. Data were transformed to log (X + 1) prior to factorial analysis of variance. Means were separated using Fisher's protected least significant differences ($P = 0.05$). Cultivars were considered resistant to a given root-knot population if RF was < 1.0 and susceptible if RF was ≥ 1.0.

RESULTS

Coastal, Coastcross-1, Grazer, and Tifton 44 were resistant to all *M. incognita* host races (Table 1). No nematode reproduction was detected on Coastal or Coastcross-1 for the *M. incognita* race 4 population, or on Coastcross-1 for the *M. incognita* race 1 population. Grazer and Tifton 44 had RF values of 0.1 and EGR < 250 for all *M. incognita* populations (Table 2). Lancaster was resistant to *M. incognita* races 1, 2, and 3. Alicia was resistant to *M. incognita* races 1 and 2. Tifton 78 was only resistant to the race 1 population. The common bermudagrass genotype was resistant to *M. incognita* races 2 and 3. Calley and Maddox were susceptible to all *M. incognita* populations. The greatest reproduction by *M. incognita* races 1 and 4 were on Calley with RF values of 3.5 and 4.3, respectively. Maddox was the most susceptible to races 2 and 3 of *M.*

Table 1. Reproductive factors (RF)[y] of *Meloidogyne incognita* on selected bermudagrass cultivars.

	M. incognita population and host race							
Cultivars	MS-9 race 1		MS-8 race 2		MS-6 race 3		NC-1 race 4	
Coastcross-1	0[z]	(0.00)	0.1	(0.08)	0.1	(0.04)	0	(0.00)
Coastal	0.1	(0.03)	0.2	(0.14)	0.1	(0.02)	0	(0.00)
Tifton 44	0.1	(0.02)	0.1	(0.12)	0.1	(0.08)	0.1	(0.14)
Grazer	0.1	(0.13)	0.1	(0.07)	0.1	(0.11)	0.1	(0.04)
Lancaster	0.3	(0.25)	0.1	(0.06)	0.3	(0.27)	1.1	(0.47)
Tifton 78	0.7	(0.49)	1.0	(0.63)	3.1	(1.25)	3.3	(1.21)
Alicia	0.8	(0.52)	0.2	(0.20)	1.1	(0.43)	1.9	(0.69)
Maddox	1.4	(0.72)	4.0	(1.45)	5.4	(1.66)	3.8	(1.45)
common	1.6	(0.86)	0.2	(0.20)	0.6	(0.42)	2.3	(1.00)
Calley	3.5	(1.33)	3.5	(1.24)	3.0	(1.00)	4.3	(1.39)
FLSD ($P = 0.05$)		(0.35)		(0.36)		(0.46)		(0.49)

Data are means of 10 replications.
[y]RF = final number of eggs/initial number of eggs.
[z]Arithmetic mean. The means of data after $\log_e(X + 1)$ transformation are given in parentheses.

Table 2. Number of *Meloidogyne incognita* eggs per gram of root (EGR) on selected bermudagrass cultivars.

	M. incognita population and host race							
Cultivar	MS-9 race 1		MS-8 race 2		MS-6 race 3		NC-1 race 4	
Coastcross-1	0[z]	(0.00)	113	(3.06)	42	(0.94)	0	(0.00)
Coastal	36	(0.59)	80	(1.18)	36	(1.01)	0	(0.00)
Tifton 44	104	(1.11)	146	(2.18)	44	(2.18)	163	(1.68)
Grazer	47	(1.87)	58	(1.51)	204	(1.24)	110	(1.52)
Lancaster	179	(3.64)	24	(1.09)	198	(4.72)	481	(3.45)
Tifton 78	252	(4.83)	323	(5.10)	944	(6.44)	1 102	(6.59)
Alicia	418	(4.65)	127	(3.81)	1 008	(4.81)	363	(3.93)
Maddox	423	(5.14)	1 669	(6.91)	2 462	(7.57)	1 126	(6.78)
common	875	(6.12)	320	(3.05)	582	(5.27)	2 136	(6.91)
Calley	1 397	(6.67)	1 009	(6.06)	1 063	(5.79)	1 118	(6.67)
FLSD ($P = 0.05$)		(1.78)		(1.98)		(1.82)		(1.65)

Data are means of 10 replications.
[z]Arithmetic mean. The means of data after $\log_e(X + 1)$ transformation are given in parentheses.

Table 3. Reproductive factors (RF)[y] of *Meloidogyne arenaria* race 2 populations on selected bermudagrass cultivars.

	M. arenaria race 2 population		
Cultivar	MS-7	MS-17	NC-2
Coastcross-1	0.1[z] (0.15)	0.1 (0.10)	0.2 (0.24)
Coastal	0.1 (0.01)	0.1 (0.01)	0.0 (0.00)
Tifton 44	0.1 (0.06)	0.1 (0.03)	0.4 (0.33)
Grazer	0.1 (0.01)	0.1 (0.01)	0.1 (0.09)
Lancaster	0.1 (0.03)	0.1 (0.01)	0.2 (0.20)
Tifton 78	0.1 (0.08)	0.1 (0.04)	0.7 (0.51)
Alicia	0.1 (0.14)	0.3 (0.17)	0.7 (0.37)
Maddox	2.0 (1.01)	4.8 (1.68)	2.6 (1.25)
common	0.2 (0.16)	0.4 (0.29)	0.6 (0.45)
Calley	1.0 (0.51)	3.2 (1.16)	0.2 (0.21)
FLSD (P = 0.05)	(0.26)	(0.32)	(0.24)

Data are means of 10 replications.

[y]RF = final number of eggs/initial number of eggs.

[z]Arithmetic mean. The means of data after $\log_e(X + 1)$ transformation are given in parentheses.

Table 4. Number of *Meloidogyne arenaria* race 2 eggs per gram of root (EGR) on selected bermudagrass cultivars.

	M. arenaria populations		
Cultivar	MS-7	MS-17	NC-2
Coastcross-1	95[z] (2.56)	45 (1.79)	170 (4.21)
Coastal	11 (0.91)	7 (0.63)	0 (0.00)
Tifton 44	54 (2.66)	14 (0.97)	399 (4.90)
Grazer	3 (0.34)	4 (0.56)	62 (2.63)
Lancaster	7 (0.71)	11 (0.47)	239 (3.16)
Tifton 78	35 (1.74)	17 (1.50)	275 (5.46)
Alicia	84 (1.51)	64 (1.41)	327 (3.03)
Maddox	783 (6.44)	1 054 (6.93)	1 123 (6.93)
common	196 (2.55)	239 (3.21)	313 (5.33)
Calley	311 (3.07)	676 (5.61)	223 (4.07)
FLSD (P = 0.05)	(1.93)	(1.67)	(1.92)

Data are means of 10 replications.

[z]Arithmetic mean. The means of data after $\log_e(X + 1)$ transformation are given in parentheses.

incognita with RF values of 4.0 and 5.4, respectively. Differences among EGR values roughly paralleled differences among RF values (Table 2). Coastal and Coastcross-1 had EGR values of 0 for the *M. incognita* race 4 population, and Coastcross-1 also had a 0 value for the race 1 population. Coastal also had the lowest EGR value, 36, for the race 3 population, whereas Lancaster had the lowest EGR value, 24, for the race 2 population.

Most of the bermudagrass cultivars were resistant to the *M. arenaria* populations (Table 3). Alicia, Coastal, Coastcross-1, common, Grazer, Lancaster, Tifton 44, and Tifton 78 were resistant to all of the *M. arenaria* populations. Calley was susceptible to the Mississippi populations and resistant to the North Carolina population. Maddox was susceptible to all of the *M. arenaria* populations and reproduction was highest for all nematode populations on this cultivar. Levels of resistance of the bermudagrass cultivars to *M. arenaria* were also reflected by EGR values (Table 4). No reproduction by the North Carolina population was detected on Coastal. Grazer had the lowest EGR values for the Mississippi populations with values of 3 and 4 for the MS-7 and MS-17 populations, respectively.

DISCUSSION

Our results confirm the resistance of Coastal, Coastcross-1, and Tifton 44 bermudagrasses to *M. incognita* and *M. arenaria* (1,12,14,15,19) and indicate a high level of resistance in Grazer as well. Coastcross-1 and Tifton 44 are hybrids of crosses of Coastal with other bermudagrasses and apparently inherited a high level of Coastal's root-knot nematode resistance (2,5). Tifton 78 was the most vigorous of a number of F^1 hybrids between Tifton 44 and Calley bermudagrasses (6). Tifton 78, like Calley, was highly susceptible to *M. incognita* races 3 and 4, but, like Tifton 44, was resistant to *M. incognita* race 1 and all three populations of *M. arenaria* race 2.

Variations in reproduction among *M. incognita* host races on the bermudagrass cultivars is probably not related to race specificity. Populations of *M. incognita* within the same race from diverse geographical areas may respond differently on plants that are not included in the North Carolina Differential Host Test (21,23).

Pastures infested with *Meloidogyne* species could be planted to Coastal, Coastcross-1, Grazer, or Tifton 44. When nematode population densities drop below damaging levels, the bermudagrass pastures could be overseeded with annual or perennial clovers. There are several problems which must be addressed in using bermudagrass in crop rotation schemes to control root-knot nematodes. Although Coastal bermudagrass is a poor host for *Meloidogyne* species, several other genera of plant-parasitic nematodes such as *Belonolaimus, Pratylenchus,* and *Xiphinema* may increase in fields planted with this bermudagrass (9). For sod rotations to be effective, long term rotations with bermudagrass may be necessary to reduce root-knot nematode populations. Also, because many weeds are excellent hosts for these nematodes, bermudagrass pastures must be maintained relatively weed free to effectively reduce root-knot nematode numbers (7).

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