Races of the Barley Root-Knot Nematode, Meloidogyne naasi. III. Reproduction and Pathogenicity on Creeping Bentgrass[1]

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Abstract: Reproduction and pathogenicity of the five known races of *Meloidogyne naasi* on two selections of creeping bentgrass were compared. Toronto C-15 was a host for Races 3, 4 and 5, whereas Northmoor 9 supported reproduction of all five races. Differences in susceptibility and population increase demonstrated that the races could be separated by degree of reproduction on the two selections. Root weights generally were unaffected. Based on cumulative clipping weights, all but Race 1 were pathogenic on at least one of the selections; Race 3 stunted top growth of both. Slight differences in degree of pathogenicity, associated with final populations, were not broad enough to be useful in race separation. *Key words: Agrostis palustris*, host range, population increase.

The barley root-knot nematode, *Meloidogyne naasi* Franklin, parasitizes creeping bentgrass, *Agrostis palustris* Huds., in California (5), Illinois (2) and Kentucky (9), and may become a problem in maintenance of this important turfgrass. In California, *M. naasi* has been associated with excessive daytime wilting of Seaside creeping bentgrass (6). Recently, a population of this nematode from a creeping bentgrass golf green in Illinois was found to stunt growth of the Toronto C-15 selection under greenhouse conditions (7).

Five physiological races with differing host preferences were designated within *M. naasi* (3), and Race 5 from Kansas differed from the other races in its rate of development (4). Criteria such as nematode pathogenicity and reproduction on differential plant varieties were used to separate races or pathotypes within other species of heteroderid nematodes (8).

The present study was undertaken to assess the comparative importance of the different races of *M. naasi* on creeping bentgrass and to determine whether the known races of this nematode could be further differentiated on the basis of their comparative pathogenicity and reproduction on varieties of the same plant species.

MATERIALS AND METHODS

Single egg mass isolates of *M. naasi* from England, California, Illinois, Kentucky and Kansas (Races 1, 2, 3, 4 and 5, respectively) were maintained in a greenhouse on barley, *Hordeum vulgare* L. 'Traill'. Methods of nematode storage, extraction, disinfestation and inoculation were the same as those described earlier by Michell et al. (3). The creeping bentgrass selections Toronto C-15 and Northmoor 9 were chosen for comparison because of differences in susceptibility to an Illinois population of *M. naasi* observed by Hodges (1). Propagation cultures of the grasses were established from single-node stolon cuttings to reduce plant-to-plant variation.

Clay pots, 12.5 cm diam, were filled with a steam-pasturized mixture of sandy loam soil and quartz sand (2:1). In one experiment, each of 20 pots for each bentgrass selection was planted with three single-node stolon cuttings, centered 5 cm apart. Five days later, four pots of each selection for each of Races 2-5 were inoculated with a 15-ml aqueous suspension of 6000 second-stage larvae. An experiment with Race 1 differed only in that each pot contained one cutting and the inoculum level was 2000 larvae/pot due to an insufficient amount of available inoculum. Thus, an initial nematode density of 2000 larvae/plant was common to all races. Four uninoculated pots of each selection served as controls. Pots were randomly arranged on a greenhouse bench where ambient temperatures averaged 25 C.

Pots were watered daily and, at monthly intervals, each pot received 150 ml of 23-19-17 fertilizer solution. Every 2 weeks, plants were trimmed to a height of 2.5 cm with the aid of a

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metal guide ring, and the weight of oven-dried clippings from each pot was recorded. Eight months after inoculation, the final clippings were taken and roots washed free of soil. After blotting to remove excess water, roots from each pot were cut into 1.5-cm sections and weighed. One-half of the root system then was oven-dried and weighed. The other half was stained in 0.1% acid fuchsin in lactophenol and comminuted in a blender for 60 sec. Number of eggs and second-stage larvae then were determined in replicated aliquots and tabulated on the basis of numbers per gram of dry root. Actual numbers were transformed to log (x + 1) for convenience in statistical analysis and to overcome effects of zero values in the data.

RESULTS

Toronto C-15 selection of creeping bentgrass was susceptible to Races 3, 4 and 5 of *M. naasi*, whereas Northmoor 9 supported reproduction of all 5 races (Table 1). Where reproduction occurred, there were significant (P = .05 or greater) differences in final population levels among the races on both selections. Eight months after inoculation, significantly (P = .05 or greater) higher populations were attained by Races 4 and 5 on Toronto C-15 than on Northmoor 9, whereas Race 3 reproduced equally well on both selections. The highest and lowest mean number of eggs and larvae were produced by Race 3 on Toronto C-15 (1,763,000) and Race 5 on Northmoor 9 (84,000), respectively. Considering the lower inoculum level of Race 1, it appeared to reproduce as well as Race 3 on Northmoor 9.

All but one of the races caused significant (P = .05 or greater) reduction in the cumulative weights of oven-dried clippings of at least one bentgrass selection (Table 1). Races 3, 4 and 5 reduced weights of Toronto C-15 by 14, 14 and 10%, respectively. Races 2 and 3 reduced top growth of Northmoor 9 by 20 and 9%, respectively, whereas Race 1 had no significant effect on this selection. Wherever there was a significant reduction in top growth, the mean dry root weight was somewhat higher than that of the uninoculated control, attributable to the large number of galls and associated lateral root proliferation. The only significant (P = .01) increase in root weight (60%) occurred with Race 4 on Toronto C-15.

DISCUSSION

The five races of *M. naasi* differed considerably in ability to utilize either selection

TABLE 1. Reproduction of five races of *Meloidogyne naasi* on two selections of creeping bentgrass and their effects on plant growth.

Bentgrass selection	Nematode race[a]	No. eggs and larvae/g of dry roots[b]		Dry weight (g)[b]	
		Final (thousands)	log (x + 1)	Cumulative clippings	Roots
Toronto C-15	1	0	0	13.7	1.4
	C	0	0	13.3	1.2
Northmoor 9	1	539	2.64	15.5	1.2
	C	0	0	14.9	1.4
LSD=.05				1.5	0.6
LSD=.01				2.4	0.9
Toronto C-15	2	0	0	15.9	1.0
	3	1763	3.22	14.3	1.4
	4	1001	2.99	14.3	1.7
	5	500	2.65	15.1	1.2
	C	0	0	16.7	1.0
Northmoor 9	2	177	2.23	16.2	1.6
	3	1467	3.16	14.2	1.4
	4	546	2.72	16.4	1.5
	5	84	1.87	16.8	1.1
	C	0	0	17.8	1.2
LSD=.05			0.21	1.4	0.4
LSD=.01			0.28	1.9	0.6

[a]Races 1-5 represented by populations from England, California, Illinois, Kentucky and Kansas, respectively; C = uninoculated control.

[b]Eight months after inoculation; each value is the mean of four replications.

of creeping bentgrass as a host. Susceptibility ranged from a nonhost status of Toronto C-15 for Races 1 and 2 to a high degree of susceptibility of both selections to Race 3. These findings support the earlier conclusion of Michell et al. (3) that distinct physiological races do exist within *M. naasi*. Moreover, they demonstrate that the races can be separated by their degree of reproduction on these two selections of creeping bentgrass. The variation in susceptibility emphasizes the need for more extensive screening of selections against *M. naasi* and for discretion in recommending selections for use where infestations of this nematode occur.

Four out of five of the races stunted top growth of at least one of the creeping bentgrass selections. Among those reproducing on both selections, Race 3 was pathogenic to both, whereas Races 4 and 5 affected growth of Toronto C-15 alone. Race 2 attacked and injured only Northmoor 9, whereas Race 1 did not affect its only host, Northmoor 9. There were slight differences in degree of pathogenicity, which in general were associated with final nematode populations. The differences were not considered broad enough to be useful in race identification, but may be of value in supplementing the more reliable criterion of host suitability.

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