PLANT-PARASITIC NEMATODES ON CREEPING BENTGRASS IN MICHIGAN

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INTRODUCTION

Nematodes are commonly associated with creeping bentgrass in Michigan. At least 12 different genera of plant-parasitic nematodes have been recovered from bentgrass greens in the state. Greens often exhibit disease symptoms of undetermined causes. Often high population densities of nematodes are recovered from these sites. Therefore, indirect evidence suggests that nematodes can be a problem on creeping bentgrass greens in Michigan. However, care should always be taken to identify the causal agent(s) in any situation before implementing management strategies. Otherwise, treatment may not result in the alleviation of the disease symptoms.

A greenhouse experiment was conducted in the winter of 1995 to obtain information on the pathogenicities of nematodes commonly associated with creeping bentgrass. The results of that experiment will be presented. In addition, information will also be provided on a USGA Project coordinated by Dr. Trey Rogers and Thom Nikolai examining the maintenance and characteristics of creeping bentgrass greens. Nematode samples were collected from this study during 1995. Nematode populations were also monitored at the Knollwood C.C. following a fall application of Nemacur 10G and these numbers will also be provided.

PATHOGENICITY STUDY

A study was initiated in the greenhouse to examine the pathogenicities of various plant-parasitic nematodes to creeping bentgrass. The nematodes utilized in this study were the northern root-knot, lesion, ring, stunt, lance and spiral. These nematodes were recovered from samples collected from golf courses in Michigan in 1993 at the following respective frequencies: 16.5; 49.5; 69.7; 76.1; 22.0 and 61.5. Although, these nematodes are common associates of cool season grasses, very little is known concerning their impacts on these plants in Michigan. The primary objective of this research was to obtain this information.

The experiment was initiated on Dec. 13, 1994. Two seedling creeping bentgrass plants were transplanted in Conetainers (plastic containers *ca.* 5.0 cm id and 25 cm in length) containing 100 cm^3 of a loamy sand soil and nematodes (Table 1). The design consisted of 11 treatments with 7 replications. The heights of the plants were measured every 10 days (following an initial cutting on Dec. 17) for the first 40 days of the experiment and these data are presented in Table 1. The grass was cut every 10 days to a height of approximately 2 cm. The numbers of leaves per plant were also recorded at 10-day intervals beginning on Jan. 6, 1995 through Feb. 5 (Table 2). When the experiment was terminated on March 9, the plants were destructively sampled and leaf and root weights collected (Table 3). In addition, the percent of the soil surface covered by the turf was also quantified by an independent observer (Table 3). Root and soil samples were processed for nematodes immediately following the termination date (Table 4). The data were subjected to an analysis of variance.

No nematode treatments caused reductions in creeping bentgrass heights on any of the sampling dates (Table 1). However, some of the treatments resulted in lower leaf numbers than the controls (Table 2). These differences were observed within the first 20 days of the experiment and were maintained through day 50. Initial population densities of 7,000 ring and stunt nematodes, 200 lance and 5,000 spiral nematodes resulted in significantly fewer leaves produced per plant than the other treatments when compared to the controls. Leaf weights were not significantly reduced by any treatments but, root weights were reduced (Table 3). For example, ring and stunt nematodes at 7,000/100 cm^3 reduced root weight by 38% compared to the control. This treatment, along with the other ring/stunt treatment, resulted in a difference in the percent cover observed at the termination of the experiment.

The initial and final nematode population densities are presented in Table 4. Virtually no root-knot nematodes were recovered at the end of the experiment. These results were unexpected because root-knot nematodes have been recovered from established bentgrass greens in Michigan however, based on these greenhouse results it appears the plant is a poor host for these nematodes. All the other nematodes were recovered at harvest. However, lesion nematode numbers were also lower than anticipated.

Secondary symptoms due to nematode feeding on established turf include chlorosis, stunting and patchy stands (reduced turf density). Although this experiment only proceeded for 80 days, some of these symptoms were observed. Leaf numbers were reduced, affecting density. Chlorosis was not observed, but root weights were reduced. Damaged roots are unable to function properly, nutrients are not captured efficiently leading to foliar symptoms. If this experiment was allowed to proceed for a longer period of time, chlorosis may have occurred.

USGA STUDY

A project was initiated at the Hancock Turfgrass Research Center to investigate engineering characteristics and maintenance of golf course putting greens. This is a multi disciplinary project. The initial phase consisted of monitoring soil invertebrates along with foliar diseases. The greens were topdressed with sand. Soil samples were collected from May-November to monitor population densities of plant-parasitic nematodes, predatory nematodes, bacterial-feeding nematodes, fungal- feeding nematodes, mycorrhizal fungi, oligochaetes, springtails, mites, rotifers and tardigrades.

Creeping bentgrass is growing on 3 different greens: USGA construction; an 80:10:10 mix over gravel USGA construction and an unamended sandy clay loam textured soil. Stunt nematode counts were significantly higher in samples collected from the sandy clay loam plots than the other 2 soils over the duration of the sampling period (Table 5). The same trend was observed for mycorrhizae (Table 6). In general, the sandy clay loam plots contained higher numbers of all the organisms monitored. Lighter soils are usually considered “nematode loving soils,” so these results were somewhat unexpected. However, the soil in these plots was undisturbed prior to initiating this study whereas the other soils were imported to the area. They apparently contained lower population densities of organisms than the “native,” sandy clay loam and time is necessary for organisms to increase in numbers.

A hypothesis is, over time, the numbers of stunt nematodes in the USGA and 80:10:10 plots will exceed the numbers recovered from the sandy clay loam plots. Sandy soils generally contain higher numbers of nematodes. However, this may not occur for quite some time because nematodes will have to invade these plots from surrounding turf or move from deeper in the soil profile. The amount of time required for this to occur is unknown because nematodes only travel short distances (2-4 inches/year). Nematodes and other organisms will be monitored over a 5-year period. In addition, an attempt will be made to monitor nematode movement from the borders of the plots.

CONTROL STUDY

Many, if not all, the greens at Knollwood C.C. supported high levels of plant-parasitic nematodes in the fall of 1994. Disease symptoms were very prevalent that summer. Therefore, all the greens at Knollwood except 11 were treated with Nemacur 10G in the October, 1994 for nematode control. Samples were collected prior to the nematicide applications, approximately 3 weeks following treatment, and 3 additional times in 1995 to monitor nematode population densities.

Nemacur apparently provided no or very little nematode control (Table 7). More nematodes were recovered from soil samples collected from 6 of the 8 treated greens 3 weeks (Nov. 9) following the applications. Counts were lower for most of the treated greens in April and June 1995, but by August nematode numbers had increased dramatically.

Davis and co-workers (1994) found that spring-applied Nemacur provided very little control of ring nematodes in one putting green located in Illinois. Ring nematode counts were higher in samples collected from the treated area than the untreated area on Oct. 22, 1990. They suggest that if chemical control is to be most effective, nematicides should be applied when population densities are at a minimum. However, their Nemacur applications were timed with this occurrence. Population densities of plant-parasitic nematodes were very high at Knollwood when the material was applied so, this may explain why Nemacur was not effective. However, fall applications are often quite effective on fruit trees. It is also possible that the material was applied too late in the year preventing adequate breakdown into its nematicidal components. Another potential explanation is that high levels of microbes degraded the product. Regardless of the cause(s) of the material’s failure (Nemacur is generally an effective nematicide), more research is necessary examining proper timing of nematicide applications and identifying effective alternatives. This will be the primary objective of research to be conducted in 1996.

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REFERENCES

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Table 1. Heights of creeping bentgrass plants in greenhouse pathogenicity study, 1995.

Nematode	P_i	Creeping Bentgrass Heights (cm)			
		Dec. 27	Jan. 6	Jan. 16	Jan. 26
Control	0	4.8	4.4	4.0	4.3
root-knot	150	4.2	4.3	3.9	4.8
root-knot	1500	4.7	4.1	3.6	5.1
lesion	250	3.9	4.4	3.8	5.0
lesion	2500	3.9	4.1	4.0	4.8
ring/stunt	700	3.8	3.8	3.3	5.0
ring/stunt	7000	3.5	4.1	4.1	5.4
lance	20	3.4	4.0	3.9	4.8
lance	200	3.8	4.2	4.1	4.8
spiral	500	3.6	4.4	4.0	4.8
spiral	5000	3.8	4.2	4.5	4.8

Table 2. Numbers of leaves produced by creeping bentgrass plants in greenhouse pathogenicity study, 1995.

Nematode	P_i	Number of leaves/plant			
		Jan. 6	Jan. 16	Jan. 26	Feb. 5
Control	0	8.2	10.3	15.6	29.5
root-knot	150	7.1	10.2	13.6	23.5
root-knot	1500	**5.5**	10.1	15.4	27.0
lesion	250	6.5	9.5	14.3	28.0
lesion	2500	6.8	10.8	15.1	31.1
ring/stunt	700	6.5	11.0	16.9	35.0
ring/stunt	7000	**5.2**	**6.5**	**9.0**	**17.1**
lance	20	**5.6**	8.6	12.0	22.7
lance	200	**4.6**	**6.0**	**8.0**	**16.3**
spiral	500	**4.9**	**7.5**	**9.8**	21.6
spiral	5000	**4.6**	**6.7**	**8.5**	**18.0**

Means in **bold** significantly different than the controls using Bonferroni's t-statistic (nonorthogonal designed contrast) at p=0.05.

Table 3. Leaf and root weights of creeping bentgrass plants in greenhouse pathogenicity study, March 9, 1995. Ground cover information also provided.

Nematode	P_i	leaf weight (g)	root weight (g)	% cover
Control	0	2.3	2.1	81.4
root-knot	150	1.8	2.0	81.4
root-knot	1500	2.4	2.3	77.1
lesion	250	2.6	2.2	77.9
lesion	2500	2.4	1.9	82.9
ring/stunt	700	2.1	**1.4**	**70.7**
ring/stunt	7000	1.9	**1.3**	**71.4**
lance	20	2.3	**1.4**	82.9
lance	200	2.2	**1.6**	78.6
spiral	500	2.0	**1.6**	81.4
spiral	5000	1.9	**1.6**	75.8

% cover = percentage of soil surface of Conetainer not visible due to cover by grass

Means in **bold** significantly different than the controls using Bonferroni's t-statistic (nonorthogonal designed contrast) at p=0.05.

Table 4. Numbers of plant-parasitic nematodes recovered in soil and root tissue from creeping bentgrass plants in greenhouse pathogenicity study, March 9, 1995.

Nematode	P_i	P_f 100 cm^3 soil	P_f 1.0 g root	Total P_f
Control	0	0.0	0.0	0.0
root-knot	150	0.3	0.0	0.3
root-knot	1500	0.4	0.0	0.4
lesion	250	10.9	55.9	66.7
lesion	2500	8.0	124.6	132.6
ring/stunt	700	748.6	0.0	748.6
ring/stunt	7000	3987.1	0.0	3987.1
lance	20	15.9	34.6	50.4
lance	200	81.0	34.1	115.1
spiral	500	871.4	0.0	871.4
spiral	5000	4066.7	0.0	4066.7

Table 5. Numbers of stunt nematodes, *Tylenchorhynchus nudus*, recovered/100 cm^3 soil in 1995 from 3 creeping bentgrass greens located at the Hancock Turfgrass Research Center, E. Lansing, MI.

Soil Type	Stunt Nematodes							
	5/3	5/25	6/15	7/6	8/3	8/31	9/28	11/8
USGA	10	6	2	2	6	4	4	13
80:10:10	1	0	4	5	2	2	0	3
Sandy Clay Loam	295	161	187	269	89	118	177	640

Table 6. Number of mycorrhizal fungal spores recovered/100 cm^3 soil in 1995 from 3 creeping bentgrass greens located at the Hancock Turfgrass Research Center, E. Lansing, MI.

Soil Type	Mycorrhizae							
	5/3	5/25	6/15	7/6	8/3	8/31	9/28	11/8
USGA	48	56	59	82	33	20	51	493
80:10:10	109	159	81	97	79	32	273	327
Sandy Clay Loam	948	635	546	540	109	123	576	687

Table 7. Numbers of plant-parasitic nematodes (sum of stunt, ring and spiral) recovered from 100 cm^3 soil from creeping bentgrass greens located at the Knollwood Country Club, W. Bloomfield, MI

Green no.	stunt, ring and spiral nematodes				
	9/29/94	11/9/94	4/6/95	6/26/95	8/31/95
1	1400	2440	180	13	435
2	1200	480	280	141	350
7	380	2080	3300	221	1480
8	1680	1160	380	178	1365
9	1120	1800	530	289	2010
10	2000	3320	370	164	1060
11	**2480**	**2400**	**1030**	**927**	**1685**
12	780	1260	150	55	470
15	940	1300	280	244	1215

All the greens except **11** were treated with Nemacur 10G at 100 lbs/A on Oct. 17, 1994.