PLANT-PARASITIC NEMATODES ON CREEPING BENTGRASS IN MICHIGAN

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INTRODUCTION

Plant-parasitic nematodes are frequently associated with creeping bentgrass (*Agrostis palustris*) in Michigan. Twelve genera of plant-parasitic nematodes have been recovered from bentgrass greens in the state. Moderate to high population densities of nematodes are often recovered from greens exhibiting disease symptoms. This evidence suggests that feeding by plant-parasitic nematodes can result in poor bentgrass health.

A greenhouse experiment was conducted in the winter of 1995 to obtain information on the pathogenicities of nematodes commonly associated with creeping bentgrass. Nematode feeding resulted in the production of fewer leaves per plant. These differences were observed as early as three weeks after the initiation of the experiment and were maintained throughout the course of the study. The nematode treatments did not affect plant heights or leaf weights but some of the treatments resulted in reduced root weights. From this study it was concluded, that feeding by plant-parasitic nematodes results in reduced turf density and lower root weights.

Another greenhouse study was conducted in the winter of 1996 to obtain additional information on the pathogenicities of selected plant-parasitic nematodes to creeping bentgrass at different temperatures. The results of this study are included in this report in addition to information on a nematode management study, a creeping bentgrass variety trial and the USGA Project.

PATHOGENICITY STUDY

A study was initiated in the greenhouse to obtain additional information regarding the pathogenicities of selected plant-parasitic nematodes to creeping bentgrass. The nematodes utilized in the study were lance, ring, spiral and stunt nematodes. These nematodes, with the exception of lance, were recovered in over 50% of the samples collected from various Michigan golf courses in 1993.

The experiment was initiated on February 7, 1996. Each experimental unit consisted of one single-leafed creeping bentgrass (*A. palustris* var. Penncross) seedling transplanted into a Conetainer (plastic cone-shaped container *ca.* 5.0 cm id and 25 cm in length) containing 100 cm^3 of a loamy sand soil (86.5% sand, 7.2% silt and 6.4% clay) and nematodes. The design consisted of 6 treatments with 10 replications. The conetainers were then placed into 1 of 2 temperature tanks. One temperature tank was maintained at 10^oC (50^oF), the other at 25^oC (77^oF). In a temperature tank, the roots are maintained at a constant temperature. The objective was to simulate a cooler-growing season or portion of one (spring and fall) and a warmer season and compare the results. The experiment was maintained for 75 days.

The turf was trimmed every 7 days to a height of approximately 2 cm beginning on Feb. 22. The number of leaves/plant was recorded on Feb. 22 and at 7-day intervals until April 10. When the experiment was terminated on April 22, the plants were destructively sampled, leaves were counted and leaf and root weights were collected. Root and soil samples were also processed for nematodes.

The nematodes tested did not reduce leaf numbers, leaf weights or root weights at either of the two temperatures after 75 days (Table 1). The lance nematode treatment caused a reduction in leaf numbers compared to the controls at 25C ($p=0.1$) until the final sampling date (Table 2). However, these nematodes did not cause reductions in leaf numbers at 10C. Creeping bentgrass plants had higher leaf and root weights after 75 days at 10C than 25C although there was virtually no difference in the numbers of leaves produced. This may help to explain why cool season turfgrasses, such as creeping bentgrass, tolerate feeding by plant-parasitic nematodes.

The final population densities of the nematodes tested were generally higher at 25C than 10C (Table 3). Spiral nematodes were the exception, they seemed to prefer the cooler soil. The final population densities of lance nematodes were much higher at 25C than 10C. This may explain why creeping bentgrass leaf numbers were reduced by these nematodes at 25C and no decrease was observed at 10C.

MANAGEMENT STUDY

A plant-parasitic nematode management trial was initiated at the Hancock Turfgrass Center on June 19, 1996 in an area where creeping bentgrass had been recently established. Samples collected in April revealed the presence of stunt nematodes, *Tylenchorhynchus nudus*, but at low population densities.

The primary objective of this study was to investigate alternatives to synthetic nematicides for control of plant-parasitic nematodes in established creeping bentgrass greens. Very little is known regarding the uses of composts or biological control agents for management of nematodes in these situations. Therefore, it is difficult to recommend them with confidence.

The research site consists of two adjacent 1600 ft^2 areas of creeping bentgrass. Each test plot measures 64 ft^2. All the treatments with the exception of the fall Nemacur application were applied late in the afternoon on June 19. It was an overcast day with light rain. The materials were applied at this time to minimize the exposure of the entomophagous nematodes, *Steinernema riobravis,* to ultraviolet light. Soil samples were collected on June 19, prior to the applications, for quantification of plant-parasitic nematodes and other soil invertebrates. Samples were again collected on Sept. 30 when the fall Nemacur application was made.

The treatments and results are presented in Table 4. No treatment provided effective control of stunt nematode, including the spring applied Nemacur 10G($p=0.05$). The treatments did not result in significant decreases or increases in the numbers of microbiotrophic nematodes or mycorrhizal fungi. It was anticipated that the numbers of microbiotrophic and other nematodes would increase in plots treated with ABG-9008. In research trials conducted around the country, numbers of free-living nematodes increased in plots treated with ABG-9008. Although only microbiotrophic nematodes are reported in Table 4, dorylaims, mononchs and other tylenchs were quantified in this study but the results did not differ from those observed with the bacterial-feeding nematodes.

These plots were visually inspected in August for differences in creeping bentgrass health. No differences in turf quality were observed. However, this was expected due to the low levels of plant-parasitic nematodes present. No treatments appeared phytotoxic.

CREEPING BENTGRASS VARIETY TRIAL

A creeping bentgrass variety trial was established at the Hancock Turfgrass Center on Sept. 6, 1993. This national trial includes twenty-eight varieties from various sponsors in a randomized complete block design with 3 replications. This research is under the direction of Dr. Trey Rogers at MSU.

Ten varieties appear to have promise for use in Michigan and elsewhere in the U.S. based on quality evaluations to date. Dr. Rogers provided the list of these varieties and they were sampled for nematodes for the first time on July 12, 1996. Soil samples were again collected on Nov. 19.

The fewest numbers of stunt nematodes were recovered from the Southshore plots in July (Table 5). Other plant-parasitic nematodes were present but the stunt nematode, *Tylenchorhynchus nudus*, is the dominant species. However, the average number of stunt nematodes recovered was lowest in the Crenshaw plots on Nov. 19. The Southshore plots had the second lowest count.

The mean numbers of *T. nudus* were calculated for the 30 plots on July 12 (x = 98.13) and Nov. 19 (x = 111.23). Three varieties, Crenshaw, Southshore and L-93, had mean stunt nematode counts below the whole trial average on both sampling dates. Four varieties, Providence, SR 1020, G-2 and Pennlinks had mean *T. nudus* counts above the average for all 30 plots on both sampling dates. The three remaining varieties had mean counts below on one date and above on the other.

These data should aid in the selection of creeping bentgrass varieties in locations around Michigan particularly in locations where *T. nudus* is present. However, none of the varieties included in this trial appear resistant to stunt nematodes and based on the variability in the actual counts, it is difficult to draw conclusions at this time. Additional studies, possibly in the greenhouse, should provide information on the responses of creeping bentgrass varieties to feeding by plant-parasitic nematodes.

USGA STUDY

A project was initiated at the Hancock Turfgrass Research Center in 1995 to investigate engineering characteristics and maintenance of golf course putting greens. This is a multi disciplinary project funded by the USGA. Creeping bentgrass is growing on three different greens: USGA construction; an 80:10:10 mix over gravel USGA construction and an unamended sandy clay loam textured soil (native). Soil samples were collected throughout the 1995 and 1996 growing seasons to monitor population densities of plant-parasitic nematodes, predatory nematodes, bacterial-feeding nematodes, fungal-feeding nematodes, mycorrhizal fungi, oligochaetes, springtails, mites, rotifers and tardigrades.

Stunt nematode population densities were very low in the USGA and 80:10:10 plots throughout the 1995 growing season (May-November). The native soil plots had significantly higher numbers of stunt nematodes as well as most of the other organisms monitored. However, stunt nematode population densities have increased in the USGA and 80:10:10 plots in 1996, whereas the numbers have stayed virtually the same in the native soil plots. These results were predicted. Sandy soils are generally regarded as "nematode-loving soils" because very high population densities of nematodes are frequently found within these types of soils. It is predicted in the plots with higher sand contents, stunt nematode population densities will eventually exceed those in the native soil plots. However, this study will be 5 years in duration and no conclusive statements can be made at this time.

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Table 1. Numbers of leaves, leaf weights and root weights of creeping bentgrass plants, 75 days after transplanting, at 10C and 25C in a greenhouse pathogenicity study, April 22, 1996.

Nematode Treatment	10C			25C		
	no. leaves	leaf wt. (g)	root wt (g)	no. leaves	leaf wt. (g)	root wt. (g)
Control	95.3	1.9	0.9	103.2	1.2	0.5
100 Lance	113.9	2.0	0.8	76.6	0.8	0.3
500 Ring & Stunt	117.4	1.9	0.7	93.7	0.8	0.3
1500 Ring & Stunt	91.7	1.5	0.5	109.5	1.1	0.4
3000 Ring & Stunt	118.2	2.1	1.1	95.7	1.1	0.4
500 Spiral	105.0	2.2	0.9	96.0	1.2	0.5

Table 2. Mean numbers of leaves produced by creeping bentgrass plants at 25C in a greenhouse pathogenicity trial, 1996.

Nematode Treatment	Dates							
	2/22	2/29	3/6	3/13	3/20	3/27	4/3	4/10
Control	4.6	7.8	10.2	18.4	25.9	37.4	52.4	66.0
100 Lance	3.4	5.0	7.4	9.6	16.3	23.9	34.6	45.2

Table 3. Numbers of plant-parasitic nematodes recovered/100 cm^3 soil and roots from creeping bentgrass plants at 10C and 25C in a greenhouse pathogenicity study, April 22, 1996.

Nematode Treatment	10C	25C
Control	0	0
100 Lance	31	122
500 Ring & Stunt	201	422
1500 Ring & Stunt	618	634
3000 Ring & Stunt	1156	1334
500 Spiral	369	211

Table 4. Mean numbers of stunt nematodes, *Tylenchorhynchus nudus*, microbiotrophic nematodes and mycorrhizal fungi recovered/100 cm^3 soil from creeping bentgrass plots on 2 sampling dates at the Hancock Turfgrass Research Center, E. Lansing, MI, 1996.

Treatment	June 19			Sept. 30		
	T.nudus	micro. nemas	mycorr.	*T.nudus*	micro. nemas	mycorr.
Untreated control	15.2	265.0	34.0	57.8	161.0	99.0
Nemacur 10G, 100 lbs/A (spring)	33.2	271.0	48.0	15.4	150.0	99.0
Nemacur 10G, 100 lbs/A (fall)	33.2	359.0	83.0	61.0	232.0	111.0
S. riobravis, 4 billion/A	15.8	340.0	47.0	55.8	201.0	68.0
S. riobravis, 2 billion/A	20.0	463.0	76.0	19.4	230.0	132.0
S. riobravis, 2 billion/A & leaf litter compost, 1T/A	36.0	423.0	69.0	55.2	205.0	70.0
ABG-9008, 100 lbs/A	33.0	363.0	39.2	62.4	204.0	63.0
ABG-9008, 50 lbs/A	15.2	502.0	42.0	68.6	182.0	105.0
ABG-9008, 50 lbs/A & leaf litter compost, 1T/A	25.0	333.0	37.0	61.8	194.0	86.0
ABG-9008, 50 lbs/A & *S. riobravis*, 2 billion/A & leaf litter compost, 1T/A	21.6	483.0	34.0	54.6	183.0	72.0
p values	.609	.590	.201	.242	.834	.245

Table 5. Mean numbers of stunt nematodes, *Tylenchorhynchus nudus*, recovered/100 cm^3 soil from selected creeping bentgrass varieties at the Hancock Turfgrass Research Center, E. Lansing, MI., 1996

Name	Sponsor	*T. nudus* counts	
		July 12	Nov. 19
Seaside	Standard entry	58.33	115.33
Crenshaw	Loft's Seed, Inc.	78.00	86.00
Southshore	Loft's Seed, Inc.	25.67	96.00
Providence	Seed Res. Oregon, Inc.	115.33	144.67
SR 1020	Seed Res. Oregon, Inc.	158.33	113.67
Penncross	Standard entry	103.33	103.00
A-4	Tee-2-Green Corp.	121.00	105.33
G-2	Tee-2-Green, Corp.	107.33	125.67
Pennlinks	Tee-2-Green, Corp.	125.33	120.67
L-93	Loft's Seed, Inc.	88.67	102.00