WHAT WE DO AND DON'T KNOW ABOUT NEMATODES IN MICHIGAN TURFGRASS

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INTRODUCTION

Many species of plant-parasitic nematodes attack the roots of turfgrasses. Nematode feeding often results in the production of disease symptoms. This damage is often quite subtle or is often improperly diagnosed because feeding by nematodes doesn't always result in characteristic symptoms. Proper identification of the causal agent(s) should be accomplished before implementation of any management strategies. Otherwise, treatment may not result in alleviation of disease symptoms.

The impact of plant-parasitic nematodes in Michigan turfgrasses is not very well understood. Nematodes are often found in samples collected from turf exhibiting disease symptoms. This was apparent when samples were collected from selected golf courses in 1993. However, this represents indirect evidence that nematodes are a problem in golf course greens in Michigan. Greenhouse experiments were initiated in 1994 to obtain more data on the impact of nematodes on creeping bentgrass.

In addition to the 1993 survey and the greenhouse study, further information will be provided on the effectiveness of post-plant nematicides for control of nematodes in creeping bentgrass greens in Michigan. Also, information documented in research literature will also be provided.

1993 SURVEY

Sixteen golf courses in Michigan were sampled for plant-parasitic nematodes in the fall of 1993. Ninety-five samples were collected in total from these locations. Twenty-three samples were taken from fairways, 68 from greens and 4 from tees.

Seven home lawns (12 samples) and one business (2 samples) were also sampled as part of the survey. These samples were collected from E. Lansing or Lansing. In total, 109 samples were gathered from all the locations. Samples were usually collected from turf displaying disease symptoms, however, at least one sample was taken at each location from apparently healthy turf. The samples were collected with a variety of soil probes to a depth of ca. 5 inches.

Samples were processed for plant-parasitic nematodes after they were returned to the laboratory. Nematodes were identified and counted. Thirty-eight samples were then taken to the soil testing lab at M.S.U. for fertility and soil particle analyses. Samples with low and high counts of nematodes were analyzed in an attempt to determine of one or more edaphic factors correlated with the presence of nematodes or the disease symptoms observed.

Plant-parasitic nematodes were found in 106 of the 109 samples collected during the survey. A total of 32,292 plant-parasitic nematodes were counted with a mean count of 262.3 nematodes per sample.

Stunt, ring and spiral nematodes were the most commonly encountered nematodes. These nematodes were extracted from over 60% of the samples (Table 1). In total, 12 different types of nematodes were

recovered during the survey and they are also listed in Table 1. At least 5 types of nematodes were found associated with the turf at every location sampled. In general, turfgrasses support a great diversity of nematodes.

The total numbers of plant-parasitic nematodes were summed for all 109 samples and grouped into 7 ranges. Roughly 20% of the samples collected had 500 or more nematodes in total (Table 2). Regardless of nematode species, samples with counts of 500 or more nematodes can be considered above damage thresholds for commonly grown turfgrass species.

Thirty-eight samples were saved for fertility analyses. Many of the greens sampled were deficient in potassium (Table 3). Potassium applications were recommended on 88% of the green tested. Disease symptoms due to nematode feeding are often more pronounced in soils low in potassium. Phosphorus applications were recommended for very few samples.

GREENHOUSE STUDY

A controlled experiment was initiated in the greenhouse in Dec., 1994, investigating the impacts of various plant-parasitic nematodes on creeping bentgrass. Two creeping bentgrass seedlings were transplanted into soil with high sand content (>90%), inoculated with various nematodes in Containers. The plants were trimmed to identical heights 4 days after transplanting. Growth measurements (heights) were taken every 10 days at which time the grass was trimmed to its original height. On the second date, 24 days after transplanting, density (measured as the number of leaves per plant) estimates were also collected. The nematode treatments and the data are presented in Table 4.

Preliminary evidence suggests that although plant-parasitic nematodes do not affect plant height, they may impact turf density. All plants, in the Containers inoculated with nematodes, had fewer leaves, although the differences were not always statistically significant ($p = 0.05$). Significant differences were observed for the following treatments: 5,000 ring and 2,000 stunt; 200 lance; 500 spiral and 5,000 spiral nematodes. It is important to note however, that these results are preliminary and it appears that even after 10 more days, creeping bentgrass has the ability to compensate for the impacts of early nematode feeding.

NEMATICIDE STUDIES

A nematicide investigation was initiated at Knollwood C.C. in the fall of 1994 and another was completed at the MSU Hancock Turf Research Facility in 1993. Nematode samples were collected from both locations as described for the '93 survey.

Nemacur 10G was applied to all the greens at Knollwood C.C., except for no. 11, for nematode control in October. Preplant nematode samples were collected for 9 greens, 3 weeks before the applications and post-plant soil samples collected for the same greens 3 weeks after Nemacur was applied (Table 5). Nematode counts were very high before and after the nematicide applications. Actually, it appears, that Nemacur provided no control of the nematode populations present in these test locations. However, these greens will be sampled at least 3 times during 1995 to continue the investigation. The samples collected from Knollwood also demonstrate the green-to-green variability in expression of symptoms. Green 11 was rated as healthy yet had high numbers of nematodes present in the soil. This location, however, did have the highest potassium level of any of the 4 greens tested. This is further indirect evidence of the benefits of potassium for possibly alleviating the symptoms due to nematode feeding.

The treatments and the stunt nematode counts for the 1993 Nematicide Trial are presented in Table 6. All the nematicide treatments reduced numbers of stunt nematodes compared to the control plots at the termination of the experiment, Oct. 15, 1993. However, no differences were observed in turf quality throughout the study because the pretreat population densities of stunt nematodes were extremely low, considerably below estimated damage thresholds. No symptoms of phytotoxicity were evident.

LITERATURE

There is not extensive literature on the impacts of plant-parasitic nematodes on cool season grasses. The Univ. of Florida has a nematode research program in turf, but their data are for species of grasses not grown in Michigan. They have reported levels of nematodes that may warrant applications of nematicides to turfgrasses in Florida. This information as well as similar information estimated for Michigan is presented in Table 7. Nematodes are not considered as damaging to turfs grown in temperate climates as in subtropical areas.

Information published by researchers at the Univ. of Illinois indicate that stunt nematodes can reduce root lengths of creeping bentgrass and annual bluegrass. Bluegrass is affected more than bentgrass by these nematodes. Plants with shortened roots would be less able to compete or obtain soil nutrients. They also report that annual nematode numbers vary greatly and that damage thresholds may vary on a green-to-green basis due to many causes.

Postplant nematicides (Mocap 10G and Nemacur 10G) are generally effective for nematode control, but some types of nematodes are more difficult to control than others. Root-knot nematodes are often difficult to control with post-plant nematicides particularly after they are well established. Some nematodes may increase in numbers following nematicide applications. The timing of the application will also affect its efficacy.

CONCLUSIONS

What We Know About Nematodes in Michigan Turfgrasses

1. Many types (up to 12 genera) of plant-parasitic nematodes are associated with turfgrasses grown in Michigan and their presence is often correlated with disease symptoms.
2. Samples collected from Michigan golf courses often contain 5 or more types of nematodes.
3. A species of stunt nematode present in Michigan has been shown to reduce root lengths of creeping bentgrass and annual bluegrass in Illinois.
4. Nematodes are often difficult to control with post-plant nematicides.

What We Suspect About Nematodes in Michigan Turfgrasses

1. Nematode feeding may reduce turf density.
2. Damage thresholds are higher for cool season turfs than turfgrasses grown in Florida.
3. Potassium plays an important role in alleviating symptoms due to nematode feeding.

What We Don't Know About Nematodes in Michigan Turfgrasses

1. Actual damage thresholds for single species of nematodes for creeping bentgrass and annual bluegrass and the relevance of this information.
2. The combined feeding effects of 2 or more nematode species is not understood.
3. How to manage nematodes without nematicides.

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Table 1. List of plant-parasitic nematodes, frequencies of recoveries and maximum counts in 1993 turfgrass survey per 100 cm^3 soil (n=109).

NEMATODE	Frequency	Max. Count
Stunt	76.1	880
Ring	69.7	1400
Spiral	61.5	2040
Root-lesion	49.5	140
Lance	22.0	399
Pin	17.4	99
Root-knot	16.5	55
NEMATODE	Frequency	Max. Count
Cyst	10.1	41
Sheath	6.4	60
Dagger	4.6	20
Needle	3.7	1
Stubby-root	0.9	1

Table 2. Distribution of 1993 turfgrass samples by total numbers of plant-parasitic nematodes recovered in 100 cm^3 soil.

Nematodes/sample	no. samples	% in range
0	3	2.7
1-49	23	21.1
50-99	16	14.7
100-249	19	17.4
250-499	27	24.8
500-999	18	16.5
1000-1999	2	1.8
2000+	1	0.9

Table 3. Soil testing data, 1993 turfgrass survey

	pH Data	% Fert. Recommendations		
LOCATIONS	mean	range	Phos.	Potash
GREENS (n=25)	7.3	6.9-7.8	28	88
FAIRWAYS (n=8)	6.8	6.3-7.5	0	25
TEES (n=2)	6.95	6.7-7.2	0	50
HOME LAWNS (n=3)	7.0	6.5-7.5	0	100

Table 4. Impact of Plant-Parasitic Nematodes on the Growth of Creeping Bentgrass in a Greenhouse Study, 24 Days After Inoculation, Jan. 7, 1995

Nematode Treatment	Ave. Plant Growth (height, cm)	Turf Density (ave. no. leaves)
No Nematodes, Check	4.4	8.2
150 root-knot	4.4	7.1
1500 root-knot	4.1	7.5
250 root-lesion	4.5	6.5
2500 root-lesion	4.2	6.8
500 ring + 200 stunt	3.8	6.5
5000 ring + 2000 stunt	4.1	5.2
20 lance	4.1	5.6
200 lance	4.3	4.6
500 spiral	4.4	4.9
5000 spiral	4.3	4.7

Table 5. Pretreat and post-treat nematode counts (combined counts of stunt, ring, spiral, lance, root-lesion and root-knot) from creeping bentgrass greens located at the Knollwood Country Club, 1994

Green No.	Health Status*	Pretreat Count[1]	Posttreat Count[2]	Dominant Nematode	Potassium Level (lb/A)
1	D	1400	2480	Stunt	---
2	D	1240	490	Stunt	184
7	H	390	2080	Stunt	168
8	D	1680	1200	Stunt	---
9	D	1140	1840	Stunt	---
10	D	2000	3360	Stunt	200
11	**H**	**2480**	**2400**	**Ring**	**264**
12	D	800	1300	Stunt	---
15	D	1000	1340	Stunt	---

*As determined by superintendent, D = Diseased, H = Healthier
[1]Nematodes/100 cm^3 soil on Sept. 29, 1994
[2]Nematodes/100 cm^3 soil on Nov. 9, 1994 ca. 3 weeks following the application of Nemacur to all but green 11

Table 6. Mean numbers of stunt nematodes (Tylenchorhynchus nudus) recovered from a creeping bentgrass green at the Hancock Turf Research Facility, 1993.

	Stunt nematodes (x, S.E.)/100 cm^3 soil		
TREATMENTS	5/20/93	6/29/93	10/15/93

	Stunt nematodes (x, S.E.)/100 cm^3 soil		
Mocap 10G, 50 lbs/A split application*	0.4 (0.4)	2.2 (1.74)	19.4 (6.53)
Mocap 10G, 75 lbs/A split application*	0.8 (0.37)	4.4 (2.98)	8.2 (2.35)
Mocap 10G, 100 lbs/A split application*	0.8 (0.49)	0.0 (0.0)	0.0 (0.0)
Mocap 10G, 100 lbs/A	0.0 (0.0)	0.0 (0.0)	3.2 (1.59)
Mocap 10G, 200 lbs/A	0.0 (0.0)	1.2 (1.2)	1.4 (0.93)
Nemacur 10G, 100 lbs/A	0.2 (0.2)	2.0 (1.38)	3.2 (2.73)
Untreated Control	0.2 (0.2)	2.8 (2.8)	64.8(35.56)

*First application on May 20 (single applications applied on this date), second application on June 29

Table 7. Approximate levels of nematodes that may justify nematicide applications to turfgrasses reported for Florida and estimated for Michigan.

	Nematodes/100 cm^3 soil	
Kind of Nematode	Florida*	MSU
Cyst	--	15
Dagger	--	100
Lance	40	100
Needle	--	10
Ring	500	500
Root-knot	80	100
Root-lesion	--	100
Spiral	300	1000
Stubby-root	40	100
Stunt	--	500

*Information taken from Florida Nematode Control Guide, 1984