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TURFGRASS TRENDS

PEST CONTROL

Predicting Nematode Populations Can Pre-empt Disease

By Nathaniel Mitkowski and Katerina Jordan

Nematodes are one of the few turf pathogens that can be managed using an integrated pest management strategy. Because plant-parasitic nematodes are ubiquitous in turfgrass soils, it would be impractical and impossible to eliminate them. Thus, turf managers in the Northeast must live with a certain number of plant-parasitic nematodes in any turfgrass stand. When the population of nematodes reaches a high level, it may cross a disease threshold, and symptoms might be observed. When this occurs, treatment is warranted to knock the nematode numbers below the disease threshold.

Dr. Robert Wick at the University of Massachusetts has been actively working on the population dynamics of plant parasitic nematodes on putting greens for at least 20 years. His research has helped clarify the damage thresholds for numerous plant-pathogenic nematodes in the Northeast and has established the seasonal population growth curves for these nematodes (Wick, 1989). Using this information, diagnosticians can tell which nematodes are likely to cause damage, the number of nematodes associated with damage and the likely time of year that the damage will be most noticeable. One of the major pieces of missing information, however, is being able to predict which courses will have nematode problems and in what particular years. Not every golf course has a nematode problem, and nematode populations do not reach dramatically high levels every year, even on those courses that frequently have high nematode populations.

During the past three years, we have been conducting a project to examine the factors that can contribute to high nematode populations on golf course putting greens. During 2003 and 2004, soil samples were taken from 38 golf courses in southern New England (three greens each) during May, July and September. Nematode numbers were counted, and a wide array of cultural and environmental factors were recorded. Once all the data was obtained, it was statistically analyzed to determine what factors, if any, might lead to increased nematode populations.

Initially, we examined data to determine how populations of different nematode species changed over the course of a year and between two different years (Jordan and Mitkowski, 2006). Surprisingly, there was a major statistical and biological difference between total nematode numbers between 2003 and 2004, with 2004 having much higher total average nematode numbers, regardless of the species of turf parasitic nematode. By examining the graphs in Figure 1 (p. 40) it is apparent that most nematode populations increased into September, with the exception of the *Tylenchorynchus* (stunt) nematodes. These findings agree with what is generally observed on golf course

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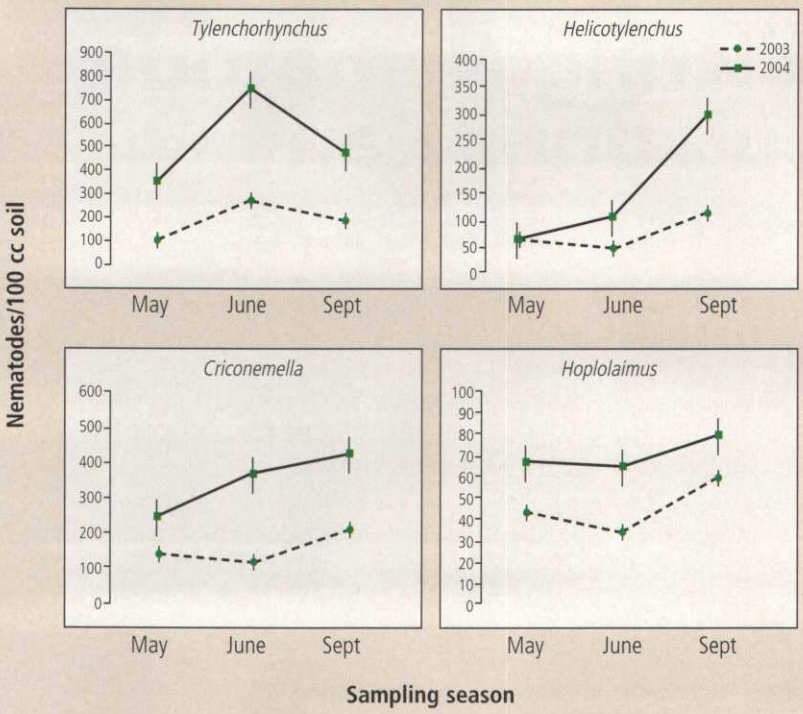
Nematodes are a growing pest problem for golf course superintendents, and control options are becoming more limited by EPA regulations on pesticides that can be used for their control. Keeping turfgrass plants as healthy as possible can help overcome nematode problems or problems created from nematode feeding. And having a balanced fertility program focused on proper nitrogen for growth, proper phosphorus for energy and rooting, and proper potassium for water relations and improved stress tolerance can go a long way in warding off pest damage. Many times we overlook the importance of potassium as a nutrient. Because potassium is consumed by turfgrass plants via luxury consumption, we must be sure to consistently maintain potassium concentrations in the soil solution. Tissue testing is the best means of determining how well a potassium fertility program is working.

FIGURE 1

Changes in nematode population in 2003 and 2004 expressed as nematodes per 100 cubic centimeters (cc) of soil.



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putting greens: a steady increase in nematode numbers that often peaks at some point in August or September.

Unfortunately, it is difficult to determine exactly why nematode populations were so much greater in 2004 than in 2003, an entirely unexpected result. Two plausible explanations are rainfall amount and temperature. Spring 2003 was extremely wet. Soil-borne nematodes require oxygen and excessive precipitation is likely to keep soil oxygen low, thereby reducing nematode viability and fecundity.

However, temperature may have played an even more significant role in nematode survival. While nematodes in temperate climates can survive the freezing temperatures of Northern soils, the fluctuation in temperatures plays an important role in their survival. Although the average temperatures for winter 2003 and winter 2004 were similar, temperatures in 2003 varied widely throughout the winter. The fluctuation in temperature was dramatic, and little ground froze. In 2004, however, temperatures changed gradually, and some areas of southern New England had frozen ground to a depth of 3 feet. We expected to see fewer nematodes in 2004, as it seemed to be a harder winter. The opposite was true. Because nematodes acclimate to their environment over weeks or months, it is possible that a hard (or consistently cold) winter allows them to maintain a regular level of dormancy.

A significant amount of information about the 114 greens was collected in order to determine which, if any, factors influenced nematode numbers. Collected data included: seven different management practices (Table 1, p. 42), 16 different soil chemical properties, grass species present and soil physical analysis. Only a few parameters were found to influence nematode numbers between golf courses. The most

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TABLE 1

Management factors tested against nematode population levels from 38 golf courses.

Factor	Mean	Median	Minimum	Maximum
Mowing *f* (per week)	7	7	5	12
HOC (inches)	0.126	0.125	0.1	0.17
Topdressing (per year)	6.4	5	1	14
Cultivation (per year)	4.3	3	1	20
Thatch level (inches)	0.5	0.5	0	1.5
Rolling (per year)	14.5	5	0	60
Rounds (per year)	28,453	30,000	11,000	52,500

Mowing f = mowing frequency, HOC = height of cut, Topdressing = topdressing frequency, Cultivation = cultivation frequency, Rounds = rounds of golf.

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important factors were green age and grass species. Although not 100 percent reliable, these two factors consistently predicted total nematode numbers. The older a green was, the more nematodes could be found on it. This stands to reason, as nematodes spread and populate soils slowly over many seasons. Although our data does not indicate whether any particular grass species is more susceptible to nematode damage than any other, it does indicate that nematode numbers are higher on annual bluegrass and velvet bentgrass. Coincidentally, many mixed velvet/creeping bentgrass greens in New England are subject to high summer nematode populations, which often results in a decline of only the velvet bentgrass.

Many of the other parameters had some ability to predict relative nematode numbers, but often only for a single species of nematode. An example would be lead, which was surprisingly correlated with increased levels of *Helicotylenchus* (spiral) nematodes. However, it had no correlation with any of the other nematode populations. An even bigger surprise was that soil texture did not seem to have any impact on predicting nematode populations. We typically think of sand-based greens as a preferable environment for nematodes. However, greens construction did not appear to influence nematode numbers. The shortcoming of this particular conclusion is that all of our sand-based greens are much newer than our push-up or soil-based greens. As green age did play a role in nematode populations, it is possible that greens construction also has an impact, but was lost in the stronger correlation of green age. Additional research needs to be done to clarify this issue.

Annually, we see significant damage on golf course putting greens caused by numerous species of nematodes. It is unclear whether nematode damage is increasing in the Northeast or if our ability to recognize their damage has improved. Regardless, the ability to predict when and where nematodes will become a problem becomes more important when one considers the impending loss of Nemacur, which is the only pesticide registered for control of plant parasitic nematodes on turf. Without this important tool, many superintendents will be unable to manage nematode populations and will suffer turf loss to nematode parasitism perennially. Although numerous organic pesticides have been developed and proposed for nematode control on turf, few have been tested scientifically, and many are ineffective.

However, the ability to predict when and where nematode populations will become a problem can allow superintendents to deal with the problem proactively through renovation, cultural practices, overseeding and communication with their greens committee. Unfortunately, the ability to predict nematode populations on turf is still a long way off.

Dr. Nathaniel Mitkowski is an assistant professor of plant pathology at the University of Rhode Island. He earned his Ph.D. in plant pathology from Cornell University. His research focuses primarily on stress-related diseases of amenity turfgrasses. He also runs the URI Turfgrass Disease Diagnostic laboratory.

Dr. Katerina Jordan is an assistant professor of turfgrass science at the University of Guelph. She earned her Ph.D. in plant sciences from the University of Rhode Island. Her research focuses on management practices of golf course turf. She also oversees the Guelph Turfgrass Diagnostic Lab.

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