
Nematode Injury to Golf Greens

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Introduction

Nematodes are small, 1/32 to 1/8 inch long, nonsegmented roundworms which are especially common in soil. Most nematodes feed on microscopic animal and plant life such as algae, fungi, bacteria and other nematodes. Plant parasitic nematodes are a specialized group, which feed on plants. Their most important adaptation is the stylet, a retractable hollow spear in the head, used for puncturing and withdrawing nutrients from plant cells. The feeding habits of nematodes are characterized as either ectoparasitic or endoparasitic.

Ectoparasitic nematodes remain on the outside of plant roots and feed by probing root hairs and other epidermal cells, or in some cases, subsurface tissues. Lance, stunt, ring, spiral, needle and stubby-root are examples of ectoparasitic nematodes (Table 1 lists common names with scientific names). The lance nematode is an exception and often enters the root entirely. Endoparasitic nematodes enter into the root and therefore do more damage than ectoparasites. Root-knot, cyst and lesion are examples of endoparasitic nematodes found in turfgrasses. Most nematodes parasitic to turf colonize roots but some species invade flowers of grasses resulting in seed galls. The seed gall nematodes are not of concern to golf course superintendents.

Ecology and Population Dynamics

Plant parasitic nematodes are dependent on a living host in order to complete their life cycle. The reproductive potential of nematodes is dependent on the suitability of the host, soil texture, moisture and temperature. A warm,

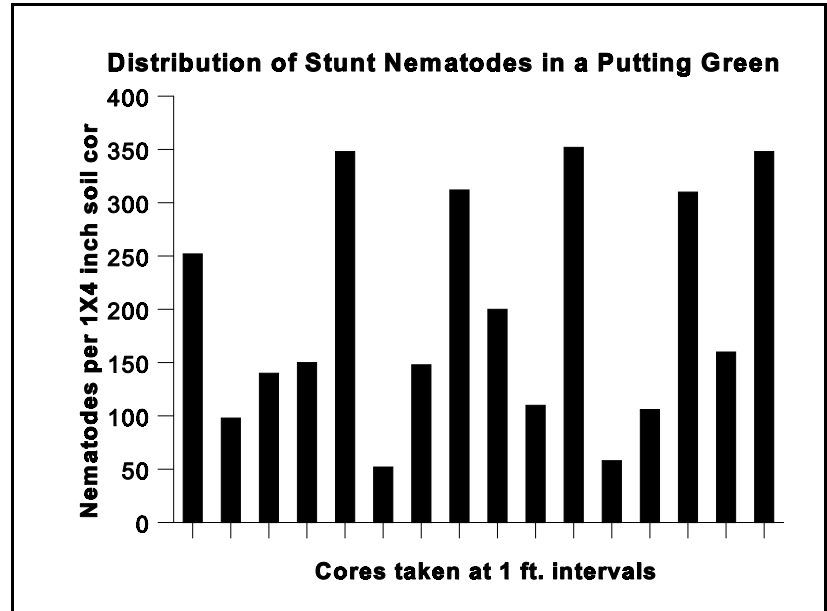


Figure 1. Each vertical bar represents the population of stunt nematodes in a single 1 x 4 inch soil core. The cores yielded from 50 to 350 nematodes. The average for this green is 196 stunt nematodes/100 cc of soil.

sandy-textured soil that receives regular irrigation and supports vigorous growth of turf is ideal for nematode reproduction. Golf greens provide these ideal conditions. While nematodes can be found in virtually all grasses, damaging populations in the northeast are not usually seen outside of golf greens.

Nematodes are not uniformly distributed in the soil. Rather, they occur in diffuse colonies of various densities and are concentrated in the top three to four inches of the soil profile. Therefore, different cores taken from the same green will have different population densities. (Fig 1). Populations also vary according to depth. For example, a sample taken at a two-inch depth may have twice the concentration of stunt nematodes as the same sample taken to four inches (Fig 2). Other nematodes

may be more evenly distributed throughout the four-inch depth. The depth of the root system, and the depth of accumulated sand from top-dressing influences the stratification of nematodes.

During winter months nematode populations decline. In the spring, as the grass begins to resume growth, nematodes begin feeding on the roots. The reproductive potential increases as the soil temperature rises. In our region, populations generally peak from mid-June through mid- to late August. Figure 2 shows how the population can rise and fall over the course of the season. In Figure 2, the dip in July was probably due to a period of unfavorable conditions approximately one month earlier.

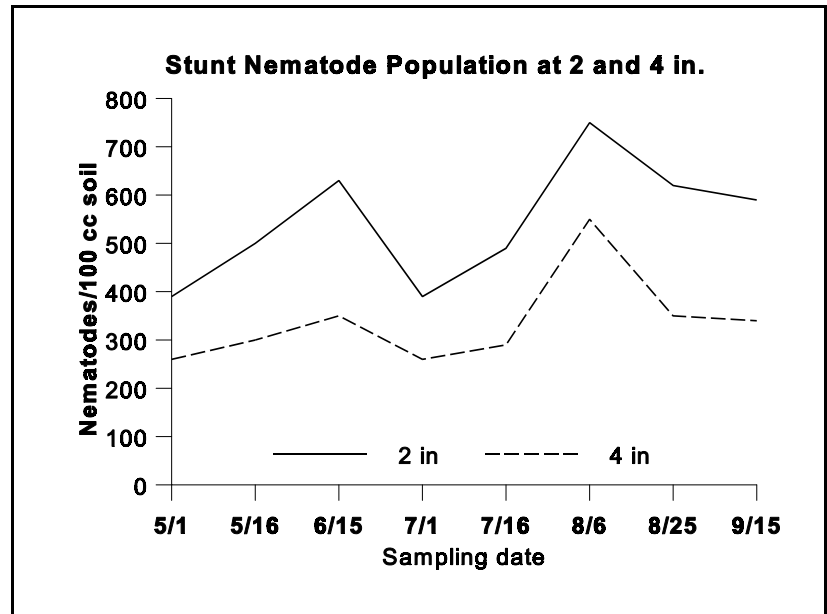


Figure 2. In this example, the stunt nematode population is nearly twice as high in the top two inches of soil than it is when sampled to 4 inches. Lance nematodes tend to be distributed more uniformly over the 4 inch depth.

Symptoms and Diagnosis

Nematodes injure turfgrass roots by either feeding on, or by burrowing through tissues. Depending on the host and the nematode involved, symptoms on roots include: inhibition of root elongation, swollen tips, galls, lesions, and shortened stubby roots. In most cases root symptoms are not obvious. Symptoms occurring above-ground result from root dysfunction and are not unique to nematodes. Patchy areas of wilting, thinning and decline occur where nematode populations are excessively high. Above-ground symptoms are of little value in diagnosing nematode problems in turf. An accurate assessment of the pathogenic potential of nematodes can only be determined by a nematode assay.

Collection of soil samples

Nematode populations are estimated most accurately with a composite sample. Use a $\frac{3}{4}$ to 1 inch diameter soil probe, or something similar, and sample to a depth of four inches throughout the site. This depth is a compromise but represents the population distribution of different species fairly well.

When damage is evident: If a portion of the turf appears unhealthy, collect 15 to 20 subsamples from throughout the affected area and bulk them as one sample. For comparison, a composite sample should also be taken from an adjacent, healthy appearing area.

When no damage is evident: The entire green can be sampled by collecting about 25 subsamples and bulking them as one. Collect samples in three parallel transects across the green, sampling about every two steps.

Delivering the sample: The soil should be placed in a container, such as a plastic bag, to prevent desiccation. Clearly identify the sample number on the outside of the container. Paper tags placed in contact with the soil deteriorate quickly. Do not subject the soil to high temperatures. After collection, refrigerate or deliver as soon as possible. The assay results will include a bill for \$50.00 per sample.

Please include case-history information including species of grass, symptoms,

chemicals applied during the current growing season, and any other information that may help in the analysis.

Important Note: Due to fluctuations in nematode populations over the course of the season, a single-sample evaluation can be misleading, particularly if the results indicate populations below "threshold levels". A more comprehensive evaluation the following year is recommended as a follow-up. Collect samples as outlined above starting in early June and re-sample every 5 weeks until mid-to late September.

Threshold levels for nematodes in turf Nematode populations should be evaluated in context with past and prevailing circumstances such as: species and numbers of nematodes present, depth sample was taken, species composition of grasses, depth of root system, soil texture, symptoms and extent of damage, and presence of other stresses to the turf. Threshold levels (the nematode population levels which justify the implementation of

Management of Nematodes in Golf Greens Nematicur® is the most effective method for controlling plant parasitic nematodes in turf. Figure 3 shows the effect of Nematicur on lance nematodes compared to an untreated control. Nematicur was applied on May 12 but note that the population did not begin to decline until sometime in June. Nematicur provides protection immediately by disrupting feeding activity; however, it takes 4 to 5 weeks before the nematode populations decline. For ectoparasitic nematodes, a single application in the first or second week of June will usually give good suppression of nematodes through the stressful period of summer. Cyst and root-knot nematodes are endoparasites, and only the juveniles that are in the soil are susceptible to Nematicur. The juveniles move into the roots

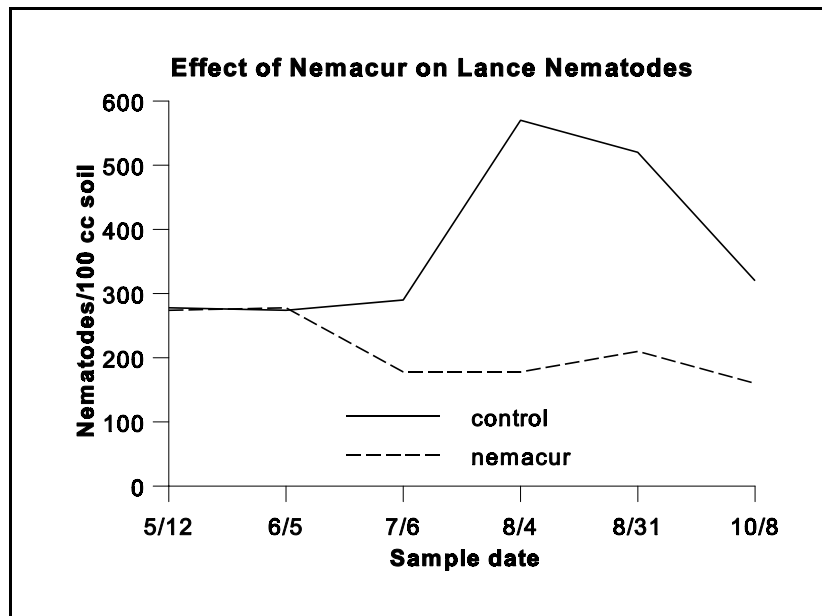


Figure 3. A single application of Nematicur at 2.3 lb/1,000 sq ft in May provided suppression of lance nematodes for the whole season.

control measures), are dependent on the variables listed above. At this time there is very little experimental data to establish threshold levels for golf greens in the northeast. The numbers listed in Table 1 are based on research from other states as well as from case-history information and survey results compiled in the northeast. They are to serve as a guide only.

soon after hatching so timing of nematicide application is important. For cyst nematodes, an application should be made about April 15 because this is when the juvenile nematodes begin hatching and infecting roots. A second application can be made about the first of August. Root-knot nematodes should be targeted about the first week in May. A second application should be made in the first or second week of July.

Cultural practices that encourage a deep root system and a healthy stand of turf are important. Raise the height of cut during periods of stress. Healthy turf may develop higher populations of nematodes than stressed turf but healthy turf will withstand nematode feeding better than turf in decline.

Table 1. Scientific names, feeding habits and threshold levels for nematodes in the northeast

Common name	Scientific name	Feeding habit	Threshold level
needle	<i>Longidorus</i>	Ectoparasite	100
lance	<i>Hoplolaimus</i>	Ecto/Endo	400
stunt	<i>Tylenchorhynchus</i>	Ectoparasite	800
spiral	<i>Helicotylenchus</i>	Ectoparasite	2,000
ring	<i>Criconemella</i>	Ectoparasite	2,000
lesion	<i>Pratylenchus</i>	Endoparasite	100
stubby-root	<i>Trichodorus</i>	Ectoparasite	100
cyst juveniles	<i>Heterodera</i>	Endoparasite	500
root-knot juveniles	<i>Meloidogyne</i>	Endoparasite	500
sheath	<i>Hemicycliophora</i>	Ectoparasite	200
dagger	Xiphinema	Ectoparasite	200
	<i>Tylenchus</i>	Ectoparasite	2,000

The decision to use nematicides must be carefully evaluated. The simple presence of plant parasitic nematodes does not warrant application. Nematicides should not be used where contamination of water may occur. Use only in accordance with the label and local regulations.

