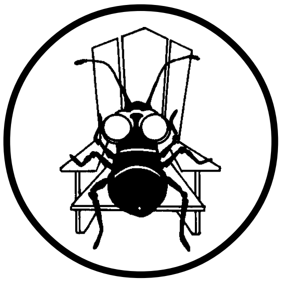
Plant Parasitic Nematodes of Cool Season Turfgrasses



Pest Watch

Over the past few years we have seen high populations of Root Knot* (Meloidogyne sp.) *and Cyst* (Heterodera sp.) *nematodes from New York State putting greens.

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Little is known about the damage potential of plant parasitic nematodes on cool season turfgrasses. Plant parasitic nematodes have been studied to a greater extent in the southern states where nematodes such as the Sting nematode, *Belonalaimus* sp., has been associated with severe damage on golf course putting greens. Since little research has been conducted on nematodes affecting cool season greens, it is difficult to determine when a course of action is required to protect the turf. As we learn more about these pathogens it is important for us to obtain a better understanding of their biology which may lead to the creation of better sampling practices and more effective and safer management strategies. This article will focus on the current knowledge of feeding behavior, how plants are damaged, and current management strategies.

There are approximately 12 genera of plant parasitic nematodes that affect turf grasses. In 1990 a survey was conducted of turfgrass samples submitted to the Plant Disease Diagnostic Clinic at Cornell University to determine the identity and abundance of plant parasitic nematodes. The most commonly found nematodes included Ring (*Criconemella* sp.), Stunt (*Tylenchorhynchus* sp.), Spiral (*Helicotylenchus* sp.), and Lance (*Hoplolaimus* sp.) nematodes. Additionally, over the past few years we have seen high populations of Root Knot (*Meloidogyne* sp.) and Cyst (*Heterodera* sp.) nematodes from New York State putting greens. This information is useful but more is needed to determine the levels at which these nematodes cause damage on our cool season grasses. In the southern states where the Sting nematode is damaging, just one Sting nematode per 100 cc soil is enough to cause damage and to necessitate treatment. At this time not enough is known about how turfgrass species interact with plant parasitic nematodes and how environmental conditions affect this interaction to confidently make decisions about management practices.

Biology of Nematodes

Nematodes vary in the way they feed but most concentrate on the root systems of plants. Migratory parasites, such as the Lance nematode, *Hoplolaimus* sp., probe a plant cell for minutes up to hours and then move onto a new feeding site. Normally the migratory parasites are also ectoparasites (those that feed externally on the outer cortical and endodermal root cells). A few migratory nematodes such as the Lesion nematode, *Pratylenchus* sp., are endoparasitic, entering the root tissue and moving internally as they feed on cells. Sedentary parasites, such as the Root Knot nematode, *Meloidogyne* sp. and the Cyst nematode, *Heterodera* sp., establish feeding sites by injecting unidentified proteins into cells near the vascular system. These proteins induce plant growth hormones to develop a specialized feeding site, drawing nutrients to the nematode.

Plant parasitic nematodes feed on plant roots with a protrusible spear called a stylet. The nematode uses its stylet to pierce the plant cell, inject digestive enzymes into the cell, and remove the contents of the cell through the hollow core of the stylet. Nematode feeding affects the plant by removing nutrients directly from the root, by reducing nutrient and water uptake, by destroying root tissue, by retarding root growth, and by creating entry points for other damaging microbes.

Above ground symptoms vary depending on the site characteristics and turfgrass species but often include stunted growth, chlorotic leaves, and wilting during hot, dry weather. These symptoms are often misdiagnosed and confused with environmental stresses such as drought stress, nutrient deficiencies, and/or insect and pathogen injury. Plant stresses created by nematode feeding may increase disease susceptibility which may be diagnosed incorrectly as the primary causal agent. Nematode feeding also creates wounds that may serve as entry points for other

Nematode trapping fungi at w

pathogens. Root symptoms of nematode damage often appear as galls, tan to dark brown lesions, excessive branching, stubby roots and necrotic root tips.

Survival Strategies

Nematodes can only travel a short distance under their own power. Therefore, the spread of nematodes is often facilitated by factors including wind, rain and irrigation water, insect and animal vectors, and vehicle and equipment parts. In northern climates, survival during winter conditions is important. Nematodes have developed a number of strategies to survive extreme conditions. Many nematodes have a broad host range. When their preferred plant is removed from an area they can gain some nutrients from other plant material and can withstand harsh environmental conditions within the root tissue.

Since turfgrasses are perennial plants, nematodes that affect them have the advantage of a year round source of nutrients and a suitable place for protection against extreme environmental conditions. In the Cyst nematode, the female body fills with eggs during the growing season. At some point the female dies and her body hardens, serving as protection for her eggs. Many nematodes have dormant stages in their life cycle that allow them to withstand extreme temperatures and lower levels of available nutrients. Another survival strategy used by nematodes is migration deeper into the subsoil to avoid environmental extremes.

ork. Note the lasso-type attack.

Management Practices

Management of these damaging pests should not be viewed in terms of eliminating nematodes from the site but in minimizing the symptoms they produce. There are a number of cultural practices that can be employed in minimizing damage. Symptoms produced by a pathogenic nematode infection are more apparent during times of water stress. Just supplying the turf with adequate amounts of water during these periods can drastically reduce the amount of above ground symptoms observed. Fertility needs to be maintained carefully. Adequate amounts of nutrients are needed to avoid stresses to the plant but excessive amounts can cause more damage due to abundant succulent root production that attracts nematodes. Avoiding water stress and maintaining adequate fertility levels are probably the most important factors to address, but also consider stresses produced by soil compaction and low mowing height.

Amending the soil by introducing peat, composts or sludges can greatly improve the structure of the soil. These amendments decompose producing organic compounds that have been found to be toxic to some nematodes. Soils with high levels of organic matter produce plants that are able to avoid many of the stresses previous discussed. They have been found to avoid drought stress more efficiently as a result of the soil retaining water for longer periods of time, being less prone to compaction, more rapid degradation of thatch, and plant developing better root systems. But the most important feature of organically amended soils is the higher populations of competing and predatory microorganisms.

Limited research has been conducted on the role of biological control organisms as possible management options. When we talk about biological controls in this case, we are talking about organisms that can be applied to the environment, establish themselves, and lower the populations of the pathogenic nematodes. Maintaining a biological system like this is very difficult. As pathogenic nematode populations decease due to the predator, so do the populations of the predatory organism. Many species of microorganisms, such as fungi, bacteria and actinomycetes, have been found to have antagonistic properties against pathogenic nematodes.

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Nematodes

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Numerous fungi use nematodes as a part of their diet but a few have developed rather complex strategies for the sole purpose of trapping nematodes.

The Pesticide Management Education Program at Cornell also lists the following products as being labeled for nematode control, Ditera (listed as a biological), Amazin, Ecozin, Ornazin (Azadirachtin), Cladosan (Chitin), Champ Formula 2 (Copper hydroxide), and Safe-T Green 18 (Alcohols, C11-15-secondary, ethoxylated).

There are a group of fascinating organisms known as "nematode trapping fungi." Numerous fungi use nematodes as a part of their diet but a few have developed rather complex strategies for the sole purpose of trapping nematodes. Some fungi produce adhesive knobs and sticky hyphal branches that trap nematodes as they swim by. One fungus produces constrictive rings that close around the nematode as it moves through and brushes against the ring. The fungus produces a toxin that paralyzes the nematode and then digests it. One of the most interesting aspects to this story is the fact the these fungi only produce these constricting rings when nematodes are present. Currently there are no known commercially available products.

Chemical Controls

Nematicides are available as a chemical option for control of plant parasitic nematodes. However, the long term availability of these products is in question. Products that are currently registered for use in New York on turfgrass include methyl bromide, which is used as a soil fumigant when preparing a new site. Methyl bromide was scheduled to be phased out by the year 2000 but since no effective substitute is available, the phase out has been extended for a short period of time. For established turf, non-fumigants such as Mocap and Nemacur are available. Mocap works as a contact nematicide that is effective against ectoparasitic species of nematodes. Nemacur is a systemic nematicide that is taken up into the plant and therefore effective against endo- and ectoparasites. The Pesticide Management Education Program at Cornell also lists the following products as being labeled for nematode control, Ditera (listed as a biological), Amazin, Ecozin, Ornazin (Azadirachtin), Cladosan (Chitin), Champ Formula 2 (Copper hydroxide), and Safe-T Green 18 (Alcohols, C11-15-secondary, ethoxylated).

In conclusion, we hope to begin to learn more this summer about this important group of turfgrass pests as we conduct a population distribution sampling on a putting green at the Coun-

Hoplolaimus nematode on a turf root.

Root Knot nematode on a turf root.

try Club of Ithaca. With the help of D. Cord Ozment and his staff we will collect samples from 115 grids across the putting green at three separate collection periods throughout the growing season. The green shows characteristic symptoms of nematode damage and an assay conducted last fall indicated high levels of plant parasitic nematodes are present. Our survey will provide valuable information to turfgrass industry members and university researchers by focusing on the distribution patterns and population levels across a putting green to learn how varied the population can be and in turn determine the accuracy of our current sampling procedures.

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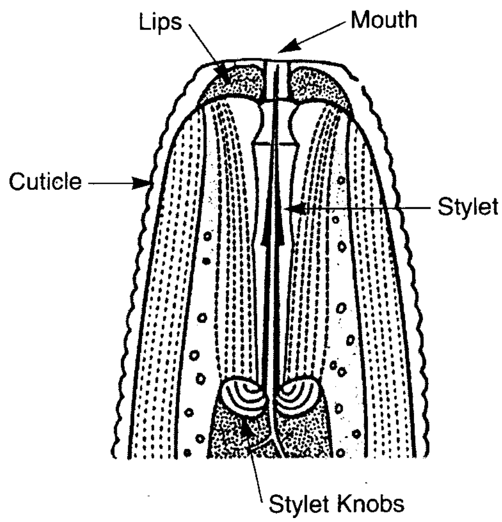

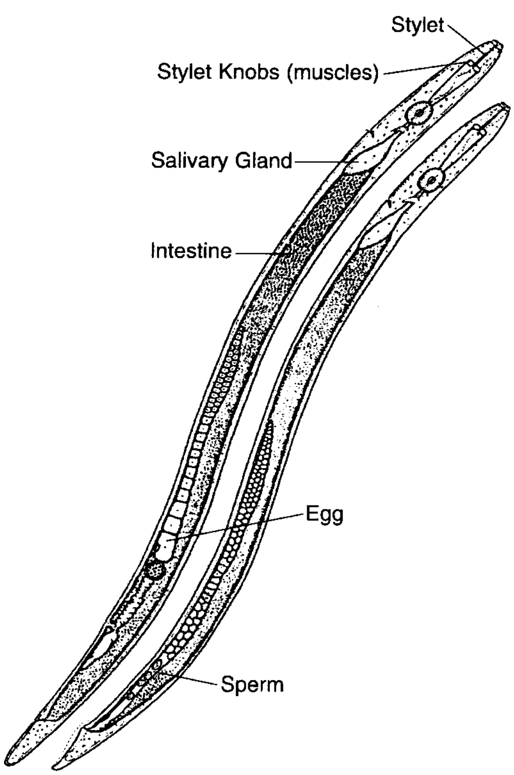

Above: diagramatic representation of a typical male and female plant parasitic nematode.

Above right: side view of a nematode head.

Short Cutts

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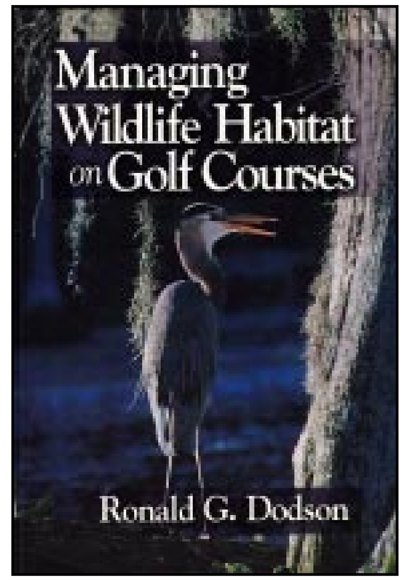
habitat perspective, some historical information on how golf and the conservation movement have evolved to a place where they share common interests. The remaining chapters establish a scientific basis for managing habitat and some practical tips for how to get started implementing these tips on your property.

Many golf turf managers hear of the steps being taken by those in the Audubon Program and have a sense that it is extra work to "do the right thing" for water quality and wildlife. This book should inspire those individuals to start doing "little things" to conserve resources and create habitat while maintaining the playability of the golf course. Whether it is adding landscape plantings, preserving nonhazardous tree limbs, encouraging aquatic vegetation, or engaging the community in the efforts, Ron has something in this book for all of us.

My favorite sections of the book are the last two on case studies and "the right thing to do". In these chapters, Ron provides an important call to action for the golf industry (including the golfers) to become conservation minded and promote the attributes of the human managed landscapes that enhance the quality of our life, not juts as golfers, but as members of a community. The case study section provides a nice overview of the various approaches taken by golf course superintendents regardless of the size of their budget. Implicit in this chapter is the sense that anyone can enhance the environmental quality of their landscape; all it takes is some information and a commitment. Ron provides some of the former and inspiration for the latter.



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