



Botany and



Plant
Pathology

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Root Knot Nematode

Richard Latin, Professor of Plant Pathology

Nematodes are microscopic roundworms that inhabit all kinds of soils. Most are saprophytic (they live off dead and decaying organic matter). Some are parasitic (they live off live host plants). All plant parasitic nematodes penetrate plant cells with a dagger-like structure called a **stylet**, which functions like a syringe, enabling them to suck nutrients from host cells.

Plant parasitic nematodes are subdivided into **ectoparasitic** and **endoparasitic** types. Ectoparasitic nematodes attach themselves to the outsides of roots where they remain while they feed and reproduce. Endoparasitic nematodes enter plant roots, embed into root tissues, and feed off cells in the vascular system. Most nematode-related turf damage is associated with intensively managed, closely mown turf on golf courses and, to a minor extent, athletic fields.

Among the most destructive plant parasitic nematodes in turf systems are root knot nematodes (RKN), classified in the genus *Meloidogyne*. This publication describes the RKN life cycle, and how to identify and manage them in turf.

RKN infection is very common on warm-season grass species in the southern United States, and rather infrequent on cool-season grasses north of the transition zone. RKN are endoparasitic and thrive in sandy substrates typical of golf course putting greens.

Life Cycle

RKN enter root tissues and migrate toward meristematic regions (growing points) of the root, where they undergo several transformations (molts) until they mature into adults. RKN adults remain embedded in turf roots where they feed voraciously and produce hundreds of eggs. Egg masses protrude from root surfaces. Eggs hatch into active juveniles that begin feeding immediately. Juveniles enter roots and migrate to meristematic tissues and continue the life cycle.

The plant's response to RKN infection is abnormal cell growth, which results in swelling on roots and impaired root function. Turf suffering from environmental stress (heat, drought, and compaction) tends to wilt and die more quickly if also infected by RKN.



Figure 1. Turf affected by RKN may first appear as small clusters of unhealthy turf.



Figure 2. RKN damage on older swards of turf may show no discernable pattern.



Figure 3. RKN-affected plants wilt and die quickly.

Identification

There are few (if any) obvious and distinguishing aboveground symptoms of turf affected by RKN. Initially, the turf simply appears unhealthy. Individual plants turn yellow and decline from the leaf tips backward toward the crown.

Symptomatic plants often are clustered in patches (Figure 1). However, a general nondescript decline pattern also may occur (Figure 2). As environmental stresses increase, plants with roots impaired by RKN infection are quick to wilt and die (Figure 3), with little or very slow turf recovery.

More recognizable symptoms occur below ground level. Affected root systems tend to be sparse, and characteristic swellings (observed under magnification) are consistent with RKN-affected turf (Figure 4).

Management

RKN infection can occur on all grass species and cultivars used on golf courses. No known host resistance has been reported. Managers who follow agronomic practices that promote dense roots and otherwise healthy plants will be better prepared to sustain high nematode populations without serious turf damage.

Nematode control is complicated by the fact that nematode populations are not always correlated with turf damage. Few chemical options for RKN control are available, and all options are burdened by certain issues.

Restricted-use fumigants and the organophosphate fenamiphos (Nemacur[®], which is being phased out after a ban by U.S. EPA) are associated with health and environmental risks. Furfural (Multiguard[®]) has similar risks. Abemectin (Avid[®]) has a limited spectrum of activity (ring and sting nematodes only). Nortica[®] is a biological product (*Bacillus firmus* I-1582) that may reduce nematode populations and may be effective under conditions of low to moderate stress.

Like any chemical application targeted to soil pathogens, numerous factors influence the results, and there is no guarantee of satisfactory performance. Published research focused on RKN control on cool-season grasses is scarce.

Until research generates a more comprehensive understanding of the effects chemicals have on nematode populations, the best recommendations for avoiding damage are based on sound agronomy: growing healthy turf in spring and fall and reducing summer stress.



Figure 4. Root swellings often are diagnostic symptoms of RKN infection.

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June 2015

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