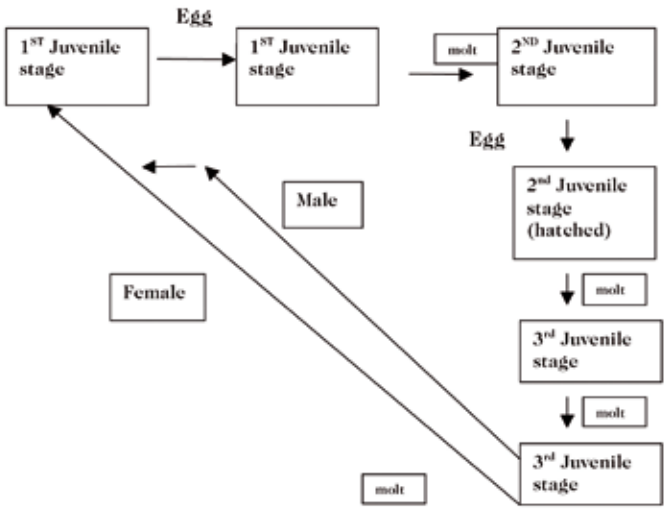
NEMATODES IN TURFGRASS

By Dr Tim Butler

Nematodes belong to the phylum nematode and are invertebrate, non-segmented, soil-dwelling, microscopic round worms that range in size from 1/25th of an inch up to 100 inches (Warner, 2006. Pers. Comm.). There are about 10,000 different species of nematodes, a large proportion of which are beneficial and are being used as biological control agents for insect pests in many crops ranging from mushrooms to turfgrass.

Control of insect pests such as cutworms and armyworms with specific nematode species is being used in the United States. Several types of nematodes exist including algal feeders, fungal feeders and carnivores. However, plant parasitic nematodes are a big problem on turfgrass. About 15 per cent of nematodes are believed to be plant parasites (Wick, 2007, Pers. Comm.). Most plant pathogenic nematodes are less than 4mm in length (Wick, 2007, Pers. Comm.).

NEMATODE LIFE CYCLE – Nematode lifecycles are made up of several stages. Most turfgrass nematodes have about four molts after the egg stage, followed by the adult stage. Sexual reproduction is usually the means of reproducing. It is important to realise that many nematode populations are only female and that females can produce fertile eggs with the male nematode. The lifecycle can last for up to a few months and many hundred eggs can be produced by one female. The common turfgrass nematode lifecycle is given in Figure 1 below.



DISTRIBUTION – From experience, many golf course managers and greenkeepers often say they have no obvious problem on their fairways or roughs from nematodes, but that it is their tees and greens that are affected. This is because many golf greens contain around >85 per cent sand depending on the specification, which is an ideal environment for nematodes. Nematodes are usually found with the top 6in layer of the rootzone and move through the layer of moisture around soil particles. Nematodes can be spread through soil, machinery, water, and wind.

CLASSIFICATION – Plant parasitic nematodes have a styla (mouthpart), which allows them to feed on plant roots by puncturing the plant cell and subsequently feeding on the contents within. Plant parasitic nematodes are often broken down into:

- Root Ectoparasites
- Root endoparasites
- Foliar feeding parasites (Warner, 2006. Pers. Comm.)

A very low proportion of nematodes are foliar-feeding, with endo and ecto parasites making up the vast majority. Ectoparasites feed outside plant tissues and not within, whereas endoparasites feed within the plant tissue (Warner, 2006. Pers. Comm.). Endoparasites can be divided into mobile (migratory) and immobile (sedentary) nematode feeders.

ENDOPARASITES – Root-knot nematodes (Meloidogyne sp.) are well known to golf course greenkeepers and can cause a lot of damage to turfgrass. Juveniles enter into turfgrass roots and begin feeding. When feeding, cells form on the grass root as a response from enzymes produced by the nematode and injected into the root of the grass.

It is also believed that the nematode may communicate with the plant in order to build nurse cells by genes controlled by the nematode. Female root-knot nematodes often lay hundreds of eggs in or on turfgrass roots. The eggs are extruded to the surface of the root in a sticky mass (Wick, 2007, Pers. Comm.).

Damage is very common on bentgrass swards, with many greenkeepers feeling the root-knot nematode is one of the main nematode problems. Damage includes irregular yellowing of the turfgrass and in some cases root galls. It is estimated by some that an action threshold for root-knot nematodes is about 100 nematodes per soil and root sample (Warner, 2006. Pers. Comm.).

Cyst nematodes (Heterodera sp.) are a big problem on bentgrass and can cause a lot of damage which can be somewhat similar to root-knot damage. These nematodes can persist in the soil for many years and the estimated

action threshold is about the same as for root-knot nematodes.

Lance nematodes (Hoplolaimus sp.) are mobile within the turfgrass root, and lay eggs and feed with the root system itself. Damage includes brown, rotten roots and turfgrass thinning.

ECTOPARASITES – Stubby root nematodes (Paratrichodorus sp.) cause root tip death through root piercing and subsequent sap-sucking. It is thought these nematodes have a synergistic effect with fusarium.

Sting nematodes (Belonolaimus sp.) have a styla which penetrates deep into the root of the plant, causing considerable damage. Symptoms include root blackening, die back and cell death.

Ring nematodes (Criconemella sp. and others) are relatively small nematodes, which are commonly found in turfgrass in many countries. These nematodes appear not to be very pathogenic to turfgrass and at levels of over 100 per sample, turfgrass may still be healthy (Wick, 2007, Pers. Comm.).
Other examples include dagger nematode, stunt nematode and spiral nematode.

DAMAGE SYMPTOMS – Symptoms of nematode damage on turfgrass above ground include chlorosis of the turf in irregular patches which – even after fertilisation – persists, followed in some situations by turfgrass wilting and general poor health of the sward.

Above ground damage is usually more apparent during high stress conditions on the turfgrass, such as found under high temperature and limited water supply. Damage below the surface of swards appears as a short unhealthy root system, with limited density. With root-knot nematodes, the plant may form cells on its roots as a means of feeding the nematode. These cells allow the nematode to feed from a large pool of nutrients within the plant. In time the turfgrass roots become altered due to the feeding nematode and the large cells on the plant roots, and the term knot or gall is then used to describe the condition.

Turfgrass plants suffering from nematode invasion have a reduced ability to uptake water and nutrients and thus excessive applications of both may be required to get some response from the plant. It is important to understand that nematode feeding concentrates on the xylem parenchyma, which transports water and nutrients. Many turfgrass managers do not realise that they have a nematode problem, and associate the poor turf with management practices and in many cases disease problems, when neither are the truth.

Nematode species have specific optimal temperatures from growth and reproduction, although it is well known that moderate to warm soil conditions are generally most favourable to nematode populations. It is generally believed that conditions that favour grass growth, favour nematodes also. During cold weather, nematode activity decreases and many nematode eggs will over winter in plant material or in the dead female body. Nematode damage is usually more prevalent on sand based rootzones, particularly during summer and autumn.

SOIL TESTING – If problems with nematodes are suspected, then field evaluation is critical in order to establish if they are present, species type and numbers in the soil. A commonly used method is to take numerous separate random subsamples from suspected areas and healthy areas, usually to a depth of about four on golf greens or tees. The subsamples should be subsequently bulked together. Samples should be kept cool but not frozen during storage. In my opinion, soil samples should be taken when the turfgrass is actively growing, and not during cold periods.

MANAGEMENT – Using nematode-free planting material and rootzones is the ideal method of avoiding nematode problems. However in reality it is very difficult to have on a continuous basis plant parasitic nematode-free material. Even when such material is sourced, nematodes over time may still invade rootzones on greens and tees.

Many feel that the best solution is to keep the turfgrass sward as healthy as possible, by ensuring that the grass has adequate access to nutrients and water and is subjected to limited amounts of stress. Proper irrigation is essential, particularly during periods of warm weather, if nematode populations are high, since the turfgrass rooting system may be limited and water uptake severely reduced. Reducing plant stress levels is also vital in order to maintain a relatively healthy sward. In recent years, the application of biostimulant products on turfgrass has gained much momentum. These products include seaweed extracts, humic acids, sugars and microbial inoculants and research has shown that they may reduce stress levels within turfgrass swards.
Raising mowing heights is also an excellent way to reduce stress levels on turfgrass plants. In recent years, pressure has increased on golf course greenkeepers to lower mowing heights, which reduces photosynthetic capacity and stresses the plant.

Several plant-derived materials are currently being used on golf courses throughout Europe, with varying degrees of success. Such products include mustard bran, thyme and oils from various trees and shrubs. Mustard bran is gaining much attention at present. It works by releasing allyl-isothiocynate in the soil, which kills the nematodes through a biofumigation action. This product has been trialled in the USA and shown some promise.

Many microbial inoculant products, containing live blends of bacteria and fungi are on the market, although research looking at specific microbial antagonists for nematodes is also underway. Some inoculants currently available may have some negative impact on nematode populations, although limited if any research is available. The use of resistant germplasm, which could be developed into commercial varieties, may be of use in the future and such varieties may be seeded into existing turfgrass stands. But as yet this is not readily available.

Nematode problems will continue to grow in magnitude on golf courses in years to come. Research is underway and it is hoped that more reliable control will be available in the future.

ABOUT THE AUTHOR

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