

Nematodes in turf

Graham Paul offers you the chance to collect some BASIS points and learn some information on nematodes, the plant parasitic nematodes that affect amenity turf

Nematode as seen through low power microscope

If you have ever seen damage on turf that doesn't fit in with the symptoms of disease, animal or insect attack, then you may have experienced the effects of a nematode infestation.

Nematodes are round worms that belong to the phylum Nematoda - the second largest group of invertebrate animals after the Arthropods (Insects and bugs). Over 80,000 species of nematodes have been described but scientists believe the total number of species on this planet exceeds one million! They occur in a wide variety of habitats existing as both free-living and parasitic species.

This article will concentrate on the plant parasitic nematodes that affect amenity turf.

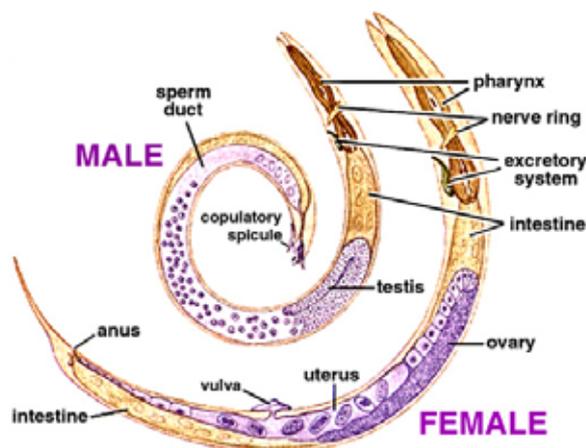
The majority of nematodes are free-living, existing on a diet of dead organic matter. Pathogenic species are known to affect most forms of macroscopic life - including plants, animals, birds, fish, crustacea, insects and bugs.

Most nematodes are so small that they cannot be seen without a microscope or strong hand lens. They are un-segmented and at the

anterior (head) end there is a mouth with three lips and armaments, which may include; teeth, hooks, a spear or stylet.

The nematode body consists of a long hollow tube with another tube inside it, containing the alimentary canal and reproductive organs. The body shape is maintained by holding body fluids between these 'tubes' under pressure (1.4 to 2.4 p.s.i.) A muscular pharynx is needed to propel food through the intestines, which tend to collapse under the force of the internal body pressure. The nematode has no blood circulatory system but it does have a fairly well developed nervous system. There are only longitudinal muscles, so they move with a 'snake-like' whipping motion.

Nematodes species often have both males and female sexes but it is not uncommon for plant parasitic nematodes to reproduce asexually by parthenogenesis - a process in which the unfertilized ovum develops directly into a new individual. Most of the nematode's body cavity is taken up by reproductive organs. Females are typically larger than males, since the production of thousands of eggs takes up much



ISNET ABOVE: Diagram 01 - Anatomy Of The Nematode - see acknowledgements

more body space than the creation of sperm by her partner.

The male introduces sperm into the females vulva with the help of two horny, stiff spicules that are part of his cloaca. Fertilisation is internal and the female lays her eggs over a prolonged period of time. Some species can lay eggs at the rate of 200,000 per day. The eggs hatch and go through four moults before the adult stage is reached.

Almost 4100 species of plant parasitic nematodes have been

RIGHT PAGE: Nematode eggs
Courtesy of Dr Ruth Mann, STRI

studied. They are mostly microscopic - 400 to 3000 microns (0.4– 3mm) in length and most are armed with a stylet or other weapon, which is used to pierce plant cells to enable the worms to feed on the cell contents.

The majority of plant parasitic nematodes feed on the roots of their host and can be divided into two sub-groups: -

Endoparasitic – the nematode invades the living host, entering the root system and moving into the vascular tissue. Some species, e.g. Root Knot Nematode, secrete substances that modify the host plant cell division to create specialised enlarged cells to accommodate the parasites while they feed.

Ectoparasitic – the nematode remains outside the host and pierces the plants cell walls to extract the cellular contents for food.

Many different species of nematodes are known to infest turf throughout the world. An article published in the journal 'Biologist' in May 2008 (see references) lists 14 different species that were found in 272 turf samples taken from European soccer pitches and golf courses during 2006. These included both endo and ectoparasites.

Listed next are the main characteristics of the more commonly found nematodes infesting turf:

a) Endoparasitic species

- The Cyst Nematode *Heterodera spp.* causes galls or lumps where the roots swell up. Immature nematodes move through the soil in search of a host. When they find a suitable root, they enter and inject substances that cause the cells to enlarge and provide accommodation and an on-going food source. The female nematode is fertilised inside the feeding cell where she remains and eventually dies. Her dead body becomes a swollen bag of fertilised eggs known as a cyst. As the damaged root breaks up the cyst is released into the soil where it can remain 'dormant' for a long time, eventually releasing the eggs and emerging juveniles.

- The Root Knot Nematode *Meloidogyne spp.* produces 'knotty' galls in the root. It bears similarity to the Cyst nematode in the way it enters and feeds in the root but it does not form an egg cyst; instead the eggs are released into the soil when the root knots break down, where they hatch and develop into juveniles. Damaged roots are often much shorter than unaffected roots.

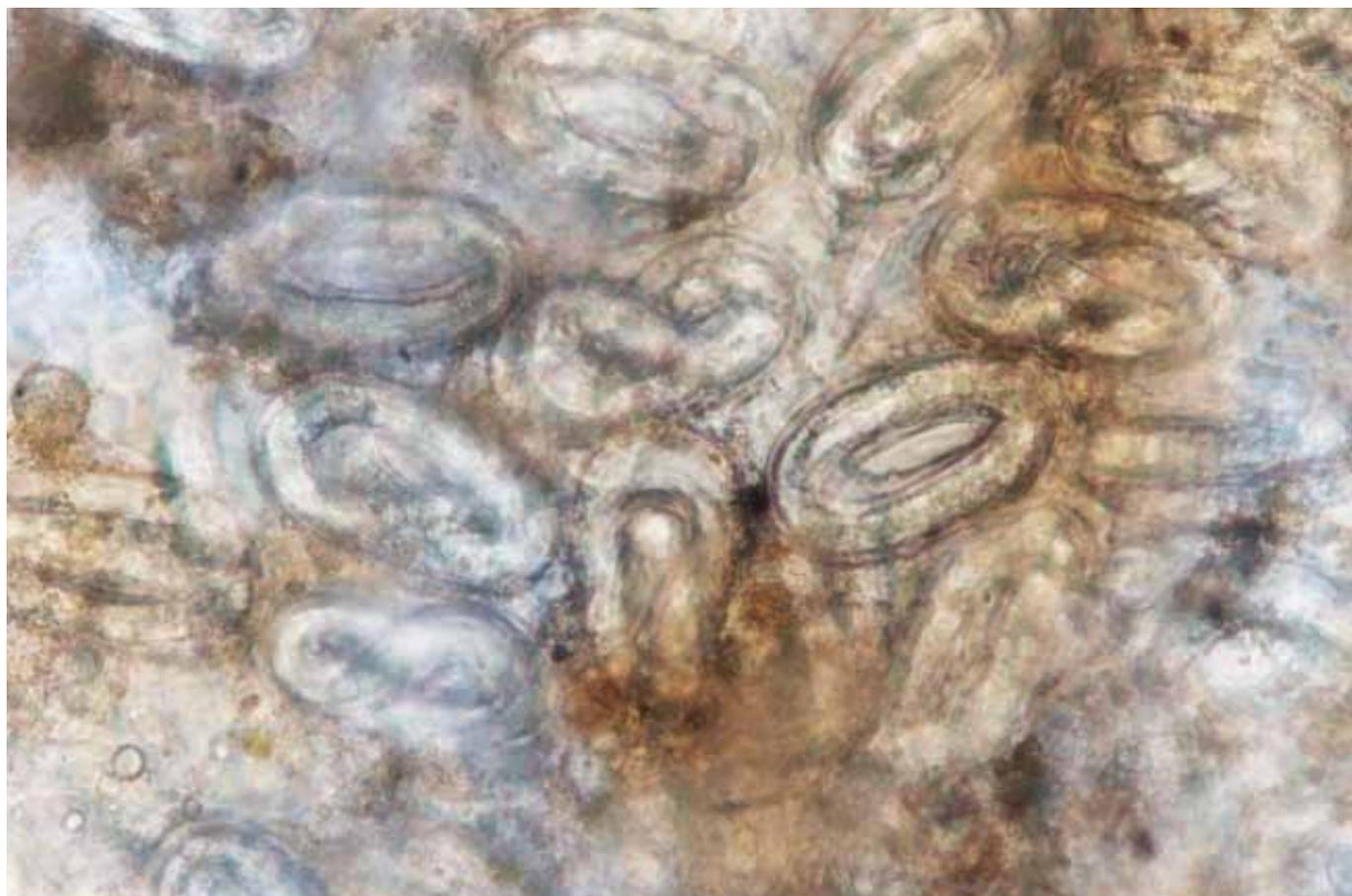
- The Root Lesion Nematode *Pratylenchus* is one of the most damaging and widespread pests in agriculture. This nematode initially attacks roots from the outside, but



Cyst Nematode *Heterodera spp.*
Dr Kate Entwistle, The Turf Disease Centre



Root Knot Nematode – *Meloidogyne spp.*
Dr Kate Entwistle, The Turf Disease Centre





LEFT: Spiral Nematode *Helicotylenchus* spp.
Dr Kate Entwistle, The Turf Disease Centre

RIGHT: Sheath Nematode feeding *Hemicyclophora* spp.
Dr Kate Entwistle, The Turf Disease Centre



LEFT: Ring Nematode *Cricone-mella* spp.
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as death of the cells progresses, it moves into and through the root, destroying tissue as it goes.

b) Ectoparasitic species

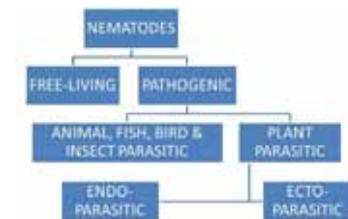
The Spiral Nematodes *Helicotylenchus* spp. & *Rotylenchus* spp. These nematodes typically adopt a spiral posture. They 'graze' around the outside of roots using a short, hollow stylet to pierce cells and feed on the contents. The cells die after this attack, leaving many damaged areas in the roots.

The Stunt Nematode *Tylenchorhynchus* causes the plant to be stunted both above and below ground. Adults feed around the outside of the roots using a short, hollow stylet. Numbers can build up quickly so while individual nematodes do not cause much damage, their combined effect can be significant.

The Sheath Nematode *Hemicyclophora* - so named because the adult female has a protective sheath around her body. This picture below shows the hollow stylet penetrating root cells during feeding.

The Ring Nematode *Cricone-mella* spp & *Macroposthonia* spp appear to be segmented like the earthworm. However, closer examination reveals this is due to corrugation of the outer membrane.

The Stubby Root Nematode *Paratrichodoros* feeds from the root tips causing damage which



prevents further root elongation, hence its name. The nematode pierces the roots with a solid stylet, sucking up the sap with the mouth. Stubby Root nematodes are known to transmit viruses and have a synergistic effect with *Fusarium*.

SYMPTOMS OF NEMATODE ATTACK ON TURF

From the surface of the turf, the visual signs of nematode infestation are fairly non-specific and depend on the severity of infestation and the species of nematode involved.

Symptoms can vary from a yellow discolouration to wilting and general thinning of the sward. The physical damage to the root system results in a reduction in wear tolerance that can devastate heavily used turf.

Damage is particularly evident with endoparasitic species such as *Meloidogyne* spp., the Root-Knot Nematode and the severity of symptoms can be made worse by external factors such as fungal disease attack and also by low

Claim 2 BASIS points

SELF ASSESSMENT

Use the questions below to check your understanding of this topic. Readers can claim BASIS points if answered correctly! Circle the correct answer(s)

1) Approximately how many species of plant parasitic nematodes have been studied?

- a) 80,000,
- b) 1 million,
- c) 4,100, d) 3000

2) What term is used to describe the process of asexual reproduction that can occur with some nematodes?

- a) mutagenesis,
- b) parthenogenesis,
- c) mitosis,
- d) symbiosis

3) Which of the following are endoparasitic nematodes? (More than one may apply)

- a) *Cricone-mella* spp.
- b) *Meloidogyne* spp.
- c) *Heterodera* spp.
- d) *Hemicyclophora* spp.

4) Why do nematodes require a muscular pharynx?

- a) To keep food in once it has been ingested
- b) To propel the stylet into the host root cell
- c) For respiration purposes
- d) To force food into the intestines against the internal body pressure

5) Problems with nematodes on turf are more likely to occur in . . .

- a) Dry soils,
- b) acid soils,
- c) wet soils,
- d) nutritionally deficient soils

REFERENCES

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ACKNOWLEDGEMENTS

• Thanks to Dr Kate Entwistle, The Turf Disease Centre and Dr Ruth Mann of the STRI for their assistance and for photographs used to illustrate this article.
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light levels that are often found in football stadiums.

In the last 15 years we have seen a dramatic increase in golf construction to the USGA standard, which utilises pure sand or a high sand percentage in the rootzone, seeded with creeping bent (*Agrostis stolonifera*). This type of golf green has been found to be particularly susceptible to the root knot nematode *Meloidogyne minor*, its presence affecting both visual appearance and the roll of the ball as a result of turf thinning. Affected turf responds badly to routine maintenance such as aeration and feeding and the wear tolerance is greatly reduced.

Problems with nematode infestations are especially frequent in wet climates. It has been reported that in Ireland 90% of sand-based golf greens built since 1977 are infested with *Meloidogyne minor*. It is believed that the parasite is distributed in the sand used for construction, since it has been found to occur naturally in sand dunes all around the UK.

In many cases the presence of a nematode infestation can go unnoticed if the attack is less severe. Due to their small size examination of a soil core may not reveal the true cause.

Control of nematodes in turf

There are no chemical pesticides approved for nematode control in turf. However, a natural product based on garlic extract and sold under the brand name 'Eagle Green Care', has CRD approval for use on established turf in the UK.

Research has been carried out on the use of plant bio-stimulants to relieve the stress caused by nematodes feeding on the roots. Such products can improve the health (depth and thickness) of the root system and enable the grass to endure nematode attack without showing adverse visible symptoms. Of these, seaweed extracts obtained from *Ascophyllum nodosum* e.g. 'Seavolution' appear to give the best results. Research on some soil amendment products, such as Bio-Mass sugar and mustard bran, has also revealed benefits to the health of turf that is being damaged by feeding nematodes. The effect is deemed to be similar to that experienced with the use of bio-stimulants, encouraging the development of strong roots that can help to compensate for the damage caused by the nematodes. But, it must be stressed that these products are not authorised nematicides for use in reducing nematode numbers in turf.



ABOVE: General yellowing and thinning
RIGHT: Root knot symptoms

Dr Kate Entwistle, The Turf Disease Centre



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