MELOIDOGYNE 'YELLOW PATCH' ON CREEPING BENTGRASS GREENS

by Dr Kate Entwistle

The purpose of this second article on root-knot nematodes in turfgrasses is to provide some general information on the nematodes themselves and to show some of the results of recent independent research that proves these nematodes to be the cause of the yellow patches seen over the past four years on creeping bentgrass greens in the UK and Ireland.

In the previous article, I detailed the evidence that was collated from over 20 golf courses across the UK and Ireland which showed that the incidence of large, yellowing patches of creeping bentgrass turf was consistently associated with a root-knot nematode infection. To be absolutely certain of this and to calm the resulting scepticism that followed this diagnosis, Headland Amenity funded independent research to show whether or not this identified cause for the turf symptoms was indeed correct. Before looking at the results of this research, it may be useful to have a few facts and some general information on these root-knot nematodes – they are after all, a relatively new turfgrass pest as far as cool season turf management is concerned.

Root-knot nematodes belong to the nematode genus Meloidogyne. Nematodes are unsegmented roundworms, most of which are microscopic (not visible by the naked eye) and are generally translucent (without colour) making them virtually impossible to see in affected rootzones without the aid of a microscope. Many nematodes are elongated but some, like the female root-knot nematode, swell and become more spherical as adults. Nematodes in general feed on over 3000 plant species worldwide and although some may be able to cause damage to several plant types, there are those that are less common which are very host specific. It is worth remembering that not all nematodes cause damage to plants and some are beneficial in the rootzone feeding on rotting plant debris. Some plant parasitic (damage or disease causing) nematodes live mostly on the outside of the plant roots (in a comparable manner to that in which greenfly feed on plant shoots) while others live the majority of their lives inside the root tissues affecting water and nutrient uptake and movement. Although nematodes will vary between genera (and species), their life cycles are roughly similar. They develop from eggs through four larval (or juvenile) stages to become adults. In most species, nematodes hatch from the egg as second-stage juveniles (J2) and these move through the rootzone in water films searching for a host on which to feed. Males may or may not be necessary for completion of the nematode life cycle. Most nematodes complete a lifecycle from egg to adult in about three to six weeks and some juveniles are able to withstand periods of desiccation.

The female root-knot nematode is what's called a sedentary endoparasite of roots, which means that after emerging from the egg she very quickly makes her way inside a root and spends the rest of her life embedded inside the root tissues. Males and juveniles may be found moving freely in the rootzone. Root-knot nematodes cause general unthriftiness, stunting, chlorosis and nutrient deficiencies to infected plants. These plants may wilt on hot days and severely infected plants may even die. Infection by these nematodes causes a complete change in the functioning (or physiology) of the turfgrass plant. The most notable changes are the development of swollen cells in the roots that form the visible root-knots or galling which is always associated with their infection.

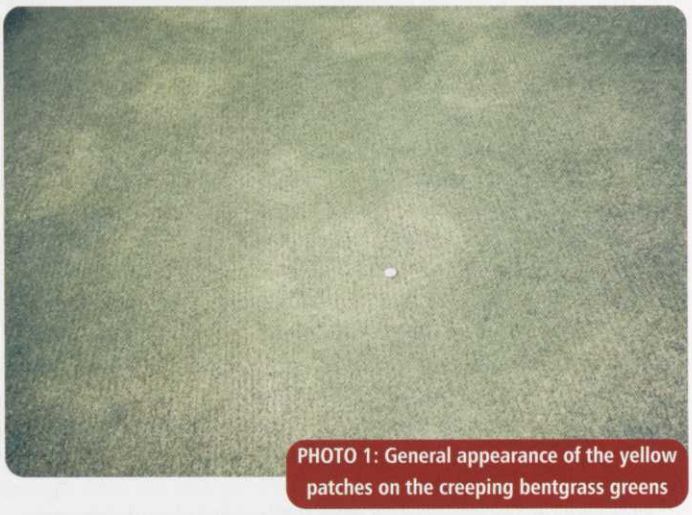

PHOTO 1: General appearance of the yellow patches on the creeping bentgrass greens

Although these nematodes are microscopic and, until now not recognised as potential pests of cool-season turfgrasses, their effects on the sward can be quite dramatic. Many nematode types can cause a general decline of the affected turfgrass areas with large areas of the turf showing general symptoms of stress. I have always considered that the best way to identify a possible nematode infection is when the sward appears to be suffering from drought but it doesn't actually need watering, or it appears to need a feed but the nutrition is adequate. Overall, turf that looks 'unthrifty' or in need of 'some attention', when you know that nothing is lacking with regard to its maintenance, this is a sward that may well have a problem with nematodes. As for the root-knot nematode, the symptoms are a little different. Although affected turfgrass plants still have these same general characteristics, the affected area of the sward is much more clearly defined and, as in these cases, can appear as very distinct patches on the turf surface. In the case of these yellow patches that we have been investigating on courses across the UK and Ireland, we know that the nematode present is a root-knot nematode (Meloidogyne) but more importantly, that it is a new

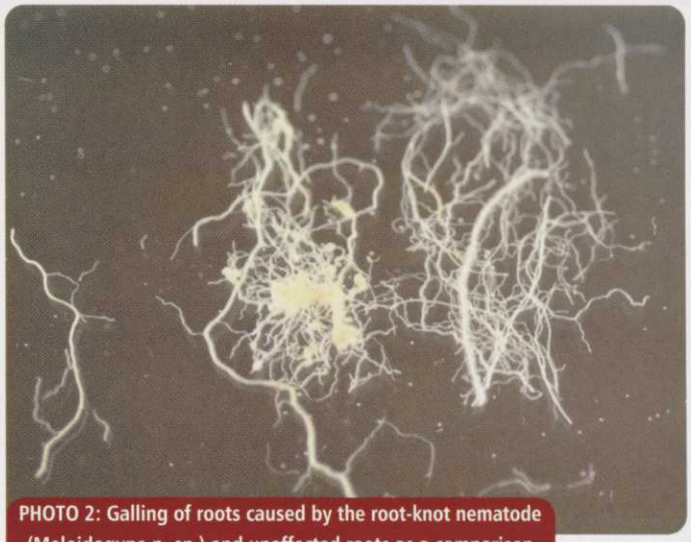

PHOTO 2: Galling of roots caused by the root-knot nematode (Meloidogyne n. sp.) and unaffected roots as a comparison

species (Meloidogyne n. sp.) which is currently being described by an expert in root-knot nematodes.

Now that we know a little more about the root-knot nematodes in general, we can take a look at the independent research that was completed under the direction of Dr Roger Cook at IGER, Wales. The aim of the research was to confirm whether or not the root-knot nematode (Meloidogyne n. sp) identified on the affected greens was the cause of the symptoms seen on the surface of the swards and to see if reducing the population levels of the nematodes present would allow improvement of the overall turf quality.

Three golf courses across the UK and Ireland, that had been affected by these yellow patches for up to four years, agreed to help with this experiment. All of the courses had been seeded with American bred creeping bentgrass cultivars and all had USGA-type rootzone constructions. From each course, 16 hole-cutter core samples were removed to a depth of 10 cm, eight from yellow affected areas and eight from green unaffected areas. All of the sixteen cores were wrapped separately to avoid movement of material between individual cores and to keep the rootzone profile intact. The cores were delivered either on the day of removal from the course or by next day delivery, to the laboratory at IGER. Once received, the cores were removed from their packing and prepared for the experiment. Details of this preparation are available should anyone be interested in reading it but for the purpose of this article, the set-up can be seen in Photo. 4.

A 'cake-slice' sample weighing on average 200g was removed from each of the cores to allow for an assessment of initial nematode population and degree of root galling to be made. Initial readings of turf colour were also recorded. Of the eight affected and eight unaffected cores from each course, half (i.e. four of each) were then treated with a nematicide. The purpose of this was to see if the nematodes that were present could be killed, resulting in subsequent improvement of turf quality and also, if further infections of new root growth could be prevented thereby determining the correlation between the nematode presence and the root galling /sward yellowing symptoms.

Initial assessments of the cores (which had been removed from each golf course by the Course Manger and not by anyone involved in completing this experiment) showed that on all courses, the samples removed from the yellow affected turf areas had populations of Meloidogyne n. sp. nematodes and numbers of root knots far in excess of those found on the green unaffected cores. In fact on two of the three courses there were no nematodes or galls present in the unaffected samples. On the third course, the apparently unaffected cores did have a few nematodes and galls present but their numbers were much less than those present on the yellow infected areas. It was concluded that these initial observations were strong evidence for constant association of nematode and symptom and indicate that this new root-knot

PHOTO 3: The female root-knot nematode inside the root (stained red and with the galled root tissue removed to show her size)

nematode species is the cause of the yellow patch problem.

Root damage was deemed to be so severe at the start of this experiment that any responses to the nematicide treatments in the short term, may have been difficult to determine. At the end of the experiment, there were many undeveloped juveniles in many new galls as well as newly matured females in older galls and newly hatched J2 in the rootzone. The results of the nematicide applications showed that the treatments controlled nematode populations in samples from all courses and reduced the severity of new gall development on new root growth. The experiment showed that controlling the root-knot nematode reduces symptom expression, confirming the conclusion based upon constant association, mentioned above, that these nematodes are the cause of the symptoms as seen.

It is accepted that, since the Meloidogyne n. sp. female is endoparasitic, any possible options for control would be best achieved if they could be applied before the female becomes embedded inside the roots. Once in the root, she is well protected from the treatments applied and therefore, able to continue feeding on the root and reproducing. However, the eggs and juveniles that she produces during her life will, during their early stages, be free-living in the rootzone. At this time, applications of the nematicide would have prevented their further development and subsequent symptom expression on the turf. The use of the nematicide in this experiment was to prove a point – that this new species of the root-knot nematode is the cause of the symptoms as seen. This has been achieved. The use of any nematicide to control this or any other nematode problem on amenity turf in the UK and Ireland is not permitted as no products have approval for use. The product used in this work is extremely toxic and was used under controlled experimental conditions in the laboratory.

So now that we have identified and confirmed the cause of this yellow patch problem on creeping bentgrass greens, how can we best control it? At the moment, the symptoms can be masked by foliar application of nutrients. The nematodes affect nutrient uptake due to their distortion of the roots and so if nutrients can get in to the plant without having to go through the root, the yellowing of the turf will be reduced. Work is ongoing and further research is being planned by Headland Amenity to help Course Managers find practical and lasting control options for this newly identified pest problem on cool season turf. I would like to thank Headland Amenity for allowing me to use some of the information gained from their independent research and for their photographs used in this article.

Dr Kate Entwistle, The Turf Disease Centre, Waverley Cottage, Sherfield Road, Bramley, Hampshire RG26 5AG. United Kingdom
Telephone: 01256 880246

All photographs courtesy of Headland Amenity

PHOTO 4: The set-up of the sample cores used for the experiment (before randomisation)