

ROOT KNOT NEMATODE INFECTION OF CREEPING BENTGRASS GREENS

Dr Kate Entwistle becomes Miss Marple as she tries to solve a nematode mystery



Characteristic 'knots' on *Agrostis stolonifera* roots caused by the *Meloidogyne* sp. nematode

While visiting golf courses across the UK and Ireland during the summer of 1997, Mark Hunt, of Headland Amenity, became aware of a number of courses that all showed unusual patches of yellowing turf across the surface of the putting greens. The affected greens did not show any loss of sward cover or any detrimental effect on the playing quality of the sward but the visual effect was quite dramatic due to the extent of the patch development across each green and the speed at which the problem had apparently developed on the new surfaces.

It was not until the following year when more courses were identified as showing the same symptoms, that Mark realised all of the affected courses had creeping bentgrass greens above a USGA rootzone construction. The symptoms were the same on all courses; patches of yellowed turf approximately 30 cm diameter, developing from around April/May and persisting until November each year. The patches returned to the affected greens each year and developed equally on all greens, regardless of local environmental conditions. Several turf samples were sent off to a laboratory in the UK to identify the cause of the yellowing and in each case the analysis result came back as *Rhizoctonia* (no species identification). The symptoms certainly resembled those of the documented disease, Yellow Patch (caused by *R. cerealis*) and so, with the analysis results in hand, fungicide applications were made to control the disease. The fungicide treatments, although different between courses, showed no effect on the disease expression. During 1999, the problem showed again and although further analyses continued to confirm the cause as a *Rhizoctonia* fungus, no single, multiple or combination of fungicide applications, put down at any rate, showed any effect in reducing or controlling the disease.

During November 2000, Mark approached me to see if I would be interested in working with him in trying to solve the mystery of this apparent turf disease. I was eager to help and curious about this potential 'new' pathogenic fungus that apparently did not respond to any fungicide treatments. Although the symptoms were not showing on any course at that time of the year, Mark had photographs and information that I was able to take a look at in order to get an idea of the type of fungi that may be involved with this problem. I had considered the possibility that one of four possible types of fungi may be associated with the symptoms and my

reasons for and arguments against each, were as follows:

The symptoms of these patches as expressed on the turf surface distinctly resembled yellow patch, a known turfgrass disease caused by the fungus *Rhizoctonia cerealis*. During 1997 and 1999, 15 separate turf samples had been sent to a diagnostics laboratory in the UK for identification of the cause of the disease and in all cases, the result given was a *Rhizoctonia* sp. However, I didn't understand how this could be yellow patch because the pathogen would normally cause damage to cool-season turfgrass over the winter and spring – not from spring to winter, through the relative heat of the summer months. One other nagging doubt that I had about this being related to a *Rhizoctonia* sp. was that the symptoms, once they showed in April, remained unchanged throughout the year. Diseases caused by a *Rhizoctonia* sp. would be more than likely to enlarge at some point as the fungus grew outwards but this was never seen to be the case – not on any green or on any course affected. In addition, if it were a fungal disease, why should it appear on the places on the same greens, year after year? If it were a fungal disease, this was very unusual symptom development.

I had also considered some type of superficial basidiomycete to be the cause of these symptoms, but this did not feel quite right either as a possible diagnosis. Although these fungi do cause development of yellowed turf, they are not commonly seen on seeded greens but are more likely to show on recently turfed areas. In addition, it would be more likely that only some of the greens would be affected, those in which the local environmental conditions were conducive to basidiomycete development. But this problem was appearing equally on all greens. In addition, the presence of superficial fairy ring fungi would almost always be identifiable by the development of surface mycelium and/or a characteristic musty smell. Neither of these symptoms had been associated with any patch on any green on any course.

One further consideration was that the roots were being colonised by a pathogen similar to, if not the same as, the one responsible for take-all patch disease. It is well known that take-all patch is a common disease of bentgrasses and so if a similar type fungus was affecting the roots of these plants, it could cause patch symptoms on the turf surface. However, if this were the case, these type of fungi (of which there are quite a few!) would be easily recognisable and should have been obvious to the diagnostic laboratory in the UK that had seen 15 samples of turf already. Surely it would have been detected on one of them? A gut feeling told me that this type of root infection may not be the cause – as with the *Rhizoctonia* sp. idea, if this was the cause, you would expect there to be variation in the size of the patches and in their growth between years. Neither appeared to be the case.

The only other type of fungi that readily came to mind as having any possible involvement in the yellow patch development, was a *Pythium* species. These fungi can colonise the roots of turfgrasses and cause a yellowing of the plant due to their impairment of water and nutrient movement through the plant. Again, these fungi, if present, would leave characteristic spores in the roots that would be easily identified by any diagnostician! These fungi rely on free water for movement, but only on one green out of all of the courses affected was there any evidence of patch development being associated with water movement across the green. And if a *Pythium* sp. was infecting the roots, why should all greens be affected and why would the patches be so large and not vary in size or location from year to year?

Discussions had now led me along many avenues but, in all cases, had resulted in a dead end. For one reason or another I had come to the conclusion that none of the fungi that I had thought MAY be involved with these symptom expressions, could be. The only way to be sure of what was present was to wait for the symptoms to show and take a look at a sample.

In 2001, I collected some turf samples from an affected course in the UK. The Course Manager offered a little more information on the problem



general view of the yellow patches on a creeping bentgrass sward (photo courtesy of Headland Amenity Limited)

and his comments were found to echo those of all the other Course Managers in the UK and Ireland. The symptoms start to show on all greens on the same day, usually following torrential rain. Regardless of which fungicide active ingredient had been applied, alone or in combination, at recommended rate or otherwise, no reduction in the severity of symptom expression was identified on any green, on any course. Although all of my potential theories on the likely cause of the symptoms could be dismissed for one reason or another on the facts as presented by the Course Managers, it was this realisation that the problem did not respond to any fungicide treatment, that made me start to seriously doubt any direct fungal involvement with the patches.

I analysed the samples from the affected course in my laboratory and found that in all cases, there was no *Rhizoctonia* sp., no superficial fairy rings, no 'take-all patch'-like fungal or *Pythium* sp. root infections, but that all were affected with a root knot nematode (*Meloidogyne* sp.). The samples taken from unaffected areas of turf did not show the root knots. Although the cause of the symptoms appeared to be quite obvious from the samples, I was unsure as to whether nematodes could cause such discrete patch symptoms. I contacted Dr Roger Cook, Nematologist at IGER, Aberystwyth, and asked if he would confirm these nematodes as *Meloidogyne* sp. and also, identify the species for us. He came back with the news that they were root knot nematodes on the affected turf and that in his opinion, they were a new species that had not previously been described. He also confirmed that of all the different plant pathogenic nematodes known, *Meloidogyne* sp. were able to cause patch type symptoms, rather than diffuse areas of affected turf that are generally associated with nematode infections.

When it was announced that we believed these yellow patches were caused by this nematode, there was considerable doubt expressed by many in the Industry. The symptoms looked so much like yellow patch (*R. cerealis*) that it was still believed to be a fungal disease – even though many of those doubting the diagnosis had not seen the problem first hand nor had any analysis done on samples from affected areas.

Since Mark had spent four years working with Course Managers trying to determine what was happening on their greens, Headland Amenity decided to fund independent research at IGER to prove one way or another whether these nematodes were indeed causing this problem. The results of this research will be the basis of the next article about these yellow patches.

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