When diseases develop on turfgrasses, it is almost invariably fungi that are the cause of the problem. Under the right conditions, the symptoms of disease can develop and spread rapidly and in some cases, cause extensive and lasting damage. But when conditions are not conducive for disease development, what happens to the fungi? Dr Kate Entwistle, from the Turf Disease Centre investigates ...

FINDING FUNGI

This month's front cover shows mycelium and appressoria of Colletotrichum graminicola (the fungus that causes anthracnose basal rot of Poa annua)

This slide shows the magnified spores of Microdochium nivale, the fungus that causes Fusarium patch diease

In the vast majority of cases, the fungi that are responsible for turfgrass diseases are permanently present on the sward or in the rootzone. The most obvious exception to this is in newly constructed areas where the microbial populations will naturally be very low. However, these areas will not remain free of microbial presence (or sterile) for very long and within a short period of time, both beneficial and pathogenic microbes will begin to colonise them. Once present, these microbial populations will fluctuate over time increasing and decreasing in response to the local conditions. But as far as the pathogens are concerned, once they have become established in an area, they are likely to remain. So why is disease not an everyday occurrence?

To answer this fully we need to take a closer look at the agents of disease; the fungi. The mere presence of a fungus that has the propensity to cause disease on turfgrasses, doesn't necessarily mean that disease will develop, nor indeed that it is the cause of any symptoms expressed! Although the fungi are an extremely diverse group of organisms, they share similar characteristics and life cycles. However, there will always be exceptions that may vary widely from the general model, but on the whole, the fungal life cycle can be described as shown in Figure 1. By appreciating and working through the fungal life cycle, we can understand why disease is not an everyday occurrence, even if the fungi that cause the disease are always present.

Let's choose the spore as an arbitrary starting point for the fungal life cycle. The spore is the reproductive unit of the fungus (resulting from sexual or asexual reproduction) and it is extremely important for accurate fungal identification. Spores are liberated in vast numbers and dispersed locally or disseminated over large distances to enable the fungus to find a new host.

Spores may be present on the leaf surface, in the rootzone and in the air above the turf area but for any fungus to have a chance of causing disease, these spores must 'land' on a susceptible plant. Spores are, however, moved about at random and the vast majority will be deposited on areas or plants that they are not able to colonise. Thus, inoculation (or the arrival of a fungus on to an area) does not necessarily mean that disease will develop. Only a relatively low number of the released spores will end up on a suitable turfgrass host. Inoculation of susceptible turf with a potential pathogen will still not result in disease if the fungus can't enter the plant. Firstly, the fungal spore must germinate to produce a germ tube and ultimately, mycelium that can be considered as the 'body' of the fungus. If the environmental conditions are not right for the fungal spore to germinate, or the conditions change soon after germination, the spore will not germinate or the germ tube will die. In either case, disease will not occur. If the spore does germinate, the germ tube will start to grow across the plant tissues trying to gain access to the plant.

In order to penetrate the plants defences, the fungus will either take advantage of natural openings (eg stomata) or wounds (eg caused by mowing), or it will directly penetrate the plant by force. Once the fungus has infected the plant and gained access to its internal cells, you might imagine that disease development will be inevitable. Not so. In plants that are able to recognise the initial presence of the fungus, the fungus may be restricted to only one or two cells. In these cases, the resistance shown by the plant means that the recognisable symptoms of disease will never develop. The effort made by

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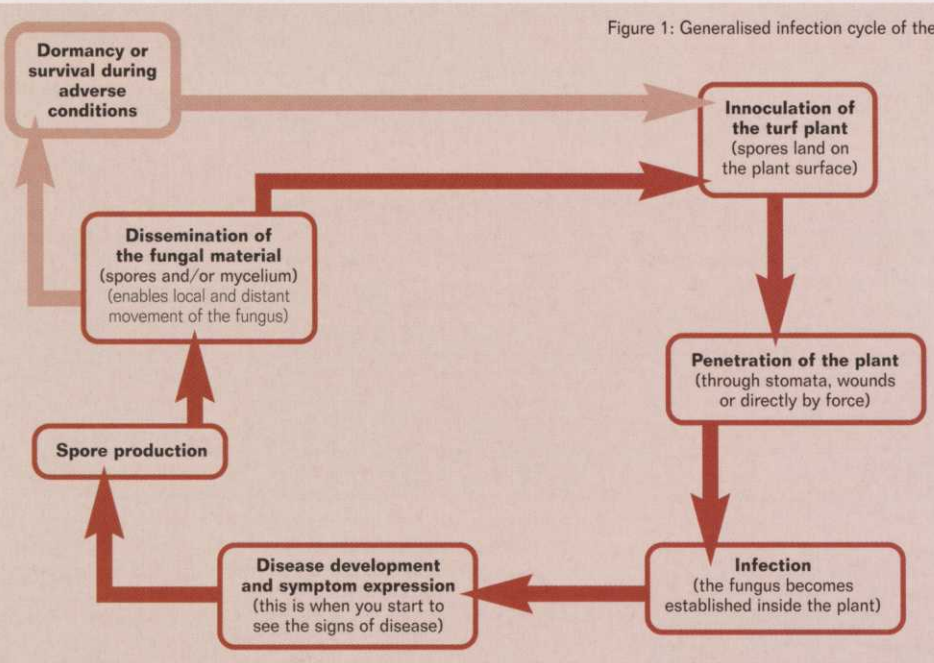
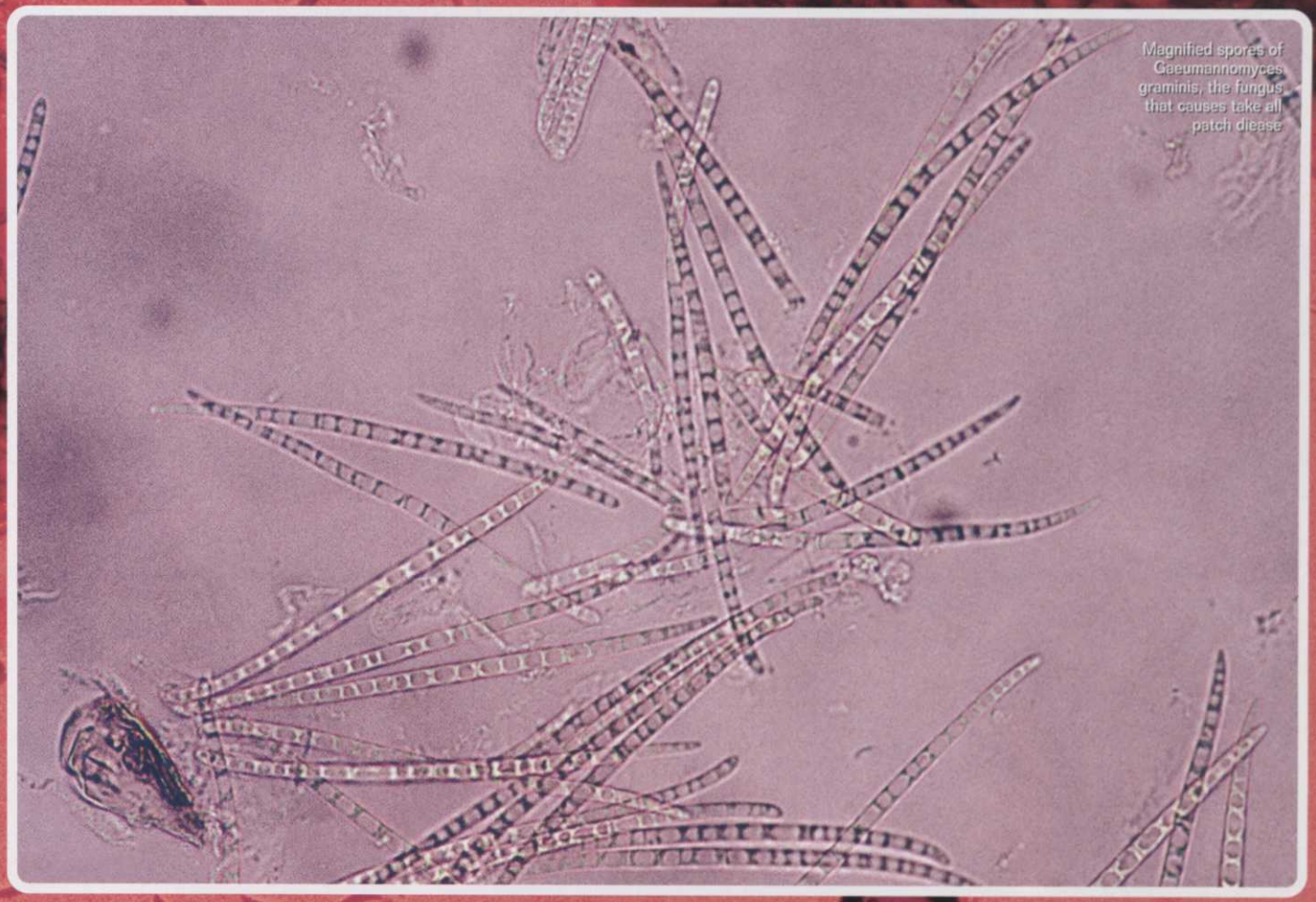
recognisable symptoms of disease will never develop. The effort made by the fungi to get this far has come to nothing. However, this situation does not always occur. In many cases, the fungus can progress further in to the plant causing damage to the plant tissues as it removes nutrients from them. This part of the life cycle can be regarded as disease development and symptom expression. The extent and severity of the disease is directly related to the relative susceptibility of the host plant and the virulence of the pathogen. Once the fungus has colonised the plant tissues and removed the available nutrients, the fungus will need to move on to find a new host to colonise. In the majority of cases, it does this by producing spores which are disseminated either in the water film on the surface of the sward or within the rootzone, or alternatively through the air.

Parts of the fungal mycelium may also be disseminated across the turf to allow colonisation of new areas of the same sward. And so we return to the start of the life cycle. But there is one additional part of the life cycle that is of importance to many fungi and that is the development of structures that will allow the fungus to survive adverse conditions. When they are not able to cause disease, some fungi can live on dead and decaying organic material and will do so for as long as is necessary until the conditions are right for them to actively cause disease. Other fungi cannot and they rely on some alternative method of survival. The means by which fungi do this are diverse and include the production of specialised spores or accumulations of mycelium, but ultimately these structures may allow fungi to survive in a dormant state for many years or decades until they become active again.

So what do we now know about the fungi that cause disease? Firstly that they are extremely diverse in their modes of action, their life cycles and their ability to attack plants. Secondly, their mere presence in a sward does not necessarily mean that disease will occur. Thirdly and arguably of most importance, there are many stages during the lead-up to symptom expression, during which disease development will fail. Therefore, disease must be regarded as the ultimate expression of a series of events in the development of the pathogen and its effect on the turfgrass plant. This 'relationship' between the fungus and the plant is significantly affected by the local environmental conditions and they directly control the severity of any

Figure 1: Generalised infection cycle of the fungi





Magnified spores of Gaeumannomyces graminis, the fungus that causes take all patch disease

may be so minor or so restricted as to cause little or no concern to the turf manager. Conversely, they may develop into devastating outbreaks that could claim large areas of a sward in only a few hours. The extremes are uncommon, as extremes generally are in all aspects of life, but they are a real possibility. The ability of these fungal pathogens to cause disease should not be underestimated. At the end of the day, these fungi need to obtain nutrients from the turfgrass plant in order to survive. Some pathogens have evolved along with their hosts and their relationships are extremely complex. Many are less choosy and will cause disease on any susceptible sward.

There is one last but very important thing to remember. There are many physiological conditions and invertebrate problems that can develop on a sward and resemble the symptoms of turfgrass diseases, but which are not caused by the activity of a pathogen and will therefore not respond to fungicide application. Before you waste time and money in applying fungicides unnecessarily, get the problem checked and not just for fungal presence. Choose carefully where you get the analysis done because being told what fungi are present on your turf does not necessarily mean that you have found the cause of the symptoms that you see!

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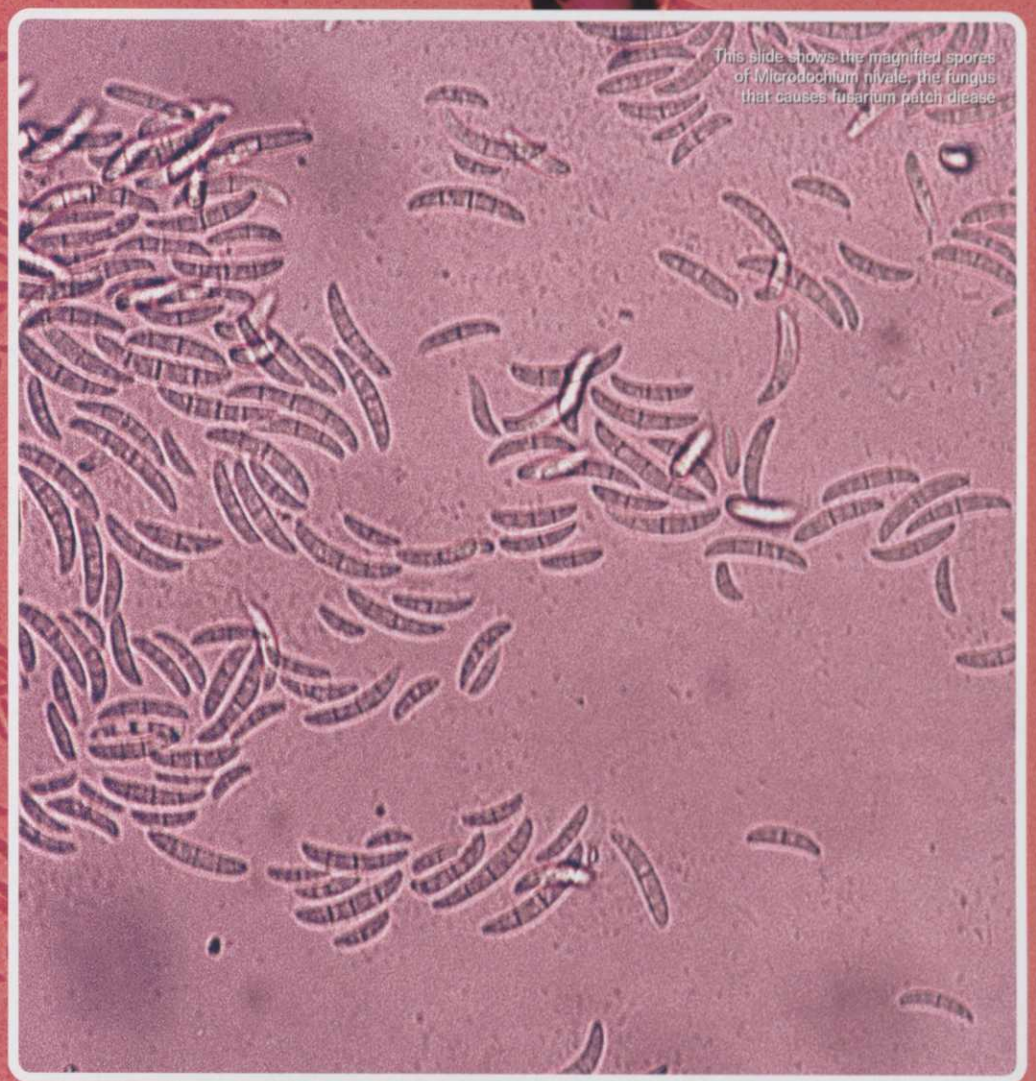

This slide shows the magnified spores of Microdochium nivale, the fungus that causes fusarium patch disease