

# Dollar spot and integrated pest management



Julie Wheater looks at one of the most common turf diseases



**Dollar spot (caused by *Sclerotinia homoeocarpa* F.T. Bennett1) is one of the most common diseases of turfgrass in the USA, and for the unlucky turfgrass manager in the UK it can be devastating to golf greens, tees and fairways.**

The disease symptoms appear initially as hourglass-shaped lesions on the leaves, followed by bleached circular patches in turf the shape and size of a dollar – hence the common name. These patches may coalesce leaving large areas affected. Apart from the detrimental visual effect that occurs, this disease also adversely affects ball roll as sunken patches of turf occur. These symptoms may be mistaken for old pitch marks. Although initial records of the disease appeared to be restricted to red fescues in the UK, dollar spot has since been observed on annual meadow-grass, bentgrass and fescues.

Although not yet very common on UK turf, dollar spot tends to recur at the same UK sites (primarily golf courses and bowling greens) from year to year. Some isolates of dollar spot in the USA have exhibited resistance to fungicides including iprodione and propiconazole<sup>2</sup>, although to date this has not been recorded in the UK. While there are a number of fungicides available for the control of active dollar spot, as the saying goes prevention is better than cure.

The EC Sustainable Use Directive 2009/128/EC emphasises the implementation of integrated pest management programmes to reduce sole reliance on chemical inputs and include other control methods such as cultural control and biological control. Understanding more about the disease can help in developing suitable integrated pest management programmes to

minimise infection, reduce spread of the disease and aid recovery of the turf.

## How the problem arises

Dollar spot is a polycyclic disease which means that there is more than one infection cycle through the season (see Figure 1). In turfgrass, a secondary infection occurs on foliage after initial infection from the soil. The dollar spot fungus survives as resting bodies of masses of mycelia known as stroma. This inoculum may be present within the thatch layer as well as the root-zone. Infection of turfgrass occurs as the active dollar spot mycelium enters the leaves through wounds (e.g. created by mowing), through the stomata (gas exchange pores) or by direct penetration where the fungus actively breaks through the outer cell layer of the leaf.

Within the plant cells the fungus releases chemicals which break down the cells with resultant necrosis. Infection can also occur from dormant mycelia spread by wind, water, clippings and traffic. In addition, studies by STRI of dollar spot populations in the UK have described release of ascospores as a further source of inoculum<sup>3</sup>. The dollar spot pathogen can also adversely affect the roots of bentgrass due to toxins released by the fungus, which results in discoloration and stunting of the roots<sup>4</sup>. This will inevitably reduce the optimal uptake of water and nutrients.

## Influencing factors

Dollar spot symptoms are usually observed when temperatures increase in summer. Initial symptoms may be observed from late June and the disease can be active into late September or Octo-

ber depending on temperatures. At temperatures above 15°C the pathogen grows from its dormant state. Warm, humid conditions are optimal for dollar spot infection as free water aids the spread of mycelium among leaves. Cobweb-like mycelia of the dollar spot pathogen may be observed in these conditions.

Reducing the period of leaf wetness therefore is one method of cultural control. Irrigating deeply and less frequently and timing irrigation to occur first thing in the morning followed by switching to remove excess moisture in the canopy is recommended. Improving light penetration and air movement in the sward by reducing shade will also reduce leaf wetness by allowing quicker evaporation.

Selecting turfgrass cultivars which exhibit greater resistance to dollar spot in areas of recurring problems is another method of cultural control. Disease resistance ratings are reported in the Turfgrass Seed booklet where possible, and some seed producers also report on relative disease resistance.

Dollar spot is observed more frequently where nitrogen fertility is low. Therefore, striking the correct balance in fertility levels is important for turf managers. Supplying enough nutrients to allow recovery of the turf once the infection is under control is also essential to regaining a healthy sward. In STRI trials, regular applications of fertiliser – in particular slow release fertiliser – significantly reduced dollar spot infection compared to unfertilised plots.

## Biological control

Studies have also shown that the use of some biological additives can greatly help in reducing the symptoms of dollar spot,

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either applied alone or in conjunction with an appropriate chemical fungicide. The first biological control of turfgrass diseases was registered by the Environmental Protection Agency (EPA) in the USA in 1996. This was a granular formulation of *Trichoderma harzianum* strain 1295-22 (Bio-Trek 22-G). The active product *T. harzianum* is actually a fungus itself, but one that is able to parasitize some other plant parasitic fungi including *Sclerotinia homoeocarpa* (the causal agent of dollar spot). This approach, which was developed by researchers at Cornell University over many years, involved selecting a strain which exhibited the best parasitic and inhibitory features, and which also showed the best ability to survive in the natural target environment. In the registered granular product, *Trichoderma harzianum* strain 1295-22 (aka T-22) was shown to be able to grow and function within the root system or rhizosphere<sup>6</sup>.

*Trichoderma* are asexual fungi of the order Hypocreales (Phylum Ascomycota). Some *Trichoderma* species inhibit plant pathogenic fungi and are used for biological control in horticulture. These *Trichoderma* species occur naturally in most soils and are able to colonise plant roots. The active fungus is able to survive and grow in the rootzone where it can come into contact with the dollar spot fungus and inhibit its growth. Studies have shown that *Trichoderma* species have a range of mechanisms to inhibit pathogens, and parasitic coiling of *T. harzianum* has been observed on turfgrass pathogens including dollar spot.

In addition, other mechanisms such as the release of antibiotics and enzymes which inhibit and degrade pathogenic fungi; competition for resources with the pathogenic fungi; the induction of the plants own resistance mechanisms to protect from damage by plant pathogenic fungi, have all been reported in studies on *Trichoderma* fungi as biological control agents. By reducing the amount of pathogenic fungi in the soil the risk of infection is reduced.

Initial trials undertaken in the USA showed that the granular formulation reduced initial disease symptoms occurring from the primary inoculum, but was not effective in controlling subsequent foliar phases of disease infection among the turf canopy. In order to maintain an effective population of the *Trichoderma* fungi in the canopy,

a liquid formulation was developed which survived on the leaves (phyllplane) to provide better control as the disease spreads across the leaves. Combining granular applications to the rootzone with liquid applications onto the turf canopy was shown to improve dollar spot control.

Granular applications must be made preventatively, hence a management plan of applying early in spring once soil temperatures are high enough is recommended. This allows the active fungus to establish in the rootzone and begin reducing the pathogen. Foliar applications can also be applied preventatively in order to ensure that an effective population of *Trichoderma* is present as soon as the dollar spot fungi begins infecting the leaf canopy – prior to disease symptoms being observed.

One of the key requirements for efficacy as a biological control is that control is proven against different isolates of disease. As part of my recent studies I undertook a laboratory experiment comparing different isolates of dollar spot obtained from a range of locations in the UK. When grown on agar plates in the same conditions, different isolates exhibited significantly different growth rates.

Being aware of the reported effect of the *Trichoderma* product on dollar spot in the USA, I tested the effect of growth of the dollar spot isolates when plated in conjunction with spores from the *T. harzianum* strain T-22. For all of the isolates tested, growth of *S. homoeocarpa* was inhibited by the presence of the *Trichoderma*. When examined under a microscope I was able to observe parasitic coiling of the *Trichoderma* fungi around the mycelia of the dollar spot fungus.

There are a number of other biological control products in the USA which have demonstrated varying degrees of control of dollar spot. EcoGuard® (Novozymes) was registered in the USA as a bio-fungicide listed as effective for control of dollar spot in 2003. The active biological ingredient is a specific strain (SB3086) of the bacteria *Bacillus licheniformis*. *Bacillus subtilis* strain QST 713, e.g. Rhapsody®, also has EPA registration as a bio-fungicide for dollar spot on turf.

It is important to be aware that none of the biological products described are at present approved as bio-fungicides in the UK. However, further research into alternative methods of disease management is being encouraged and pursued at present.

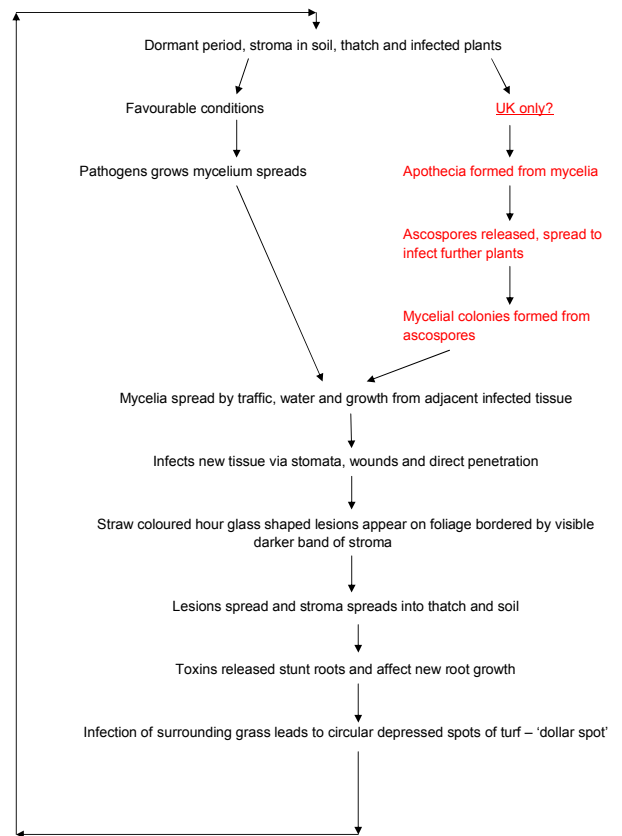


Figure 8: Lifecycle of *Sclerotinia homoeocarpa* – 'dollar spot'

