The SMART way to manage disease

Ruth Mann provides some interesting advice on managing disease

Chemical control of diseases in managed amenity turf may become more limited over the next few years as a result of the European review of all plant protection products used. Only active ingredients that are shown to be 'without danger to human or animal health or to the environment' will pass onto Annex 1. Member States within the European Union will then each decide on which active ingredients they will allow use of in their country.

This decision will usually be made by a government agency (in the case of the UK, the Pesticide Safety Directorate). We have lost quintozene and triforine (dossiers on both were not submitted to the review) and we may lose more fungicides as the review continues. Therefore, as part of a good Integrated Pest Management (IPM) strategy, we must make the best use of those fungicides we have and ensure that we keep the active ingredients working as efficiently as possible without encouraging field resistance in our pathogen populations. IPM strategies will not only reduce the chance of resistance occurring but may also reduce the amount of plant protection products required providing environmental and financial benefits. An IPM strategy consists of:

Cultural Practices
Disease Resistance
Biological Control
Plant Protection Products

Good IPM starts long before a disease is ever encountered – we would call it traditional greenkeeping methods. In the IPM strategy it is termed cultural practices. By this we maintain the turf as healthily as possible. There is no exact recipe that can be followed by everyone. Each aspect of your management strategy depends on what you are trying to achieve in the long term and what the problems are to begin with.

CULTURAL CONTROL.

This includes using adequate fertiliser to keep the grass growing but never lush, appropriate fertiliser (such as acidifying fertiliser like ammonium sulphate to discourage alkaline conditions that may encourage certain diseases) and fertilising at the correct times. Returning clippings is also a form of fertilising as the nutrients within them can be broken down and reused. However, they also form food sources for earthworms and many pathogenic fungi and so should be avoided on greens.

Irrigation and drainage are other important issues. If the rootzone of your greens is sandy, suffers dry patch and drought is a problem you will need to irrigate and perhaps use wetting agents. This leads to ensuring that your irrigation water is not alkaline (and so may encourage take-all) or that the salinity is not too high. However, on wet, water retentive rootzones the issues for concern are different. The most important issue is to improve drainage. In the long term this may mean installing drains. In the short term surface drainage can be improved by aeration. This will also help keep the rootzone aerobic and decrease thatch accumulation, which can further exacerbate problems of surface drainage. Thatch layers can encourage the formation of wet surfaces in the winter and dry hydrophobic surfaces in the summer. Thatch can also be the primary source of many fungi that spend most of their time growing saprophytically on the thatch, becoming pathogenic and causing the disease when the environmental conditions favour their growth. Thatch should, therefore, be kept to a minimum.

Airflow over greens is important for the removal of surface water. Many of the pathogens that affect turf require water for spore germination and infection. By decreasing the length of time the surface stays wet you can reduce the amount of spores that germinate and infect the grass. Removal of surface water can be done by switching and by increasing the airflow over greens by judiciously pruning trees or shrubs that surround the area. Shading by trees and shrubs may increase the length of time for greens to dry due to lack of direct sunlight. Some diseases are also more prone to occur under low light intensities.

The cutting height should be appropriate for the grass species that you are growing. Leaving grass too long can encourage a microclimate more suitable for the pathogenic fungi. However, too short a cutting height leads to stressed grass plants that are also more susceptible to disease. The incidence of anthracnose has increased rapidly over the past few years. Part of the reason for this may be due to the concurrent lowering of cutting height. This may have lead to stressed annual meadow grass plants that are more susceptible to anthracnose.

DISEASE RESISTANCE.

Some species of grass are not susceptible (or less susceptible) to certain pathogens. Fescues are not affected by Gaeumannomyces graminis (the pathogen that causes take-all). If take-all becomes a problem and is killing bentgrass, the area could be oversown with fescue to keep grass cover and prevent the ingress of annual meadow grass or broad leaved weeds.

Some cultivars are more susceptible to certain diseases. This may be important in the case of red thread. Normally, red thread is associated with low fertility and would be controlled by the application of a nitrogenous fertiliser. However, we are observing red thread that is not controlled by increasing the fertility and requires the application of a fungicide. The tables in Turfgrass Seed (Anon, 2003) show varieties of bent and fescue that are not as affected by red thread. For example, Agrostis capillaris variety Bardot has a 'freedom from red thread' score of 6.2 compared to Highland bent (A. castellana) with 4.3. If red thread was causing a problem on fertile greens Bardot could be used for oversowing which will help establish a bent sward that is not as susceptible to red thread without increasing the use of fungicides.

BIOLOGICAL CONTROL.

Biological controls consist of using antagonistic fungi and bacteria to compete with or parasitise the pathogenic fungi. In a sense, traditional greenkeeping methods help to enhance the biological profile within the rootzone encouraging a natural biological control. The use of applied biological controls can be complicated. The applied fungi or bacteria must be able to establish and persist in the rootzone. They must have activity against local isolates (products with good efficacy in the USA may not be as effective on our pathogens). All applied fungi and bacteria needs to be compatible with fungicide use. In the UK, we have no registered biological controls for

managed amenity turf at present (biological controls that control diseases should be registered as a plant protection product in the UK). In the USA, Trichoderma (a fungus that can compete with and parasitise pathogenic fungi) can be used against pythium and rhizoctonia. However, if the disease becomes established, a fungicide is required. Most manufacturers of Trichoderma can also supply lists of compatible fungicides that will not kill the applied biological control.

PLANT PROTECTION PRODUCTS.

A particularly prolonged period of conducive conditions can increase the disease pressure to the extent that the amount of disease on greens becomes unacceptable despite the employment of all of the above non-chemical control methods. Plant protection products then become an essential part of an IPM strategy.

The pathogen must be correctly identified before any fertiliser or plant protection product is used. Some diseases can be encouraged by fertiliser application. If the identification is wrong and a fertiliser is applied, it may make matters worse. Similarly, some diseases are not controlled by certain fungicides. Applying the wrong one will cost a lot of money and it was never going to make any difference. Seek confirmation if you are not 100% sure.

When you know what the pest or disease is, application of any plant protection product should be carried out according to the manufacturers recommendations on the product label. Remember that all persons applying plant protection products should have the correct training (NPTC certificates) and that you always adhere to the recommendations on the label of the particular product and ensure COSHH regulations are applied.

RESISTANCE MANAGEMENT.

In order to reduce the chance of resistance occurring in our pathogen populations you need to be aware of the properties of the products that are approved. Some fungicides work better on certain pathogens, some provide better control when applied to protect the plants from disease spread whereas others can cure established infections.

At present we have seven fungicides approved for use in managed amenity turf (Table 1). 'Contact' fungicides protect the plant from infection at the point of application. Contact fungicides such as chlorothalonil do not move from the point of application and so protect the plant at the leaf surface. Therefore, if a spore of Microdochium nivale (the causal agent of fusarium patch) lands on a leaf that has been treated with chlorothalonil it will not be able to infect due to the barrier that has been created by the chlorothalonil. Contact fungicides are often multi-site fungicides. This means that in controlling the pathogen the active ingredient works on more than one biochemical process. Pathogens are less likely to develop resistance to active ingredients with multi-site modes of action as it is more difficult for the pathogen to overcome more than one biochemical process being affected.

We often describe iprodione as a contact fungicide. However, this is a little too simplistic as iprodione does have some translaminar movement. It penetrates locally into the leaf surface (it is absorbed but does not move far from the site of application) and so is listed here as a localised penetrant. Iprodione is a single-site fungicide (in that it affects one biochemical process in the pathogen) from the dicarboximide group. It inhibits spore germination (the protective part of the action, similar to chlorothalonil) and prevents mycelial growth (the curative part). Resistance to the dicarboximide group of fungicides is rated as medium. This is because isolates of a pathogen that have become resistant to iprodione are not as fit for survival as sensitive isolates. This means that the resistant isolates will be out competed by the sensitive ones. Therefore, when the exposure to iprodione stops the pathogen population shifts back to being more sensitive to the active ingredient. Isolates of Sclerotinia homoeocarpa (dollar spot) and M. nivale have been shown to be resistant to the dicarboximides in the United States.

Carbendazim, thiabendazole and thiophanate-methyl all belong to the group of chemicals called the methyl benzimidazole carbamates (MBC). They are site-specific fungicides that affect cell division and so disrupt germination and growth of the pathogen. We would describe these fungicides as

'systemic'. Again this is a little too simplified. They are acropetal penetrants. They are absorbed into the plant and move within the xylem (the structures that water moves in within the plant). Therefore, after absorption, they can move upwards from the point of application and so can give a longer period of protection than either of the afore mentioned contact or localised penetrant fungicides. The chance of resistance occurring to the MBC's is high as the resistant isolates are fit for survival (i.e. they are not out-competed by sensitive isolates in the absence of the fungicide) and so the resistant population does not reduce even if the use of the MBC's discontinues. There is also a high risk of cross-resistance between the fungicides in the MBC group. There has been a lot of resistance to the MBC's within agricultural pathogens in the UK. However, field resistance to the MBC's has not been proven in the UK for turf pathogens but has been reported in the United States for Colletotrichum graminiciola (anthracnose) and S. homoeocarpa. In the UK, we have established a reduced sensitivity, in some isolates of M. nivale, to carbendazim in laboratory based poison assays but this does not indicate field resistance and further work needs to be done to establish if field resistance has occurred in our pathogen populations.

Fenarimol is another acropetal penetrant from the demethylation inhibiting (DMI) fungicide group. DMI's are part of a group of active ingredients that affect a particular step in the production of sterols, which are essential for fungal growth. Therefore, they control the pathogens by preventing fungal growth. Similar to the dicarboximides, resistance to the DMI's is considered to be medium risk as the resistant isolates do not appear to be fit for survival in the absence of the fungicide. Resistance problems result in a slow decrease in product performance leading to increased dose rates and/or more frequent applications to achieve the same level of control. There is also evidence of cross-resistance to other sterol inhibiting fungicides. However, in the UK we do not have any other active ingredients from this group approved for use on managed amenity turf at present.

Azoxystrobin comes from a newer category of fungicides called the strobilurins. They are site-specific and affect the production of ATP in the mitochondria (the energy source in cells). This leads to the pathogen being controlled by not having enough energy for growth. The risk for production of resistant isolates is high. In the UK resistance has been found in populations of Erysiphe graminis (which causes powdery mildew) on wheat and barley.

See table 1: The fungicides currently available with 'on-label' recommendation for control of diseases in managed amenity turf below.

With all fungicides, applying the same active ingredient continuously in any one year, or over a few years will increase the potential for resistance to occur. Once we have widespread resistance (especially in populations where the resistant isolates are as fit for survival as the sensitive isolates) we have effectively lost that group of fungicides from our armoury. This reduces the number of effective fungicidal active ingredients that we have left. To prevent this occurring the Fungicide Resistance Action Group (FRAG-UK) suggests the following -:

1. Avoid prophylactic treatments (always treat at the first sign of disease rather than preventatively).
2. Avoid repeated applications of fungicides from the same GROUP. For example, do not follow carbendazim with thiophanate-methyl as they affect the same biochemical process and this may encourage resistance to the MBC's.
3. For control of red thread and rusts, make full use of disease resistant varieties.
4. Pay attention to guidelines on labels for maximum dose rates, maximum number of treatments, rotation of fungicidal groups, recommended mixes or approved tank mixes.

Remember that an apparent loss of efficacy of a certain product does not immediately imply field resistance as incorrect identification, incorrect dose rates and inclement weather conditions directly after application may all contribute to ineffective control. By following a good IPM strategy, personalised for your grass type, soil type and conditions, greens may be kept disease free most of the time. However, when the pathogens are winning, the implementation of IPM will also keep the fungicides working effectively, providing the last line of defence.

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References.
Anon, 2003. Turfgrass Seed 2003. British Society of Plant Breeders and STRI. pp 24
Couch, H. B. 1995. Diseases of Turfgrasses. Krieger Publishing Company, Florida. pp 259-278.

TABLE 1: The fungicides currently available with 'on-label' recommendation for control of diseases in managed amenity turf

Active ingredient	Example product	Group	Single or multi-site action	Topical mode of action *	protective or curative
Chlorothalonil	Daconil turf Fusonil turf	Phthalonitrile	multi	contact	protective
Iprodione	Rovral Green	Dicarboximide	single	localised penetrant	protective and curative
Carbendazim	Turfclear Mascot Systemic Headland Regain	MBC	single	acropetal penetrant	protective and curative
Thiabendazole †	Tecto	MBC	single	acropetal penetrant	protective and curative
Thiophanate-methyl	Mildothane turf	MBC	single	acropetal penetrant	protective and curative
Fenarimol	Rimidin	DMI	single	acropetal penetrant	protective and curative
Azoxystrobin	Heritage	QoI	single	acropetal penetrant	protective and curative

* Topical mode of actions are given as described by Couch (1995).
† Thiabendazole is in its use up period and must be used before 2 February 2004.