Focus on Fungicide Action

Dr Terry Mabbett looks at fungicide and its place in modern turf management

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Turf disease control with fungicide looks easy but first impressions are misleading. Unique circumstances pre-dispose turf grasses to diseases which are difficult to control due to specific nature and management of the sports turf environment.

Virtually all turf diseases in the United Kingdom are caused by fungal pathogens. Most are present in thatch even when there is no active disease in the sward. Microdochium nivale causal pathogen of Fusarium Patch and Colletotrichum graminicola (anthracnose) are versatile fungi, living as parasites on living grass plants or as saprophytes on thatch according to prevailing conditions. Horticultural crop debris is generally discouraged but thatch is maintained as a 'cushion' in the playing surface.

Sports turf is subject to continual wear and tear that builds up through spring and summer. Grass becomes progressively more stressed and vulnerable to disease with lowest ebb in early autumn just when increasing rainfall, mists and dew start to favour diseases like Fusarium Patch and anthracnose.

ABOVE:
Close up of Fusarium Patch
(Picture courtesy of Vitax Ltd)

Focus on fungicides

Mowing maintains grass as turf but favours disease by wounding leaves and spreading fungal spores and infected grass clippings especially when wet.

Mowing removes green photosynthetic tissue and grass plant's total capacity to manufacture carbohydrate for shoot and root growth. Turf responds to increasingly lower cuts with more tillers but this increases sward density, raises humidity and encourages disease development and spread.

Wounds from mowing breach grass plant defences. Xylem tissue continues to carry water from roots to shoots. Nutrient-rich sap exudates at the severed ends of grass leaves are readily exploited and colonised by fungal pathogens including Colletotrichum graminicola, Rhizoctonia solani (brown patch) and Sclerotinia homoeocarpa (dollar spot).

Disease symptoms appearing in straight lines across turf indicate spores or infected clippings were carried by the mower especially if grass was wet because moist clippings adhere to mower blades and wheels.

Fungicide on the surface or inside the tissue of excised lengths of leaves is lost in the clippings.

When all these factors are considered it is hardly surprising that turf is vulnerable to disease which is difficult to manage with fungicide sprays.

"Fungicide on the surface or inside the tissue of excised lengths of leaves is lost in the clippings"

ABOVE: Turf disease control after an early new year's start in West Sussex

Greenkeepers are conversant with fungicide label recommendations but it is helpful to delve deeper than what is said on the packet or in the brochure. This information will graphically describe what can be achieved and the mechanics of getting there, but how the fungicide works is often relayed too simplistically.

Deeper understanding allows greenkeepers to ask more questions and achieve more benefit through their own initiative and best practice. They can develop disease management programmes using a range of complementary fungicides of varying behaviour and modes of action and not necessarily from the same 'stable' and source.

Contact fungicide

First thing to know is how a fungicide behaves physically on turf grass because this determines how it affects the pathogen to prevent or cure disease. Contact fungicides are purely preventative (protectant) in action. They are sparingly soluble solid chemicals formulated as wettable powders, water dispersible granules or suspension concentrates and which stay on the outside surface of the leaf.

Once in place at adequate concentration and coverage they inhibit or kill germinating fungal spores or fungal hyphae growing out from the thatch. Contact fungicides must be in place on the plant before fungal inoculums arrive and they cannot suppress, cure or eradicate established infections inside leaf tissues because they cannot reach them. By the same token contact fungicides are of little use against pathogens which infect the crown and roots.

Essential requirements for contact fungicides are good coverage and tenacious deposits resistant to rainfall and irrigation or physical removal by high wind and traffic abrasion. Use of recommended spray nozzles and spray volumes should ensure optimum coverage. Use of excessively high spray volumes is generally counter-productive because contact fungicide 'running-off' into soil is not absorbed by the grass roots and is

therefore lost and wasted. Choosing a suitable 'window' when wind speed is low, grass is dry and rain not imminent allows spray droplets to impact, dry out and leave tenacious weatherproof deposits on the turf.

Manufacturers can enhance sticking power (tenacity) by micronizing the fungicide to a very fine mean particle size. Number of particles in a set mass (weight) of fungicide will rise exponentially (steeply) as particle size is reduced. This translates into more fungicide particles per unit area of grass leaf and shorter distances between deposited particles, so the entire leaf surface is 'covered' and protected.

The smaller the particle the higher will be its surface area to mass (weight) ratio and therefore the forces of adhesion which

INSET LEFT: Thatch is an important cushion for turf but also a reservoir of potential grass pathogens

ABOVE: Greens spraying at Tilgate Forest Golf Centre (Crawley, Sussex) and a job well done. Head Greenkeeper Colin Chilvers (Left) and Sprayer Operator, Barry Edwards

stick particles of fungicide to leaf surfaces. Contact fungicides with a mean particle size (diameter) of around 1µ (micron) are most tenacious and perform best in rain simulation tests.

Manufacturers can also improve tenacity and weatherproof properties by formulating the fungicide with appropriate adjuvants as surface active chemicals.

Contact fungicides possess a brozal action against the pathogen. Fungicidal effect at many points in the fungal metabolism will control a correspondingly wider range of fungal pathogens.

Extended and intensive use of a contact fungicide is therefore less likely to select out (encourage) pathogen populations insensitive to its action. The risk of fungicide resistance is low so there is accordingly less restriction on frequency of use.

Systemic fungicides with curative properties operate by single-site action against the pathogen. There is a much higher risk of fungicide resistance and this is why most are restricted to just one or two treatments per year. The classic contact fungicide used on UK turf is chlorothalonil (phthalonitrile group) available in a range of products and established in the market for many years.

Systemic fungicide

Most modern turf fungicides enter the plant and move around inside to a greater or lesser extent. In UK parlance they are called systemic fungicides, but only those that move from point of entry (leaf or root) into other parts of the plant have true systemic activity and offer all the benefits this brings. Others that move into the leaf but not laterally from the point of entry show trans-laminar activity.

Mesostemic' is a relatively new term describing fungicides that bind to the waxy leaf cuticle and move across the leaf surface as vapour to bind at points away from site of deposition. Penetrant is the term more commonly used in North America to describe all fungicides that move at least some way into the plant and this appears to offer a more appropriate and less confusing description.

Fungicides that move around the entire plant are the only ones that can provide a full range of benefits afforded by true systemic activity, but even they are constrained depending on point of entry. First things to know about a systemic fungicide is whether entry is via roots, leaves (or both), how long it remains on the leaf surface before absorption and movement profile once inside in the plant.

Systemic fungicides arrest disease through curative or eradicant action. These terms are interchangeable although some manufacturers try to differentiate by using curative and eradicant to describe fungicide action against vegetative and reproductive phases of the pathogen, respectively.

Systemic fungicides actually inhibit or suppress further development of infections inside grass plants. Curative and eradicant action are well established and widely accepted terms that imply that fungus inside the plant is killed or totally destroyed when actually it is not.

Systemic fungicides will also protect turf by contact action while they remain on the leaf surface, and from inside the plant by preventing entry of germinating spore

about the author

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germ tubes or vegetative hyphae. Systemic fungicides may enter the plant through the leaves, the root system or both. Advantages of leaf absorption are quicker entry and additional preventative action while the fungicide remains on the leaf surface.

However, since all truly systemic UK approved turf fungicides show acropetal movement (carried upwards in the xylem or water conducting tissue) there is limited scope for movement inside the plant for fungicide that secures entry through the leaves.

A big advantage of absorption by root system is potential for acropetal movement of the systemic fungicide from the roots and through the plant to tip of every leaf. Systemic fungicides taken up by the roots can establish a reservoir in the root system and crown and replenish fungicide lost when grass is mown and protect post-spray new grass growth from disease.

Systemic fungicide washed off leaves into the soil as run off during spraying or by subsequent rainfall is not necessarily lost like contact fungicides suffering the same fate.

When root absorption is the main mode of entry then spray volumes which are higher than normally used for purely contact fungicides can prove beneficial. Systemic turf fungicides have been used for around thirty years beginning with benzimidazole group of chemicals. Classic and truly systemic chemicals used on turf today include the triazole fungicides propiconazole and tebuconazole.

More sophistication and complication

Not all turf fungicides fall neatly into purely contact or true systemic action categories. One that does not is iprodione. Iprodione is a long-established and highly valued member of the dicarboximide group of fungicides.

Iprodione is traditionally classed as a contact fungicide but also has curative action which implies a degree of leaf penetration. Iprodione is a contact fungicide apparently showing some local penetration and therefore additional curative action. It is traditionally considered to be multi-site action but, according to STRI, should be reclassified as a single-site action fungicide.

Leaf penetrating fungicides first move into and then through the waxy cuticle that covers the epidermis. Lipophilic (fat loving) fungicide molecules are best equipped to achieve this. The strobilurin fungicide pyraclostrobin moves rapidly into the cuticle concentrating there to form a reservoir of fungicide that protects the leaf against infection.

As turf disease control becomes more sophisticated so do the fungicides used to carry it out. Mesostemic is the term used to describe fungicides that bind to the waxy leaf cuticle and have extra vapour phase activity facilitating redistribution of fungicide across the leaf surface and subsequent binding away from the initial deposit. The strobilurin fungicide trifloxystrobin falls into this category.

Combining two or three different fungicides within a single product is an increasing feature in the turf fungicide market.

These combination products have a wider spectrum of activity and should control a correspondingly wider range of pathogens and disease.

Products which combine a range fungicide chemistries and biochemical modes of action, with dual contact and curative properties, help minimise risk of pathogen resistance to specific single-site action systemic fungicides.