Golf course drainage: Short term pain, long term gain

David Shelton describes the extensive drainage work that has been carried out at Loch Lomond Golf Club

A framed certificate on the office wall informs visitors and staff alike that this golf course is rated in the top 100 best golf courses in the world.

The rain gauge in the Met. Station outside records a total of two metres of precipitation a year. The waters of the loch to the east lap several fairways. The course hosts the annual Barclays Scottish Open Competition in the week before The Open Championship. Yes, this is Loch Lomond, famous the world over where the setting is superb and the course maintained to the very highest standards.

In years past the winter months were usually the wettest but more recently the rainfall pattern has been changing. In 2009, for example, the two wettest months were August and November with 345mm and 360mm of rain respectively. Conversely, precipitation in January 2010 was negligible. In circumstances such as these, good course drainage is essential so how has this been tackled?

Initially, specialist sportsturf drainage contractors were employed to undertake some of the work. It was expensive for intensive drainage systems were required in view of the high rainfall, and the trench digging was hard on machinery due to the excessively stony sub-soil.

It was decided to undertake the drainage work in-house. The course is closed in the winter months and this would be an ideal time to carry out the work. The John Deere tractors are fitted with the widest of wide grassland tyres to minimise compaction problems and the course workshop, with Charles Johnson in charge, built a specialist trailer and trench back-filling equipment to install the permeable fill. A Shelton Supertrencher 560, with conveyor to elevate the arisings into a trailer running alongside, was purchased; it was powered by one of the John Deere tractors fitted with creep gears.

Susan Rothwell has been on the staff since 2003 and is now Assistant Golf Course Superintendent. Responsible for the drainage operations she has an ochre problem to contend with! Where gravel has been used as a permeable back-fill in earlier drainage works the ochre has cemented this together, dramatically reducing its effectiveness. This problem has been overcome by using a free-draining medium-course sand from the Tillicoultry pit, 45 miles away.

Explaining the drainage techniques in detail Susan said 50 kilometres of piped drains have been installed on the fairways in phase one the laterals at 5 metre intervals. Due to the stones the bottom of the trenches were not smooth so prior to placing the 50mm and 100mm diameter pipes 25mm of gravel was placed in the trenches to give a smooth bed. Over the pipes the sand was placed in two, sometimes three passes with a tractor-mounted consolidating wheel used after each pass. In an ideal world kiln-dried sand would be preferable but cost prohibited its use. The final pass of sand is left slightly proud, using back-pack blowers any excess is removed and the grass 'fluffed-up' to hasten its growth.

A total of 74½ kilometres of phase two drainage with trenches dug 55mm wide and 225mm deep spaced at 1 metre intervals speed excess soil water to the piped system. The same Tillicoultry sand is used in back-filling these drainage channels, also.

In the winter of 2009-2010 the course at Loch Lomond had over 16 weeks of frosts – severe at times. On the fairways this frost penetrated

> **"Where gravel has been used as a permeable back-fill in earlier drainage works the ochre has cemented this together, dramatically reducing its effectiveness"**
> David Shelton

in excess of 400mm, in the rough less than half this. In mild winters it has not been possible to drain areas of excessively wet rough but with frost in the ground the opportunity was grasped to carry-out drainage works. The Shelton Supertrencher dug exceptionally neat trenches in the frozen ground, and wear on the tungsten carbide tipped cutters was not excessive. Susan succinctly summarised the operations; "short term pain, long term gain".

Charles' work entails keeping the golf course machinery in first class order. The Shelton Supertrencher has been used to install over 112 kilometres of drainage in hard rocky ground. He had had to change the drive shaft, the drive chain and sprockets, and the machine was now on its third elevator belt. A remarkable performance he considers in view of the conditions. Steel wash on the cutters is treated by building up with welding using a MIG welder. He had found this more cost-effective than hard-facing. The original digging wheel was still fitted due to the fact that the turbo bars and nut/bolt protecting blocks had been replaced at regular intervals.

The accompanying pictures show the exceptionally high standards of operations undertaken by the eight strong drainage team. In all but extreme weather conditions this course should be able to host the most prestigious competitions for the enjoyment of players and spectators alike.

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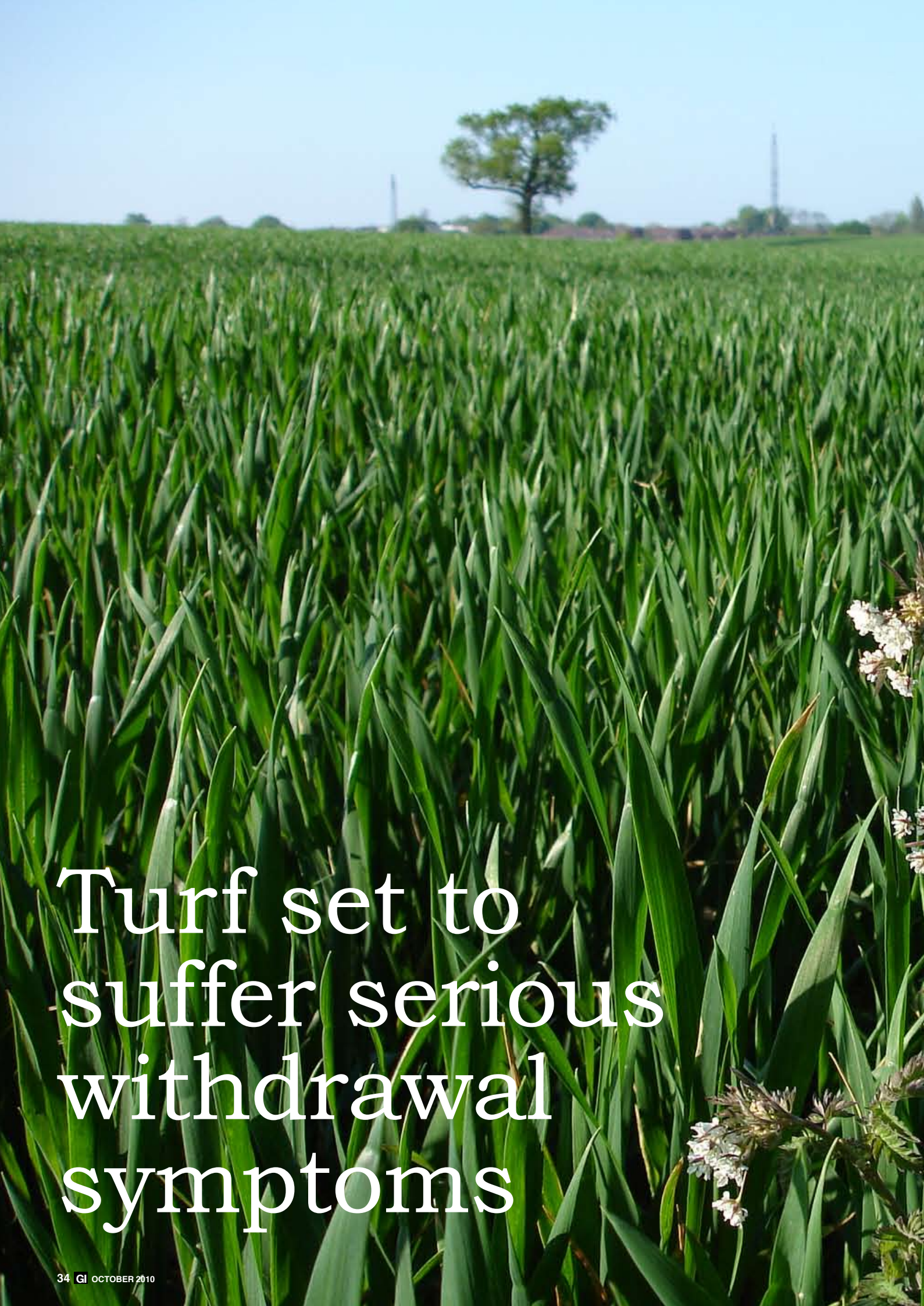

Turf set to suffer serious withdrawal symptoms

Dr Terry Mabbett, shares with us once more, his technical expertise, and predicts some serious suffering for turf...

Herbicides used in small quantities on turf could be dragged down by residues from much greater use of the same actives in agriculture

Without chemical insecticide there is no quick, clean and easy way of dealing with a sudden burst of chafer grubs and the collateral damage caused by badgers, birds and foxes looking for a feed.

"Perhaps the most 'dangerous' aspect of this directive for future use of chemical pesticides, is increasing calls for tighter restrictions on pesticide use"
Dr Terry Mabbett

Chemical pesticides registered for use on managed turf are disappearing at an alarming rate. The same is happening in other sectors but professional turf is most between a 'rock and hard place'. On one side is EU politicians and bureaucrats looking at what they would claim is the bigger picture. On the other is the greenkeeper concerned with more 'bread and butter' issues like maintaining his/her greens, tees and fairways in the pristine condition which the club membership expects and is accustomed. When things go wrong such as a sudden burst of chafer grubs or an unwelcome carpet of Fusarium patch, then the remedy needs to be applied promptly and act fast which only chemical pesticides can achieve.

Legislative weapons currently used against chemical pesticides by the EU essentially come in four directives, highly complex when dissected but simply as follows:

- Revision 91/414 Directive
- Sustainable Use Directive
- Machinery Directive
- Water Framework Directive

Revision 91/414 Directive: Brussels' onslaught on the use of chemical pesticides across the 27 member-country EU is a multi-pronged attack with some chemicals targeted and shot down directly by EU legislation on toxicity and environmental safety grounds. Other long established pesticide products which should have years of safe and effective use in front of them are essentially being withdrawn by default, due to pressures piled on manufacturers to provide more and more technical and environmental data to ensure the active ingredient's continued registration and use. There comes a point for the manufacturer when a product's projected financial reward does not square up with the costs involved, and unfortunately this position is usually reached more quickly and easily in a tiny market sector like professional turf.

The Sustainable Use Directive is all about the way pesticides are used. Perhaps the most 'dangerous' aspect of this directive for future use of chemical pesticides in turf and amenity is increasing calls for

Without herbicides there is only one way to deal with this plantain, established in a tee – get on your hands and knees and dig it out!

The EU Machinery Directive targets pesticides via their application machinery

tighter restrictions on pesticide use in public places which is what turf and amenity situations inherently are.

The Machinery Directive deals specifically with the application equipment used to deliver pesticides. It requires every new turf and amenity sprayer to achieve certification to a required level of environmental protection before being released onto the market. This is clearly not a direct hit on pesticides but the potential effect could be the same. Remove the most appropriate application technique and you essentially remove the pesticide.

The Water Framework Directive say inside observers is the one with the largest and widest potential impact on current pesticide use. In many cases the active ingredients under scrutiny in water supplies will originate from agricultural and hard surface applications in the industrial and amenity sectors. An active ingredient could be withdrawn from use in turf, although the offending residues in water were largely due to its greater use in agriculture, and direct run-off of the chemical into ground water supplies from application to hard surfaces.

Pesticide use in agriculture dwarfs that in turf and amenity while applications of pesticides to hard surfaces (pavements, roads, railways, car parks etc.) lack the soil-soaking and soil-holding buffering capacity afforded to those chemicals applied to sports turf and amenity grass. Both factors stand to impact heavily, albeit indirectly, on the future security and availability of chemical pesticides for use on turf, where the same active ingredient is used in agriculture or hard surface applications.

What's more it will be harder to replace chemicals lost from professional turf with its unique specific and stricter chemical use and application requirement and higher demands as a natural grass playing surface. Golf courses with their inherently high proportion of professional turf would suffer more than most.

There are many active ingredients widely used in agriculture that don't come anywhere near professional turf such as IPU previously used as a cereal herbicide, now banned but still causing problems. Unacceptably high residues still appearing in water supplies suggest some farmers held onto stocks and may have still been using them. Of course this has nothing to with either turf or amenity because IPU was never registered for use in these sectors. In the same way residues of aminopyralid (hormone-based herbicide used against deep rooted weeds in pasture) in farmyard manure have no relation to turf weed control.

However, EU eyes are also focussed on water pollution by other herbicide actives like clopyralid and mecoprop, both widely and intensively used in farming but

Industry watchers believe the Water Framework Directive for environmental protection will have the biggest negative impact on future use of chemical pesticides

Well-rounded and experienced greenkeepers can keep the lid on turf disease with good management practice

also in turf. Volumes used in turf compared with agricultural grassland are miniscule but if a problem arises any ban is likely to be blanket. These actives would be hard to replace with alternatives for turf but not so difficult in agriculture.

New turf pesticide products are appearing all the time which could cause greenkeepers to believe there is not too much to worry about. What they probably don't realise, and there's no reason they should, is that all these 'novel' actives appearing in new dedicated turf products are not as 'new' as they seem.

When a hitherto undiscovered active ingredient first shows up as promising on the manufacturer's laboratory screen first focus is on those sectors where biggest returns can be made most quickly. This means cereal crops and other large-scale globally-grown field crops like potatoes, oilseed crops and sugar beet followed by grapevines and high value horticultural crops. Turf and amenity comes way down the list. For instance, imadocloprid introduced several years ago as the undisputed saviour of UK turf from chafer grubs has its roots in the late 1980's. Only last week I was reading a old copy of African Farming giving the insecticide a rave write up for controlling insect pests on rice – that was in 1992.

The UK and indeed the EU is only part of the worldwide market for chemical pesticides and the turf and amenity sector is even smaller than that. Its costs money to bring an active ingredient (even an established one) to full registered use in turf, and if chemical manufacturers think a planned new product may fall foul of EU legislation in just a few years then the incentive to proceed and to pay for the privilege may be lost.

Should the worst happen to the chemical pesticide arsenal then lack of selective weed control is that likely to pose the biggest single problem for professional turf. Turf disease can be avoided or at least managed by good cultural control and more developments in turf grass varieties specifically resistant to diseases like Fusarium and anthracnose. UK turf has relatively few insect pest problems and there is biological control based on entomopathogenic nematodes for use against both chafer grubs and leatherjackets, although it is clearly less versatile and fast-acting as chemical insecticide.

Much is made about likely effects of global warming on the sustainability of UK turf but relatively little is said about its potential effect on turf weeds. As a traditionally cool wet country we tend not think of our native (and introduced) weeds as drought resistant plants, but many turf weeds are. You only have to look around at the moment to see how well white clover, bird's foot trefoil, yellow suckling clover, yarrow and even self-heal are doing in the current South of England drought and therefore how predicted effects of global warming could make the weed situation for UK turf a whole lot worse.

"Volumes used in turf compared with agricultural grassland are miniscule, but if a problem arises any ban is likely to be blanket"
Dr Terry Mabbett

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Close up of Fusarium Patch. (Courtesy of Vitax Ltd)

Nature's cure

Graham Paul offers some useful fungicide advice, which can also go towards building your BASIS Points

If you are using fungicides or advising others on their use to control turf disease, you will understand the need to keep abreast of this rapidly changing market place.

Advances in chemistry and technology may cause us to change our thinking on how to choose fungicides to combat the ever present threat of disease on sports and amenity turf. The simple choice of contact fungicides in the winter and systemic products in periods of strong growth now has to be tempered by the fact that the modern fungicides, brought in to replace those withdrawn on environmental or toxicological grounds, do not always behave in the manner we are accustomed. This article reviews the introduction of a new group of fungicides to the turf market and how they are best used for maximum effect.

In 1977 a group of German scientists discovered two anti-fungal antibiotics which they named 'strobilurin A' and 'strobilurin B' because they were isolated from the pine cone fungus Strobilurus tenacellus. This organism produces these natural fungicides to restrict other species of fungi that are competing for its main food source. As a result of this research we now have a whole new family of fungicides based on these naturally occurring products.

Strobilurins were found to be very effective against a wide range of species, from all of the four families of fungi but were easily broken down by UV light. Strong sunlight is not an issue to the pine cone fungus living on the heavily shaded forest floor but out in the open it's a different matter, so UV stable synthetic strobilurins were produced to get round the problem.

Today we have three strobilurin molecules registered for use on turf in the UK. The first of these was azoxystrobin, launched under the brand name 'Heritage' in 1997 followed soon after by 'Scorpio' (trifloxystrobin) and 'Insignia' (pyraclostrobin). Since the initial introductions there have been several 'me too' products formulated from straight strobilurins and two mixtures with other fungicides; 'Headway' (azoxystrobin and propiconazole) and 'Dedicate' (trifloxystrobin and tebuconazole)

All members of the strobilurin family have the same mode of action. They interfere with energy production in the fungal cells, bringing all activity to a halt – like tripping out a circuit breaker! To be more specific, they all have a 'single site' mode of action, targeting energy conversion in the cell – a process which is know to biochemists as 'mitochondrial respiration'. The strobilurins are classified under the group name QoI (which stands for 'Quinone outer Inhibitor' the specific binding site where they disrupt the cellular energy process). Without energy conversion the fungus cannot grow or reproduce and death follows.

However, despite the common mode of action of these QoI fungicides, the three active ingredients used in turf have fundamental differences in the way they move within the plant. All demonstrate 'trans-laminar' movement from one leaf surface to the other but azoxystrobin ('Heritage') also moves upwards in the plant's xylem system enabling it to be distributed through the plant. Such movement is sometimes referred to as 'acropetal systemic activity' to differentiate it from 'true' systemic action, which involves both upward and downward distribution.

Trifloxystrobin ('Scorpio') and pyraclostrobin ('Mascot Eland') are not systemic or contact fungicides but they are strongly lipophilic and become firmly embedded in the waxy cuticle cells of the leaf surface. This makes them very rain-fast and during periods of slow growth they will persist for longer than the upwardly mobile 'Heritage'.

Bayer's product 'Scorpio' differs from the others in that it has the ability to move a short distance in the vapour phase from one leaf to another or onto adjacent plants – so achieving a degree of re-distribution after spraying. Bayer describe the movement of their product as 'mesostemic' – reflecting the fact that it does not fit in with any existing terminology!

QoI fungicides are very effective at killing germinating spores, which makes them ideal for use as preventative treatments or in the very early stages of disease. However, they cannot be relied upon to work curatively on most diseases – especially those products that bind to the waxy cuticle: 'Scorpio', 'Insignia' and 'Mascot Eland'. Trans-laminar movement carries the active ingredient through the leaf tissues and out onto the other side where

"This organism produces these natural fungicides to restrict other species of fungi that are competing for its main food source. We now have a whole new family of fungicides based on these natural products" Graham Paul

Further advice on the use of QoI fungicides can be found on the FRAC website (See References below)

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