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 past years 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 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 oche problem to contend with! Where gravel has been used as a permeable back-fill in earlier drainage works the oche 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 drainage in hard rocky ground. He 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 with 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 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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David Shelton
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 age systems were required in view of the conditions. Steel wash on the cutters is treated with a free-draining medium-course sand from the Tillicoultry pit, 45 miles away.

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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 foxes looking for a feed, 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 simple as follows:
- Revision 91/414 Directive
- Sustainable Use Directive
- Machinery Directive
- Water Framework Directive

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

**“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**

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 shut 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 accrue 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 situations inherently.

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 is of most interest to turf developers as it essentially remove the pesticide. The Water Framework Directive says 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 farm- ers 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 aerosol (hormone-based herbicide) now banned used against deep rooted weeds in pastures in farmyard manure have no relation to turf weed control.

However, EU eyes are also focused on water pollution by herbicide actives like clopyralid and mecoprop, both widely and intensively used in farming but...
“Perhaps the most ‘dangerous’ aspect of this directive for future use of chemical pesticides, is increasing calls for tighter restrictions on pesticide use”

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When things go wrong such as a sudden burst of chafer grubs or an unwelcome carpet of Fusarium, then the remedy needs to be applied promptly and act fast which only chemical pesticides can achieve.

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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 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 pesticide or amenity application technique 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.

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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 actions 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 are appearing in new dedicated turf products are not as ‘new’ as they seem.

When a hitherto undiscovered active ingredient first shows up as an established one to full registered use in turf, and if chemical manufacturers think a planned new product may fail 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 sucking 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.

Dr Terry Mabbutt

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― Jason Elstob, Head of Biological Pest Control

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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.

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. This organism produces these natural fungicides to restrict other species of fungi that compete with it for nitrogen in the soil. 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 is a different matter, so UV stable synthetic strobilurins were produced to gain maximum use.

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. Soon after, both ‘Scorpio’ (trifolystrobin) and ‘Insignia’ (pyraclostrobin) were launched. Since the initial introductions there have been several ‘me too’ products formulated from straight strobilurins and two mixtures with other fungicides; ‘Headway’ (oxazystrobin and propiconazole) and ‘Fusarium’ (flusystrobin 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 known to biochemists as ‘mitochondrial respiration’. The strobilurins are classified under the group name QoI fungicides and tank-mixes should involve products from different chemical groups. Many scientists believe the theory of evolution dictates that fungi will develop a way around any chemical agent in time. The strategy must therefore be to delay this for as long as possible by sensible use of these valuable materials.

In the past, cases of resistance have been attributed to over-use, under-dosing or incorrect application. When fungicide resistance develops, it is often the most popular, most effective material that becomes worthless almost overnight. Fortunately we now have watch groups like FRAC who routinely follow up and monitor suspected cases of acquired resistance and more importantly advise manufacturers and users on the best way to minimise resistance risk.

The following guidelines for use of QoI fungicides may help to prolong their usefulness:

1. They should be treated as preventative fungicides and applied before or at the earliest moment of disease development.
2. Fungicide programs must deliver effective disease management.
3. QoI fungicides may help to prolong the useful life of other non QoI fungicides, applied before or at the onset of visible symptoms.
4. The number of applications per year must be minimized.
5. The build-up of resistant pathogen populations.

In the UK, the turf market in the USA is much larger than ours in the UK and the QoI products have been used there more extensively and a much longer period.

QoI fungicides are very effective at killing germinating spores, which makes them ideal for use as preventive treatments or in the very early stages of disease. However, they cannot be relied upon to work once the fungal germinating spore is located on the leaf surface. Application of QoI fungicide based on the vapour phase from one leaf to the other but upwardly mobile ‘Heritage’. Bayer’s product ‘Scorpio’ differs from the others in that it has the ability to move a short distance in the plant’s xylem enabling it to be distributed throughout the plant. Such movement is sometimes related to a common mode of action, the germinating spore is located on the outside surface of the leaf and is easily controlled. Once the fungal spore penetrates the leaf, the level of chemical present is often too low to halt the growth of the fungal mycelium. Therefore, timing is critical to the successful use of these QoI products. A disadvantage of ‘single-site’ mode of action is that it offers a much greater potential for resistant strains to develop than the case of fungicides with a ‘multi-site’ mode of action. While we do not want to cause unnecessary concern over the potential for fungicide resistance in UK turf, it is something we all need to be aware of when selecting a fungicide strategy. Acquired resistance is an ever present threat that needs careful management to prevent the loss of valuable chemical weapons in the fight against disease. The turf market in the USA is much larger than ours in the UK and the QoI products have been used there more extensively and a much longer period.

A study by the Fungicide Resistance Action Committee (FRAC) has revealed isolated cases of resistance to turf-grass diseases in the USA – notably Anthracnose, Gray Leaf Spot and Pythium Blight – the latter two being of no importance to the UK turf. However, there are also reports isolated cases of resistance to Microdochium nivale in wheat grown in Europe. In the same fungus it is the cause of the UK’s most important turf disease formerly known as Fusarium Patch.

Where a group of fungicides has the same mode of action, resistant strains of fungi will demonstrate cross resistance to all members of the same group. Rotation of fungicides must therefore be used outside the QoI family with substances having different mode of action.

“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 in the PFAZ website www.pfa.ch/englisch/Rehovot/Bezirke/Messpflanzen/Weitere/Reh/POE_19_2006_Aussparung_4.pdf

1) Fungicide resistance Action Committee – QoI A group Action Fungicide Resistance Action Committee (first published in Mosse& FrAC Monograph no. 1) second, revised edition) keith J Brent

4) QoI (Strobilurin) Fungicides: E. Grounds Maintenance 2002

www.apsnet.org/education/controls/turningpoints 2010

FRAC stand for?

1) Fungicides resistance Action Committee
2) Fungicide Research into Agricultural Chemicals
3) Fungicide Resistance Action Committee
4) Federation of Royal Agricultural Colleges
5) Which UK turf diseases have produced strains resistant to QoI products in the USA?

a) Fusarium Patch
b) Anthracnose
c) Gray Leaf Spot
d) Take-all Patch

In general, how would you classify QoI fungicides in terms of their uptake activity?

a) Contact acting
b) True Systemic
c) Trans-laminar

6) If a fungicide has a ‘single-site’ mode of action, will it:

a) be unlikely to encourage resistance to the disease
b) work better in warm climates
c) be more prone to develop resistance than those with ‘multi-site’ mode of action.
d) be cheaper to produce

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FUNGICIDES

SELF ASSESSMENT

Use the questions below to check your understanding of this topic. Readers can claim two BASIS points if the questions are answered correctly, by filling in the form online at www.sherriff-amenity.com

Circle the correct answer(s)

1) Which of the following active ingredients are registered for use on managed amenity turf in the UK? More than one may apply.

a) pyraclostrobin
b) fluzoxystrobin
c) pyraclostrobin

d) kresoxim methyl

2) What do the initials FRAC stand for?

a) Friends Reunited Against Chemicals
b) Fungicide Research into Agricultural Chemicals
c) Fungicide Resistance Action Committee
d) Federation of Royal Agricultural Colleges

3) Which UK turf diseases have produced strains resistant to QoI products in the USA?

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4) In general, how would you classify QoI fungicides in terms of their uptake activity?

a) Contact acting
b) True Systemic
c) Trans-laminar
d) Root absorbed

5) In which year were the strobilurin fungicides first discovered?

a) 1979
b) 1997
c) 1977
d) 1967

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