Over the last three years, KATE YORK, research officer at the STRI, has been researching the biology and control of dry patch as it affects golf greens in the UK, supported by funding from the Royal and Ancient Golf Club of St Andrews. Dry patch is a term used to describe a turf condition which is characterised by the presence of underlying water-repellent soil. This article is the first of two showing how our knowledge of dry patch in the UK has increased, with reference to results obtained from an extensive questionnaire survey and provides a practical guide for the greenkeeper on how best to manage dry patch on the greens.

Symptoms of dry patch first become apparent during the spring, but usually develop to a maximum through the summer months when it is generally most severe. The localised circular to irregular shaped areas of the golf green affected by dry patch range in size from small, isolated patches to a general effect, as can be seen in the photograph. The turf present in affected areas generally shows signs similar to those of drought stress, i.e. the turf wilts and is unable to return to an upright position following compresion by, for example, foot traffic. The botanical composition of the sward and its appearance is one way of determining areas of the golf green affected by dry patch. Due to the low moisture content of soil in affected areas, the relatively shallow rooting annual meadow grass (Poa annua) tends to die out, leaving the deeper-rooting, darker green Agrostis spp. and Festuca spp. to dominate affected areas. Under extreme conditions of high summer temperatures and low water availability, the grass in affected areas will eventually die out resulting in unsightly bare patches. The photographs overleaf show the condition of the soil in both unaffected areas and those affected by dry patch on the same green. In the first photograph, the soil appears dark due to its high moisture content, which ‘holds’ the soil together following the removal of the soil core. In areas affected by dry patch the soil moisture content is severely reduced and the soil takes on an almost dust-dry appearance, which causes the soil profile to crumble when a soil core is removed (second picture).

An extensive questionnaire survey has enabled us to determine the extent and severity of dry patch on UK golf courses. The questionnaire was divided into several subject areas including presence/severity of dry patch, greens maintenance and the use of wetting agents. Eighty-five percent of completed surveys confirm the common belief that dry patch generally affects older, more mature greens. However, the results showed that just over 10% of courses surveyed indicated the presence of dry patch on greens which were less than ten years old. Severity of dry patch on individual greens was recorded as the percentage area exhibiting symptoms. On the majority of courses included in the survey, between 5-25% of the green’s surface was affected by dry patch, but in extreme cases up to 75% of the surface showed dry patch symptoms. The results of the survey indicated that in the majority of cases, once dry patch had been identified, there appeared to be no annual increase in the extent of the symptoms, i.e. dry patch does not appear to ‘spread’ like fungal diseases are known to do.

Applications of high sand content top dressings have frequently been suggested as a likely cause of dry patch development. Many courses do use these top dressings, but if they were causing this condition it might be expected to occur as a blanket effect across the entire greens’ surface, rather than as the patchy distribution which is actually observed. However, it is true that if by some means a water-repellent material is being deposited in the soil, sand grains will be ‘covered’ more readily than smaller soil particles, due to their lower surface area:volume ratio and express the symptoms of water-repellence more rapidly.

Both thatch and root breaks have also been suggested as causing dry patch, however, neither appears to be a significant problem on affected greens included in the survey. Thatch if allowed to dry out is known to be highly water-repellent and is capable of forming a barrier to water penetration. It is possible therefore, that thatch may enhance the severity of the symptoms but it is not a primary causal factor in dry patch development. Root breaks can appear on any green, irrespective of its construction type or its age and occur as a result of a change in the physical state of the soil. Most commonly, this is a result of a change in top dressing material, which eventually leads to shallow rooting, poor turf composition and frequently an increase in its tendency to dry out.

From the results of the survey, we have found no evidence that dry patch is caused by compacted soils – another common misconception. Over 60% of the affected courses surveyed indicated no association between areas of dry patch and the normal traffic routes/pin position. Compaction may itself cause reduced water infiltration and subsequent deterioration of the sward, but it is not directly associated...
reduction in the moisture content of soil from areas affected by dry patch when compared with adjacent, unaffected areas. However, soil analysis has also shown that there are no significant differences between soil from dry patch and unaffected areas with regard to levels of pH, phosphate, potassium or nitrogen, nor are there any significant differences with depth with regard to soil particle distribution or soil organic matter content. These results tend to imply that dry patch is more likely to be a biological problem rather than a purely chemical or physical one.

In conclusion, we are now aware of the distribution and severity of dry patch on UK golf courses, its associated maintenance factors and how the problem is currently being alleviated with wetting agents. In addition, the physical and chemical characteristics of soils from areas affected by dry patch have now been well defined. This information is crucial for the development of techniques to remove the deleterious effects of dry patch on UK golf greens.

In April's Greenkeeper International, the results of research at the STRI on the influence of turf irrigation practices on dry patch formation and the possible biological causes with dry patch development. Finally, as expected, non-ionic wetting agents are used on 93% of courses affected by dry patch, in an attempt to control the symptoms. Currently, a wide range of wetting agents are in frequent use as a tool to combat the problem. However, it appears that although wetting agents solve the short-term problem of getting water into the soil profile and sustaining plant growth, the symptoms of dry patch recur shortly after treatment stops. Various methods of aerating the soil such as spiking are frequently used, particularly on severely affected areas prior to wetting agent application. If certain areas on particular greens are known to have a severe problem with dry patch, it is perhaps advisable to complete the first application of the wetting agent in the early spring before the symptoms begin to show.

It is well known that whilst wetting agents have a role to play in turf management, they will never be able to solve the problem of dry patch completely, but currently they are an effective means available to greenkeepers to reduce the symptoms. Laboratory analysis of soil has identified a significant reduction in the moisture content of soil from areas affected by dry patch when compared with adjacent, unaffected areas. However, soil analysis has also shown that there are no significant differences between soil from dry patch and unaffected areas with regard to levels of pH, phosphate, potassium or nitrogen, nor are there any significant differences with depth with regard to soil particle distribution or soil organic matter content. These results tend to imply that dry patch is more likely to be a biological problem rather than a purely chemical or physical one.

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Demand for golf in Germany to ‘explode’

Under the Communist regime in East Germany, golf was rarely played, as the sport was viewed as typically capitalist, and its introduction was discouraged.

For a long time even in the former West Germany there was a suspicion that only the wealthy could afford to play. For this reason the number of players has been, and continues to be, small. Of a total population of about 80 million, there are only 170,000 golfers, belonging to about 370 clubs.

In comparison to the United States or Great Britain, Germany is, in golfing terms, an under-developed nation. Still, there is an unmistakable upwards trend: the number of players has doubled every ten years. Recent surveys indicate that more people would play golf if more courses were available. Many existing clubs will accept no new members and public courses are almost non-existent. The only public course in the whole of Germany is in Düsseldorf, at Lauw ard.

Many golf course projects in the western part of Germany do not proceed because of the concerns of the politically appointed committees that are responsible for issuing permits, or because they cannot overcome conflicts with environmental protection measures. In addition to their significant successes in national politics in recent years, members of the Green political movement have gained considerable influence in elected bodies at the city and town level. They regularly oppose the construction of new golf courses. Considerations of preservation of the countryside and protection of the environment lead many of them to try to put a stop to a sport they have chosen to mistrust. For these and other reasons the construction of golf courses in the densely populated parts of western Germany has become almost impossible.

So it is not surprising that shortly after the reunification of Germany in 1990 planning commenced for new golf courses in the eastern part of Germany. The eastern part offers many good conditions. It is not as densely populated as the western part, so there is more space available and environmental concerns can be more easily accommodated. Most importantly, there is a more open-minded view of golf in many cities and towns. Golf is associated with expansion, prosperity, and the growth of industry. There is keen interest in any form of investment, which (for example) is a factor weighing heavily in favour of a proposed development when the effect on the countryside is being assessed.

The real boom will only come when the federal Government Ministries have been completely transferred from Bonn and Berlin is fully established as the capital of Germany. The demand for golf courses and golf clubs is then expected to explode. The golf courses that profit most from this boom will be those that were under-developed nation. Still, there is an unmistakable upwards trend: the number of players has doubled every ten years. Recent surveys indicate that more people would play golf if more courses were available. Many existing clubs will accept no new members and public courses are almost non-existent. The only public course in the whole of Germany is in Düsseldorf, at Lauw ard.

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ARNE VAN AMERONGEN discovers how the developing German greenkeeping industry is taking its lead from the United States, in preference to following the traditions of 'real' golf

Deutschmarks

though this money thing is something which I am led to believe is not uncommon in Scotland as well!

Regular spring and summer applications of NPK fertilisers, allied to overwatering (to stop the ball on greens, never mind the putting quality), autumn fertilisers often high in phosphates, lack of regular and appropriate aeration and the use of poor quality compost top-dressings are not uncommon practices on German golf courses, regardless of soil types and with inevitable results (not to mention costs!).

Poa annua is by far the most dominant grass species, particularly on greens, even on very young greens originally sown out to Agrostis Palustris. Here again the American influence is strongly evident in both northern and southern parts of the country, although some courses have started out with festuca rubra/agrostis tenuis seed mixtures on greens only to succumb to Poa annua infestation. Ryegrass fairways are commonplace and various unsuitable seed mixtures have been used on teeing grounds.

Greenkeeper education in Germany is in its infancy and is consequently well behind the training available at colleges in Scotland. With no established golfing heritage and with little recognition of the original concepts of the game, many ill-conceived developments have resulted.

I have seen it happen - the president or owner of a golf club will suddenly decide that the course needs some water hazards (which he saw whilst on holiday in the USA), perhaps a windmill or two, or flower beds around the tees! This public park concept has little in common with golf and the putting quality), autumn fertilisers often high in phosphates, lack of regular and appropriate aeration and the use of poor quality compost top-dressings are not uncommon practices on German golf courses, regardless of soil types and with inevitable results (not to mention costs!).

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MAFF No. 05712
The passing of 1992 saw the withdrawal of approval for the use of the wormkiller chlordane. Later this year a similar fate will befall some of the triazine herbicides — namely atrazine and simazine. Is this “weeding out” of chemicals going to become a trend for the years to come? GRAHAM PAUL looks at the future for the chemicals we have come to take for granted and suggests measures we might take to preserve their usefulness.

The loss of atrazine and simazine will mean that almost one hundred products will no longer be available to the greenkeeper. This will be quite a devastating blow for users and suppliers alike, for the triazine herbicides provide useful long-term control of weeds and grasses in non-cropped areas. They persist in the soil, preventing seeds from germinating, and it is this persistent behaviour which has resulted in the detection of minute amounts of triazines in ground water. One could argue that the popularity of this large group of products has contributed to their demise. Alternative methods of controlling weeds in non-cropped areas are not easy to find. There are chemical alternatives — such as diuron and imazap — which are available, but the process of developing and registering new products based on these is very costly and can involve long delays: three or four years to develop a formulation and carry out laboratory studies and field trials, plus up to two years waiting for the necessary approval from the Ministry of Agriculture.

The wormkiller chlordane has been off the shopping list for some time now, although the approval for its use remained until December 31, 1992 to enable stocks to be used up. In a similar way to the triazine herbicides, the persistence of chlordane in the soil made it an excellent product for achieving long term control. Now that we have to use less persistent products we might need as many as ten applications to do the same job — a fact that will be welcomed by the manufacturers and, I imagine, by the worms!

When mercury based fungicides were withdrawn in 1981 their place was filled by alternative, less persistent fungicides such as iprodione, chlorothalonil, quinotone and the systemic fungicides; thiophanate methyl, carbendazim and thiabendazole. These chemicals were available as substitutes because they had been developed for uses in the much larger agricultural market. However, that happened in the 1980s. Registering new products was easier then and there were more new active ingredients being discovered and developed for uses in agriculture. Today there is no endless supply of alternatives to replace those being withdrawn and we have to take great care in the use of the remaining armoury of pesticides, or they too maybe withdrawn. It is not just the recession that has reduced the rate of registration of new products, but more durable causes such as the effect on the farmer’s purse of policies to reduce surplus food production. Farmers have been forced to spend less on chemical sprays and so the manufacturers are looking harder at what money they can invest in the search for new active ingredients. Currently it costs about £30 million to bring a totally new active ingredient to the market-place. A large proportion of this is the cost of providing data on the toxicology and environmental impact to support the approval of products containing it.

Clearly, if we wish to continue to benefit from using chemicals to control weeds, pests and diseases, then we must learn to safeguard those we already have. This might be achieved by ensuring that all pesticides are only used when necessary, with the utmost of forethought and care to prevent contamination of ground water supplies. We should take particular care in using the few residual herbicides new to this market, such as those based on diuron, lest these too find their way into ground water and are banned — like the simazine and atrazine products.

Users should avoid under-dosing as well as over-dosing because the former can result in the need to re-apply a product which fails to perform, thereby using in total nearly twice the correct dose. Consideration must also be given to the possibility of pesticides losing effectiveness through resistance developed by the target species. Although this has not been common in the past, cases have occurred in most areas of pesticide use; such as warfarin resistance developed by rodents and fungicide resistance in grey mould and powdery mildew.

In many cases such resistance can be attributed to popularity and sheer over-use of the product. Where there are several alternative products to choose from, as with turf pesticides, sensible rotation will go a long way to help preserve our armoury.

We are all in favour of cleaning up our environment to improve the quality of life on earth, but pesticides can provide a useful benefit to our society without posing a threat to its future. The continued availability of these valuable tools will only be assured by sensible and responsible use.

by GRAHAM PAUL
Earthworms have both beneficial and harmful effects on fine sports turf. If you like, this makes them both goodies and baddies and goodies. The good news is that by going about their daily business, worms tunnel through the soil and give much needed aeration. The bad news is that some species, actually only two or three of the twenty or so found in Britain, come to the surface to cast. This causes the unsightly heaps of which we are all aware. 

So how can we prevent the harmful effects of the baddie earthworms, while encouraging the benefits provided by the ones in the white hats? Well, a knowledge of their life cycles, plus knowing when and why they cast can help with a sensible approach to their control. The first point to note is that in any healthy soil, whatever may be growing, earthworms are present in abundance. This is particularly true in undisturbed turf, which unlike annually cropped land is not regularly disturbed by ploughing or cultivating. Up to one million worms per hectare were recorded in trials conducted at the Sports Turf Research Institute.

All these earthworms naturally are very hungry. They eat virtually anything organic, including living and dead plant and animal matter. Thatch formed under fine turf is one of their favourite feeding places. So if you control earthworms too thoroughly by chemical means you could finish up with a worse build-up of thatch. If you add the benefits they give from improving soil aeration and structure, their general activity is beneficial. But the difficult trick is to balance this with the suppression of surface casts. 

The three worms which cast are the two Alolobophoras species longa and nocturna and the common Luminbricis terstriis. Like most earthworms, their activity is worst in heavy soils containing a large reserve of organic matter, and least on lighter, well-drained turf like the greens of links golf courses. Moisture also plays a part and casting is always more prevalent in moist springs and autumns than in a dry summer, when worms go deep down in the soil to avoid the effects of drought. At this time they go into a form of suspended animation, waiting for moisture to return. Obviously, this is less likely under heavy irrigation. 

The damage caused by casts is obvious, but not always fully appreciated. They are unsightly, ruin the true running of a green, suppress grass growth, spoil surface drainage and encourage fungus disease, whilst the excreted fine soil particles can make ideal weed seed-beds. After a wet autumn, unless they are swept up, the casts can lead to muddy playing conditions all winter. 

Finally, all earthworms, but especially those that live near the surface, also encourage moles – I speak with a lawn currently looking a bit like a miniature version of the western front. So, as most greenkeepers would agree, casting worms must be controlled. Adopting the right cultural measures will help; quite a lot can be achieved, for example, by regularly discouraging the production of the thatch, which gives the casting species a near-surface source of bed and board. A regular programme of slitting and coring where it is needed is therefore important, coupled with the removal of grass clippings and restriction in the use of organic surface dressings. 

Earthworms also dislike acid conditions, so be careful of over-limiting and in naturally chalky conditions use acidifying fertilizers like sulphate of ammonia and sulphate of iron. In a wet, heavy soil further improvements to the drainage system are also worth considering. 

In past years, a number of different chemical pesticides were used to kill earthworms. These were usually aimed at the whole population, casters or not – I don’t think in those days we knew the difference. These included mercuric chloride, lead arsenate, copper sulphate, sodium hydroxide and potassium permanganate. Some of these are very nasty materials indeed and at least two of them may by law no longer be sold for any horticultural use. Apart from the now totally banned lead arsenate, which gave control for up to two years but also killed off most other soil organisms, most had a short-term effect and needed repeat treatment. 

Mowrhameel was a much safer alternative to all these and was used widely for earthworm control until about 25 years ago. Broadcast dry, it needed watering into the turf with a copious amount of water by hose pipe. After a fairly short period the worms came wriggling up to the surface, quickly died and could then be brushed up and removed. This treatment undoubtedly helped to control a lot of worms, most of them sub-surface and probably casting species. The effect could be seen for up to two seasons. But it used a lot of mowrhameel, up to eight ounces per square yard was the recommendation, and thorough watering-in was needed to gain full effect. Removing the bodies, which otherwise could make an even more disgusting hazard and cast, was another tedious operation. Therefore, as older greenkeepers will remember, all in all, applying mowrhameel was a very time consuming process. The organic matter left from this bulky material might itself also have helped encourage another generation of sub-surface feeding species. 

In more recent years chlordane has been a successful successor to mowrah meal. The two forms available were the liquid Sydane 2S and Sydane Granular. It was relatively safe to apply, controlled worms for a fairly long period, but has been decreed to be excessively harmful environmentally. So, as most greenkeepers will now be aware, official approval for sale and supply ceased on 31 December 1990, and storage and use for earthworm control ceased to be permitted after 31 December 1992. After this date, unused stocks of chlordane should have been destroyed. 

Fortunately, we have approved alternatives. One of the most useful is a mixture of gamma-HCH with thiophanate-methyl, which controls both earthworms and leatherjackets – a considerable bonus where they are troublesome. It is sold as Castaway Plus and is available in normal flowable and CDA formulations. The makers also claim that it gives selective control of casting worm species. 

Another modern approved replacement is the carbamate insecticide carbaryl, sold in flowable formulation as Twister Flow by Rhône-Poulenc. Carbaryl is a pesticide with a wide range of uses as an insecticide, even for use against head lice! 

The length of activity of the modern wormicides is usually less than older materials like lead arsenate, which also helps make them more environmentally friendly. The proper time of application for all of them is when the earthworms are casting most actively, usually in wet periods in spring and autumn. In areas where levels of casting worms are high, repeat applications will almost certainly be needed to achieve complete control. Carbaryl is said to remain active in the soil for up to two months. 

When and how much you use a chemical control will depend on the situation and the problem the worms are causing. Usually the problem is worse at the back end rather than spring, and it was particularly bad last year following a wet September and October. On light soils and where the playing surface is not used
over winter you might decide not to bother. In that case you
must be prepared to deal with any weed seedlings growing the
following year in the convenient seed-bed the casts have left for
them.

But I suspect that many greenkeepers on heavier, wetter soils,
especially if they are chalky, will find it pays them to apply
wormicides as a fairly regular treatment. It will also pay to
remember the benefits from the goodie, non-casting worms and
the thinning of trees and under-scrub, is one of the best 'fungi-
ment' in an ideal world we would never have any problems with
fungus attacks on the golf course if healthy and vigorous turf,
with good disease resistance, could be maintained by careful
cultural management to shrug off disease. Then there would be
no need to use chemicals to keep down pathogenic organisms.
However, very few are blessed with the ideal golf course turf,
especially on greens, where fungal attacks are most likely to
occur and cause damage and where sustaining uniformity and
density is vital year-round.

This is not to say that courses which do not have disease-
resistant turf on greens (ideally fescues and bent grasses, care-
fully managed for growth, sited on healthy, well-structured,
free-draining soil, out in the open air to produce a stable sys-
tem) should not practise good cultural control of disease.
Indeed, this is essential if reliance on chemical control is to be
kept to the minimum. Whilst there is a range of fungicides avail-
able for treatment of turfgrass diseases, the range is not limit-
less: chemical applications are expensive and any input of
chemicals into the environment should be avoided if possible. It
is always best not to have to deal with disease in the first place
and the use of fungicides should be a line of last resort.

The principle of good cultural practise is to create an environ-
ment in which disease is less likely to occur. Again, manage-
ment to encourage disease resistant species within the turf has
to be a primary consideration, looking for good aeration and
free drainage, together with careful control of fertilizer input,
application of irrigation and timing of top dressings. This latter
item is a frequent means of encouraging autumn diseases, when
year-end dressings are applied late and cause some smothering
of the swards at a time when top growth is slow and the grasses
are damp.

In the same vein, operations to promote drying of the grass
cover are always valuable. The switching of surface moisture is
an obvious one in this respect, but of equal if not greater value
is ensuring that greens are recipients of a draught whenever
possible. A good breeze across a putting surface, encouraged by
the thinning of trees and under-scrub, is one of the best 'fungi-
cides' around.

Applying Sulphate of Iron as a routine dressing is often cited
as a means of limiting incidence of fusarium patch. This is true
up to a point, and there are other beneficial spin-offs from
applying sprays of iron. On the other side of the coin though,
acidification of the soil profile can come about by excessive use,
and it must always be remembered that Iron is not a fungicide.
It may make an outbreak of fusarium less likely, but it will not
stop one which has already started.

Working on the above principles, there are clubs that rarely, if
ever, use fungicides to deal with disease problems. Nevertheless,
there are many more reliant on chemical applications to keep
putting surface turf in as good a condition as possible year-
round, and these have to apply fungicides fairly regularly.

The main problem to be dealt with in relation to fungicide is
(by far and away) fusarium patch disease. On average, the
majority of clubs will treat for fusarium on greens three times in
any one autumn/winter period, costing in the order of £1000-
£1500 for an 18-hole golf course. This average treatment fre-
cency may fall within a range of 1-5 treatments per annum
depending upon the weather.

So, for most clubs, use of fungicide is a significant item within
the budget for the green, merely allowing for applications on
putting surfaces. Treatment of other sections of the course
beyond immediate greens surround is very rare. Here, the cost-
benefit of fungicide application is much less, as the effect of dis-
ease is much less damaging in the medium term.

Returning to greens, while application of fungicide is not
cheap, nine times out of ten procrastination in its use is expen-
sive too. A few spots of fusarium can run riot in quite a short
spell, causing lingering damage. Never forget either that fungi-
cides work best at the outbreak of disease, and the earlier that
spraying is carried out (wind and rain permitting) the more
likely the chance of complete success first time. Constant moni-
toring of disease outbreaks is essential if timing of spraying is to
be to the best advantage.

When it comes to choice of fungicide for treatment of fusar-
ium, in principle, systemic types are best for the bulk of the
year, confining use of contact type materials to the very...
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