and cultivating plants in rows hundreds of metres long. Ongoing maintenance is carried out in the same fashion, by tractors crawling alongside the crop trimming and undercutting the plants automatically.

The person walking behind is there only to monitor the progress of the machine as it moves along. The results are spectacular too – hedges can now be supplied that are arrow straight, two metres tall and are literally the finished article.

Many growers are now offering very high quality, instant hedging plants or 'elements' which would fool most people that the hedge has been growing in that spot for a number of years.

The days of lining out and spiralling thousands of bare root whips may be numbered as the customer increasingly wants a solution that won't take years to achieve.

The best compromise would be to use the internet to find a supplier that will engage with you in a professional manner to find the best solution to suit your needs and will guarantee to deliver a fantastic end product whatever your budget.

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Moss in turf and on hard surfaces

Graham Paul gives you the opportunity of adding to your BASIS points while offering some very sound advice on clearing moss

Moss is believed to be one of the earliest plant forms to have evolved on dry land. Approximately 20,000 species of moss have been identified and they exist on every continent.

Mosses are classified in the phylum Bryophytes; a group that contains the liverworts (Marchantiophyta), the hornworts (Anthocerotophyta) and the mosses (Bryophyta). Evolutionists believe that the first life on earth began in the oceans and developed from primitive single-celled organisms. Around 1.5 billion years ago the first plants to evolve in these oceans were the algae – organisms that developed the chloroplast; giving them the ability to trap energy from sunlight in a process we call photosynthesis. All plants that exist today have evolved from types of algae that began to emerge from the seas some 450 million years ago!

In botanical terminology we refer to 'lower' and 'higher' plant forms, a reference to the degree of evolution and sophistication rather than the physical height! Bryophytes are considered to be lower plants and differ from higher plants in that they have no vascular transport system to distribute water and nutrients throughout the plant. They do not produce flowers or seeds but reproduce through spores. Bryophytes have no defined root structure for obtaining moisture and nutrients.

The life cycle of moss is complex, involving a sexual stage where the male gamete (sperm) fertilises the female gamete (eggs), to produce an embryo that gives rise to a spore-bearing structure known as a sporangium. During the sexual stage the motile male 'sperm' is transported on water droplets (rainfall or dew drops) to the female 'egg', therefore moss cannot survive in a totally arid environment. Moss spores are simple single-celled structures that serve to colonise new ground. They germinate in the presence of moisture to form new male or female plants. Asexual reproduction of mosses occurs by the development of new shoots from the previous year's growth or by fragmentation of the plant.

Mosses acquire nutrients through a variety of means; some get nourishment from direct contact with water droplets, others can extract nutrients from the soil or materials on which they are growing.

Dealing with moss in turf

Well managed actively growing turf will rarely suffer from the invasion of moss. Mosses are opportunists; they will only thrive where grass lacks vigour, so treatment with chemicals alone will not provide a long-term solution. We need to look for the cause of weak grass growth and take remedial action to provide sustainable moss control.

Just as moisture is an essential requirement for the growth of moss, it will also have an impact on turf health. Excessive moisture reduces the air supply to the

roots putting the grass under stress. We often see the worst moss infestations in the winter and early spring when the water table is high and surface moisture is in abundance. Waterlogged turf can be caused by inefficient or inadequate drainage and by water retention in the thatch layer. Examination of the drainage system and the soil profile should reveal the cause of poor water management in these situations so that remedial action may be implemented.

Too little moisture has obvious effects on plant vigour since drought conditions will thin out the sward making room for moss to take hold when the moisture levels are reinstated. It is therefore important to maintain adequate moisture in the sward by irrigation, where this is possible, during prolonged dry periods. The application of a suitable wetting agent in dry weather can help to move the irrigation water away from the surface, getting it quickly down to the roots where it is most needed.

Light is essential for healthy plant growth and where it is restricted by the season or by buildings, trees, shrubs and other objects, grass growth will be affected in the immediate vicinity. We cannot influence the seasonal patterns of solar radiation but we can in some cases address the problems caused by shading. Pruning or the complete removal/relocation of offending trees and shrubs may provide a dramatic improvement in turf health. While it may not be possible to achieve similar improvements near permanent structures such as buildings, it may be possible to increase light levels by making surfaces reflective with special coatings, cladding or reflecting paints.

Providing the correct balance of nutrients is important in encouraging strong growth, especially on intensively managed sandy soils. In most cases this requires a seasonal programme of feeding based on soil analysis that can identify deficiencies and supplement these when the conditions dictate. In striving for optimum grass growth one must also consider the need to avoid triggering other problems such as turf disease that can occur when the appropriate timing of fertiliser applications is not observed.

Soil analysis will provide essential data on the acidity, which can also have a detrimental effect on turf growth. Moss is quite often found in the thinned swards growing on acid soil. A pH value around 5.5 will provide the optimum pH for growing fine turf.

Scalping or mowing the grass too low can be a further cause of summer stress. Clearly the height of cut depends on the type of sward. Putting surfaces and bowling greens use grass cultivars that can adapt to a low cutting height and are more intensively managed to counter the effects of close mowing but even these areas have limits beyond which scalping will thin the turf. Therefore, where moss is a problem in turf, increasing the mowing height may be worthwhile.

The final consideration in the search for the cause of poor grass growth is compaction, resulting from heavy traffic (machinery and foot) – particularly during the wet seasons. Compaction restricts air movement through the soil and physically slows root penetration. The resultant loss of turf vigour will often give an opening for moss invasion. Dealing with compaction may require an increase in mechanical aeration, traffic management to steer users away from bottlenecks and problem areas or soil amelioration with aggregates designed to permit air and water movement such as 'Axis' based on diatomaceous earths.

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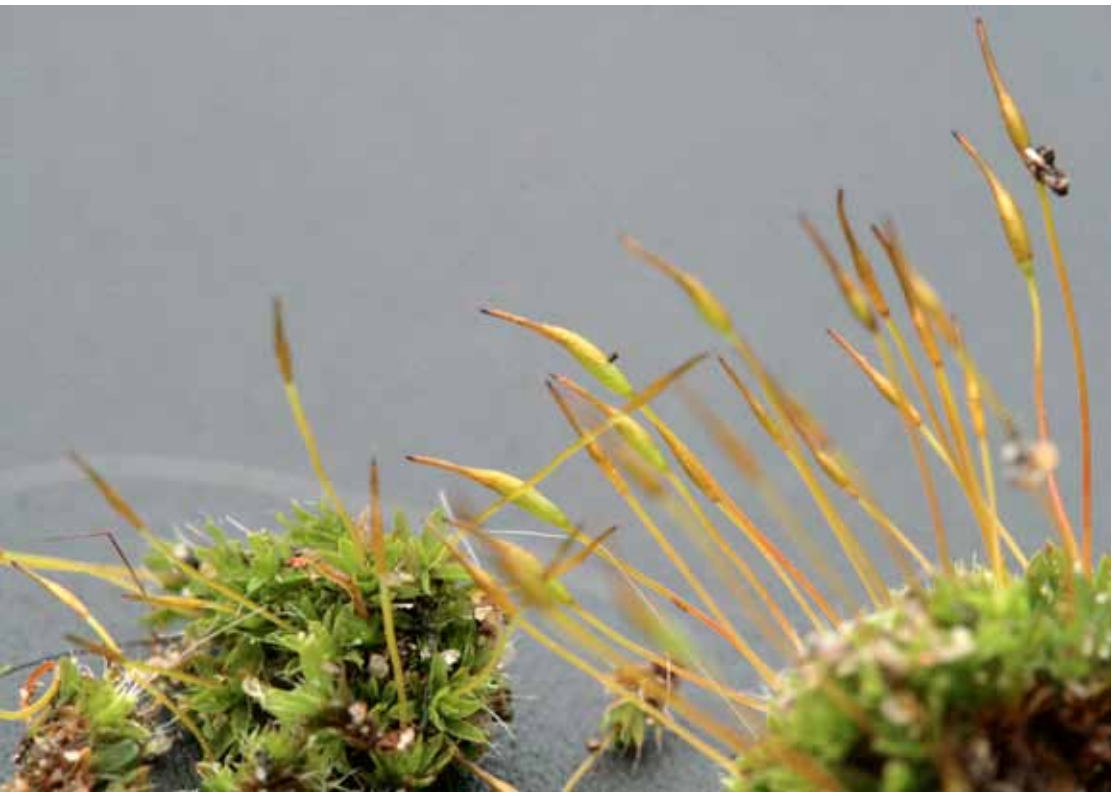
Treating moss on turf with chemicals

Fewer chemicals are available to deal with moss problems today, as legislation from the EEC has caused manufacturers to withdraw some of the more useful products. Prior to the early 1980's mercury-based moss killers, which contained calomel (mercurous chloride) were used for moss control. These were withdrawn, along with the mercury-based fungicides, because of their inherent broad spectrum toxicity and long soil persistence. They were quickly replaced with products containing dichlorophen e.g. 'Super Mosstox'. Dichlorophen had recommendations for use on both turf and hard surfaces and was known to have an affect on the spores as well as on the moss itself. However, dichlorophen was withdrawn after it failed make it into 'Annex 1' – Directive 91/414/EEC. This directive was issued under the Plant Protection Products Regulations 1995.

Today, only two alternatives are available for controlling moss in turf – these are:-

• 'Jewel' a selective herbicide spray from Scotts containing carfentrazone-ethyl and mecoprop-P that will control moss and a range of broad-leaved weeds.



• Products containing ferrous sulphate – available in a multitude of formulations; a ready-to-use liquid sold under the brand name 'Feromex', fertilisers containing high levels of ferrous sulphate e.g. Scotts 'Greenmaster Mosskiller', and various brands of lawnsand.

The use of wetting agents and adjuvants to counteract the hydrophobic conditions associated with moss will improve the effectiveness of liquid moss control products.

Controlling moss on hard surfaces

Moss will survive on a wide variety of hard surfaces such as roads, paths, playgrounds, athletic tracks, hard tennis courts, other solid sports areas, artificial turf, building surrounds, walls and roofs. It just needs moisture, some nutrients from dust and atmospheric fall-out and a small crack or crevice for anchorage.

Cultural control of moss on hard surfaces is not as effective as it can be on turf. However, drying out regularly affected surfaces may be possible by improving drainage to prevent flooding and by increasing the natural airflow that might be restricted by overgrown trees and shrubs. Brushing can be effective on certain surfaces.

There are no longer any approved pesticides for hard surface moss control. Products containing ferrous sulphate will leave rust stains on bricks, paving and other artificial surfaces so these should be avoided. However, there are a number of specialist hard surface cleansers that have proved effective in dealing with the problem.

Some surface cleaners require a very high water volume and are not easy to apply on large areas with conventional spray equipment. A promising new product 'Safor' works by denaturing chloroplasts with biocides and can provide a rapid, long-lasting solution for cleaning deposits containing algae, moss and lichen. The required water volume is well within the capability of knapsack and machine mounted sprayers.

Note that the use of surface cleaners will require an application of the material followed by a secondary cleaning operation after a few days to remove the loosened deposits. Also, when treating hard surfaces (especially artificial turf) it is important to test a small area for material safety before treating the whole area.

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 at:
www.sherriff-amenity.com/technical.asp?newsid=21

Circle the correct answer(s)

1) Mosses and all other plants we know today evolved from algae. At what approximate time in earth's evolution did these algae first appear in the oceans?
a) 450 million years ago
b) 300 million years ago
c) 1.5 billion years ago
d) 5 billion years ago

2) Which of the following characteristics distinguishes the Bryophytes from higher plants? (More than one may apply)
a) They produce green flowers only
b) They do not have leaves
c) They reproduce through spores
d) They do not have a vascular system to transport water and nutrients.

3) Which of the following can contribute to lack of vigour in grass? (More than one may apply)
a) Poorly drained turf
b) Aeration with solid tines
c) Shading by trees
d) Soil with pH below 4.0

4) In which year were the Plant Protection Products Regulations issued?
a) 1986
b) 1994
c) 1995
d) 1991

5) What is the chemical constituent of the active ingredient calomel (now withdrawn from use)?
a) Calcium chloride
b) Phenyl mercury acetate
c) Aluminium chloride
d) Mercurous chloride

6) How many pesticides are currently approved for moss control on hard surfaces?
a) 5 b) 2 c) 4 d) None

A for anthracnose

Dr Terry Mabbett continues his examination of the country's most common turf diseases by looking at anthracnose.

'A' was for anthracnose in appearing in late autumn as a distinctive dark-coloured basal (crown) rot of Poa annua (annual meadow grass) as long shadows and brown leaves fell across the greens.

Dry and compacted summer-stressed swards refreshed by rain and flushed with nitrogen fertiliser resumed growth in earnest during October but so did the anthracnose fungus having lain 'dormant' in the thatch during the dry summer months.

Anthracnose was a definitive of disease of autumn through to spring with root causes in stressed grass plants in dry and compacted summer swards but has since become a real conundrum. A form of anthracnose distinguished by different symptoms, and called foliar blight, now perversely appears in summer to affect a much wider range of turf grass species.

The fungus responsible (Colletotrichum graminicola) has suffered a recent illogical scientific name change. More than two dozen different species cause anthracnose (means 'like coal') on everything from mangoes to bananas but just four are associated with anthracnose in the family Graminae (grasses and cereals).

The four species are distinguished by small but distinct structural differences and discrete physiological differences which determine exact host range.

C. graminicola was associated with anthracnose across a broad range of grasses and cereals but more recent findings indicate C. graminicola exclusively attacks cereals and mycologists now say the species infecting turf grass is Colletotrichum cereale. In layman's language and understanding C. graminicola and C. cereale are for all intents and purposes interchangeable.

Anthracnose is no longer exclusive to shortening days, cool nights and morning mists of late autumn but already up and running as foliar blight during the warm still 'Dog Days' of August and often earlier. Basal or crown rot remains closely associated with late autumn and is still essentially confined to Poa annua (annual meadow grass) but has been seen on Agrostis. The foliar blight form of anthracnose is much less discerning and affects most cool season turf grass species.

Anthracnose is now firmly established as the second most important disease of UK turf after Fusarium patch (Microdochium nivale). Contemporary anthracnose infection is heavier and active over a longer part of the season on a much wider range of turf grasses. Its recent rise up UK

A' was for anthracnose in autumn as a distinctive dark-coloured basal (crown) rot of Poa annua (annual meadow grass), as long shadows and brown leaves fell across the greens.

Greens are now at risk of anthracnose for most of the year, not just in late autumn and through to spring

turf disease rankings has resulted in a re-assessment of measures required to avoid, manage and control anthracnose including use of fungicides.

Gone are the days when anthracnose was purely a problem for autumn greens with a high percentage of Poa and only acted upon when disease symptoms appeared in October though present year-round in the thatch. Year-round vigilance and action to avoid and alleviate turf conditions and management practices which may aggravate anthracnose into action from its 'saprophytic' existence in thatch is required.

Basal rot and foliar blight

Basal rot anthracnose is generally a disease of cool wet autumns on close cut annual meadow grass swards, but also creeping bent grass (Agrostis stolonifera) in North America where it is called 'winter anthracnose'. Leaves turn yellow then orange/red due to the accumulation of specific pigments in the tissue and unmasked by destruction of normally overpowering green chlorophyll.

Closer inspection shows older leaves are affected first because the crowns suffer infection and necrosis from the outside inwards. The water-soaked bases of infected grass plant tillers are easy to pluck from the soil. At an advanced stage of infection erumpent conidia-containing structures called acervuli (singular is acervulus) appear as black stained areas at the base of the plant. This rotting and necrosis of the crown where new roots and buds are formed is the more serious of the two phases of anthracnose, which are basal rot and foliar blight.

Foliar blight was prevalent in North America long before it appeared and took off in the UK. Infection occurs, symptoms show and disease spreads during spells of high humidity with temperatures above 22°C, especially on turf struggling to grow over a dry root zone.

Water from summer showers or irrigation is repelled by the dry compacted surface of the root zone. Instead of percolating into the soil, moisture hangs around on the surface moistening and raising humidity within the thatch to create ideal conditions for spore germination, leaf infection and the onset of foliar blight.

Patches of turf affected by foliar blight are yellow at first and then bronze with affected grass assuming a dull and darkened appearance. Annual meadow grass and creeping bent grass are the prime targets but smooth-stalked meadow grass (Poa pratensis) and creeping red fescue (Festuca rubra) are also affected.

Once liberated from the acervulus conidia are spread across the turf by rain splashes, air currents, machinery and footwear to infect previously healthy areas of turf. Dead tillers and plants killed by basal rot and leaves with foliar blight die back to become thatch, where C. cereale survives as a saprophyte until conditions are right for re-infection.

Arrival of typical autumn conditions with morning mists, rainfall and increasing cloud cover sets the scene for the resurrection of anthracnose. Free water on leaf surfaces and high humidity in the sward re-activates the fungal mycelium on the thatch and

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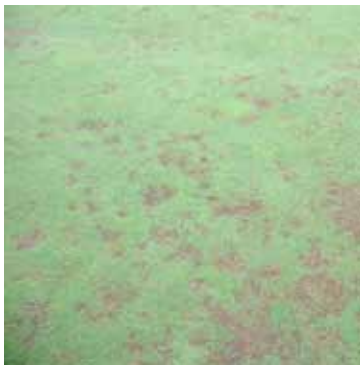
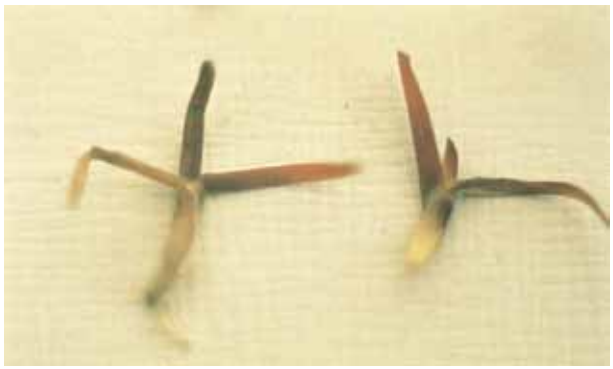
Anthracnose damage on a green high in Poa (Poa annua var annua) (Photo courtesy Headland Amenity)

Close up on basal rot anthracnose of Poa annua
(Photograph courtesy Headland Amenity)



The aftermath of anthracnose infection
(Photograph courtesy Headland Amenity)



Detached tillers of Poa annua showing dark coloured basal rot due to anthracnose
(Picture courtesy Bayer Environmental Science)

initiates a new cycle of infection.

Grass trying to grow out of stressful conditions including soil compaction, deep thatch and dry root zones is an easy target for anthracnose. Soft growth responding to rain and poorly balanced (high nitrogen) autumn fertiliser over deep wet and humid thatch can be very susceptible to anthracnose. And especially if the ground is compacted, poorly drained and turf cut inappropriately low for this time of the year.

Thatch, stress and anthracnose

Twin key factors underpinning anthracnose are the pathogen's propensity to invade stressed and damaged turf grass and year-round presence of the fungus on the thatch.

Even when turf is green and clean Colletotrichum cereale, like Microdochium nivale, is ticking over in a saprophytic or weakly parasitic mode on the dead and dying grass material comprising the thatch. Thatch in itself adds to turf sward stress if allowed to become inappropriately deep, thick and matted.

Single most important biological factor aggravating anthracnose is the presence of Poa annua (annual meadow grass) in turf grass swards. Annual meadow grass is a fast-growing, high-thatch forming species that exploits and monopolises turf suffering from high compaction and physiological stress, the very conditions that make turf grass generally more susceptible to anthracnose infection. Turf carrying a high proportion of Poa annua with its high-thatch and high humidity baggage offers a broader and bigger base for anthracnose residence and persistence and a more attractive substrate for infection and spread.

Poa annua is present to some degree in many fine turf swards even if unwanted. The species is variously regarded as a useful turf grass species or a rough grass weed, depending on original status of the turf and the ultimate goal of the greenkeeper. Poa annua has always stirred mixed emotions amongst the green keeping fraternity with much time and effort invested in reducing Poa and its accompanying high risk of anthracnose infection.

High humidity is a trigger for anthracnose infection so good aeration above and below the ground by scarification, compaction relief, aeration and swishing dew should all help to keep the disease at bay. But anthracnose is a weak wound parasite and too much of the very techniques used to improve aeration and root zone drainage and reduce humidity may make matters worse. Added stress weakens the turf and abrasions to grass stems and leaves offer easy points of access and entry for anthracnose.

Twin key factors underpinning anthracnose are the pathogen's propensity to invade stressed and damaged turf grass and year-round presence of the fungus on the thatch.

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