The

Comprehensive Guide

to

Lawn Care

Learn the best kept lawn maintenance procedures from the grass growing experts

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Introduction

It is estimated that there are around 620 genera and 10,000 species of grasses to be found in the world. Grass plants are used extensively and utilised throughout the globe for many different reasons and have adapted themselves to all the differing world climates and zones. Many grasses are used for food, in fact, it is said that 20% of the worlds cultivated land is planted with wheat, barley, rye or rice. Yes, rice is included in the grass order.

Grasses, even though you may think they all have similar appearances, are as diverse as we are. Many genus (main breeds) of the grass family are utilised in horticulture for aesthetic and ornamental reasons and many are utilised in sports turf to allow us to play our recreational games upon or utilise for our pastimes. Nevertheless, perhaps the most extensive managed use of grasses in the United Kingdom can be attributed to those areas called ‘lawns’.

As far back as medieval times, it was discovered that grass seeds and turfs from pastures were an economical and easy way to beautify space around buildings or to cover soils in the landscape. Since then, grassed areas have fulfilled a multitude of different functions.

Grasses are pleasing to the eye, provide an appropriate surface for play and sport, provide life-giving oxygen, allow stabilisation of soils and provide employment and enjoyment. The lawned area, forming part of the suburban garden, complement planting schemes, define and balance height, texture and colour while also forming part enclosure, sun lounge, sports pitch and pet run. Grasses are even used simply to encourage time spent outside. Overall, grasses are common, popular and a fact of life…. but, it could be said, for lawned areas, rarely managed in the correct manner!

Chapter 1 - Lawn maintenance scheduling

Introduction

This chapter looks into the timing of the maintenance operations needed to produce quality lawns. Quality lawns that are dense, visually pleasing, uniform in colour and texture, growth and of course able to tolerate wear and tear. The most frequent operations associated with lawn or garden care are those of mowing and watering. Though these in themselves do not directly guarantee the growth and development of a healthy, vigorous sward. Minor operations, as detailed in the following pages are just as important to overall, long-term turf grass health and development.

The most vital aspect in obtaining a high quality turf surface is the hard work put in by the lawn owner. The lawn owner must have an appreciation of the growing habits and characteristics of grass, the effect and consequences of user wear upon the surface, an understanding of how and why each maintenance task is carried out and an understanding to the responses of the grass plant to each (as outlined in this book). Armed with this knowledge a quality turf grass surface will be guaranteed.

It is also important to note that many mechanical operations can be carried out as and when necessary (we do not have to stick religiously to calendar dates!) as long as the turf is growing vigorously enough to recover. The calendar below acts as a guide. It is not designed to be exact (For a more detailed calendar see page 5) but gives you the lawn owner a good idea as to when you may think about carrying out any particular procedure or operation during the year.

The descriptions found after the *'little maintenance calendar'* explain the importance and relevance of each operation and lead you to further pages of the book for more detailed explanations if required.

The little maintenance calendar

	Mow	Irrigate	Feed	Aerate	Scarify	Top-dress	Weed control	Disease control	Moss control	Renovate	Apply seed	Lay turf
January				☻				When needed				
February				☻				When needed				☻
March	☻			☻			☻	When needed			☻	☻
April	☻	☻	☻	☻	☻	☻	☻	When needed		☻	☻	☻
May	☻	☻	☻	☻	☻	☻	☻	When needed		☻	☻	☻
June	☻	☻		☻		☻		When needed				☻
July	☻	☻		☻		☻		When needed				☻
August	☻	☻	☻	☻	☻	☻	☻	When needed	☻		☻	☻
September	☻	☻	☻	☻	☻	☻	☻	When needed	☻	☻	☻	☻
October	☻	☻		☻			☻	When needed		☻		☻
November	☻			☻				When needed				☻
December				☻				When needed				

Mowing – Should be carried out according to growth. There is no set time for commencing mowing operations or finishing them this s purely dependant upon growth. Removal of clippings can increase the amount of fertiliser needing to be applied to the lawn over the year. The higher the height of cut set the stronger the plant will become. Even a very slight increase in the height of by 1 mm will enable the grass plant to photosynthesis more efficiently. The plants root depth will be proportional to the height of cut. See pages 12 - 15.

Irrigation – Irrigation practices should encourage root growth. Heavy and infrequent applications are best. Irrigation should only be carried out when necessary. See pages 22 – 23.

Nutrition – Carried out as and when needed. Optimum root and shoot growth periods to aim for will be during the spring and early autumn correct application at these times can greatly improve the colour, density and quality of a sward while ensuring fast recovery of any wear that may have occurred. However, light applications of nitrogen or iron during the summer period (if irrigated properly) can improve colour and leaf vigour. See pages 17 – 21.

Aeration – This is vital for root growth and general plant development. If also carried out during the summer period when the soils oxygen demand is high improvements in plant growth will be encouraged as will increases in the natural process of thatch reduction. Aeration work carried out during the colder months will improve water infiltration rates into the soil and speed up the rate at which it moves through the soil, keeping the surface relatively dry while allowing the soil to warm up quickly when spring arrives. During the summer it aids the growth of the plant and helps decompose thatch. See pages 24 – 27.

Scarification/Verti-cutting – Can be carried out frequently to remove and control thatch. No more than two directions the second being 45^{o} to the first. If scarification is to be carried out frequently it is advisable only operate in one direction each occasion. The grass plant must be growing vigorously to

ensure speedy recovery. A light application of fertiliser two weeks prior to scarifying or will encourage a speedy recovery. Verti-cutting is less damaging and can be carried out more frequently. Irrigation will be vital to ensure recovery after this operation. See pages 28 - 31 and 22 – 23.

Top-dressing – Should be carried out infrequently (twice per year). Applied heavily after aeration practices such as hollow-tining to improve the soils texture, structure, drainage, and aeration properties. Frequent light dressings are recommended if a smooth surface is required, light frequent dressings also prevent thatch build-up. See pages 32 – 33.

Weed control – To achieve a true, dense and uniform lawn, surface weeds will need controlling periodically (see yearly maintenance planner for timings). The best defence against weed growth will be a dense turf surface that prevents the weed seeds from germinating. Identification of weeds and control measures can be found on pages 60 – 73.

Disease control – Diseases can be a problem any time of the year. With good maintenance practices proneness to disease will decrease. However, diseases are often encouraged by heavy and late applications of nitrogen (after late September), top-dressing material that has a high lime content, poor irrigation practices but, most importantly, the environmental conditions such as soil moisture, soil and air temperature, humidity, pH of the soil etc. Environmental influences are mostly beyond our control but the management techniques carried out incorrectly can encourage outbreak and attack of disease.. Correct cultural practices will be the best defence against disease. See pages 47 - 55

Moss control – Most effective if treated during the autumn time. Control can also be achieved during spring. The whole plant should be dead before removal from the sward. See pages 43 – 44.

Renovation – Carried out during spring and/or autumn when shoot and root growth is at maximum due to the naturally occurring high moisture levels and raised temperatures associated with these seasons. Prepares and repairs the turf area for the seasons use ahead. See pages 34 – 36.

Application of seed/laying of turf – Essentially these operations can be carried at any time indicated. Irrigation should be applied after seeding or turfing from late spring to autumn if dry weather is encountered or forecast. Application of seed early spring must be complemented through the summer period with irrigation if death through desiccation of the newly germinated plants is to be avoided. See pages 37 - 42

The yearly maintenance planner

This maintenance planner should be treated as a suggested routine that could, if carried out correctly, ensure vigorous, healthy turf coverage throughout the year.

Month	Operations to be carried out	Tips
January	- Service and clean mower, tools and equipment	Set winter height of cut
	- Remove any debris that may have accumulated on the lawn, keep off during frost	Light brushing
	- It is possible to lay turf at this time	
	- Repair and adjust turf levels with suitable soil by hand (peel back turf)	Fill or remove soil
	- Establish edges	
	- Check for signs of disease	See pages 47 - 55
February	- Check for signs of worm activity. If casts appear brush these in when dry	
	- Complete any major turfing before the month ends during periods of good weather. Ensure soil condition is suitable before attempting this.	
	- Check for signs of disease	See pages 47 - 55
	- Keep off during frost	
March	- Mow the turf at a relatively high height of cut (tip off sward)	See page 12
	- Reduce height of cut slowly (if necessary) over the next three months	Helps root growth
	- Toward end of month prepare for spring sowing	See pages 39 - 42
	- Hand pick any weeds from turf	Use daisy grubber
	- Over-sow with seed or lay turf toward end of month	See page 34
	- Check for signs of disease	See page 55
	- Keep off during frost	Prevents damage
April	- Remove any patches of coarse grass by hand, fill, level and seed if necessary	Cut and fill with suitable turf
	- Treat moss if necessary (can take up to 3 weeks to die off)	Lawn sand
	- Apply weed killer if necessary (hand weeding preferable)	See pages 60 - 73
	- Scarify or rake turf to remove thatch & moss	Ensure moss is dead first
	- Apply fertiliser early to middle of month (depending on weather)	Spring/summer dressing
	- Top-dress	Do not smother turf
	- Irrigate only if long term forecast is predicting dry weather	See pages 22 - 23
	- Check on the progress and soil levels of germinating grass or newly laid turf	
	- Mow according to growth	
	- Seed any sparse areas	
	- Aerate the soil	Hollow time if thatchy
	- Establish edges	
May	- Slowly establish summer cutting height	See pages 9 and 12
	- Continue weed killing if necessary	Chemical use possible
	- Irrigation may be needed	Watch weather forecast
	- Apply sulphate of iron if moss still a problem	Use spreader
	- Aerate if drainage, compaction or thatch a problem	
	- Mow frequently as growth dictates	
	- Check for signs of disease	See page 55
June	- Mow frequently as growth dictates	
	- Check and adjust mower blades	
	- Lightly top dress	Sand if drainage problems
	- Irrigate if necessary	Watch weather forecast
	- Lightly scarify if thatch a problem (ensure water is applied after)	Hand raking may suffice
	- Establish edges	
July	- Mow as growth dictates	
	- Remove any weeds by hand	Daisy grubber
	- Feed lightly (nitrogen only)	See pages 17 - 21
	- Irrigate as necessary	
	- Aerate soil if thatch a problem, ensure soil is in suitable condition for operation	Slit tine or solid tine
August	- Mow as growth dictates	
	- Irrigate when necessary	
	- Top-dress	Can be applied heavily
	- Fertilise mid August	Nitrogen and potassium
	- Weed kill if necessary	
September	- Mow as growth dictates	
	- Hand weed	Use ‘daisy grubber’
	- Begin to raise the height of cut on mower	
	- Check for disease	
	- Treat moss	Dichlorophen only
	- Fertilise lightly late September	Potassium & magnesium
	- Check for worm activity and brush in casts	

	- Top-dress - Aerate the soil and thatch layer - Seed any worn areas after aeration - Establish edges	
October	- Set mower at winter height of cut - Apply seed early or lay turf mid to end of month - Mow as growth dictates - Aerate this month if unable to do so during September - Remove any falling leaves immediately - Brush the lawn stiffly twice this month (before mowing) - Possible to turf at this time - Apply iron fertiliser	1- 2" would benefit lawns See pages 37 - 39
November	- Only mow if necessary - Keep off the lawn during frost - Continue removing any fallen leaves - Watch for disease - Possible to turf at this time	
December	- Oil moving parts of maintenance equipment - Keep turf clear of debris - Keep off during frost - Watch for disease - Lightly aerate soil with fork or solid tines if soil in correct condition	

Note - To prevent leaf yellowing or death from dog urine apply water to area immediately after

For further information on operations see:

Pages 12 - 16 for Mowing
Pages 17 - 21 for Fertilisation
Pages 22 - 23 for Irrigation
Pages 24 - 27 for Aeration
Pages 28 - 31 for Scarification
Pages 32 - 33 for Top dressing
Pages 37 - 39 for Turfing
Pages 39 - 42 for Seeding
Pages 43 - 44 for Moss control
Pages 47 - 55 for Diseases
Pages 60 - 73 for Weed control
Pages 75 - 76 for Thatch

All the technical terms used are described and explained within Chapter 3 'The maintenance procedures' and a glossary of terms can be found at the rear of the manual.

Chapter 2 - The turf trouble-shooter

Lawns can have many problems associated with them. The key to fixing any problem is to firstly identify the cause and then to take the correct remedial actions.

Dead or dry patches →

1. Thatch build up – see pages 75 - 76
2. High areas exposed to sun and steep enough to allow water to run off before wetting – see pages 22 - 23
3. Pest attack – see pages 56 - 59
4. Animal urine (Water in)
5. Uneven sowing in new turf – see pages 39 - 42
6. Heavy compaction – see pages 24 - 26
7. Damage from wear – see pages 24 - 26
8. Incorrect choice of grass species – see pages 8 - 11

Off colour patches of grass →

1. Caused by animal urine (water in)
2. Diseased turf – see pages 47 - 55
3. Pest attack – see pages 56 - 59
4. Mowing height too low – see page 9
5. Uneven ground causing scalping while mowing – see pages 14 - 15
6. Damage from wear – see page 9 and pages 24 - 26
7. Different grass species in sward – see page 8
8. Not enough top-soil beneath grass in places

Yellowing of the grass (majority) →

1. Caused by mowing too infrequently and when mown too closely – see pages 12 - 15
2. Turf in need of fertilisation (Nitrogen) – see pages 17 - 21
3. Severe pest attack – see pages 56 - 59
4. Severe disease attack – see pages 47 - 55
5. Herbicide over dose – see page 73
6. Poor drainage – see pages 24 - 26
7. Inadequate top soil depth (extremely shallow)
8. Lack of water – see pages 22 - 23

Thin sparse growth →

1. Caused by heavy shade – reduce shade
2. Infestation of moss or weeds – see pages 43–44 & 60-73
3. Disease attack a possibility if yellowing also occurs – see pages 47 - 55
4. Poor drainage – see pages 24 - 26
5. Over-dosing of chemical herbicide – see page 73
6. Compaction – see pages 24 - 26
7. Pest attack – see pages 56 - 59
8. Incorrect sowing rate if new turf – see pages 39 - 42
9. Moss – see pages 43 - 44

Cracks in the soil and turf →

1. Heavy loam type soil dried out – see pages 22 - 23
2. Poor irrigation practices – see pages 22 - 23
3. Newly laid turf needing water

Scalped or shaved turf in places →

1. Incorrect mowing height of machine – see page 9
2. Incorrect mower for land shape – see pages 12 - 15
3. Uneven ground – see pages 32 - 33
4. Moss – see pages 43 - 44

Chapter 3 - The Maintenance procedures

Introduction

This chapter looks initially into the importance of correct grass species selection, and then introduces the types of ongoing maintenance that will need to be carried out if you require a visually pleasing, dense, uniform and disease free lawn area. Many lawns will initially after sowing or planting look fantastic and are a sight to be seen. Many will carry on being visually pleasing, although, the majority of lawns will see change, in some cases a change for the worse.

Wear and tear leading to loss of leaf cover and compaction of the soil, shade, drought and/or the lack of the correct maintenance and the incorrect choice of grass species can influence the long-term characteristics of the turf and affect the general health and vigour of the plant. Weeds, diseases and moss can encroach; the little oasis of green that once was is no more!

The maintenance practices described herein are not all strictly required for grass to develop and grow. Grass is a resilient plant, surviving thousands of years before we came along to nurture it. These practices are however utilised in the professional market to produce the wonderful grass surfaces we see on television. All the procedures can be carried out on a small or large scale and if followed results will be seen. Correct choice of grasses and maintenance procedures encourage active growth. Working with the correct species, the local environment and ensuring adequate stimulus in the form of water is supplied will give the lawn colour, appearance, texture, growth and ultimately ensure suitability for use.

Choosing the right grasses

The correct choice of grass plant for its growing environment is vital for successful growth, development and the areas aesthetic value in future years. It is intended that this section will aid you with species and cultivar selection and help you understand the many environmental aspects that will influence growth. Perhaps the most important of these being the initial choice of grass species for your chosen application or desired characteristics required from the lawn. Many give this thought to other plants purchased, why not for your grasses?

There are many uses for turf grasses, from lawns to sports turf applications such as football to rugby, polo or tennis, they are used in landscaping, for road verges, airfields and building surrounds even orchards. Choosing the correct species is vital to success.

The table below outlines some of the growing characteristics today's species and cultivars exhibit and should help you with your choice of grass plant(s) for your specific situation and growing conditions.

Grass species characteristics table (To view, use tool bar -Click view, click rotate clockwise)

Botanical name	Growing habit	Nutrient requirements	Leaf Colour	Suggested applications	Tolerance to shaded conditions	Tolerance to wear & tear	Tolerance to drought conditions	Minimum cutting height advised
Lolium perenne	Tufted	Medium	Dark green	Lawns, sports, most applications	Good	Good	Moderate	5 – 25 mm Dependant on cultivars
Festuca rubra ssp. rubra	Rhizomes	Low	Medium to dark green	Lawns, some sports, landscape	Moderate	Poor	Good	10 mm
Festuca rubra ssp. litoralis	Rhizomes	Low	Medium to dark green	Lawns, sports, most applications	Moderate	Moderate	Good	5 mm
Festuca longifolia	Dense tufted	Low	Grey/blue green	Lawns, landscapes, some sports	Moderate	Poor	Good	10 mm
Festuca ovina	Dense tufted	Low	Blue / green	Lawns, landscapes, sports	Moderate	Moderate	Good	25mm
Festuca rubra spp. commutata	Dense tufted	Low	Green	Lawns, sports, most applications	Moderate	Moderate	Good	5 mm
Agrostis tenuis	Slender stolons and rhizomes	Medium/low	Yellow green – medium green	Lawns, sports, most applications	Moderate	Moderate to good	Moderate	5 mm
Agrostis stolonifera	Stolons	Medium	Green	Lawns, sports, most applications	Moderate	Good	Poor but recovers well	5 mm
Agrostis castellana	Rhizomes	Medium / low	Green	Lawns, sports, most applications	Moderate	Moderate / poor	Moderate	5 mm
Agrostis canina	Stolons	Medium	Dark green	Lawns, sports, most applications	Moderate	Good	Moderate / good	5 mm
Poa annua	Tufted	High	Light green	Classed as weed, but found all over	Moderate	Poor	Poor	< 5 mm
Poa trivialis	Stolons	Medium / high	Yellow / green	Lawns, landscape	Good	Moderate	Poor	30 mm
Poa pratensis	Rhizomes	Medium	Dark green	Lawns, sports, most applications	Moderate / good	Good	Moderate	10 mm
Poa nemoralis	Tufted	Medium / low	Green	Landscape	Moderate	Poor	Poor	50 mm
Cynosurus cristatus	Dense tufted	Medium / high	Dark green	Lawns, sports, most applications	Moderate	Moderate	Good	10mm
Phleum bertolonii	Tufted, sometimes stolons	Medium	Green	Lawns, sports, most applications	Poor	Good	Moderate	20 mm

Common Name	Perennial ryegrass	Strong creeping red fescue	Slender creeping red fescue	Hard fescue	Sheep's fescue	Chewing's fescue	Brown top bent	Creeping bent	Highland bent	Velvet bent	Annual meadow grass	Rough meadow grass	Smooth meadow grass	Wood meadow grass	Crested dogs-tail	Small leaved timothy

Grass mixes and blends

Sowing mixes (or blends as they are sometimes referred to) are used to create lawns for a number of reasons. Mixing grass genus and species offers benefits to the grower as it allows traits such as differences in texture to be introduced giving a dense characteristic to the sward. We can specify individual grasses that may be resistant to shade, drought or wear to make the lawn (sward) highly adaptable and help increase its survivability. Colour is another feature that can be specified, as is the tolerance to mowing height differences. One of the main benefits associated with sowing mixes is that of guaranteeing resistance to some diseases. If one of the grasses in the mix were to be diseased the others would still flourish and grow (for susceptibility of grasses to disease see pages 47 - 55).

There are many turf grass seed blends used today that are specified with one genus and species but different cultivars are used. These single mixes of grass are known as 'mono-stands'. Mono – *one* – stand – *grass*. Many sports surfaces are sown as mono-stands utilising the differences in cultivar only. This allows some protection from diseases while giving an even texture and density throughout the sward.

The table on the next page gives examples of mixes for lawns subject to heavy wear, shade, dry and wet soils and also lawns of high quality reminiscing fine turf sports areas such as golf greens.

Note that the suggested proportions of different grass species are guidance only. There can be many combinations of mixes. Practically differences of 5 – 10% from the tables suggested proportions would in most cases have little effect. Soil, local environment, use and management practices will have a bearing on the range of grasses used. (See grass characteristic table for further information – page 9)

Mix 1 – Turf subject to heavy wear
Mix 2 – Turf subject to high levels of shade
Mix 3 – Dry soil situations
Mix 4 – Wet soil situations
Mix 5 – Fine textured 'golf green like' turf (cutting height less than 10 mm)
Mix 6 – The multi-use lawn
Mix 7 – Acid situation

Mix 8 – Alkaline situation

Mix 9 – Economy

Mix 10 – Low maintenance

Mix 11 – High maintenance, high quality

Mix 12 – Coarse textured lawn

Suggested seed mixtures (To view, use tool bar -Click view, click rotate clockwise)

	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5	Mix 6	Mix 7	Mix 8	Mix 9	Mix 10	Mix 11	Mix 12
	50%					40%			100%			50%
	20%			30%						10%		30%
		40%	50%			30%		50%				
		20%	20%					40%		15%		
										40%		
	20%	25%	30%		80%	25%	20%					
	10%	15%			20%			10%		20%		
							30%					
				20%						15%		
						5%						
				50%								
							50%					20%

Common name	Perennial ryegrass	Smooth meadow grass	Slender creeping red fescue	Strong creeping red fescue	Sheep's fescue	Chewing's fescue	Creeping bent	Brown top bent	Hard fescue	Velvet bent	Highland bent	Rough stalked meadow grass	Crested dog's-tail

Mowing

Mowing is the most frequently carried out and the most fundamental practice utilised in turf grass culture. It is a defoliation process in which a portion of the turf grass leaf is 'removed'. Any cutting or defoliation is detrimental to the turf. The turf grass plant is able to survive mowing through continual leaf growth. Although the cut tip of a leaf proves to be an ideal site for the penetration of pathogens.

Choice of mower

Simple planning should have determined the shape, size and quality of the lawn to be maintained. These factors alone will then largely determine a fairly narrow range of suitable mowing equipment. The following points however, should be looked at closely:

a) Ability of the machine to complete the job to the required standard.
b) Machine features such as blade type (rotary/cylinder); engine size; cutting width and heights; machine weight; grass collection features.
c) Ease of transportation
d) Maintenance and servicing
e) Safety features
f) Ease of use
g) Cost

The two basic types of mowing actions used for cutting lawns are cylinder mowers and rotary mowers. There are of course other methods that can be utilised although for the purposes of turf aesthetics, quality and smoothness the choice of equipment is limited.

Cylinder mower – This type uses a continuous scissor action. The blades on the rotating cylinder cut the grass against a fixed bottom blade. Produces a smooth cut, runs quietly and is energy efficient. Usually does not scalp on uneven ground and does not throw hard objects. This type of mower is especially good for closely mown turf. The disadvantages of cylinder mowers are that they do not cut long

grass well if at all and can need special sharpening and maintenance needs. It is advised that any lawn is firstly walked over before mowing operations begin to remove the risk of damage or injury to the lawn, operator or any other party.

Rotary mower – The grass is cut by the impact of a high-speed cutting blade travelling parallel to the ground. Cuts tall grass easily, rotary mowers are easy to sharpen and maintain. Hover-type mowers are also very easy to manoeuvre. The disadvantages of rotary mowers are that they can be dangerous if a metal blade is used for the cutting mechanism, can be noisy if petrol driven and may scalp uneven turf.

Cutting height

Cutting height is defined as the distance above the soil at which the leaf is cut. The bench setting is the height at which the 'cutting edge' or 'bottom blade' is set above a level surface. Turf grass species vary greatly in tolerance to cutting height. Prostrate – low growing – turf grasses such as creeping bent (*Agrostis stolonifera*) tolerate a much shorter cutting height than erect growing non-creeping types such as perennial ryegrass (*Lolium perenne*). For further information see the grass species selection table on page 9.

Mowing too high can cause as many problems with certain turf grass species, as cutting too close. The prostrate growing species (grows with stolons, rhizomes or both) ideally would be closely mown; otherwise excessive thatch accumulation could occur.

The greater the height of cut (usually expressed in mm) the greater the ability the grass plant will have from recovering from inconveniences such as wear, disease attack and the mowing operation itself. Turf grass roots naturally will grow proportionally to the height of the leaf. Therefore we can assume that any increase in the height the grass is mown will directly benefit the rooting system and boost the entire plants vigour and growth. Even an extra one millimetre gained in cutting height will significantly improve the plants photosynthetic power.

Lawns that have high levels of thatch (see pages 75 – 76 for a definition of thatch) are prone to scalping as the weight of the machine (in most instances) will sink down into it, effectively lowering the height of cut set prior to the mowing operation.

Frequency of mowing

Mowing frequency depends upon mowing height and user preference. The shorter the grass is mown then the more often it must be done. Mowing should really be determined by the growth rate of the grass. This will vary with the seasons and the weather encountered. In the

spring turf growth rates will be fast, the summer relatively slow and the autumn growth rates will be intermediate. Mow regularly at a suitable height according to the requirements and use of the lawn. Finer turf may need to be mown up to 5 days per week during the growing season if a specific height of maximum growth and high levels of finish are required. Lawned areas may need mowing perhaps three times per week during high growth times of the year such as April/May and September/October. Coarser type turf may need cutting as little as once per month or possibly as often as once a week. Cutting during the late Autumn/Winter period should not be neglected if growth is taking place.

Return or removal of clippings?

If cuttings are to be removed it is possible that more fertiliser will be required to restore soil nutrients, as the disposed clippings will contain nutrients taken up from the soil solution. Return of clippings produces a more drought resistant sward of better colour, but also a softer turf, more susceptible to disease and to an increase in weeds and worm populations. If clippings are returned to the sward then the mowing frequency may also need to be increased due to the subsequent encouragement of growth.

Direction of mowing

The direction of mowing should be varied as often as possible (if using a cylinder mower) for each cut in order to reduce the risk of a strong 'grain' or 'nap' occurring in the sward.

Faulty mowing - problems and remedies

Wash boarding

This is a series of broad & even mounds formed in the turf grass sward, running across and along the mown strip. It forms a wave-like pattern. It is caused by constantly mowing in the same direction and produces a ripple effect in the soil surface. This problem has increased with the appearance of the heavy motor mower. Only a real risk if the lawn is mown with a triple mower.

Remedy

- Change direction of cut each time you mow
- If already present, lightly top-dress and work in manually until a level is produced.

Ribbing

Grass being mown is too long, wet or machine is badly adjusted. Ribbing is a series of narrow bands of longer grass running across and along the mown strip. Possibly caused by a cylinder mower with the blades running (revolving) too slow or the number of blades on the cylinder being insufficient (minimum number cuts per metre) for the height of cut desired.

Remedy

- Grass maybe too long – cut more frequently
- Mowing height maybe too low – raise the cutting blades
- Wet grass – remove moisture first with brush or allow to dry
- Insufficient number of blades – change machine used

Skinning and scalping

Cutting height is set too low for the contours of the land and all of the green leaf tissue is removed from the sward. In this instance a cylinder mower is just as likely to cause scalping as a rotary. Excessively wet or high levels of thatch in a turf can cause skinning or scalping. The weight of the mowing implement will sink into this effectively lowering the cutting height, therefore scalping the turf.

Remedy

- Raise the height of cut and improve surface levels through top-dressing
- Never press downward or put excess weight on the mowers handles
- Remove excess thatch

Hover scalping

Brown tipping

A browning to the cut tips of the grass plant after mowing

Caused by:

a) Dull blades – the grass is bruised and ripped instead of being cut

b) Damaged blades/damaged bottom blade – Check machine condition. (cylinder mowers also)

c) Cutting when wet – Chewing and uneven cutting

d) Loss of air cushion on hover mower (effectively the grass is scalped)

Safety while mowing

- Wear protective clothing, steel toecap boots, gloves, etc.
- Walk the area to be mown before hand
- Ensure you are familiar with all the controls and the machines starting procedure

- Complete a safety check of the mower before starting
- Check, fuel, water, blade condition (take spark plug off or remove power source while doing so) and ensure all guards are in place.
- Do not refuel on grass surfaces
- Start the mower on an even surface
- Watch your footing on steep slopes and wet grass
- When finished remove the spark plug before storage (if present)
- Store mower and fuel in the correct manner

Mower maintenance

As with any machine, proper maintenance is a must. A correctly maintained mower will last longer and cut the grass with a greater efficiency. At the end of each mowing session clean and check the mower. Remove all excess grass and dirt from the mower housing and operating parts (ensure the mower if has the spark plug lead disconnected if petrol driven and if electrically powered remove the plug from the socket). Regularly clean the air filter (if present); check all fasteners and parts as recommended by the manufacturer's handbook. If refuelling is needed avoid spilling any fuel on the mower or turf and also keep a check on the oil level. Make sure any excess oil is removed from the engine and housing by wiping with a cloth.

Nutrition (fertilisation)

Understanding fertilisation

The grass plant (as all plants) has the ability to obtain energy for growing from some very basic materials: Nutrients from the soil in the form of 'ions', oxygen, water, carbon dioxide and light. Now that science has ascertained a greater understanding of the individual role each nutrient plays within the growing process we tend to see fertilisers as the solution to all the numerous plant growth problems. Yet these fertilisers do not provide the energy the plant needs for growth but simply act as some of the many raw materials that together with sunlight, water, oxygen and carbon dioxide allow the plant to produce organic compounds such as leaves and roots.

The grass plant obtains the vast quantity of its nutrients from the soil solution (nutrients mixed within the soil water), organic material such as peat, from the fertiliser we apply and to a lesser extent from the atmosphere itself. When we carry out operations such as mowing (a defoliation process), we create and cause stress to the plant through wear and tear, or the plant has some type of disease the root system looks to collect nutrients as raw material from the soil in order to supply and fuel its own self recovery process we know as growth.

When deciding upon the type, extent and timing of nutrient applications we apply to the turf in order to encourage growth, factors such as the amounts and type of existing nutrients available and the interactions of these nutrients with one and other should be considered. As, just as importantly, should the soil type, watering patterns and soil temperature (as a rule of thumb the soil should be at a temperature of around 6^{o} C for most nutrients to be made available).

How nutrients are lost from soils

Nutrients can be lost from the soil or plant through some or all of the following:

- The collection then removal of clippings while mowing
- There may be an imbalance of nutrients that result in one becoming unavailable
- Uptake of nutrients by the plant may be reduced by wear on the surface. Could be through compaction or damage to the plant itself
- Some nutrients such as nitrogen are easily washed through (leached) the soil.

When to apply nutrients

Let's get something straight from the start! It is not necessary for us to supply nutrients to the plant in form of fertilisers in order to encourage growth. Grasses survive and thrive in many inhospitable areas, just go and look at the pavement outside your house. Look at sand dunes that have extremely sandy, dry soils or salt marshes on the sea front covered from land to sea with different species of grasses. Grasses are adaptable and to a large extent self-sufficient they do not necessarily need to be fertilised!

It may however be necessary to supply nutrients to plants in the form of fertilisers if we desire, encounter or are faced with one or some of the following scenarios.

- We require a fine, dense, uniform visually pleasing turf grass surface cut at minimal mowing height
- We remove clippings when mowing
- Intense wear and tear is likely or encountered
- The desire to grow certain grass species such as bents (*Agrostis sp*.) on very free draining soils such as sands
- We require a certain 'greenness' from the turf
- To encourage a quick 'surge' of growth to allow rapid recovery from damage
- To encourage rapid establishment of seed
- We want to encourage or discourage certain plant species

What fertilisers do?

The following table briefly gives the role of each major nutrient within the grass plant. Using this information we can begin to understand the effects that these may have on the plant after application.

Nutrient	Effect	Typical sources of nutrient	Percentage nutrient
Nitrogen (N)	Improves leaf growth, colour, aids recovery from wear, improves sward density, can increase disease proneness due to thinning of cell walls	Ammonium sulphate Ammonium nitrate Potassium nitrate Isobutylidene (IBDU) Urea formaldehyde (UF) Hoof & horn Dried blood	21% 35% 13% 32% 40% 13% 10-14%
Phosphorus (P)	Aids establishment, seed-head production and reproduction, involved in the maturation process of the plant	Superphosphate Triplesuperphosphate Ammonium phosphate Bone meal	19% 47% 50% 22%
Potassium (K)	Aids rooting, increases drought hardiness, improves disease resistance, aids the retention of water	Potassium sulphate Potassium sulphate	50% K 42% K
Calcium (Ca)	Important for the cell walls, needed for cell production and growth, can neutralise	Rarely becomes unavailable due to the high	

	potentially toxic substances within the plant cells	quantities available	
Magnesium (Mg)	Important for colour, needed for the movement of phosphorus within the plant, involved with many enzymes within the plant	Magnesium sulphate Kieserite Dolomitic limestone	10% 16% 11%
Sulphur (S)	Primarily involved in production of amino acids needed to produce protein	Only in extreme cases would this need to be applied as a single nutrient	
Iron (Fe)	Needed for colour, helps make nitrogen available. Too much in the soil will reduce levels of available phosphorus	Ferrous sulphate Ferrous oxalate Chelated iron	20% 30%

One way of determining if fertilisers need to be applied is to closely inspect the plant looking for what are known as deficiency symptoms. If spotted (should be a rare occurrence) these symptoms can give a clear picture as to what type of fertiliser should be added.

Nutrient	Deficiency symptom
Nitrogen	Yellowing of older leaves on plant. Closely followed by yellowing of entire plant and slow growth.
Phosphorus	Older leaves turn dark green followed closely by a purple discolouration of the leaf edges
Potassium	Leaf tips tend to turn brown and dry up while leaf edges look burnt and brown. You may find excessive amounts of new growth appearing from the plant
Calcium	Very rare, but if present the youngest leaves turn a red-brown colour at their edges. This colour likely to turn light red as the deficiency persists
Magnesium	Older leaves exhibit a cherry-red discolouration. Necrosis of the leaves appears as the deficiency persists
Sulphur	Very rare, but if present leaves initially turn a pale yellow while the leaf tip and edges turn brown and appear burnt.
Iron	Interveinal yellowing of the leaf appears. Growth of the plant can be slowed significantly

Interveinal = between the leaf veins running up the leaf

Chlorosis = Yellowing of the leaf (can be partial)

Necrosis = Browning and death to some parts or all of the leaf

Many fertilisers are available on the open market and come in many different forms the following tables introduce the most popular.

Form of fertiliser	Comment
Organic fertiliser	Would have been originally living, since processed to make fertiliser
Inorganic fertiliser	Made of synthetic material(s)
Elemental or element	One chemical an example being a fertiliser containing only a source of nitrogen
Compound	A mixture of more than one element
Quick release	Nutrient released over a short period of time
Slow release	Nutrient released over a long period of time
Controlled release	Nutrient released in a controlled manner generally over a

	long period of time. Control can be through temperature or level of wetness
Granular	Elements compressed into granules for ease of distribution over large areas
Mini granular	Elements compressed into small granules for ease of distribution and to reduce amount picked up through mowing
Powder	Element(s) applied as a powder. Not an accurate method and usually quick release
Liquid	Element(s) dissolved in water. Easy application and usually a quick response seen

Quick release versus slow release

Characteristics	Quick release	Slow release
Plant growth response	Rapid plant response, flushes of growth sometimes occur	Initially a slow response but a uniform growth will occur over a long period of time
Length of time before plant response	Short (days or weeks)	Long (weeks to months)
Application	Most forms	Dry forms
Potential to burn plant	Potentially high risk	Low risk
Cost	Relatively inexpensive	Expensive
Example	Ammonium nitrate, urea, ammonium sulphate	IBDU, Urea Formaldehyde

Applying fertiliser

Fertilisers can be applied in a number of different ways to any lawn. The choice of application method will to a large extent dictate how the overall surface responds to this. The most important factor will be to ensure an even application over the entire target surface. If this is applied all plants will respond equally ensuring even growth and colour.

The bulk of fertilisers applied to soil or turf are done so using a fertiliser spreader (distributor). Distributors must be capable of applying a wide range of fertiliser forms from powder to granular and there should be some way of adjusting the application rate. All parts of the distributor should ideally be made of materials resistant to rust and should be capable of being adapted to allow spreading of grass seed and top-dressing as and when necessary.

Liquid fertilisers can be applied to the lawn through using a pedestrian knapsack or bottle pressure sprayer, tractor mounted or trailed sprayer, quick coupler that attaches to a hose pipe or simply spreading it by hand or out of a box although this method will require some level of skill for even application.

How should fertiliser be applied?

1. Always read the label and wear personal protective equipment
2. Do not apply in strong winds
3. Ensure machine is calibrated correctly
4. Sweep up any spills and water heavily if on turf surface

5. Avoid fertilising surrounding plants and areas (ponds)
6. Fill distributor away from turf surface
7. Apply evenly using markers if possible (dew!!)
8. Always wash equipment to prevent corrosion
9. Wash hands and other areas that come into contact with product
10. Store un-used fertiliser safely and correctly
11. Keep records of what has been applied and in what amounts

Calibration of distributors and application

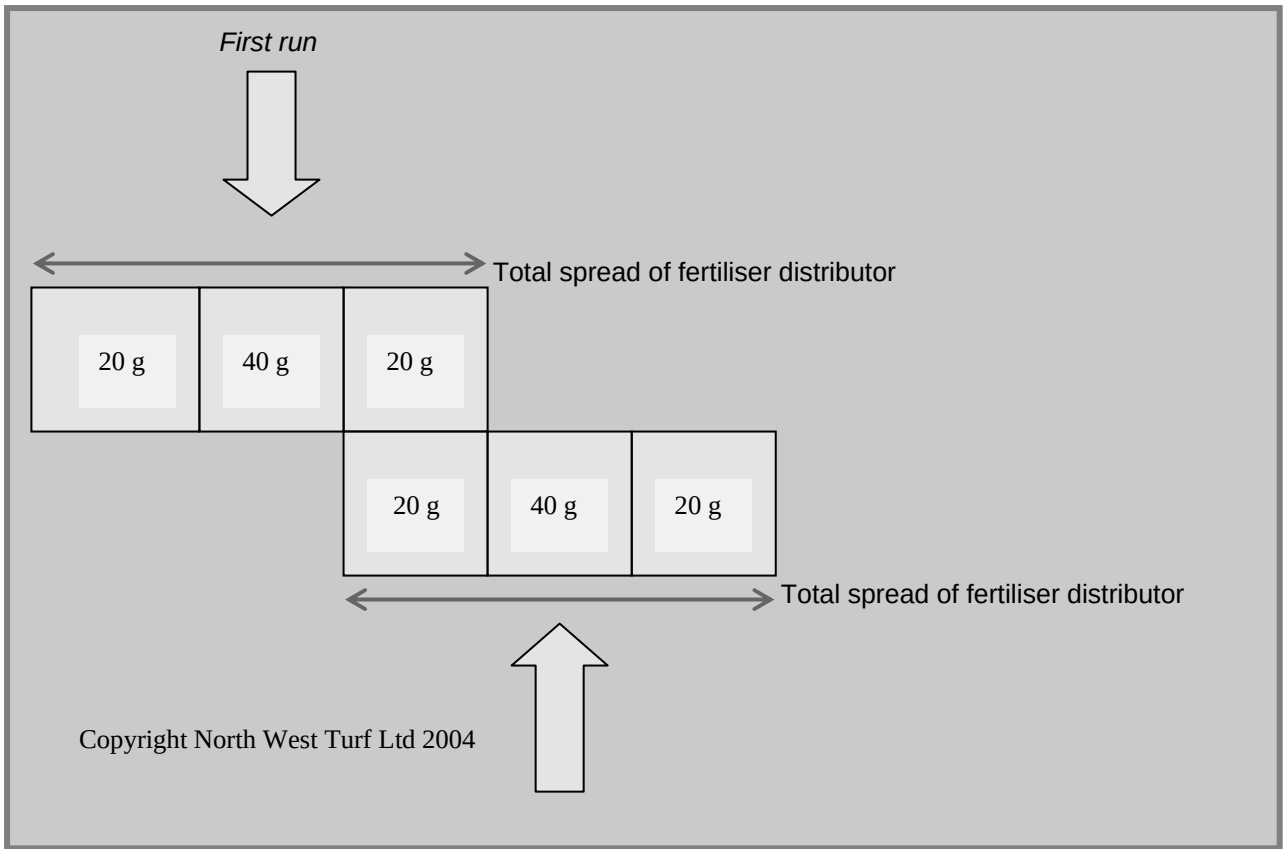
Failure to apply fertiliser to recommendations can lead to the following:

1. Burning of the sward
2. Inconsistent colour
3. Inconsistent growth rates
4. Increased cost as more is applied

Calibration of spinning disc distributors

1. Find application rate. i.e 40g m^2
2. Lay out three one metre sheets of cloth on a level surface
3. Set distributor to half mark and run over sheets at normal pace
4. Weigh material found on centre mat and continue until that found on the mat equals 20g m^2. Ensure you clean mats each time!
5. Weigh material found in outer mats. Ideally this will be half the centre mat's rate (20g m^2)

Application



Second run

Irrigation

As the turf grass plant physically consists of about 85% water and 15% dry matter we can assume irrigation or application of water will be fundamental to survival and growth. Soil acts as the reservoir supplying the major proportion of this water to the plant.

Why irrigate?

If we are to maintain adequate leaf growth it is advisable to artificially supply water to the soil in order to maintain growth, colour and appearance in some form. During the dry months of the year soils of all types have a tendency to dry-out. Water is lost to the atmosphere from both the plant (transpiration) and the soil (evaporation) leaving the reserves left for root up take and plant growth slowly diminishing as the plant utilises all the available water deeper in the soil. Without this supply of water the turf grass plant will enter into a period of dormancy leaving the area looking brown and dishevelled. The plant will not die (rare in the UK) but the aesthetic value of the sward will deteriorate. This state of dormancy (a survival mechanism) will be quick to appear on those turf grass areas mown at a low height of cut due to the shallower root system. (See mowing, pages 12 - 16 for further information)

In order to maintain adequate top growth and colour we must ensure there is a sufficient supply of water in the soil. A deficiency in this supply may lead to stress for the plant and eventual wilting.

What are the benefits?

There are many reasons to irrigate soils and also many reasons why we should not irrigate soil. As with all things, excess water can and will lead to as many troubles as insufficient. We should contemplate applying water to the soil for the following reasons:

- To keep the grass alive
- To maintain turf colour, appearance and strength (turgidity)
- To aid the germination process
- To prevent turf disorders such as dry areas or dry patch developing
- To water in fertiliser

When to irrigate?

Water will be required when a distinct lack of growth and discolouration is noticeable or drought conditions prevail. Some grasses are known to be more drought tolerant than others (see grass characteristic table page 9) if irrigation is applied to turf incorrectly (too frequently) it is possible to see the decline of such grasses and the entry and growth of undesirable species such as Annual Meadow grass (*Poa annua*).

In the ideal world the timing of irrigation would be governed by turf grass wilt, just as the plant is about to wilt we would irrigate. Wilting occurs when the roots can no longer supply the growing plant water for growth and cooling. Essentially so much water is lost through transpiration into the atmosphere that the cells (once strong and full of water, think of a balloon filled with water) can no longer support the weight of the plant and it falls to the ground. This failure in stature will normally be accompanied with a loss in greenness. Of course irrigating to wilt will be a tricky process to judge correctly, especially to the untrained eye. Consideration to the water holding capabilities should also to be given to the soil the grass is growing upon. For instance, sandy soils hold less water than heavier clay or silt types.

Whilst grass roots require relatively high amounts of water a slight deficiency is not always a bad thing. Some degree of stress on the plant will be of benefit to the root system. If the soil is allowed to periodically dry out, entry of oxygen into the soil can be permitted, the deficiency simply encouraging deeper root growth leading to a more drought resistant plant. We can summarise by stating:

(a) **Little and often** applications can result in uneven wetting of the soil and lead to shallow plant rooting. Irrigation applications of this frequency can lead (during the drier months) to the condition where any water applied will simply be lost to the atmosphere the very next day through evapotranspiration (water lost through leaf and soil), and dry uninviting (for the roots) under-lying soil.

(b) Infrequent, heavy applications at intervals with a number of days between (say 10 days) supplemented by lighter applications during every second or third day. This encourages air into the soil profile and a deep extensive root system. While providing a supply of water deep in the soil lessening the risk of loss through evaporation.

The results

Correct irrigation practices will ensure a deep-rooted drought resistant plant that eventually requires less frequent application of water. Saving you time and money. Correct irrigation ensures good recovery from wear, good colour, even growth and development. It will even allow the plant make better and more efficient use of fertiliser applications whilst discouraging

thatch build up (see page 75). Correct timing and frequencies of irrigation also determine to a large extent the survival of more desirable grass species such as fescues (see grass characteristic table page 9)

Wetting agents

Wetting agents are products that we can apply to heavily drought stricken turf that proves difficult to re-wet even after rainfall and always look drought stricken. Wetting agents lower the surface tension of water, improving the rate at which it can penetrate into and through the surface. Some 'ionic' types even allow dry soils to better hold water within them. Wetting agents should only be used to allow soil re-wetting, and should not be used as a long-term fix.

Aeration

Lawns may deteriorate over time due to soil compaction and/or the consequences of excess thatch. Aeration is the term used to describe the mechanical methods we use to combat the effects of excessive thatch (see pages 75 – 76) and/or soil compaction. Soil compaction in its simplest form can be described as a soil squashed together leaving minute pores or spaces between the particles the end results being little room for root growth and reduced levels of oxygen held in the soil so vital for root growth. Carried out when necessary, aeration will aid the growth of a dense, healthy turf resistant to diseases, water logging, weeds and pests.

In most home lawns (especially on new builds) the natural state of the soil would have at some time been disturbed or compacted during the building process. The natural topsoil is most likely to have been, disturbed, removed and possibly replaced with sub-soil or a mix of the two leaving the soil in a poor, compacted state. This situation is worsened where clay or heavy soils are natural to the site. Grass sown or turf laid on this type of soil will eventually require aeration to improve the depth, extent and vigour of the rooting system and to improve the effectiveness of fertiliser and water use.

Compaction of soil and turf grass areas can occur through the simplest processes such as raindrops falling onto a bare soil, animal movement or by walking, playing upon or even mowing the grass. Compaction will eventually lead to stress for the turf grass plant and can reduce its growing vigour. Most compaction occurring in the soil is likely to develop in the top one or two inches.

Why aerate?

Aeration is the term used to describe the natural occurring process of gas exchange with the soil and atmosphere. Practically, aeration is the process of slitting, spiking or removing cores (known as plugs) from the soil to improve gas and water exchange. Most turf grass areas subjected to wear from traffic and/or high thatch levels (greater than ¾" in thickness) will require some form of aeration (for a definition of thatch see page 75). The more heavily compacted or thatched the grassed area the more frequent the procedure should become.

The benefits of aeration

Aeration will aid the turf grass sward's health and vigour and eventually may reduce its maintenance requirements. Soil cultivation through aeration benefits the turf grass through:

- Reducing the amount of 'surface run-off' (water loss across the surface) as it is intercepted by the holes or slits.
- Increasing the level and amount of water that infiltrates into the soil below (root zone)
- Can help increase the rooting depth of the plant, aiding drought resistance.
- Disrupts and destroys any undesirable compacted layers in the soil.
- Increases the rate at which thatch will be broken down.
- Severs (cuts) any stolons and rhizomes encouraging new leaf growth and a dense sward.
- Aids the ingress of any fertiliser applied to the grass surface.
- Some practices will relieve compaction in the soil.
- Creating favourable soil conditions.

Aeration may not be necessary if the soil is not in a compacted state (most very light sandy soils resist compaction) or if the thatch layer is less than ¾" in thickness. Although any aeration will always give some benefit to a turf grass sward. Ideally any aeration procedure would cause minimal disturbance to the surface and allow rapid recovery back to the condition prior to the operation.

How to aerate

- Coring – Aids compaction relief, aeration, water movement and allows soil modification procedures such as top-dressing (see page 32) to work effectively.
- Spiking – Aids aeration, compaction relief (if surface heave caused, pulling backward on the handle of a rake is one example) and water movement.
- Slitting – Aids aeration and water movement.

All these actions will improve the exchange of gasses and water with the soil and atmosphere creating ideal conditions for grass plant growth and development.

When to aerate

Aeration is best carried out when the soil is moist enough to allow penetration of the tine but dry enough to prevent smearing. Surface smearing is caused when an implement such as a solid metal tine penetrates into a heavy soil (such as a clay or silt loam) when the soil is in a wet or plastic state. The action of downward then upward penetration (outer metal surface of the tine) smears the soil. This smearing or sealing of the soil (when dried) can prevent any water or gas movement within and also in some cases cause further compaction.
Annual or frequent aeration generally will benefit most lawns. Turf grown on heavy soils such as clay's or silts may need more frequent aeration work as will heavily thatched areas. Spring and autumn have traditionally been popular times to carry out this operation when the soil is in a moist (not wet) condition and the grass is active allowing speedy recovery. It is suggested that during the summer months when the soils oxygen demand is high that lawns with excessive thatch levels are further aerated to encourage its breakdown.

The timing and frequency of aeration will depend upon:

(a) The type of traffic the soil is subject to. Generally the heavy the traffic levels (foot, or machine) the more frequent aeration will be needed.
(b) The level of soil moisture in the soil. The more moisture the greater the likelihood of soil smearing, in this case the operation should be avoided until the soil becomes drier. (See 'When to aerate' page 25)
(c) Soil texture and structure. The heavier the texture (the more clayey/silty/loamy) the greater the frequency of cultivation through aeration. The lighter the texture (sandy soils) the lesser the requirement of aeration work.
(d) The type of turf grass species and depth of thatch layer. Tufted grasses may reduce the amounts of thatch produced and therefore require less frequent attention.

The results

If the turf area is aerated through slitting the immediate effects will be hardly noticeable from the surface apart from the slice marks on the surface. If spiking or hollow coring has been carried out the surface will effectively be covered with hundreds or thousands of holes. If hollow cored initially after the operation the surface will be littered with plugs of soil. With light and sandy soils the plugs can be left on the surface until completely dry and simply dragged or brushed back into the surface (effectively top-dressing). If the soil is heavy (clayey or silty) then it is advisable to remove them from the surface. On heavy soils sand can be applied to the newly aerated surface and brushed into the surface and core holes to help improve the

soils texture. After around 10 to 14 days the core or slits holes will begin to fill with white roots (if left open). This is a sure sign that the turf is responding to the new levels of oxygen in the soil. The roots found in the holes tend to be relatively useless as they are not in contact with the soil. However, the plant should have also responded in the soil immediately around the core hole, here the roots would have contact with soil and begin to utilise the greater amounts of water and nutrients now available.

You will see an immediate difference with how the soil reacts with water. Any soil aeration procedure opens passages (be they slits or core holes) increasing the rate at which water drains from the surface leaving it in a dryer state. The deeper root system encouraged by the greater levels of oxygen available deeper in the soil should increase the turf's drought resistance. Fertiliser applications may become more available deeper in the soil again encouraging a deeper root system and the thatch layer should begin to diminish.

Do not expect an instant response from soils and the grasses growing upon them if they are in a heavily compacted condition or the thatch layer is extremely deep. Aeration will improve matters but many benefits may only become apparent after a number of years of repeated treatments.

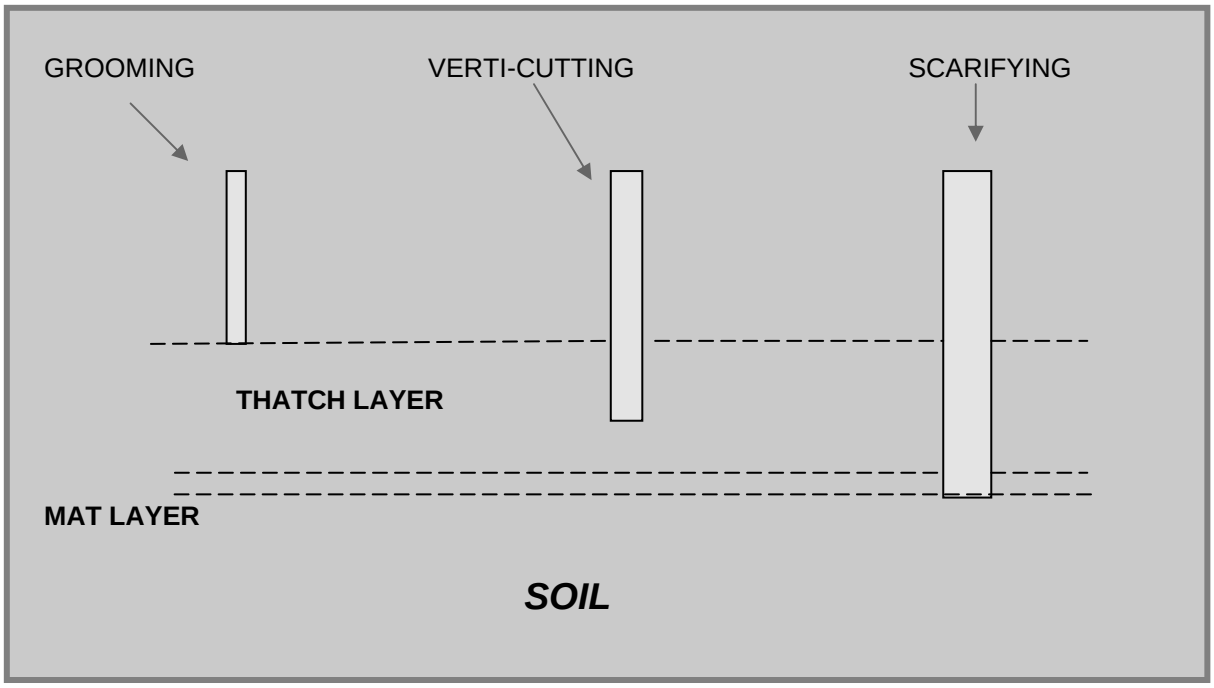
Picture shows turf recovering one week after hollow tining during the growing season

Scarification (Vertical mowing)

Scarification or 'vertical mowing' is a cultural operation mainly used to control and remove thatch (see page 75) although there are other benefits associated with it. It involves the use of vertical sets of thin, knife like tines connected vertically on a rotating horizontal shaft.

There are many different types and shapes of knives that we can mount onto the shaft. The type selected will depend upon the type of vertical mowing operation required.

How to vertical mow



Grooming

Cuts stolons (encourages new growth or tillering to occur), removes grain caused by mowing in the same direction, stands the grass upright before mowing is carried out.

Verti-cutting

Controls the thatch layer, allows water and oxygen into the thatch layer, allows nutrients into the thatch layer, allows gas build-up to escape and cuts stolons and rhizomes

Scarification

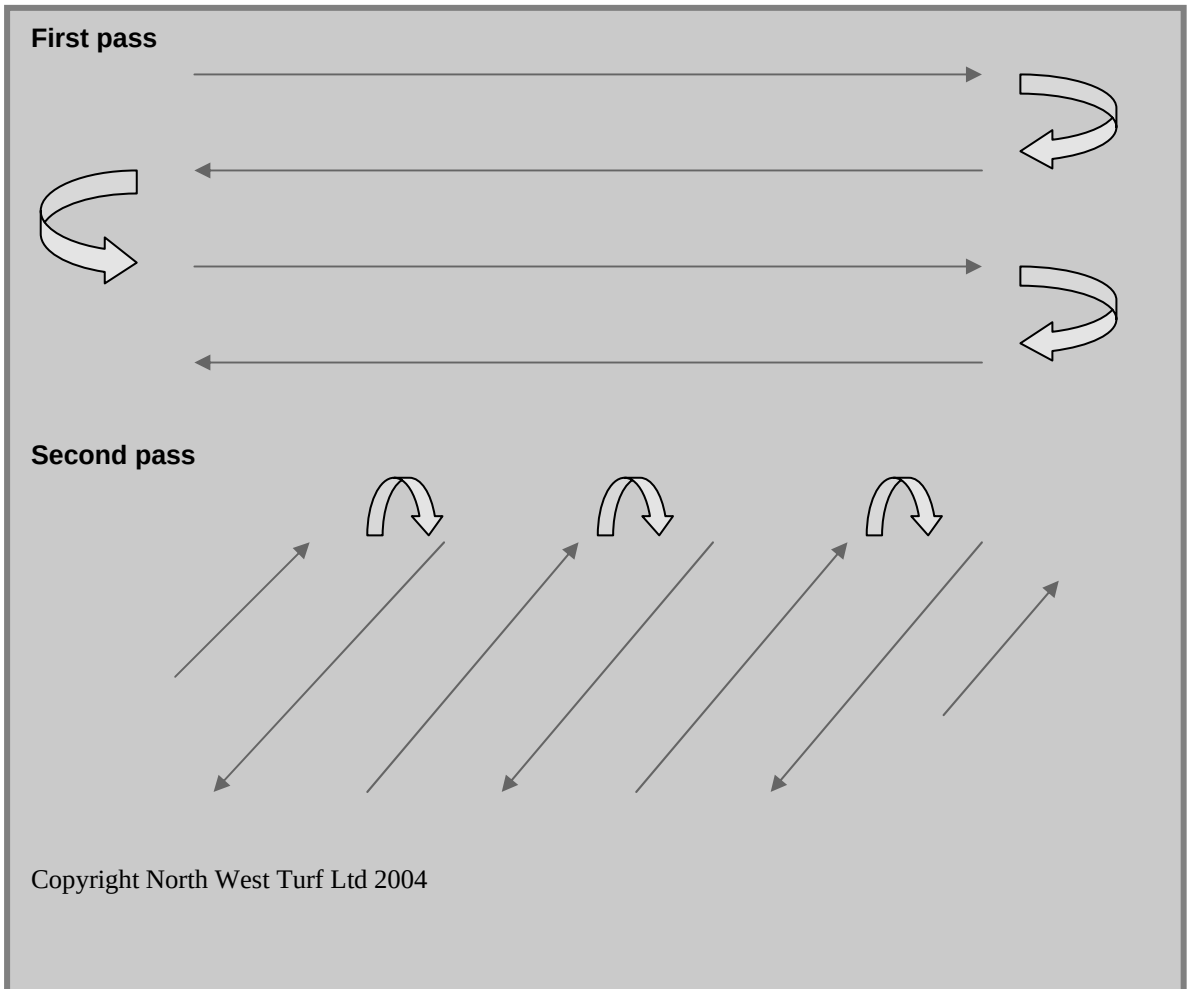
Physically removes thatch and mat layers from the sward and, all the benefits above. Scarification is usually carried out only when thatch is a distinct problem in the sward. It is a brutal and effective operation that must be carried out with care and thought as abuse can literally ruin a turf area.

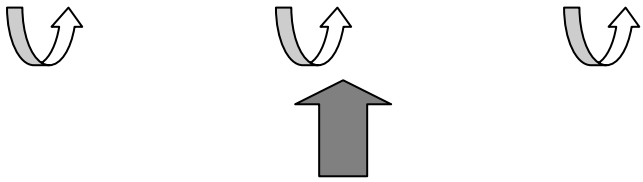
When to vertically mow

Vertical mowing in the form of 'grooming' can essentially be carried out as frequently as required due to its limited damage potential to the sward. Verti-cutting can be carried out up to four times yearly as long as the plant is growing actively enough to ensure recovery. Scarification and verti-cutting should be carried out in two different directions each time. The second pass with the vertical mower should be of 45^0 to the first. This encourages maximum amounts of thatch removal but also limits the damage caused by the slicing action of the machines blades.

Scarification is usually carried out at the end of the growing season (autumn) therefore allowing the grass plant time to recover. However, in cases of extreme thatch build up it can also be carried out during the spring (April)

It is generally best to carry out scarifying prior to any other maintenance operations bar fertilisation (helps the plant to recover) or moss control (Moss must be dead before any vertical mowing is carried out to prevent spread of spores).





Direction of wind

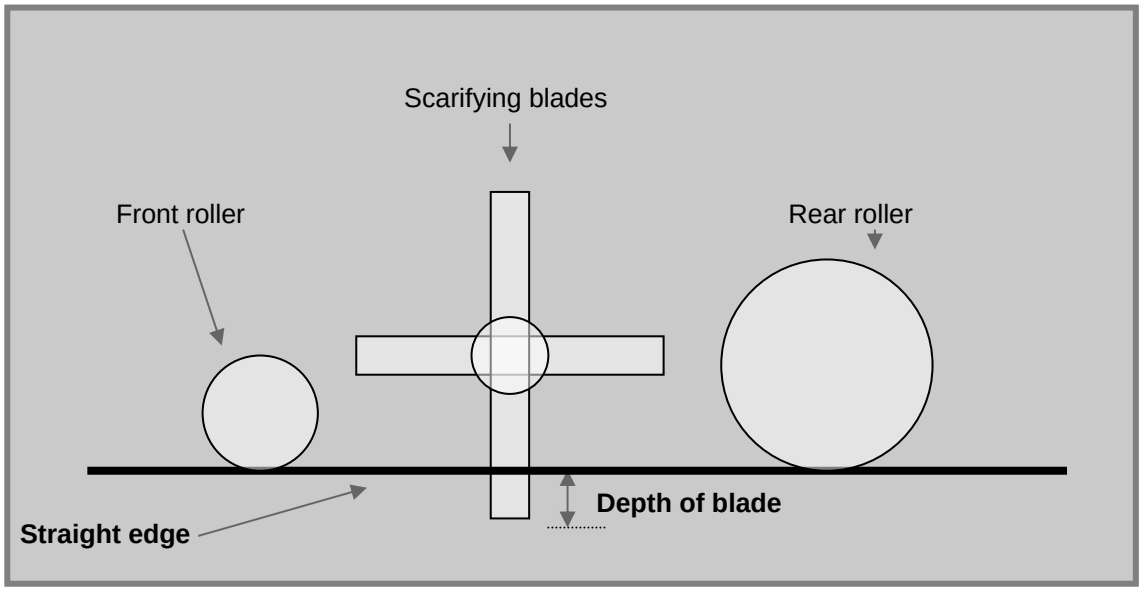
Depth of vertically mowing

The depth of vertical mowing will depend upon a number of factors:

- The ability of the machine to complete the task effectively.
- The thickness of the thatch layer. Generally, a thatch depth of over 1 ½ inches can begin to cause problems
- The growing conditions of the sward

Setting the depth

Once decided upon the reasons for carrying the operation out the depth of the vertical mower unit should be set. Find a suitable straight edge that is able to reach and rest on either the front and rear rollers or wheels. Measure the depth of your thatch layer (see pages 75 - 76) then adjust the tines or blades to depth required from the operation.



Note *– Always remove the spark plug or power source from or to the machine when attempting to adjust the depth of cut*

Removal of debris

Removing thatch from a turf surface will be a messy business and large amounts of debris may be produced. Frequent emptying of the collection box (if present) will minimise this debris but dramatically slow down the time taken in completing the procedure. Even with a

collection box sometimes a fair amount of debris will be left on the surface. This can be collected in a number of ways:

- Raking
- Mowing (with a grass box on)
- Use of a mechanical sweeper
- Brushing

The benefits

The main benefits associated with verti-cutting and scarification will be improved overall turf grass growth due to the increased levels of soil/air gas exchange, reduced 'sponginess' to the sward surface, improved drainage, less incidence of disease and a deeper more drought resistant root system.

Note – Always wear eye protection, steel toe capped boots and the correct personal protective equipment when scarifying. Never wear loose clothing of attempt to touch the rotating shaft while moving.

Picture shows lawn after scarification carried out in one direction. Debris has been removed

Top dressing

What is top dressing?

Top-dressing is the application of a soil or organic material to the surface of a lawn. It can be made up of a mixture of minerals such as sand, silt and clay, be an organic material such as peat or a mixture of all. Top dressing or soil modification involves the incorporation of texture and/or structural improving materials that can be applied monthly, annually or bi-annually commonly although not exclusively practiced on:

1. Soils having a high clay content
2. Soils subject to intense foot or mechanical traffic

Coarse textured materials, such as sand, can be incorporated to improve soil aeration, water movement into and through the soil and to reduce the soils compaction tendency. In contrast, finer textured materials such as loams' and organic matter are incorporated to enhance water and nutrient retention. Pure organic top dressings are best avoided as these can encourage thatch build up and tend to encourage a shallow rooting grass plant.

Why are top dressings used on turf?

Top dressings are used on turf for the following reasons:

- Improve the levels of smoothness
- Dilute thatch levels
- Reduce thatch levels
- Improve percolation & infiltration (drainage) rates of water
- Modify soil texture / structure
- Cover stony surface in new turf
- Fill in cracks on newly laid turf
- Increase water and nutrient retention
- To promote decomposition of organic matter (sandy type top-dressings)

Selection of materials

The selection of the correct type of top dressing material will differ for most people. The most important factor determining selection will be that of if the applied material will improve soil conditions rather than hinder it. For instance, there is no need to apply a heavy layer of peat to a clayey loam type soil as it will already posses the characteristics of high water and nutrient retention that an application of peat would bring. A clayey loam type of soil would be better suited to a sandy type top dressing material to improve the soils drainage rates and lessen its compaction tendencies. Sandy top dressing material also can be applied to dilute the thatch layer and/or (if applied lightly and regularly) prevent thatch build up in the first case. A peaty type top dressing may give better results if applied correctly, to a sandy soil (applied after extensive hollow tining) where it might help the soils water and nutrient retention qualities and benefit grass growth.

Always bear in mind what the anticipated likelihood is of improvement through top-dressing will be before attempting application.

When to apply top dressings

Historically the autumn period has been identified as the best time to apply top dressings to turf, although it may be applied at any time during the growing season. Especially if applied lightly. It is suggested that if any top dressing is to be applied to a lawn then some type of spiking or scarification is carried out firstly, as this will ensure the dressing can at least in part by-pass the thatch layer and key into the existing soil below.

How to apply top dressing

Top dressing can be applied to the lawn in a number of ways. Whatever method is chosen it is vital that the material applied is put down at a rate that will not leave the turf grass leaves totally smothered as this will kill the plants off, leave them pale yellow coloured and/or can encourage disease, obviously this defeats the purpose of the operation. Spreading the material should be carried out using anyone of the following methods:

(a) Place piles of top dressing around the grassed area and spread out with a lute, the back of a wooden rake or by using a strong brush.
(b) Thrown over the surface evenly using a shovel then dragged out with a mat or brushed in evenly.
(c) Use a top dressing spreader (drop or spinning disc) across the whole surface then lightly brushed or dragged in with a mat.

Note: *To prevent smothering and death of the grass underneath, it is vital that the top dressing material is worked into the grass surface. Any excess material should be removed or further worked into the soil surface and off the grass blades.*

Lawn renovation

Why renovate?

Renovation is needed to prepare the lawn for the season(s) ahead, promote recovery from any wear that has occurred, and prepare the turf for wear that is expected to take place and to generally improve the growing conditions for the grass plant.

Renovation can be in the form of complete renovation or part renovation depending upon what wear and tear has been encountered. It is suggested that the whole area is renovated if any seeding is to be carried out to prevent any patchiness occurring.

Repair work on turf usually needs to be carried out due to some or all of the following:

1 Erosion
2 Desire lines – public, players, children, animals
3 Constant heavy wear
4 Disease
5 Damage by machinery or traffic
6 Installing of drainage or irrigation
7 Vandals
8 Undesirable soils and root zones – waterlogged/droughted/shallow

9 Incorrect maintenance/cultural practices
10 Overdosing of fertiliser or other chemicals such as weed-killer
11 Planting/infestation of undesirable grass species

Note: *If the grass is in poor condition due to shade then no amount of renovation will repair the damage. The cause of the shade should be addressed and if possible improved. The sowing of grass species tolerant to shade is advised. (See grass characteristic table on page 9)*

Renovation & repair operations

Usually carried out when the lawn is so poor that it cannot be improved by routine fertilisation, irrigation and cultural practices, but it is sufficient to be saved.

Steps to take:
1. Eradication of undesirable species (spray)
2. Remove all debris from turf area including twigs, sticks, stones and leaves
3. Thatch removal (see page 75)
4. Cultivation by coring, spiking or slitting (see page 24 – 26)
5. Apply fertiliser (see page 17 - 21)
6. Seeding/top dressing (see pages 39 and 32)
7. Irrigation (see page 22)
8. Edging (Using hand shears or 'half moon' edging iron)
9. Weed Control (see page 60)

Timing

Best time late summer or spring, but can work just as effectively throughout the summer months if irrigation is applied.

Inserting turf

Carried out when isolated areas of a turf grass stand are no longer viable and replacement is necessary:

Steps to take:
1. Source and purchase turf of satisfactory quality
2. Mark out area of damage
3. Cut out and remove damaged turf
4. Renovate soil through cultivation such as forking
5. Rake soil, heel in, rake soil again until fine crumb structure is achieved
6. Fertilise (not always necessary)

7. Insert new turf and blend with existing grass stand
8. Top-dress the area (top-dressing should contain seed)
9. Irrigate frequently
10. Monitor

Timing

Again, best times are spring and autumn, but if irrigation is available then anytime of the year is suitable.

Repairing edges

Carried out when the edge of a lawned area deteriorates and grass cover is lost or is damaged, usually due to desiccation, erosion or trampling. Steps taken in repair are dependent on the particular situation at hand.
Options include

1. Cut away affected area backward to establish sward again
2. Removal of affected turf and replacement with new.

Key steps to successful renovation

- Identify problem and cause of turf loss
- Decide on renovation procedures to use
- Decide on the need for nutrition
- Source replacement turf or seed (correct identification)
- Organise equipment needed
- Understand watering requirements
- Organise protection methods (such as a temporary wire/string fence)
- Monitor site or area (have your methods worked?)

Chapter 4 - Lawn establishment

Careful preparation of any site is required when a lawn is to be laid by turf or by seed. Although final seedbed preparation for sowing grass with seed is more critical than when laying with turf. A fine crumb type soil structure must be achieved on the surface as without this the seed themselves will struggle to grow after germination and the final matured turf levels can be uneven. Lawns can be made at anytime of the year but the two favoured seasons for sowing grass seed are spring and autumn. This timing is suggested as the soil is relatively warm and contains adequate amounts of moisture that ensure quick germination and establishment. If irrigation is applied then even summer planting can be desirable as the germination and establishment of the sward will be quick and effective.

Turf can be laid at almost anytime of the year, even during colder periods the turf will develop a root system even when the leaf is dormant. As with sowing seed summer planting of turf can be carried out so long as irrigation is applied.

Soil preparation should be completed as long as possible in advance of the sowing or turfing date. Ideally at least a month should be left between preparing the soil and planting the turf to allow for any final settling of the soil once the initial 'heeling in' has been carried out. Two days before the seed is sown or turf is laid the final preparations to the soil should be made. In the case of seeding a fine soil crumb should be sort by raking.

Establishing a turf from turf

Advantages of turf

a) gives an immediate sward cover
b) can lay turf at almost any time of year
c) less preparation needed
d) many types available

Disadvantages of turf

a) Cost – much more expensive than seed
b) Can contain weeds and undesirable grasses
c) Can be diseased
d) Imports different soil type to bed. Causes root break, can effect infiltration rates

Features to look for in selecting turf

a) Soil type grown on– sand/silt/clay content/does it match your own?
b) Grass species present
c) Sward density – thin, weak sward/ thick, healthy sward
d) Presence of weeds, pests and diseases

Types of turf

1. Meadow Turf
   - Grazed agricultural grassland
   - Usually coarse agricultural species
   - Cheap
   - Low quality
2. Sea washed turf
   - Fine grass species (fescue/bent)
   - Usually high percent of silt in soil
   - Considered high quality
   - Medium – High cost
3. Commercially produced turf
   a) Mature turf
   - Specified quality
   - Specified species
   - Treated for weeds, pests and diseases
   - Medium cost
   b) Custom grown turf
   - Species specified by client
   - Soil may be sterilised or specified by client
   - Treated for weed, P & D
   - High cost
   c) Seedling turf
   - Grown on a artificial medium
   - Grown to clients specifications
   - Usually has to be ordered
   - Not as tough as mature turf
   - Treated for weeds, P & D
   - High cost

Turf lifting and laying

Turf lifting can be carried out by hand, using pedestrian driven turf lifting machinery or through using tractor-mounted machinery. The latter is usually only used by professional turf growers.

Stacking and storing the turf

Stacking and storage of turf should be carried out if it is not to be used immediately. This can be done by stacking turf to turf, soil to soil or by rolling cut strips. Never over stack or those on the bottom will be damaged. If the turf is not to be layed within 48 hours, lie out (green side up) and water regularly.

Turf Laying

1) Site preparation
    - Install drainage (if necessary) and obtain levels
    - Spray off weeds with herbicide (ensure this is carried out *at least* two weeks prior to laying turf)

2) Apply a base dressing of fertiliser that contains nitrogen, phosphorus and potassium.

3) Work in fertiliser and obtain a level surface with fine soil crumbs

4) Lay turf alternate bond style (Brickwork fashion), butt all turf edges together.

- Use a plank to walk on newly laid turf, never your feet only
- Ensure at least half a turf is inserted to any edge and ensue that edges are butted together

5) After laying turf top-dress with a sand/soil mix to fill gaps in turf

6) Give the area a light roll to firm sward (a pedestrian cylinder mower with the blades raised would suffice)

7) Water the sward if no rain is forecast within 48 hrs

Establishing a turf from seed

Advantages
Cheaper than turf (approx. 1/10th)
Desired species can be chosen
Does not import weeds and disease

Disadvantages
Can take up to 6 months to establish
Subject to 'wash out' during heavy rain
Birds can eat the seed

Sowing Rate

Determined by:

Species sown	-	Bents (large number of seeds) 10 – 15 k gram (lower rate) Ryegrass (small number of seeds) 500 gram (higher rate)
Quality of site	-	Preparation (seed beds = high preparation and accurate rates) Final use (The higher quality of site required, the more accurate the seeding rate will need to be to ensure the final quality desired is achieved)
Field Factor	-	Loss in the field can be as high as 20% through loss to wind, rain or birds. Should be considered if a high quality site is required)

Some suggested sowing rates

Ryegrass (*Lolium perenne)* mixtures	-	50 – 70g m^2
Fescue/bent mixtures (*Festuca/Agrostis sp*.)	-	35g m^2
Bents only (*Agrostis sp*.)	-	10 – 15g m^2

Note

Sowing rates are an approximation and should be adjusted by circumstance. Guidance can be gained from the manufacturers or suppliers recommendations.

Site Preparation

1. Clear site of weeds
   - Glyphosate / systemic (use during the growing season)
   - Paraquat / contact (use during colder more dormant times of the year)
2. Prepare seed bed
   - Cultivate
   - Level
   - Consolidate
   - Pick stones
   - Obtain fine soil crumb on the surface
3. Apply a base dressing of fertiliser that contains phosphorus and potassium
4. Sowing times
   - Best late summer, early autumn
   - Less competition from weeds
   - High soil temperature
   - Moist conditions
   - Seedlings less likely to be killed from summer drought conditions
   - Can use ‘stale seed bed’ technique (Leave the soil exposed for one growing season. This allows all the dormant weed seeds to germinate which can then be sprayed off

with herbicide at the end of the growing cycle. This technique is time consuming but can eliminate future infestations of weeds in the newly developing turf)

5. Sow seeds as evenly as possible
   - Small areas; divide into smaller units and hand sow in two directions to ensure an even spread
   - Large areas, decide on the sowing rate then spread via 'spinning disc or drop spreader'.
6. On small areas lightly rake over the site by hand to ensure good soil contact with seeds. Be sure not to bury the seeds too deep.
   - If the surface is large and the seed has been applied via a machine it is advisable to harrow lightly or rake over the surface.
7. Deter birds

Post Germination practices

1. Roll to consolidate the surface after germination and prior to the initial cut. This will push any small stones into the surface and induce tillering of the plants. Can be done with a cylinder mower with the height of cut disengaged or raised. Large stones will need to be hand picked firstly.

2. First cut – Give the first cut once the sward is at a height of 25 mm (fine grasses), 50 mm (coarser grasses). Use a rotary mower and remove debris

3. After establishment – ensure removal of all broad-leaved weeds by hand. It will be possible to spray using a selective herbicide.

4. Commence a top-dressing programme to bring levels into line with the end use of the established area.

5. Feed the sward in spring with a fertiliser high in Nitrogen and Potassium but low in Phosphorus.

Areas for consideration when establishing lawns

From seed	From turf
1. Thorough cultivation of seed bed	1. Care with surface levels
2. Application of fertiliser	2. Application of fertiliser
3. Clean site	3. Care in selection of turf
4. Care in selection (Use of lawn)	4. Care in selection (Use and source)
5. Purchase of seed (viability, purity, germination)	5. Grasses present in purchased turf
6. Care in sowing (Timing)	6. Uniformity of sods
7. Avoidance of burying seeds with cultivations	7. Method of laying
8. After care (Light rolling, mowing and feeding)	8. After care (Light rolling, watering)
Advantages	**Advantages**
Low cost	Instant lawn
Clean results	Quick establishment
Ease of subsequent management	
Selection of required species	
Quality of results	
Disadvantages	**Disadvantages**
Slow establishment	Higher cost
Time required with seedbed preparation	Difficulty in obtaining high quality turf
	Usually high clover content
	Presence of perennial weeds
	Deterioration when stacked

Chapter 5 - Influences detrimental to turf growth

Moss

Mosses are beautiful plants in their own right, unfortunately though when present in turf they tend to look unsightly and make mowing difficult. Moss attracts water and can become hazardous underfoot. Mosses also tend to out-compete the desirable grass species during cooler seasons. There are some 600 species of moss in the United Kingdom and around 30 that are commonly found in turf. It is generally assumed that mosses occur as a direct result of acid, waterlogged and compact soil conditions. Mosses' can grow in many types of soil and conditions; some of these are outlined below.

Favoured conditions for moss growth

- High levels of moisture/poor drainage
- Low fertility
- Urban pollution
- High levels of thatch
- Compaction
- Shade
- Persistent close mowing leading to a sparse turf cover
- Insufficient top-soil (root zone) depth
- Extremely dry soil

Moss species can be broadly divided into two main groups from the way they flower and grow. Firstly there is the **Acrocarpous** (matt forming) mosses' that persist in low/closely-mown swards and enjoy low fertility levels within a soil. These mosses are able to tolerate drought conditions. The other is the Pleurocarpous (fern or feather type) moss that persists in longer turf. This type can generally be eradicated simply by lowering the height of cut of the mower.

Mosses life cycle

Spores for reproduction are produced twice per year during the spring and the autumn. The most important being the autumn spores. After producing these autumn spores the plant will over-winter then produce new spores in the spring dieing off naturally during the first signs of

prolonged hot weather during the summer. Spores are produced in a capsule at the plants head. These spore heads can prove to be a problem as we aid their spread and propagation with many maintenance practices we carry out. We can assume that even with simple raking we will be adding to the problem.

Controlling moss

Now we understand the reasons why mosses spread in the soil we can look to controlling it successfully. There are two accepted methods employed for controlling moss, culturally and chemically.

The best cultural control will be achieved through practicing the correct husbandry preventing the conditions moss favours in the first place. Using the correct cultivation methods we will ensure that control is achieved without resorting to chemicals.

We can improve drainage conditions, reduce the levels of shade, raise the height of cut on the mower (preventing the moss from photosynthesising through shading it out with the taller grass plant), apply 'lawn sand' that will both fertilise the soil and potentially kill the moss. Lawn sand contains sulphate of ammonia and sulphate of iron. The sulphate of iron will give some amount of control causing death to the plant while the sulphate of ammonia aids growth of the grass plant. Of course a strong healthy grass plant will be able to offer competition to the moss plant preventing its spread in the first place.

Chemical control of moss may be necessary initially before we employ the cultural practices in order to 're-claim' the turf area. If this is the case, an application of the chemical 'dichlorophen' will kill the plant and possibly its spores if applied correctly to the whole area. Worst case scenario's will require applications in the Spring and Autumn while lesser cases could be controlled with a well timed application during the early Autumn. On hard surfaces moss can be controlled using Borax, Simazine or Glyphosate.

After the moss has completely died (remembering the spores are in the head of the plant) it may be removed by raking or scarifying (see pages 28 - 31)

Note: When using chemicals be sure to wear protective gloves and do not apply if any skin is exposed. Dispose of the chemical container carefully and remove any traces from the skin immediately with soapy water.

In summary, consider the plants life cycle and growth habits, control by chemical means at the correct time then adopt cultural practices that encourage healthy grass growth and suppress the conditions outlined in favoured conditions for moss growth *and most importantly DO NOT rake living moss.*

Black Layer

Black layer in turf grass soils causes eventual death to the grass plant on the surface through suffocation of the roots. This condition is rare in most soils but can be a problem with heavily maintained sandy soils, waterlogged soils and those that are heavily fertilised.

What is black layer?

Black layer is aptly named as it appears as a black, foul-smelling band or streaks within the soil. It can range in thickness from fractions of an inch to an inch or more. Chemically black layer is a deposit of metal sulphides encouraged by the activity of anaerobic bacteria. It forms when hydrogen sulphide gas reacts with elements such as iron and magnesium in the soil.

How to spot black layer

Remove portions of the soil and visually inspecting the sample(s) is the easiest method to use in the identification of this condition. You will see either a black coloured band or streaks and will most likely be able to smell an odour like rotting eggs. Surface symptoms include yellowing or death of the leaves in with no particular pattern being expressed by the plant.

Background to the condition

There are many types of bacteria in soils, aerobic bacteria are beneficial to us as they break down organic matter and make nutrients available for plant uptake. These thrive in soils that have high levels of oxygen available, they respire (breath out) carbon dioxide like us. When a soil is compact or waterlogged oxygen levels are greatly or completely reduced this can lead to the demise of the aerobic bacteria. At this point anaerobic bacteria can dominate.

Anaerobic bacteria respire hydrogen sulphide; this gas bonds the metallic ions such as iron and magnesium together forming what we know as black layer. This layer can further reduce the ability of water to penetrate through the soil while also inhibiting root movement and growth. Hydrogen sulphide actually poisons the grass plant roots. Death of roots will lead to the eventual death of the plant on the surface.

High levels or an abundance of sulphur, low levels of oxygen and high levels of organic matter in the soil are all conditions that can also encourage the incidence of black layer. The anaerobic bacteria need sulphur in order to function (as we need oxygen), trace elements of oxygen actually kill the anaerobic bacteria and organic matter acts as the food and energy source for the bacteria.

Control of black layer

Control of black layer is easily achieved. Regular deep tine aeration practises (see pages 24 - 26) break through the black layer and increase the levels of oxygen in the soil killing the anaerobic bacteria whilst having the added benefit helping reduce the amounts of organic matter in the soil the problematic bacteria require for food.

Algae

Any exposed soil on lawns may develop what looks like a green 'scum' or layer on the exposed surface. This may be a mixture of moss (see page 43) and algae. Once grass is established on this bare soil any algae would disappear. Occasionally you may find that a 'thick' green-black coloured jelly appears all over any exposed surfaces and in-between thinned out grassed areas. This is known as 'squidge'. This thick jelly-like substance will usually appear on sloping ground and although it will not kill off the grass it will be a danger to those walking upon the surface as it is extremely slippery.

Control

The first step should be to improve the grass growth on the surface. Aerating the affected area and adding top-dressings of sand may help in the short term. Some control can be achieved by applying the chemical 'dichlorophen' or alternatively sulphate of iron.

Lichens

Lichens (which are plants) are a grouping of alga and fungus and will be found in lawns, walls on tree's etc. They favour conditions leading to weak grass growth and an alkaline pH.

Control

Improve the vigour of grass growth on troublesome areas. Ensure adequate fertility on the lawn. Chemical control is achieved using 'sulphate of iron'.

Diseases

Turf grass diseases could be described as beautiful! They have some wonderful mechanisms for penetrating into the plant, they have a great ability to survive through unfavourable conditions and their reproduction cycle has evolved to be highly efficient and effective. Unfortunately though, for reasons of grass aesthetics, uniformity, density and vigour of growth, we do not appreciate these diseases on our grassed surfaces. Hence there is a need for control and management. The key to the management of diseases is to be aware of the environment they prefer and the grass species they attack. To a great extent we can influence the environment that determines or deters disease growth and development with our management styles and practices. Over application of fertiliser, incorrect irrigation applications, sudden changes in surface pH through application of fertilisers or some top-dressings, creating shade or environments where air movement is minimal all will have an effect and an outcome, one of those outcomes likely to be the attack of disease.

This section is devoted to the diseases most frequently associated with turf grasses. It is hoped that armed with the ability to at least identify the disease (if any) you come across the correct control measures (both chemically and culturally) can be utilised to control and/or prevent disease incidence. Once again, as with many sections in the book, the ability to identify correctly the grass species being attacked can be the key to successful diagnosis of the disease itself. We will look at the nine principal turf grass diseases, the damage they cause, grasses affected, why they attack and how we might control them both culturally and chemically.

Fusarium patch

Causal fungus - *Microdochium nivale*

Damage caused - Fusarium patch appears as small orange/brown, brown or light brown patches, (generally, the lighter the less active) each extending in a circular pattern outward to form scars up to 50 mm in diameter. When favourable growing conditions are present these patches may have white fluffy strands (mycelium) within and around the scar. This

looks similar to candy floss, these patches may also join together to form larger areas of scaring and damage.

Grasses affected - Fusarium attacks the bent grasses (*Agrostis spp.*), the meadow grasses (*Poa spp.*) especially annual meadow grass (*Poa annua*), the Fescues (*Festuca spp.*) and sometimes the ryegrasses (*Lolium spp.*)

Factors promoting infection – A heavy thatch layer, cold, warm or humid weather conditions, a wet turf surface, poor drainage, heavy applications of nitrogen early spring or late autumn, shaded grass with little air movement and an alkaline surface pH.

Prevention and treatment - Cultural control will always be the best first line of defence in controlling fusarium patch. Thatch reduction techniques should be employed such as scarification and surface moisture should be removed by brushing or sweeping the grass surface. Any improvements to surface drainage help prevent spread. Avoid early spring or late autumn applications of nitrogen fertiliser. Improving the levels of light the sward receives and checking the pH level of fertilisers or top dressings you put on the turf surface will all help to curtail the disease and prevent the use of chemicals used in its control.

Chemical – Any turf disease product with the following active ingredient(s) will control fusarium patch disease

- Benomyl
- Carbendazim
- Fenarimol
- Iprodione
- Chlorothalonil
- Quintozene

Red Thread

Causal fungus – *Laetisaria fuciformis*

Damage caused – Red thread symptoms on the grass plant appear as withered, brown leaf tips some with red protrusions (look like red needles) sticking out from the leaf. There are no distinct margins to the affected areas but generally appears as patches of damaged turf with a red tinge to them. Usually seen during the warmer months of the year but it can persist into the

colder months. The amount of damage caused in most cases will not be severe but visually it can spoil things.

Grass species affected – Generally red thread attacks the Fescues (*Festuca spp.*) and the ryegrasses (*Lolium spp.*) but can attack most grasses given the correct conditions for growth.

Factors promoting infection – Warm weather and damp surfaces, low fertility, poor grass growth, acid to neutral pH levels.

Prevention and treatment - Cultural control will always be the best first line of defence in controlling red thread. Adequate fertilisation, removal of moisture and good management practices promoting growth of the grass plant all help to prevent the disease. Generally if the grass is infected than a light dose of nitrogenous fertiliser will help to ward this off and promote quick recovery.

Chemical – Any turf disease product with the following active ingredient(s) will control red thread disease

- Benomyl
- Carbendazim
- Fenarimol
- Thiabendazole
- Iprodione

Dollar spot

Causal fungus – *Sclerotinia homoeocarpa*

Damage caused – Dead grass, light brown or bleached in colour appearing as small spots (no larger generally than a dollar coin – around the size of a ten pence piece) that may join together to form larger areas of scarring (see picture). Upon close inspection of the leaf an hourglass appearance can be seen on the leaf blade.

Grass species affected – Generally will only attack Slender Creeping Red Fescue (*Festuca rubra litoralis*). But other fescue grass species have been known to be attacked. This disease is not common or widespread throughout the UK.

Factors promoting infection – Similar to red thread, low fertility and warm growing conditions have been associated with this disease. Low cutting height is also thought to be a factor in its development.

Prevention and treatment – The best treatment against dollar spot (assuming attack has occurred) will be the sowing of grass species other than fescue. Although good water management and adequate fertility in the soil will curtail the occurrence of this disease.

Chemical – Any turf disease product with the following active ingredient(s) will control dollar spot disease

- Benomyl
- Carbendazim
- Fenarimol
- Iprodione

Fairy ring

Causal fungus – Various *basidiomycetes*

Damage caused – Three main types. The dark green rings associated with fairy rings type 1 and 2 are attributed the causal fungi decomposing the available organic matter thereby releasing high levels of nitrogen.

Type 1 – Known to cause the most severe damage. Form two parallel rings of dark grass with a dead, dry area in between. The dead area typically shows signs of white fluffy mycelium and smells mouldy. Toadstools, mushrooms and puffballs can sometimes also be found within the dead area.

Type 2 - Forms a dark green ring with no dead area. Type 2 being the most common form of fairy ring. The dark ring can most easily been seen when the surrounding grass species are starved of nitrogen.

Type 3 – Usually, but not always, seen as rings of fruiting bodies (toadstools, mushrooms, etc) without any apparent damage to the

grass species. Mycelium can sometimes be found in the surface layers of soil.

Superficial fairy ring – Associated with dry patches of turf that proves difficult to re-wet. Sometimes depressions can be seen in the sward where the thatch layer has been decomposed. Diagnosis of this disease can be difficult.

Grass species affected – All grass species can be affected.

Factors promoting infection – Normally associated with compaction, high thatch levels, areas that were once woodlands and overuse of fungicides.

Prevention and treatment - Cultural control will always be the best first line of defence in controlling fairy rings and associated diseases. Removal of excess thatch and relieving compacted soil conditions should help prevent outbreak.

Chemical – Some chemical control of fairy rings has been achieved using an active ingredient known as 'Oxycarboxin' although control has been known to be sporadic and not always effective. Heavy forking along with applications of wetting agents to help re-wet the soil is another method worth trying. In worst cases where chemical control has not been effective physically digging out the affected area could be tried while taking care not to spill any soil on unaffected ground. The type 1 ring could simply be left to grow out, though this could take a while!

Take-all patch

Causal fungus – *Gaeumannomyces graminis*

Damage caused – Usually occurring during the summer months this disease appears as saucer-shaped patches growing to around 30 cm in diameter that may be slightly depressed. Affected grass has a light brown or sometimes bleached look. Attacks bent grass species only, therefore other grasses and weeds may be present within the dead area growing unaffected. The bent grass species attacked may be easily pulled from the sward and black spots or areas can be seen on the roots and base of the plant.

Grass species affected – Bent grasses only (*Agrostis spp.*)

Factors promoting infection – Alkaline pH levels, sandy soils, surface soil compaction, poor water drainage, humidity, has been associated with sterilised imported root zones (top-soils).
Prevention and treatment – There is no current effective treatment for Take-all patch for the home market although there is now a commercial treatment available. Correct cultural practices will be the key to preventing this disease. Monitor pH levels and do not apply treatments to the surface that may raise the pH level. Light applications of sulphate of iron could be effective in lowering the surface pH values. The sowing of any grass species other than the bent grass variety will be an effective biological control. Keep adequate nutrition and ensure the surface is relatively free draining at all times.

Chemical – Over application of fungicides will encourage the incidence of this disease as fungus levels I the soil diminish. Healthy populations of fungi in the soil prevent Gaeumannomyces developing to an extent that it becomes dangerous to the grass on the surface.

Anthracnose

Causal fungus – *Colletotrichum graminicola*

Damage caused – This disease can occur all year round but most likely to be seen during late summer through into winter. There are no distinct margins to the damage caused but usually seen as irregular spots. Frequently attacks annual meadow grass. Plants infected with anthracnose turn yellow; sometimes the youngest leaf has a red or red/orange tinge to it. The plant can be easily pulled from the sward and small black ‘pin-head’ type structures can usually be seen on the base and root of the affected plant.

Grass species affected – Particularly severe with annual meadow grass (*Poa annua*), but can also attack ryegrass (*Lolium spp.*) and fescue (*Festuca spp.*)

Factors promoting infection – Poor turf conditions encourage this disease such as compacted soil and low fertility. Long spells of wet weather and poorly drained soils will also favour attack.

Prevention and treatment – Ensure soil is treated for any compaction, ensure a free draining surface and supply adequate fertility to the sward throughout the year.

Chemical – The Any turf disease product with the following active ingredient(s) could control anthracnose disease. Chlorothalonil, Benomyl or Vinclozolin

Leaf spot

Causal fungus – Associated with the following fungi, *Drechslera spp., Curvularia spp., and Bipolaris spp.*

Damage caused – Small defined spots appear on the turf grass leaves that enlarge as the infection worsens. The centre of this spot turns brown as the cells die, with the margins of these spots turning dark brown. Some plants may exhibit spots with a yellow border to the brown dead spotted area. There will be no distinct overall visual margin to be seen from the surface just patches of infected grass.

Grass species affected – All grass species are susceptible to leaf spot although this disease is seen frequently attacking perennial ryegrass (*Lolium perenne*), as above and Smooth meadow grass (*Poa pratensis*)

Factors promoting infection – Warm humid weather conditions favour the disease, over fertilisation of a grass surface can trigger attack. High thatch levels are also thought to encourage this disease.

Prevention and treatment – Only provide fertiliser to suit your purpose, do not apply heavy doses during spring and summer. Prevent and control thatch. Keep the surface dry as water aids the spread of this disease.

Rust

Causal fungus – *Puccinia spp.*

Damage caused – During the early stages light-yellow spots are seen on the grass leaves followed by yellow, reddish-brown or black pustules (lumpy powdery substance). With no distinct borders, patches of turf will be affected.

Grass species affected – Most grass species are susceptible to attack by rust although the occurrence of this disease is quite rare.
Factors promoting infection – low fertility, drought conditions, prolonged periods of dew formation and shade can all encourage symptoms of rust.

Prevention and treatment – Relieve the conditions leading to drought and low fertility. Reduce levels of shade the sward is exposed to and remove morning dew from the surface at earliest convenience.

Chemical – Due to this disease's infrequence it is suggested that correct management of the sward will be the best line of defence to prevent attack. However, Benomyl and Fenarimol will curtail attack.

Powdery mildew

Causal fungus – *Erysiphe graminis*

Damage caused – The grass leaves appear to have a white, white/grey powder on their surface. During later stages the leaves will turn yellow resulting in death of many plants.

Grass species affected – Can affect most turf grass species although Perennial ryegrass (*Lolium perenne*), Smooth meadow grass (*Poa pratensis*) and Fescue grasses (*Festuca spp.*) are frequently affected.

Factors promoting infection – Warm dry periods, shade and poor air movement over the sward.

Prevention and treatment – Do not over fertilise with nitrogen, irrigate during dry periods. Improve light intensity the sward is subjected to and/or improve air movement.

Chemical – Correct cultural control measures will prevent the incidence of this disease.

Disease activity calendar

Table indicating disease activity

Key

	Disease likely to attack if conditions favour
	Possibility of attack if conditions favour

Disease name	Month of the year											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Fusarium patch												
Red thread												
Dollar spot												
Fairy rings												
Take-all patch												
Anthracnose												
Leaf spot												
Rust												
Powdery mildew												

Turf grass Pests

Turf grasses are subject to stress from the environment, foot and mechanical traffic, diseases, mosses, algae and weeds. We understand that maintaining a dense, uniform, attractive turf is not an easy thing to do, even less so with pests around! To make matters worse, many of the chemicals used to control them are being banned, limited and/or put under close scrutiny environmental agencies.

Unfortunately, grass stems, leaves, roots and thatch provide a bountiful habitat for a host of insects and arthropods (spiders, millipedes, mites, etc). Some pests devour leaves, crowns, roots and stems, others suck out the protoplasm from leaves and stems, thus weakening and discolouring the plant. Fortunately, many of these pests are non-threatening. In the UK we tend not to have major problems with pests and we can class most a minor destructive force.

In the UK any damage caused will be through the larval feeding stages of pests and in most cases damage is not recurring. Most damage will be caused through scavenging birds ripping up the turf to gain access to the grubs. There are large numbers of beneficial insects and arthropods in every turf grass stand. Our job is to determine between the beneficial and the damaging.

The Earthworm

The main problems associated with earthworms are the castings they produce. These castings smear under the effect of mowing and tend to form a ‘cap’ on the surface. This affects the aesthetics of the green and also makes perfect seed beds for weeds/weed grasses to germinate upon.

Found in soils with high levels of organic matter, they create large macro-pore channels that benefit gaseous exchange but can also leach pesticides and fertilisers into lower portions of the root zone where bio-degradation is minimal. Earthworms are able to burrow deeply into a soil and their burrows tend to exhibit branching further benefiting the soil’s structure. The benefits of earthworms tend to far out weigh the disadvantages. Earthworms improve a soils aeration (O_2 (oxygen) in, CO_2 (carbon dioxide) out,) relieve compaction, decompose thatch and generally enrich the soil. Perhaps the most beneficial thing would be to wait until the casts are dry, and simply brush them into the surface as a top dressing.

Leatherjackets (Crane Flies)

With slender long bodies and very long legs the adults are usually tan to brown with smoky brown wings. The laid eggs are black, oval, with one side flattened whilst the other pointed. The eggs hatch into white worm-like maggots. As these grow (larval stages) they turn greyish/brown and develop a tough skin (hence the name leatherjacket). The larvae may exceed 1" in length. At this stage they can be found near to the soil's surface.

Damage symptoms

Bare areas, dead, dying or browning turf, sparse growth, stems and crowns of the grass plant are sometimes pulled into the thatch layer.

Cycle

Hatch from August to Mid-September. Lay eggs immediately. Larvae feed slowly during winter, feeding will stop at Pupae stage (May – June). The pupae then lay in the upper layers of soil/thatch layers until hatching during the late summer or autumn time.

Frit Fly

Stem boring fly larvae known to attack turf grass, especially ryegrasses and fescues and bent grass species. The adult is a tiny, black, shiny fly about 2mm long. The larvae are white to translucent in colour, about 4mm long and pointed at the head end. The hind end is rounded to blunt and has two distinctive rounded projections that are visible upon close inspection with a magnifying glass. The pupae are small, red/brown in colour and can be seen around the site of the damaged plants.

Damage symptoms

Individual grass stems are killed by the boring activity of the larvae. Usually the seed head stems are destroyed. But when high populations are present, entire turf grass areas can be destroyed. Luckily damage does not usually affect turf areas that are mown at heights that inhibit seed head formation.

Cycle

Normally three generation cycles per year. The first generation emerges in May and lays eggs on grass tillers on which the larvae feed. Second generation emerge in July with the third emerging in August through September. The larvae of the third generation feed slowly through the Autumn and winter and pupate the following Spring.

Chafer grub

Grubs feed on a variety of plant roots and organic matter in the soil. They are known to feed on the roots and thatch of turf grass stands. Chafer grubs are known to be sort after by birds for food. Hence large areas of turf can be ripped up and destroyed by these feeding. All ripped up turf should be removed from the site of attack.

Damage symptoms

Typical grub damage is of; wilting, browning of the grass plant, and death in irregular patches. Found during Autumn/Early Spring. Upon peeling back the dead grass you should be able to visually identify grubs in the upper soil layers

Cycle

The eggs are oval shaped, shiny with a milky colour to them. After absorbing water, these turn dull grey and swell. The larvae then grow into typical C-Shaped white grubs with two parallel rows of bristles on their underside. The chafer beetle emerges after the grub stage has developed.

Minor pests

Ants

Cause a nuisance through volcano shaped mounds of granulated soil around the openings to the nests. More visually disturbing than anything else.

Damage symptoms

Grass may become weak or thin, as the soil tends to dry out quickly above the nests. Some ants may forage on grass seeds and effect the establishment of newly sown turf.

Aphids

Attack many horticultural crops. The type recognised for feeding on turf grass is the ‘green bug’. Damage most commonly found under trees.

Damage symptoms

Rust coloured areas appear early July through August. These tend to expand. Death of the turf grass plant is quite rare.

Animal urine (Dogs, cats, foxes, deer, etc.)

Concentrated urine passing through animals tends to kill off the grass in circular type patterns. Death of the grass plant is a result of the high nitrogen levels found in urine. In some cases the dead yellowed centre of the affected area will be surrounded by a lush green border of healthy grass where the nitrogen concentration is reduced. Easily controlled if the urine is heavily watered in immediately after passing

Control of pests.

With many chemicals used to control insect pests now banned and many are in the process of being banned or removed from sales shelves, it is advisable to seek clarification of chemical agents (pesticides) used for insect pest control and their latest product names from pesticide manufacturers during the time of attack.

A quick browse through your local DIY/garden centre or contact with a supplying agent should help you identify any products available. The internet can also prove to be of help here as can the hire of professional services with qualified pesticide application operatives.

Weeds

“Happy is the gardener with no weeds in his garden”. So it was once said. If they’re ever was such a garden. I would suggest that there was something wrong with the soil, because weeds are everywhere! Unless of course we understand how, why and when to control them!

This chapter looks at the weeds most commonly associated with mown grass swards, the conditions they favour and how to deal with them both mechanically and chemically. Of course the one, and perhaps most important and effective way to control and prevent weed growth in turf grass swards is to keep at all times a thick, dense grassed surface. Provide no light for germination and the weed seeds (if present) will stay as seed! How easy is that I wonder? Easy if you read and understand this guide!

What is a weed?

The common used definition for a weed is a plant out of place or growing where it is not wanted. Within terms of the turf grass community its definition can be expanded to being an undesirable plant. I like to call them ‘native wild flowers’ but this will never catch on. Some say a weed is a plant whose virtues you have not yet discovered. In a turf grass sward weeds may be tolerated in small amounts but eventually, due to their fierce competition for light, water and nutrients they must be removed. This is of course before we have even mentioned the damage weeds do to one’s eye! Not a pleasing sight for the perfectionist and some say they look unsightly.

If all weeds were visually attractive with pretty flowers and perfectly formed leaves we might be tempted to keep them and cherish them, indeed, many wild cottage gardens would not be without them. However, in lawns, and with our current thinking, they are not wanted and must go!

Weeds can be troublesome to overcome, some are extremely vigorous in growth and some can stand up to the climate better than any grass plant. They spread by seed and this seed can stay dormant in the soil for many years after the mother plant has seen its time. Many annual weeds will also cause large bare areas when they die back.

Weed control

The best way to control a weed will depend to some extent upon how long it can live, and how it spreads. Annuals live for one year only, but produce hundreds of seeds. Perennials live longer; their roots persisting in the soil even though their aerial shoots die back during the winter. Some perennials spread through the ground shooting new plants all over while other

go deep, deeper than we care to dig, even the smallest amount of root remaining can regenerate itself into another plant.

The environmentally conscious believe the best way to kill a weed is physically dig it out. In turf grass swards however this proves not to be as simple as removing one growing in an open bare soil. Many weeds found in turf can intertwine with the grass leaves.

There are tools available to help in weed removal. An example being the 'daisy grubber', is this effective? Yes, always? No. Sometimes it may be necessary to poison the weed with chemicals, chemicals known as herbicides or selective herbicides. These select the weeds from the grasses and eventually see to their death. This can be done safely if you are clear on which selective herbicide to use, and when to use it. Not all weed killers are deadly poisonous, in fact very few are! Nevertheless, all should be applied with care, with the correct equipment for application, the correct personal attire and with the environment at large in mind.

Common weeds found in turf grass

Greater plantain

Botanical name – *Plantago major*

Short description – A perennial, commonly found in grassed areas, especially the closely mown type. Forms a rosette type leaf area that shades out the grass plant.

Control

Cultural **-** Easily controlled through hoeing or grubbing with a blunt blade. Remove majority of the root and the plant will die.

Chemical – See weed control chart. Always apply herbicide when weed is actively growing, usually from April through until September.

Selfheal

Botanical name – *Prunella vulgaris*

Short description – A perennial weed that is persistent and quite troublesome on maintained turf. Prefers wet ground conditions. Have underground creeping stems and violet-blue flowers.

Control

Culturally – Very tedious to pull out by hand.

Chemically – Requires numerous applications of herbicide. See weed control chart.

Common sorrel

Botanical name – *Rumex acetosa*

Short description – Perennial, not a major weed of turf grass swards, is generally a larger plant than 'sheep's sorrel' with leaves up to five inches long. Green flowers turn red, prefers acid soils. Can be persistent where found.

Control

Culturally – Hand weeding can be carried out and should be the preferred treatment.

Chemically – See weed control chart

Sheep's sorrel

Botanical name – *Rumex acetosella*

Short description – Sometimes common perennial, found growing in acid situations creeping along the soils surface. Can be extremely vigorous forming a thick dense layer over and between the grass plants. Yellow flowers turning red.

Control

Culturally – Can be hand weeded but roots will need removal also. Due to its low growing creeping nature can prove difficult to remove from grass sward.

Chemically – See weed control chart

Pearlwort

Botanical name – *Sagina procumbens*

Short description – Common perennial, looks very similar to a grass species itself and may go un-noticed. Colonises bare swards quickly, green – white flowers, and a creeping type habit.

Control

Culturally – Keep a thick dense sward. Can be hand weeded quite easily

Chemically – See weed control

Dandelion

Botanical name – *Taraxacum officinale*

Short description – Very common perennial particularly during the month of May, bright yellow flowers and prostrate rosette type leaves that suffocate the grass plant. Has a very persistent taproot. Not to be confused with Cat's-ear or Hawk bit.

Control

Culturally – Can be hand weeded but the entire root must be removed.

Chemically – See weed control chart

Autumn Hawk bit

Botanical name – *Leontodon autumnalis*

Short description – Relatively uncommon perennial**,** flat rosette leaves smaller than Dandelion or Cat's-ear, narrow and sharply pointed. Prefers poorly draining soils.

Control

Culturally – Hand weeding possible but entire root must be removed

Chemically – See weed control chart

Cat's-ear

Botanical name – Hypochaeris radicata

Short description – Can be a problem weed, perennial, two yellow flowers per flowering stem, like all soil types. Leaf being lance shaped and many hairs present on their surface.

Control

Culturally – Can be hand weeded but entire root must be removed

Chemically – See weed control chart

Slender speedwell

Botanical name – *Veronica filiformis*

Short description – Common perennial, very small rounded and wrinkled leaves, creeping type growth. Can be matt forming on the ground. Pale-blue four petal flowers

Control

Culturally – Can be hand weeded but the entire plant must be removed from the surface.

Chemically – See weed control chart

Yarrow

Botanical name – *Archillea millefolium*

Short description – Common perennial, extremely finely leaved, almost fern-like, creeps along the soil surface between the grass leaves, strongly scented. White daisy type flowers turning pink.

Control

Culturally – Regular maintenance such as raking or scarifying will control this weed. Can be hand weeded.

Chemically – See weed control chart

Parsley piert

Botanical name – *Aphanes arvensis*

Short description – Associated with dry soils, not common and annual in nature. Very slight plant that can prove to be a problem. Have fan-shaped leaves and light-green flowers.

Control

Culturally – Can be hand weeded, as it is very shallow rooting, regular maintenance such as raking or scarifying should control it

Chemically – Very resistant to herbicides, best controlled culturally

Daisy

Botanical name – *Bellis perennis*

Short description – Very common perennial, small rosette leaves smoother grass and can form damaging colonies. Particularly persistent if not controlled.

Control

Culturally – Hand weed only if there are a few growing

Chemically – See weed control chart

Mouse-ear chickweed

Botanical name – *Cerastium holosteoides*

Short description – Very common perennial, has small white flowers, and very hairy oval-shaped small leaves, creeps along the surface and can form a dense mat.

Control

Culturally – Can be hand weeded but large infestations are probably bettered treated chemically

Chemically – See weed control chart

Field wood-rush

Botanical name – *Luzula campestris*

Short description – Not particularly common perennial, generally associated with neglected turf grass areas. Especially in acid situations. Has a similar look to grass except that its leaves are broader and thicker and covered with white hairs. Flowers are dark brown.

Control

Culturally – Good general management of a sward should keep this is check.

Chemically – See weed control chart

Ribwort plantain

Botanical name – *Plantago lanceolata*

Short description – A very common perennial. Flat rosette leaves that suffocate the grass plant. Sometimes known as *ribgrass* due to the noticeable ribs running up the leaves. Seed heads are compact with long narrow stems supporting them.

Control

Culturally – Can be hand weeded out of the turf. Generally the most cost effective and friendly method

Chemically – See weed control chart

Creeping buttercup

Botanical name – *Ranunculus repens*

Short description – Very common perennial, yellow flowers with five petals. Leaves are divided into three main leaflets. Its creeping nature can mean large colonies quickly establish.

Control

Culturally – Hand weeding is possible but the entire plant and its roots need removing to prevent regeneration.

Chemically – See weed control chart

White/Dutch clover

Botanical name – *Trifolium repens*

Short description – Common perennial, this weed can be a persistent, troublesome weed. Creeps amongst the grass competing for light and nutrients, a battle that it generally wins! White flower heads attract bees and wasps.

Control

Culturally – Near impossible to remove by hand from turf grass areas once established. Good management of the surface is needed to prevent infestation.

Chemically – See weed control chart

Common chickweed

Botanical name – *Stellaria media*

Short description – Should not prove to be persistent in mown swards. Unlike mouse-eared chickweed. Common chickweed is generally only a problem in newly establishing lawns or turf areas.

Control

Culturally – Mow regularly

Chemically – See weed control chart

Weed control chart

Selective herbicides used to control weeds

Common name	Botanical name	2, 4-D	Ioxynil/ Mecoprop	MCPA	Mecoprop	Mecoprop/ 2, -D
Creeping Buttercup	Ranunculus repens	Controls	May need **two** or more applications	Controls	May need another application	Controls
Mouse-ear chickweed	Cerastium holosteoides	May need **two** or more applications	Controls	May need another application	Controls	Controls
Common chickweed	Stellaria media	May need another application	Controls	May need another application	Controls	Controls
Pearlwort	Sagina procumbens	May need **two** or more applications	Controls	May need **two** or more applications	Controls	Controls
White clover	Trifolium repens	Resistant	Controls	May need **two** or more applications	May need another application	May need another application
Parsley piert	Aphanes arvensis	Resistant	May need another application	Resistant	**One** to **two** applications	**One** to **two** applications
Sheep's sorrel	Rumex acetosella	May need another application	May need another application	May need another application	Resistant	May need another application
Common sorrel	Rumex acetosa	May need another application	May need another application	May need another application	Resistant	May need another application
Slender speedwell	Veronica filiformis	Resistant	May need another application	Resistant	May need **two** or more applications	May need **two** or more applications
Self heal	Prunella vulgaris	May need **two** or more applications	May need another application	May need **two** or more applications	May need another application	May need another application
Greater plantain	Plantago major	Controls	Controls	Controls	Controls	Controls
Ribwort plantain	Plantago lanceolata	Controls	Controls	Controls	Controls	Controls
Daisy	Bellis perennis	May need another application	May need **two** or more applications	May need **two** or more applications	May need **two** or more applications	May need another application
Yarrow	Archillea millefolium	May need **two** or more applications	May need another application	May need **two** or more applications	**One** to **two** applications	**One** to **two** applications
Cat's ear	Hypochaeris radicata	May need another application	May need another application	May need another application	May need another application	May need another application
Dandelion	Taraxacum officinale	May need another application	May need **two** or more applications	May need another application	May need **two** or more applications	May need another application
Field wood-rush	Luzula campestris	Resistant	May need **two** or more applications	Resistant	May need **two** or more applications	May need **two** or more applications
Suckling clover	Trifolium dubium	Resistant	May need another application	Resistant	May need **two** or more applications	**One** to **two** applications

Characteristics of the main herbicides

IOXYNIL BROMOXYNIL	Suitable for use on seedling lawns, once plants have two or more leaves. Contact Action
PARAQUAT	Used for killing emerging weeds. Not selective, do not use on established lawns or turf. Suitable for ground clearance. Contact Action
MECOPROP 2,4-D MCPA	Selective, suitable for established lawns to kill broad-leaved weeds. Usually a residual effect in soil for several weeks after. Systemic action
GLYPHOSATE	Systemic, used for same reasons as Paraquat. Rapidly becomes in active in the soil. Do not use on lawns or turf unless death of the plant is required. Systemic action

Timing of applications of herbicide

Systemic herbicides can be applied at any time during the year when the plant is growing actively. In most cases the months April through September will see active growth from plants. It is suggested the ideal time for application will be late April/early May where generally excellent results will be achieved. The reason for this is that the chemical is transported quickly through the weed plant due to its active growth occurring at this time of year. The added benefit of this April/May timing is that the grass plant will also be actively growing and better able to fill any bare areas quickly after the weeds death. There may be some impaired germination (due to the effects of the herbicide) on newly sown grass seed after the application of herbicide. Higher application rates may compensate for this.

The effect of *weather* on timing

Fine, warm, still weather with a moist soil condition will be the ideal time to apply herbicide and give the best results. Application during dry or drought conditions may cause some damage and stress to the grass. The forecast should be good for the day of spraying, light showers will not necessarily have a negative effect on the herbicide although heavy downpours can cancel out the effects of the herbicide on the target plants.

The effect of *mowing* on timing

Try to leave the grass and weeds uncut for at least three days before application of any herbicide to allow for a greater leaf surface and therefore target area. Wait at least three days after application before beginning any mowing operations. This allows the herbicide to move through the weed and make an effective kill. It is also advisable not to collect clippings for composting for at least one month after spraying.

Overdosing of herbicides

Make sure the manufacturers instructions for application and mixing are fully followed before applying any herbicide. Wear protective equipment such as gloves and do not expose any skin to the chemical. Overdosing of herbicides can be very damaging to the turf grass plant the environment, and lead to a scorched or thin weak sward that allows further weeds to develop and grow.

Chapter 6 - Organic matter

All soils will have organic matter (OM) within them. It is simply the portion of the soil that was once living in some form (or still is) living within it. Dead roots, grass leaves, bark, sticks, in fact anything organic that lays on the soil long enough eventually becomes organic matter.

Bacteria and fungus help to break down organic matter. They use this as a food source for energy as this is consumed and broken down it changes state from something recognisable (such as a tree leaf) to a brown sticky substance we know as humus.

There are many interactions involved in the process of breaking down organic materials into different substances but we can broadly look at three important ones. Initially the freshly deposited recognisable OM forms what is known as the litter layer. This can be found at the base of the plant but above the soil surface. As this litter layer is attacked and consumed by bacteria and fungus it starts to break down and becomes partially decomposed. At this stage the tougher, lignified parts of the plant (such as stolons, rhizomes and nodes on the grass plant) are the only semi-recognisable parts. Eventually, the OM will be broken down into humus. Humus is the very last stage of identifiable decomposition. At this point it is highly charged and holds at its surface many nutrients.

Organic matter provides many benefits to both the soil and the grass plant. Soils benefit from having improved structure (organic matter binds mineral particles together) and improvement in the levels of nutrients available for plant uptake (known as improved condition). The soil will also be able to hold a greater amount of water. OM is able to absorb and hold (due to its negative surface charge), high levels of water therefore increasing the soils water holding capacity. This is extremely helpful with free draining soils such as those classed as sand or sandy. The grass plant benefits because of the increased amounts of water and nutrients it is able to obtain to aid growth.

Thatch

Thatch is a layer of organic matter, consisting of all the layers and properties explained above, most important to turf grass lawns and those who manage them.

Thatch can be found above the soils surface but below the grass plants leaves. It is defined as a tightly intermingled layer of dead, dieing, and living plant material, consisting of stolons, rhizomes, stems, crowns, nodes, and leaves, in fact, all parts of the turf grass plant.

In small controllable amounts it is very beneficial, unfortunately, poor management of turf (over or incorrect use of water and fertilisers) can quickly lead to high levels of thatch and many subsequent problems. Contrary to popular belief, returning the cut leaves to a sward (mowing with a rotary mower) will not increase thatch levels as leaves are made up of more than 85% water, the leaf tissue shrinks and is decomposed readily. Initially after mowing the litter layer on the surface will increase but leaves (made up of cellulose) are quickly broken down and the nutrients contained within them are re-cycled back into to the soil.

To determine the thickness of the thatch layer, cut out a triangular shaped section of the turf and soil with a knife. Looking directly below the green leaf, measure the amount of dark brown root and stem tissue above the soil (see picture, thatch layer indicated between white lines). Replace the cut piece and use the knife to knit the piece of turf back into the turf surface.

The development and accumulation of thatch can be linked to a number of factors.

(a) The growing habit of the turf grass plant (tufted, stoloniferous or rhizomatous – tufted producing the least amount of thatch)
(b) The frequency of irrigation
(c) The frequency of fertilisation
(d) Soil conditions (the more compact and/or waterlogged, the greater the build-up)
(e) Soil temperature (The lower the temperature the lower the rate of breakdown)
(f) Poor management practices

Excess levels of thatch will bring problems to a turf grass sward.

(a) The surface will feel spongy under foot
(b) Water infiltration can be reduced
(c) Provides an ideal food source and living environment for many turf grass fungus diseases
(d) Increases the incidence of mower scalping
(e) Promotes the growth and invasion of weeds, mosses and weed grasses such as Annual meadow grass (*Poa annua*)

The thatch layer benefits the lawn in small controllable amounts as it prevents moisture loss through evaporation, protects the important meristematic regions (areas of growth) such as the crown (found at the base) of the grass plant while also giving a 'cushioning' effect for laying, playing, walking or falling on.

The benefits of controlling thatch through maintenance operations such as scarifying, brushing & raking and top-dressing frequently include; keeping a firm dry turf surface, increasing in the depth of the grass rooting system and better distribution and penetration of irrigation or rain water.

There are two main types of thatch we are likely to come across the **fibrous** type (tough, dry, very wiry in feel, brownish in colour) typically found in acid situations and the more common **spongy** type (yellow/brown in colour, usually soft and waterlogged, sometimes has black streaks running through it and usually smells of eggs or stagnation – *hydrogen sulphide*). See black layer pages 45 – 46. This type will generally be found in heavily watered, over-fertilised areas or on heavy soils such as clay.

Glossary

Acid soil – Soils whose reaction is below that of pH 7 (Also see pH)

Adventitious root – A root that arises from any organ other than primary or seminal roots

Aeration, mechanical – See cultivation

Alkaline soil – Soils whose reaction is that of above pH 7 (Also see pH)

Annual, summer – Plant that completes its life cycle from seed in one growing season

Annual, winter – Plant that initiates growth during the autumn, lives over winter, and dies after producing seed the following season

Apical meristem – Terminal growing point

Auricle – Claw-like appendages occurring in pairs appearing at the base of the leaf blade

Bench setting – The high at which the bottom blade of a mower is set above a firm level surface

Blade – The flattened portion of the leaf located above the sheath

Brush – To move a brush against the surface of a turf in order to lift non-vertical stolons and/or leaves before mowing, with the end goal of producing and upright stand of grass

Bunch-type growth – Plant developing itself through tillering at or near the soil surface without the production of stolons or rhizomes

Carbohydrate – The plants food source, a compound of carbon, hydrogen and oxygen, as in sugar, starch and cellulose

Castings (Earthworm) – Soil and plant remains excreted by earthworms and deposited on the turf surface or in the burrow; forms a stable soil granule that can be objectionable on mown turf

Clippings – Leaves and in some cases stems deposited on the turf surface after mowing

Collar – Light-coloured band at the junction of the leaf blade and the leaf sheath

Coring – A method of turf cultivation by which soil cores are removed using hollow tines

Compaction – The compression of soil particles leading to unfavourable growing conditions for the turf grass plant

Creeping growth habit – Plant development by an extravaginal stem growth at or near the soil surface with lateral spreading rhizomes and/or stolons

Crown – A highly compressed stem located at the base of a vegetative aerial shoot

Culm – Flower stem of the grass plant

Cultivar – An assemblage of cultivated plants distinguished by any characters (morphological, physiological, and the like) that when reproduced sexually or asexually retain their distinguishing features.

Cultivation – Applied to turf, cultivation refers to the working of the soil and/or thatch without destruction of the turf grass surface; for example, coring spiking, or other means

Evapotranspiration – Loss of water/moisture from the turf grass leaf and the soil surface

Fun – Something I did not have much of while writing this book!

Irrigation, automatic – Hydraulic-electric control of water application in response to turf grass needs.

Irrigation, manual – Irrigation using hand set or hand valved equipment

Lateral shoot – A shoot originating from a vegetative bud in the axil of the leaf or from the node of a stem, rhizome or stolon

Layering, soil – Undesirable stratification within the surface horizons of a soil profile; can be due to construction design, top-dressing with different textured materials or inadequate mixing.

Leaching – Loss of nutrients (ionic form) through natural drainage of the soil's solution

Ligule – Membranous or hairy appendage on the adaxial side of the grass leaf at the junction of the leaf blade and leaf sheath

Liquid fertilisation – A method of applying fertiliser using liquid as the carrier. Applied as a solution.

Mat – A tightly intermingled layer composing of living and partially decomposed stem and root material and soil that develops below the thatch layer but above the soils surface

Micro organism – Minute living organisms such as bacteria or fungi

Monocot – Plant having one cotyledon in the seed; grasses are an example

Mowing frequency – The number of times a turf grass sward is mown per week, month or growing season.

Mowing height – The distance above the ground at which the leaf is cut by a mowers blade

Mulch – Any non-living material that forms a covering on the turf grass or soil surface

Nitrification – Formation of nitrates and nitrites from ammonia by soil micro organisms

Node – The joint of a stem; the region of attachment of leaves to a stem

Seminal root – The primary root

pH – per hydrogen or the negative logarithm of the hydrogen ion concentration of the soil

Root zone – A prepared mixture of minerals and organic matter used as a growth medium for turf grass

Settling, soil – A lowering of the soil surface resulting in a decrease of volume to a soil previously loosened by some form of cultivation (bare soil). Occurs naturally but can be accelerated by mechanically tampering or heeling in the surface after cultivations have taken place.

Sheath – The tubular basal portion of the leaf enclosing and wrapping around the stem

Slowly available fertiliser – Designates a rate of dissolution less than obtained for completely water soluble fertilisers; may involve compounds that dissolve slowly, materials that must be microbially decomposed, or soluble compounds coated with substances highly impermeable to water.

Soil modification – Alteration of soil characteristics by soil amendment; commonly used to improve physical conditions

Soil probe – A cylindrical soil sampling tool with a cutting edge at the lower end

Spiking – A method of turf cultivation in which solid tines or flat pointed blades penetrate the turf and soil surface

Stand – A number of established individual turf grass genus and species

Stolon – An elongated stem (or shoot) that grows along the surface of the ground and from which leaves and adventitious roots develop at the nodes

Stomates (Stoma, Stomata) – Openings in the epidermis of leaves and stems that function in the exchange of gases between the atmosphere and the plant

Sub-soil – The soil elevation established so that the top-soil placed on t will have the desired thickness and final grade or elevation

Texture, leaf – Texture imparted to turf by leaf width and arrangement

Texture, soil – The relative proportions of mineral matter found in soil

Thatch – A layer of un-decomposed or partially decomposed organic residues situated above the soil surface but below the turf grass leaves. Consists of all parts of the turf grass plant

Thatch control – The process of (a) preventing excessive thatch build up by accumulation by cultural manipulation and/or (b) removing excess thatch from a turf surface by either mechanical or biological means.

Tiller – A lateral shoot, usually erect that develops intravaginally from buds

Top-dressing – A prepared soil mix added to the surface of a turf and worked in by brushing, raking and/or irrigating to produce a smooth surface. Firms turf by working soil in among stolons and thatch forming materials. Also enhances thatch decomposition.

Tufted – See bunch-type

Turf – A covering of mown vegetation, usually turf grass, growing intimately with the an upper soil layer of intermingled roots and stems

Turf grass- A species or cultivar of grass, usually of spreading habit, that can be maintained as a mown turf

Turf grass community – An aggregation of individual turf grass plants that have a mutual relationship with the environment as well a among individual plants

Urea formaldehyde – A synthetic slowly soluble nitrogen fertiliser consisting mainly of methylene urea polymers of different lengths and solubility's; formed by reacting urea and formaldehyde

Variety – See cultivar

Vertical mower – A mechanical devise with vertically rotating blades that cut into the face of the turf for the purpose of reducing thatch, and improving gaseous exchange.

Wear – The collective injurious effects of traffic (foot or mechanical) on the turf grass plant