



GOLF COURSE CARE AND MAINTENANCE (QUEENSLAND AND NORTHERN NSW)

Well designed, well-tended courses make for greater golfing pleasure. Keeping the layout and playing surfaces in top condition is as great a challenge and as rewarding for the greenkeeper and his staff, as shooting good scores is for players.

This Agritopic will assist greenkeepers in their management of tees, fairways, and greens, and give them an understanding of fertiliser programs. Much of the information presented in this Agritopic is based on past experiences. It is possible that cultural and management practices may have changed, and there may be a need to seek updated information from other sources.

1. PLANT NUTRIENTS

The main nutrients applied in fertiliser programs are nitrogen (N), phosphorus (P), potassium (K) and sulphur (S). These are discussed in more detail below.

1.1. Nitrogen (N)

Nitrogen is an important constituent of protein and chlorophyll, the green pigment which gives colour to plants. Chlorophyll is essential for photosynthesis, the process by which green plants utilise the energy from the sun. Nitrogen deficient plants will be a pale green to yellow colour and lack vigour.

Nitrogen is taken up continuously by plant roots, and in greater quantity than any of the other nutrients. Fertiliser nitrogen is quite mobile in the soil. It can be leached or washed through the soil, beyond the root zone of the grasses, if heavy rain is received and/or excessive irrigation water is applied. Consequently, the use of an Enhanced Efficiency Fertiliser may be of benefit – like enPower or Green Urea NV fertiliser blends.

Nitrogen fertiliser needs to be applied regularly throughout the year.

1.2. Phosphorus (P)

Phosphorus, among other things, is important for root development. Unlike nitrogen, phosphorus is not readily leached from the topsoil, except on sands with a low Phosphorus Buffering Index (PBI).

Consequently, phosphorus does not need to be applied as regularly as nitrogen, though it is customary to apply it (purely as a matter of convenience) on several occasions during the year in combination with nitrogen and potassium.

1.3. Potassium (K)

Potassium is taken up in fairly large quantities by plants, second only to nitrogen. It plays a major role in plant growth and water relations within the plant and increases vigour and disease resistance.

Like nitrogen, it is subject to leaching, but not quite to the same extent. Where required, it is customary to split-apply it, in combination with nitrogen.

Potassium is most likely to be required on sandy soils, and especially where grass clippings are removed, rather than left on the surface. Golf greens require regular application of potassium.

1.4. Sulphur (S)

Like nitrogen, sulphur is required for the manufacture of protein and is needed throughout a plant's life. It is required in about the same amount as phosphorus. Like nitrogen, sulphur deficient plants are pale green to yellow in appearance.

Most complete NPK fertilisers used to fertilise playing fields contain sulphur, so deficiency does not commonly occur.

Sulphur is not always required in fertiliser programs, with variable amounts being received in rain, and some bore waters. The amount that falls in the rain is greater in coastal locations.

2. pH

pH is a measure of the soil's acidity or alkalinity. It is measured over a range from 0 to 14, pH 7 is neutral, less than 7 is acid and greater than 7 is alkaline. Soils commonly lie in the range from pH 5.0 to 8.5. A pH range from 6.0 to 7.0 is optimum, though most grasses are tolerant and will grow quite well outside this range.

Soil pH influences the availability of several of the essential plant nutrients. In strongly acidic (low pH) soils, aluminium, manganese, copper, and zinc are more available to plants and may even reach toxic proportions (with aluminium & manganese) but molybdenum availability is reduced. As pH rises above 7.0, molybdenum becomes more available, but nutrients such as iron, zinc and copper become less available.

When soils are too acid, lime (or dolomite) can be used to increase the pH. The amount of lime required depends on the degree of acidity, the target pH, and the soil type. A typical rate is 2.5 t/ha (25 kg per 100 square metres). A 'buffer pH' (or liming estimate) test is the most accurate way to determine lime rates when soil testing. The Nutrient Advantage laboratory performs this test.

On soils prone to acidification, repeat applications of lime/dolomite are required every few years.

3. FERTILISING FAIRWAYS

While nitrogen, phosphorus and potassium can be applied separately; and phosphorus does not need to be applied as regularly as nitrogen and potassium; these nutrients are customarily applied together as a complete NPK fertiliser. This saves time and is much more convenient than applying them individually. The analyses of commonly used NPK fertilisers are shown in Table 1.

For summer active grasses such as Couch, either Incitec Pivot CK 88 or Granulock Blue can be applied at 300 – 400 kg/ha (3 – 4 kg/100 m²) on three or four occasions each year, e.g. in September, December and March, with the interval between applications being extended during the winter months when grass growth is slowed.

The higher and more frequent rates are required where the turf is watered throughout the year, and where grass clippings are collected and removed, and nutrients that would otherwise be recycled are removed.

Table 1: Analyses of commonly used NPK fertilisers.

PRODUCT	ANALYSIS			
	% N	% P	% K	% S
CK 88®	15.1	4.4	11.5	13.6
Granulock® Blue	12.0	5.2	14.1	8.0

The turf's vigour and colour can be used as a guide to when it is necessary to re-apply fertiliser. When grass growth is slowed, and the grass loses its dark green colour and becomes pale green to yellow, it is time to reapply fertiliser, provided such changes are not attributable to cold weather, moisture stress, insects, or disease.

Only apply nitrogen if it is necessary, as excess nitrogen can be lost through leaching. This may be of concern in environmentally sensitive areas, as nitrate nitrogen may contaminate ground water, and re-enter surface streams and waterways. This can be managed by using Enhanced Efficiency Fertilisers like eNpower, which is an ammonium stabiliser.

It is best to water the fertiliser into the soil. Where possible, this should be done soon after fertilising and on the day of application. Otherwise, fertiliser granules and dust that lodge on plant leaves may dissolve in overnight dew and burn the foliage.

Applying fertiliser when rain is forecast may avoid the need to water the fertiliser in, provided enough rain falls to wash the fertiliser from the foliage into the soil. About 10 mm of rain in the one fall should be adequate for this to occur. Lighter rain or showers will have the same effect as dew, enough to dissolve the fertiliser but not enough to wash it off the leaves and into the soil. The risk of leaf burn is increased if fertiliser is applied to wet grass, causing the fertiliser to stick to rather than fall through the foliage, and no further (follow-up) rain is received.

Watering the fertiliser in also avoids the risk of accidental ingestion by people, pets, or wildlife.

4. FERTILISING GREENS AND TEES

Regular, monthly application of fertilisers to greens and tees is recommended. This allows fertiliser requirements to be matched to grass growth, keeping greens and tees in good order and minimising loss of nutrients through leaching. Given the nature of soils used in greens and tees and the shallow rooting depth of the grasses, nutrients can easily be lost through leaching.

While dry granular fertilisers can be used, the application of fertilisers in solution (dissolved in water) is ideally suited to greens and tees.

Solutions provide evenness of fertiliser application, which is important on greens and tees, and are convenient way to apply fertiliser if it can be applied with the irrigation water.

When preparing fertiliser solutions, soluble fine (solution grade) fertilisers or any of the Easy Liquids should be used. Granular fertilisers such as Incitec Pivot CK 88 and Granulock Blue should not be used for this purpose, as they contain insolubles, which will settle to the bottom of mixing tanks, and block filters.

Examples of fertilisers that may be used in the preparation of solutions, and their analyses, are shown in the Table 2.

Except for Liquifert N, a urea fertiliser with a smaller granule size than Granular Urea, Incitec Pivot Fertilisers no longer markets a complete range of solution grade fertilisers. Easy N[®] is a high analysis liquid fertiliser. It is just one, in the range of Easy Liquids, that can be used.

Table 2: Analysis of solution grade fertilisers.

Product	Fertiliser Analyses			
	% N	% P	% K	% S
Urea (Liquifert N)	46			
Urea Ammonium Nitrate (Easy N [®])	42.5 w/v			
Ammonium Sulphate	21			24
MAP (Tech Grade)	12	26.6		
Potassium Nitrate (Soluble Solid)	13		38.3	
Potassium Sulphate (Soluble Solid)			42	18

Incitec Pivot Fertilisers presents this information so that greenkeepers have a guide to refer to. Either of the programs in Table 3 can be used to supply nitrogen, phosphorus, potassium, and sulphur, monthly, over an area of 100 square metres.

Table 3: Monthly fertiliser requirements (grams/100 square metres) for greens and tees.

Product	Program A	Program B
Urea (Liquifert N)	400 g	300 g
Ammonium sulphate		100 g
MAP	100 g	100 g
Potassium nitrate		275 g
Potassium sulphate	250 g	

The programs are for both greens and tees. The latter often miss out, and their treatment should be tied in with the greens schedule for watering, mowing, topdressing, and fertilising.



The ingredients should be dissolved in water, e.g. in a 50 L drum, the contents of which can be injected into the irrigation line or applied by a Venturi sprayer to provide even application over tees and greens.

If applied as a spray, water the green or tee immediately after application, to wash the fertiliser solution off the leaves. This avoids the risk of leaf burn.

Over summer, during the wetter months of the year when the turfgrasses are growing most actively, it may be best to apply nitrogen on a more regular basis at lower rates, so that cumulatively a little more nitrogen is applied.

Rather than apply urea once a month, as detailed in the above programs, reduce the amount of urea applied by 150 g per 100 square metres (to 250 g in Program A and 150 g in Program B), and two weeks later, in between the monthly NPKS applications, apply an additional 250 g urea per 100 square metres on its own.

5. MAINTENANCE

5.1. Mowing

Frequent mowing, particularly through the growing season, with well-maintained and serviced gangs, tee and green mowers, is a must for all playing surfaces. Well-watered, properly drained and adequately fertilised fairways require gang mowing twice weekly in the growing season to aid in their development. Undesirable grass species will not withstand frequent mowing, whereas couch grass responds well to regular mowing.

Greens and tees should be mown at least three times per week, and greens preferably four or five times per week during the main growing season, to help develop true and even surfaces.

Mower settings should be regularly checked and varied according to the vigour of the grass. Shaving, except as part of a renovation program should be avoided; the objective is to mow growing leaves to provide even surfaces and to promote new leaf growth.

Mower maintenance, apart from ensuring proper set and even cuts, should also avoid oil leaks, particularly where hydraulic systems are used, since oil burn can be quite severe on any grass surface.

5.2. Renovating

It is difficult to lay down hard and fast rules as to frequency of renovation, as this will vary according to grass species and natural climatic conditions. Avoid renovation when natural growth of greens is slow.

Greater use of machines for coring, drilling, and reno-thinning would benefit most golf course greens. These treatments are often regarded as an annual event when more regular renovation will promote more vigorous growth during the main growing season.

Drilling with machines where available, while slow, provides “shatter” of soil down to 15 cm which softens greens and allows better water penetration. Coring assists aeration of the soil, as well as softening the surface and thinning the root mat to promote more vigorous growth.

Reno-thinning is essential on couch greens to remove runners or thatch and promote new leaf growth. This should be undertaken several times through the season, particularly on Green or Cape Couch surfaces, since these two grasses have a much lower leaf to stem ratio than Blue Couch and

are much more prone to “thatching up” during the growing season. Blue Couch, however, also responds to reno-thinning several times a year.

5.3. Topdressing

Regular light topdressing with good quality sandy loam free of weed seeds (and not just following renovation treatments), assists in gaining and maintaining even surfaces through repair of plug marks on greens and encourages leaf growth. It is not necessary on every occasion to topdress the whole green, just the uneven or worn sections.

Topdressing tees is at least a weekly requirement, certainly on the areas where tee markers have been, to repair divot marks and retain level tee surfaces. As far as possible tees should be accorded the same care and attention as greens. Tees are more prone to damage and unevenness if not regularly tended.

5.4. Changing pins and tee markers

With increased traffic on many courses, there is a real need to attend to this task every day or two to avoid badly worn surfaces. An adequate supply of topdressing should be on hand to do the job of changing pins and markers properly, patching up as you go.

5.5. Drainage and watering

Adequate drainage on greens, tees and fairways is essential for maintenance of good grass cover. Provision of good drainage is often the first step in correcting poor growth and ensuring full utilization of irrigation water and applied fertiliser.

Even distribution of water over the surfaces of greens and tees is the first requirement of good spray irrigation systems; without it, uneven growth and bare patches often result. Automatic sprinkler systems should be set to water overnight to avoid undue evaporation losses and the watering rate varied to take account of natural rainfall and prevailing weather conditions.

Every spray point in automatic systems should be regularly checked (at least weekly) and maintained to ensure even precipitation of the required amount of water.

The quality of water used in irrigation or sprinkler systems is often a cause for concern. Supply from tidal creeks and bores is sometimes harmful because of salt content. Water can be tested to determine its suitability for irrigation purposes on turf grasses.

5.6. Gypsum

Clay soils may exhibit poor physical structure. The structure, and internal drainage of such soils may be improved by the application of gypsum, at 5 t/ha (50 kg per 100 square metres). The effects generally last a few years.

5.7. Micronutrients

Trace element deficiencies can occur in lawn grasses, including iron deficiency. Where iron chlorosis (yellowing) occurs, Iron Sulphate or Iron Chelate can be applied at 25 to 50 grams per 100 square metres to provide a quick “greening” effect. Care should be exercised in applying iron fertiliser as excessive or uneven application may burn the green. Zinc & copper are other trace elements that are likely to require management.

5.8. Weed control

A well-kept green is usually free from weeds. They will usually only develop where the opportunity exists, such as on bare patches or on areas where the grass is not growing strongly. Consequently, the best method to adopt in controlling weeds is to maintain the grass in a healthy growing condition.

Even under the best of management, however, certain undesirable plants may make their appearance in the greens from time to time, and control or remedial measures must be adopted.

The weeds of greens may be broadly divided into three classes:

- grasses of the *Poa annua* type (commonly called Winter or Goose Grass);
- legumes and creeping or broadleaf weeds;
- and mosses and sedges (including Mullumbimby couch).

Specialist advice should be sought on the use of appropriate herbicides for the control of weeds.

Mosses and sedges are sure signs of poor drainage or temporary waterlogging in a heavy wet season, lack of aeration and soil acidity. While sedges may be controlled by herbicides, it is better to eliminate them by improving soil conditions by attention to drainage, spike rolling, liming, and fertilizing. Application of lime (or dolomite) at 150 to 200 grams per square metre may considerably reduce infestation.

5.9. Pests

Insects can be merely troublesome, through to having quite devastating effects, necessitating early control with a suitable insecticide.

Lawn Grubs

The lawn army worm, or lawn grub, is a most destructive lawn pest during the summer months. The larvae, or caterpillars, which are grey-green or brownish in colour, eat grass roots at surface level, leaving dead patches in turf. When fully grown they are about 2 - 3 cm long. These caterpillars feed at night and hide below the surface during the day.

The grubs are parasitized by a red-coloured wasp, which can be seen hovering over lawns when lawn grubs are active. However, since lawn grubs normally occur in such high numbers, control by insecticides is required.

Ants

Ants can be controlled with suitable products.

Black Beetle

Occasionally greens are invaded by the larvae of Scarab beetles, the most common of which is the black beetle. The beetle is black, 12 mm long, and its larvae is a typical white curl-grub. Turf damage results from the beetles eating the grass roots and tunnelling, which spoils the surface of the green. Black beetles are seldom troublesome where a program for ant control has been carried out.

Worms

In wet weather earthworms may come to the surface, leaving soil casts on top of the grass. They will move downwards when the soil dries out, so treatment is not necessary. Earthworms help aerate and move organic matter into the soil, and in the recycling of nutrients.

5.10. Disease

The most common disease problems that occur in greens are listed below. Fungicide sprays are often necessary in their control.

Brown Patch

This is a fungus disease that occurs occasionally during the cooler months. This disease causes quite large areas of grass to die out. Poor drainage increases the severity of the disease to a considerable degree.

Dollar Spot

Like Brown Patch, Dollar Spot is a fungus disease. It also occurs in the cooler months causing small spots to die out. Severity of this disease is increased under situations of poor drainage.

Helminthosporium Leafspot

This is a fungus disease which appears during warm weather. A discolouration develops in leaf sheaths, the turf becomes chlorotic, followed by a dieback to the crowns. Finally crowns and roots turn brown and rot.

Fusarium Patch (*Fusarium nivale*)

This fungus disease is most prevalent in the colder conditions of late autumn. Again, yellow patches appear which subsequently turn brown when the grass dies. The dead patches may vary greatly in size as individual patches tend to coalesce, resulting in the death of considerable areas of turf.

Fairy Rings

This is a fungus disease that expresses itself as a circular dark green band of turf. On the inner side of the ring, grass usually dies. The fungus growth, which initially begins at the centre of the area, progresses outward at 15 - 60 cm per year.

Fairy Rings are likely to appear if there is an abundance of organic matter in the soil. At first, nutrients released in the decomposition of the fungus produce a dark green growth of grass, but the fungus filaments eventually become so dense that the soil cannot be wetted, and the grass dies from lack of moisture.

Control is a problem because it is difficult to wet the entire fungus infected soil with a fungicide.

Algae

During long periods of wet weather even well drained greens can develop a green, slime-like growth on the surface. On less well drained greens this growth appears on those areas where the water does not get away quickly, even if only comparatively small amounts of rain fall.

This green growth which also flourishes in slowly draining concrete gutters consists of several species of algae. The algae are not parasitic on the grass, but they form a dense cover through which the grass leaves cannot penetrate and can therefore cause patches of dead turf. After the rain ceases, the algal growth dries, curls up, cracks and flakes over the surface of the green leaving bare patches of soil with little or no grass growth. Water is necessary to algal growth so that attention to drainage is the first essential in eliminating the trouble. As the species of algae growing on the greens are very sensitive to small amounts of copper, spraying the surface with Copper Sulphate (Bluestone) at 50 g/60 L of water to cover 100 square metres will check the growth very quickly during prolonged wet weather which favours its appearance.

6. PETS AND WILDLIFE

While animals do not normally have access to golf courses and the risk is slight, the ingestion of freshly applied fertiliser may affect the health of animals and wildlife, and in isolated incidents result in deaths. If practical, it is best to remove grazing animals from areas being fertilised, and not to readmit them until after rain is received or irrigation applied, and regrowth occurs. This minimises the risk of direct ingestion of fertiliser, and nitrate poisoning in young regrowth where nitrogen fertilisers are used.

7. SAFETY DIRECTIONS

Refer to the Safety Data Sheet (SDS) for more detailed safety advice. Before use, read the Product Label and the SDS. Use safe work practices and avoid contact with the eyes and skin. Avoid ingestion and inhaling dust. Protective clothing, eyewear and dust masks should always be used when dealing with this product. Observe good personal hygiene, including washing hands after use. Avoid loss of fertiliser to waterways.

8. WARNING

This document contains information of a general nature. Before using fertiliser seek independent agronomic advice. Fertiliser programs may need to be varied depending on the plants being grown, climatic and soil conditions, application methods, irrigation, agricultural and livestock management practices, the soil's fertility, and cultural practices. ('Unforeseen Elements')

Fertiliser may burn and/or damage crop roots or foliage. Foliar burn to the leaves, fruit or other plant parts is most likely to occur when fertilisers are foliar applied at high concentrations and/or on a regular basis, different products are mixed and sprayed together at cumulatively high rates, the water is of poor quality, or the spray is applied under hot dry conditions, e.g. in the heat of the day.

Fertiliser and supplements may affect animal health. Seek independent advice before using any supplements in livestock rations.

9. DISCLAIMER

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