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the engine, this being ideal for operating hydraulic pumps and may also be possible for use with mowers etc. Front lifts and PTO's offer interesting options for doubling tractor use and efficiency.

TRANSMISSION

While the most basic tractors only offer a limited number of gear ratios, top spec. machines have so many gears that the operator can often be confused. Gear ratios are more rational on contemporary machines and recent years have seen the advent of the 'shuttle' – one lever to change quickly and easily from forward to reverse. The most obvious use is for loader work, though there are many other manoeuvre intensive operations where shuttle is an advantage.

Drainage, coring and a number of other operations require especially low speeds and many tractors offer an optional creeper gear. On some this is easily installed without dismantling, whilst on others it becomes a factory built job. Forty km/h (25 mph) available on many



The John Deere Cab – luxury personified

new tractors makes for faster travel – although 20 mph remains the maximum legal limit on the road. Hydrostatic drive is readily available on

many compact ranges though very few standard tractors offer other than conventional gearboxes – perhaps because of the cost of larger units. Thus the clutch remains the greatest liability in transmission, though there are some tractors with clutches of greater capacity and longevity. Brakes are now both reliable and effective, a very limited number also having front wheel brakes, while all new machines are now required to have trailer braking.

The operator's platform has an important bearing on work output, and though cabs have become standard on agricultural tractors they still rate as an 'option' on compacts, TVM's and ATV's. Many operators prefer a roll-bar and open air rather than the somewhat claustrophobic atmosphere of the cab, though today's cab is much more comfortable and affords easier access.

If the major use is as personal transport then access must be a prime consideration and certainly all tractors (and cabs) are not equal. But then the tractor is NOT intended for this use – the ATV is.

There are a whole range of other options, some being easily added – such as loaders – and detached when not needed, though others have to be factory fitted. Downswept exhausts are preferred by many who work close to or under trees, and extra spool valves give more external services. Another interesting option – standard on a limited number of models – is reverse drive, which puts the work in front of the driver. With mowers this also avoids wheeling the grass in front of the cutter and reverse drive also works well with fork-lifts.



Fertiliser

What to use, how to use it

In this 11-page feature, KEITH McKEE explains the not-so-obvious elements of turf nutrition: and we take a look at the developing market and its approach to golf green fertilisation in France

Turf on golf courses is, ironically, unnatural. That is, it is an artificially maintained flora which could not survive untended, unlike the stable ecosystem of, say, a sandy heathland. Throughout a playing year, golf course turf will be trampled, kicked, scratched, torn, swiped with clubs and run over by buggies. IT WILL ALSO BE PLAYED UPON WHEN IT SHOULD BE CLOSED. Throughout all of this bombardment it should be presented like a championship course all year round. To ease such stress and produce playable, resilient turf that will keep members happy, today's greenkeeper runs a balanced maintenance programme of mechanical operations, irrigation and nutrition. Whilst this article covers nutrition only, the other elements of good turf management are just as important.

There is no doubt that to grow properly, plants need nutrients. These nutrients are well known: nitrogen, phosphorus, potassium and a whole variety of trace elements. Like general turf management, all these elements are important, with a deficiency of one upsetting the balance essential for turf growth and survival.

The nature of these nutritional elements is critical too. It is widely recognised that agricultural fertilisers are totally unacceptable for golf course grasses, especially fine turf. Certainly they are not easy to apply. Most important, however, is the priority of agricultural fertilisers to produce yield. For sports turf the priority must be quality. If quality is the key objective for the greenkeeper then he must be careful in drawing-up a nutritional programme that is right for his course.

The only common rule that applies here is that one golf course is not the same as the other. Each is as individual as a fingerprint, indeed the seventeenth green on any given course may not be necessarily the same as the eighteenth. Fertiliser

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Organic sources in focus

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requirements will vary for a number of reasons: weather, soil/substrata type, level of rainfall, frequency of mowing, wear and tear etc. Despite this, the greenkeeper should consider some general principles before devising a tailor-made feeding programme.

STRI specialists, Isaac and Canaway, believe that fine turf requires 200-250 kg N/ha per year, with experiments carried out at Fisons Levington Research Station over many years supporting this view. Certainly the Greenmaster fine turf fertiliser range was developed with this in mind. In his study of pure sand greens, Dawson believes nitrogen should be applied in excess of 250 kg per hectare per year. This is because of the greater leaching effect of such greens.

It should also be remembered that 'natural soil' greens, routinely top dressed with sand, will, over the years, become increasingly similar to greens originally constructed from sand. Nutrition must be adjusted accordingly.

Fine turf grasses can only take up nitrogen in the form of ammonium or nitrate. There are numerous compounds which provide these elements either directly, e.g.: ammonium sulphate and ammonium nitrate, or indirectly, e.g. hoof and horn, dried blood, urea and isobutylidene diurea (IBDU).

Not all sources are suitable for fine turf, but ammonium sulphate has proved to be the most successful form

of 'rapid' release nitrogen, as it encourages good growth, colour, superior texture and uniformity of Agrostis and Fescue species. It also reduces pH.

This can be desirable where a soil is not naturally acidic, but over use can lead to low vigour, poor drought resistant swards which are prone to thatch development, and the ingress of weeds. Ammonium sulphate can also scorch grass. To overcome these problems; products like Greenmaster fertilisers have included some organic or ureic nitrogen in their formulations.

Concerns for the environmental well-being of golf courses have raised the profile of organic sources once again. Hoof and horn in particular can give very good results as a slow-release nitrogen source. However, it is expensive and – in its natural form – difficult to use. Other organic mixes like those based on cow slurry cannot match the N, P, K analysis that turf demands and which inorganics offer, which makes the recent launch of Sportsmaster Organic outfield turf fertilisers all the more interesting. In this case, the Company have formulated organic nutrient sources into an easy-to-use mini pellet that feeds the grass as well as good inorganic equiva-

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Nitrogen versus other nutrients: conflict goes on



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lents. The presentation of organics in such a useful formulation is an important breakthrough for today's greenkeeper; though whether we will be able to provide similar fertilisers for fine turf remains to be seen.

Inorganic sources of slow-release nitrogen are very popular in both the United States and Europe, though in the UK a conflict of opinions has stunted their use. If applied properly however, slow release fertilisers can be a valuable, labour saving tool.

Applied on its own, granular IBDU will show a good turf growth and colour response after about five or six weeks, which is then sustained for several weeks. The apparently slow start is no disadvantage because a 50% rapid release nitrogen/50% IBDU fertiliser mix will give a good initial response as well as a sustained response. For example, Greenmaster Super N (24: 0: 0) will show a relatively even response for about twelve weeks. It is important, however, that the mix is 50 : 50 and the declared nitrogen levels are fairly high. Fifty per cent of not very much is a complete waste of money.

Whereas it is widely accepted that nitrogen fertilisation is vital for fine turf, the supply of other nutrients is much more contentious. There is no dispute over the fact that phosphorus is essential, as it assists in storing and transporting energy. Potassium, too, is important in activating enzymes that help increase resistance to fungal infections. All other essential nutrients have similarly well-defined roles. The contentious debate centres not on ingredients, but on the quantities that should be applied.

An application of 47-70 kg of phosphorus per hectare and 85-140 kg of potassium per hectare per year is a satisfactory guide. The vital key, however, lies in soil analysis. Stansfield's STRI report (1985) suggests that many golf and bowling greens contain adequate levels of phosphorus and potassium. In these cases it is wholly appropriate to use a nitrogen only fertiliser. Products with or without P and K are offered to suit individual circumstances but it must be borne in mind that these reserves will run out one day and playable sport turf does need P and K as part of its feeding programme.

Nutritional policy must be balanced. That balance can be achieved by reviewing the quantities of nutrients in the soil and by determining nutrient levels lost through clippings. The formulations that make up the Greenmaster and Sportmaster ranges are designed to make up for the natural imbalances the game of golf creates. They are also designed to complement the other key elements of turf management from pic. to aeration, irrigation to seeding. Getting the balance right will bring success to any greenkeeper.

● Keith McKee is European Technical Adviser, Fisons plc, Ipswich.



Fertile FRANCE

France is possibly the fastest growing golf market in Europe. Japanese, American, Middle Eastern and European money is being channeled into new golf course constructions, with greenkeepers being recruited from Great Britain and North America; as well as being trained in France itself. The training of greenkeepers has become a very important subject and one in which all sides of the French golf industry have had an influence. Unlike the UK, there is no 'tradition' of golf greenkeeping, so they are immediately addressing the problems posed by modern construction methods and the intensity of play that the rapid growth in golf interest has generated.

The Barbaroux Golf Course is described as 'the ultimate in European golfing'. It comprises 87 hectares for a course length of 6963 yards in wooded landscape interspersed with six extensive lakes

With limited practical experience they are tending to follow the scientific path, but this is well tempered by user experience drawn from industry sources, as well as 'imported' greenkeepers. The changes in grasses as well as construction materials has tended to make 'traditional' greenkeeping methods of limited value and this has brought new opportunities in creating new methods to produce what all greenkeepers and golfers are looking for – first class playing surfaces.

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Special fertiliser maintains quality

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A brand new modern construction in France will never be another St. Andrews, but that is the joy of visiting and playing other courses – the challenge of new surroundings. As a test of the golfer's skill French courses are equal to their counterparts in the UK and maintained to an equally high standard, but with a character of their very own, they are different. You will all have seen the postcard of the two young children entitled: "vive le difference"!

At the recent first International Salon of Golf Course Maintenance and Repair (SIERG) organised by the Association of French Greenkeepers (AGRF), this new thinking in respect of golf green fertilisation was introduced to a new product from BASF. The close affiliation between manufacturer and greenkeeper had identified a need and responded to it in an effort to make the 'manipulation of nature' called greenkeeping a little more effective.

Because most constructions in France are new they do not have the reserves of nutrients so often found in older UK greens. They have also been built with irrigation and drainage incorporated from the outset, rather than the 'add-on' situation here. This means a very free draining structure often covered with one of the new creeping bents which have a high nutrient demand, so applying nutrients in the correct balance and in the right quantities and form, enabling the plant to optimise their use, was essential.

The Company drew on all these requirements and their own experience as major fertiliser producers to create for BASF France a special fertiliser – Floranid Master – to assist in maintaining the quality of French golf greens.

The formula is 16:5:10:+5Mgo and Trace elements. It was first researched in response to the demands of the new turf grasses, (stoloniferous agrostis spp in particular), which demand a balance of nutrients at least of 3:1:2., this being determined by the losses incurred in clippings removal. Add to this the fast infiltration rates of USGA specification and pure sand constructions and you will appreciate that ingredients had to be carefully selected.

Nitrogen: with very little nitric nitrogen (2.5%) to reduce leaching and subsequent pollution by nitrates, but with a lot of slow-action nitrogen (two thirds in IBDU form) for reliable, gentle feeding without sudden flushes. Phosphate was added 5% p2o5 in the correct

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 proportion to maintain plant functions without creating an over-supply.

Potassium: this element is particularly important on free draining constructions, as these do not hold Potassium very well and it is essential in helping disease resistance. It is supplied in sulphate form to reduce the risk of polluting the subsoil with Chlorine, found in other sources of Potash, and the sulphate form reduces the risk



of scorch, (Sulphate has a salinity index of 46, as opposed to Chloride, which has 114). Furthermore, the use of Sulphate avoids the phenomena of phytotoxicity, which the chloride ion can induce, and encourages the formation of dry matter, reducing bruising and wear sensitivity.

Magnesium: this is at a high level to keep the ration with Potassium and to encourage the production of chlorophyll, for plant photosynthesis.

Trace Elements: Iron (0.5%) copper (0.01%) and zinc (0.01%) are the three most important metallic trace elements for turf, as they promote the formation of growth substances and help in chlorophyll synthesis.

The creation of this new product did not stop at the analysis, for the size and distribution of sizes of granules were specially researched for precise and regular spreading over small working areas. Even the colour was not left to chance and after several tests with different colours, carried out by the greenkeepers themselves, a brown colour was chosen. This allows easy checking of the spread pattern but quickly disappears into the sward.

Like the French golf courses it is used upon, Floranid Master is new, but it clearly shows the more open approach to greenkeeping that the lack of traditional conservatism is creating. We all hear a lot about the opportunities within Europe after 1992, but let's remember that on the continent they are all looking toward the UK and saying 'the same thing! Will the next greenkeeper at your course be French or German?

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