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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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New Fisons Sportsmaster Organic - the organic fertiliser designed to spread and perform as accurately as the best conventional fertilisers



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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.