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associates. They play a vital role in the organisation and are made up of experts in many field and disciplines. Combined they have a wealth of knowledge spanning many years in wide range of subjects. Like the members these specialists are invited to join and their participation means that members have a readily available source of information and advice relating to their services and products. This is of considerable benefit not only to the membership, but also their clients and customers. The BAGCC has a code of ethics, which is rigorously upheld.

In recent years, full golf course construction has tailed off and a lot of the work now being carried out is of a replacement nature or modifications to parts of the course.

The game itself has also undergone considerable changes. The design and use of modern materials for clubs and balls, plus higher standards of play, have meant greater distances are being achieved than in the past. For some courses this may result in the replacement of existing tees or greens to provide a greater challenge.

One of the biggest changes is as a result of the present climatic conditions. Higher rainfall can result in an alteration of the water table level causing flooding, and the existing drainage systems could be inadequate to deal with a large influx of water. There is also the increasing problem of compaction, which adds to the difficulty of the removing surface water.

During the boom time dubious materials were used and suspect practises carried out on some projects - the results of these, can surface at any time.

If new construction is required there are guidelines that need to be addressed from the moment the decision is made to go ahead. In fact, some of these should be considered when the idea is first raised as a possible project.

The success or failure of any construction hinges on the planning. It is not just a question of "that is a good idea lets do it now". No doubt some readers have heard this type of comment when dealing with a greens committee. There will always be a number of questions that have to be answered before work begins. While the project satisfies club members requirements, how will it fit into the present course management programmes? Is it going to require specific needs and would this incur extra maintenance costs? This could





# Constructive Advice



certainly apply to a new green built to modern specifications, which is sited amongst older ones. Another factor that needs thorough investigation is, will any construction work effect the playing facilities? Disgruntled golfers may be a major problem and there is always the possibility they will go to other courses, thus depriving yours of revenue.

Once the decision has been made to go ahead it is then down to formulating and producing a design that encompasses all the requirements. Depending on the work to be carried out it is likely at this stage that specialist advice is necessary. The design must be specific and leave no room for any misunderstandings. The plans should include key information and details of any existing drainage, irrigation systems and other service facilities such as electric and water supplies.

As the site is likely to be in the vicinity of sensitive ground surfaces access routes for bring in materials and equipment need to be clearly shown so any damage to the turf or ground is minimal. In instances where the work is being carried out close to buildings and there is the possibility of contact with the general public the contract needs to clearly show the contractors obligations and any safeguards necessary to protect him, the client and the general public.

It is now time to decide on a suitable contractor and as already mentioned members of the BAGCC are the best starting points. While price, in most cases is going to play a major part in who is chosen there are other aspects that need to be taken into account. If the price difference between tendering companies is significantly large it requires a detailed explanation. Word of mouth is a good indicator of the

competence of a company, especially if the bottom-line figures are close.

Once the contractor has been appointment it is important to immediately establish a strong line of communication between all involved parties. This is critical if everything is to run smoothly and the work completed within the agreed time scale. The contractor should appoint an on-site manager who can be contacted at any time. Where the main contractor is employing sub-contractors then there needs to be an easily accessible representative of the main company whose responsibility it is to sort out any problems quickly and efficiently. By establishing this network before work commences, time, frustration and money can be saved should any difficulties occur.

The question arises regarding the materials used, it could be tempting to try and save money or use an alternative specification, but decisions of this nature can result in the failure of a construction project. If this situation occurs at a later date one will probably ask, why did I allow it to happen? Today, prices generally reflect what you are actually getting so a few pounds saved could very well create considerable hassle in the future.

All materials used should be regularly check. If a shipment of turf arrives, ensure it is at the same standard as the original samples and to the correct specifications that was ordered. By used well-known established suppliers, while not a hundred percent foolproof increases the chance of it being close. The marketplace is highly competitive, so it is in a company's interest to ensure customer satisfaction.





#### SUMMARY

- Draw up comprehensive plans and specifications.
- Select a contractor who has a very good track record for the type of work required.
- Use the best quality materials possible.
- Work out with the contractor, schedules that are achievable for the work to be completed within the time scale, taking into account possible variations in climatic and ground conditions.

- Ensure there is constant supervision of all the work carried out during the construction.
- Where work is being done 'in house' ensure any equipment hired or bought will do the work efficiently and is reliable.

One of the secrets of success of any contract is for the client's representatives, consultants and contractor to become a working team that regularly communicate with each other. The project then has every chance of being carried out efficiently, to the standards the clubs requires and within the budget and time scale. The whole operation is less frustrating and stressful - on completion everyone walks away satisfied.

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# REBUILDING Golf Greens

By Steve Isaac, Senior Turfgrass Agronomist, STRI Scotland

## Why rebuild?

Most courses have a few greens that perform badly compared to the others, usually in relation to drainage and winter playability. With the increasing demand for year-round play and the uncertainty over climate change, though it does seem to be getting wetter, the need to rebuild inferior greens is greater than ever.

The latest weather data from the Climatic Research Unit and the Hadley Centre demonstrates that the climate has changed due to the inevitable effects of global warming. The data shows that total annual rainfall has increased but, more importantly, the amount of precipitation during the winter months has increased hugely (see figure 1).

Further analysis shows autumn rainfall has increased hugely, compared to the total amount of rain during August, in the past ten years. During the period 1961-1991, the percentage difference in September and October rainfall compared to August rainfall was 2% and 12% respectively. In the past ten years the difference has increased to a staggering 23% and 28% respectively, essentially meaning our autumns are much wetter than they ever used to be. This has major implications of year-round playability of golf greens and our ability to work on them to increase winter usage.

There are plenty of options to try before resorting to reconstruction, but when years of Verti-Draining, Drill & Fill or drainage options such as Fin Drains and gravel banding have failed to provide a permanent solution, reconstruction is the final answer. Whenever the subject of rebuilding a green is raised during an advisory visit, we usually get one of five responses:

- The members will not accept the disruption.
- The Club can't afford it.
- A new green will play in a wholly different way to the others on the course.
- We've tried it before and it failed miserably.
- Yeah! Let's go for it!

Whilst the last response is always the one we hope to get, there is a good answer to all of the others.

How much disruption are members prepared to put up with? If a green is a candidate for reconstruction then it probably takes little, if any, winter play and is slow to develop in the spring. It may be one of the better greens through the summer, wet greens usually perform well when it's dry, but 3 months of decent quality on an annual basis is not generally acceptable these days. If a rebuild is planned properly,

Figure 1 to show the difference in monthly rainfall during the periods 1991-2001 compared to the data from 1961-1990.

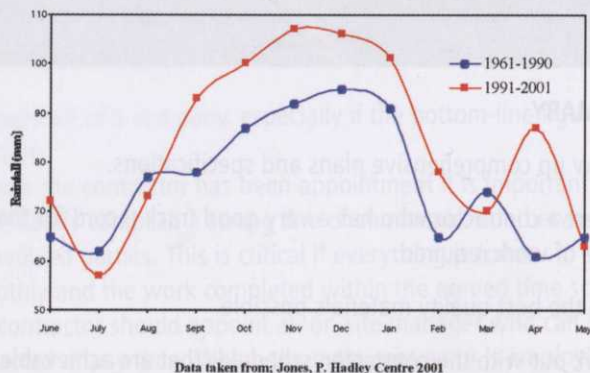
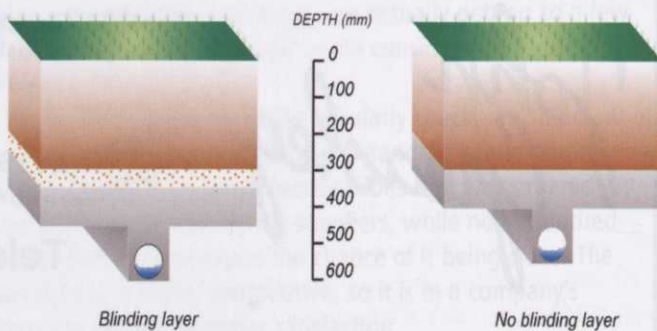


FIGURE 2

## THE USGA SPECIFICATION OF GOLF GREEN CONSTRUCTION





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the green may be out of commission for 6-7 months for just 1 year, and this assumes that it is going on the same site as the existing surface.

Cost is a factor. If you employ a contractor you could be looking at a figure of £35,000 for a new green and surrounds. However, we have seen in-house builds of quality being produced for as little as £12,000 (materials only).

A new surface can react differently to a mature one. The most frequent comment is that the new green is much firmer and less receptive to an approach shot. In some respects this is exactly what reconstruction is about, producing drier and firmer greens that will take winter play. This potential problem can be overcome by turfing rather than seeding and by relaying the original turf, which restores a surface that is likely to be far more compatible with the others on the course than might be the case if imported turf was used.

If you have a rebuilt green on your course that performs just as badly, perhaps worse, than its predecessor then it is probably due either to the use of poor construction technique, bad materials or inappropriate grow-in maintenance. To achieve a quality finished product you have to follow accepted guidelines and this includes quality materials and a greenkeeper who appreciates the difference between managing a new green and the mature ones on the golf course.

## HOW TO GUARANTEE SUCCESS

There is plenty of science in golf green construction. Indeed, there has been for over 30 years. This is how long the USGA recommendations for golf green construction have been around. The USGA Spec – as it is commonly known – has been much maligned over the years. Many so-called USGA greens have failed but, in my experience, this is because they are **not** USGA greens. Often they do not conform to the basic profile or the materials used do not comply with the stringent laboratory testing required or they are managed in an inappropriate fashion. If you follow USGA guidelines you will produce a green that will drain well and ease grass maintenance, enabling the development of a quality, year-round (frost and snow permitting) putting surface.



# REBUILDING Golf Greens

The USGA green profile is, basically, layers of free-draining materials built up over a pipe drainage scheme. Figure 2 (page 24) shows this profile for the two variations of the recommendations that are currently available.

The laboratory testing of the gravel, blinding (if used) and rootzone is critical to the success of the construction. All selected materials must conform to specific requirements and, if the blinding is omitted, the gravel and rootzone must be proven to be compatible.

## THE GRAVEL CARPET

When the blinding layer is used, the gravel must have the following properties:

- Not more than 10% of its particles in greater than 12 mm diameter.
- At least 65% of particles between 6 mm and 9 mm
- Not more than 10% of its particles less than 2 mm

And the blinding material must have at least 90% of particles between 1 mm and 4 mm.

If the blinding is omitted the spec for the gravel is tighter:

- No particles greater than 12 mm.
- Not more than 10% less than 2 mm.
- Not more than 5% less than 1 mm.

In addition, the gravel has to comply with a Uniformity Factor that puts a strict limit on the range of its particle sizes, often eliminating gravels that do not fit a tight 2 mm to 6 mm grade. The gravel is then tested against the rootzone to ensure that there will be no migration, with subsequent contamination, of the rootzone into the gravel (the Bridging Factor) and also to ensure that water will move readily from the upper rootzone into the gravel (the Permeability Factor). These factors are calculated from grading curves of the gravel and rootzone, which show the percentage of particles passing through a series of sieves. Figure 3 shows the grading curve for the sand component of a golf green rootzone. Sands falling within the grey region of the graph would be acceptable in terms of their particle size distribution.

Any similarity to the Hayter FM524

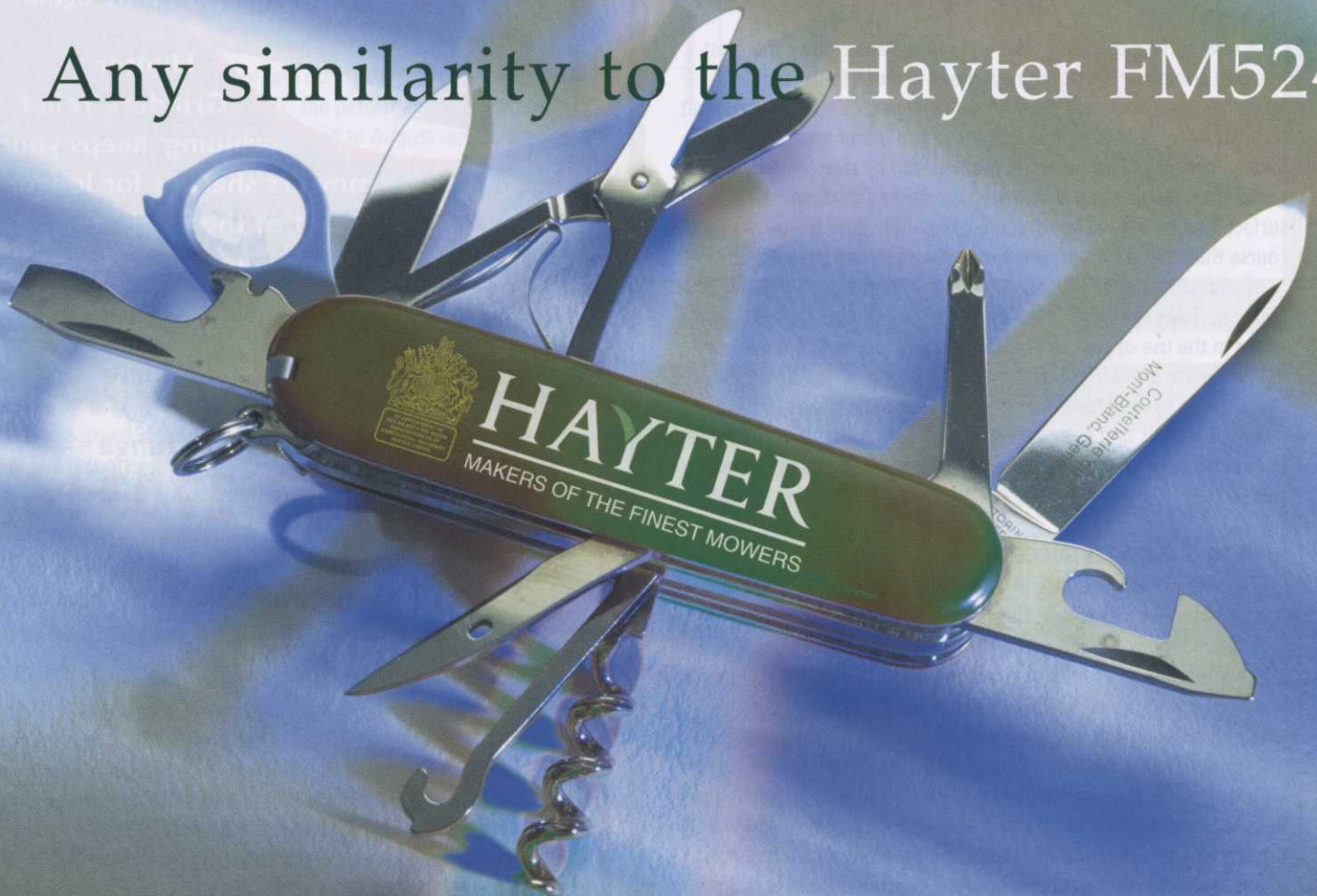
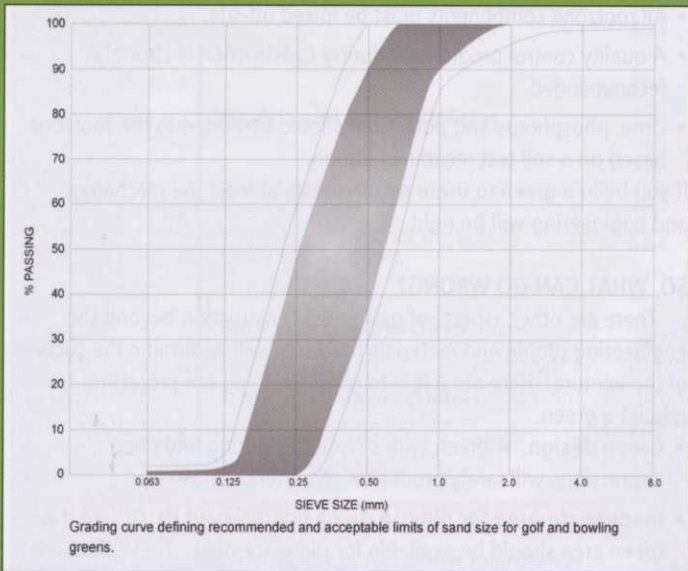




FIGURE 3.



### SELECTING ROOTZONE

There are quite a few ready-made rootzones on the market that purportedly conform to USGA recommendations. Be careful. Some do and some do for only the particle size parameter. For a rootzone blend to conform to USGA standards it must fall within the following particle size distribution:

Fine gravel including	2.0-3.4 mm	Not more than 10% of total, a maximum 3% fine gravel.
Very coarse sand	1.0-2.0 mm	Minimum 60% in this range.
Coarse sand	0.5-1.0 mm	
Medium sand	0.25-0.5 mm	
Fine sand	0.15-0.25 mm	Not more than 20%
Very fine sand	0.05-0.15 mm	Not more than 5%
Silt	0.002-0.05 mm	Not more than 5%
Clay	<0.002 mm	Not more than 3%

Total fines (very fine sand, silt plus clay) not to exceed 10%.

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# REBUILDING Golf Greens

Having passed this first test, the rootzone must then comply with further analyses that determine the physical properties of the mix. These tests determine the total space between solid particles within the rootzone (Total Porosity), that filled with air (Air-Filled Porosity) and that retaining water around rootzone particles (Capillary Porosity). Drainage rate can also be tested (Hydraulic Conductivity) and the rootzone must also contain a certain amount of organic matter. Table 1 lists the figures that the selected rootzone must comply with if it is to be used (as per the 1993 Revision of the USGA recommendations).

TABLE 1. PHYSICAL PROPERTIES OF THE ROOTZONE MIX

Total Porosity	35-55%
Air-filled Porosity (at 30 cm tension)	15-30%
Capillary Porosity (at 30 cm tension)	15-25%
Hydraulic Conductivity (mm/hr)	150-300 (Normal) 300-600 (Accelerated)
Organic Matter Content (by weight)	1-5% (ideally 2-4%)

The two ranges for hydraulic conductivity reflect the tremendous range of circumstances that the USGA recommendations have to cover; after all it is the means of building greens worldwide. Higher drainage rates are required in tropical and sub-tropical areas and where recycled or highly saline irrigation water is used, where greens have to be flushed out now and again to get rid of contaminants. In the UK the Normal range is the one to aim for.

The USGA recommendations are not right for every situation. A different approach would usually be taken if rebuilding a green on a links course, but this is one of few exceptions.

So, there are very tight guidelines for selection of materials and it is this that helps guarantee success. However, even if you follow all of these parameters things can go wrong.

## MORE RECOMMENDATIONS FROM THE USGA?

The USGA Recommendations are more than just a series of laboratory tests. The document produced by the USGA Green Section (the US agronomy service that plays a similar role as STRI) covers many other aspects of green construction. It is not a specification as such but there is more than enough advice in its pages to ensure a quality rebuild.

A selection of important, additional information includes:

- The subgrade, i.e. the soil base beneath the gravel carpet, need not conform to the general slope of the finished grade, but its shaping must reflect its purpose to facilitate water movement to the drainage system.
- The drainage design should ensure that the main line is placed along the line of maximum fall and lateral drains shall be spaced no more than 5 m apart.
- Drain lines shall be laid to ensure a minimum positive slope of 1 in 200.
- The surface of the gravel blanket must conform to the proposed finished grade.

- Materials suspected of lacking mechanical stability or of questionable weathering stability should not be used.
- All rootzone components must be mixed off-site.
- A quality control programme during construction is strongly recommended.
- Lime, phosphorus and potassium should be added to the rootzone, based on a soil test recommendation.

If you build a green to these requirements at least the mechanics and engineering will be right.

## SO, WHAT CAN GO WRONG?

There are other aspects of golf green construction beyond the engineering profile and materials used that will determine the success of the venture. Here are a few to consider if you are proposing to rebuild a green.

- **Green design.** A green with severe contouring and deep depressions will rarely produce a consistent surface.
- **Inadequate area for play.** A rough figure would be 70% of the green area should be available for pin placement. These days we, generally, look for greens with an area of at least 500 m<sup>2</sup>.
- **Capping of the rootzone.** The means of establishing a grass cover to the green will be a major influence on the final outcome. If you cap the sandy, free-draining rootzone with clay or silt brought in with imported turf or a thick layer of dense thatch from the original turf then you immediately compromise the USGA spec. Seeding is the preferred option for establishment but this assumes that you have plenty of time before the green has to come into play and a seeded green will react differently to the mature turfed greens on the golf course.
- **Inappropriate grow-in maintenance.** Broadly speaking, a new USGA green will require more fertiliser and irrigation than mature greens. The grass will have to be nursed through its first year or two in use, possibly with less aggressive mowing heights and verticutting regimes. Over-zealous top dressing can strangle a new green at birth.

## GET ADVICE – DO IT RIGHT

Rebuilding a green can be a nightmare or a sweet dream. There is an awful amount of information to consider and you must have access to laboratory facilities to get it right. STRI have the expertise to help you get it right the first time. From explaining the perceived problems of reconstruction to your members, through the materials selection process and into the grow-in programme, STRI can smooth the path to a successful rebuild.

**Steve Isaac is a Senior Turfgrass Agronomist with STRI and their Area Manager for Scotland & Ireland.**

**STRI have two agronomists based in Scotland:**  
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# THE FUTURE OF TURF MANAGEMENT

In the first of a monthly series of articles to appear under the "Continue to Learn" banner Barry Beckett outlines his view of how the industry may progress over the next few years.

Imagine a world without mobile phones, the Internet, CDs, microwave ovens and satellite TV. It wasn't too long ago that any of these existed; yet now they're part of everyday life and not given a second thought.

Now think of a greenkeepers' world in which robot mowers controlled by GPS technology carry out cutting operations throughout the night when players are asleep in their beds – and not right up behind you as you do your early morning mowing!

Far fetched? Not at all, according to some. For this scenario might well prove to be one of many technological innovations that will come to revolutionise the way in which greenkeepers maintain their golf courses in the future.

The world moves on apace and leading turf maintenance equipment manufacturers like Toro have to be actively thinking about the future of golf in, say, 10 to 15 years down the road. Questions about what technology greenkeepers will need and how this should be developed and brought to market as commercially viable products that work in practice are a constant source of challenge.

What is certain is that things will change. And for the greenkeeping industry, one of the greatest changes around the corner is the emergence into the profession of a new generation of men and women born and brought up with computers, people who will insist on using the benefits of computer technology to its fullest extent in their work.

Some changes we shall immediately embrace, others we may resist – but changing how we do things, not necessarily what we do will be at the heart of our future.

Not all changes and technologies are matched to market conditions. Some are far too ahead of their time and fail miserably.

Remember the Sinclair C5, the little car, that's now a collector's item!

It's hard to imagine that in 1970 there were no cordless let alone mobile phones, no CD players, microwave ovens, video cassette recorders, smoke detectors or even TV remote controllers.

Alternatively, not everything we need is necessarily new. For example, battery/electric-powered products are widely talked about today as something for the future in all aspects of the 'vehicle' industry including the turf industry.

But battery-powered products have been used in the UK for many years. In fact in 1912 there were 34,000 electric vehicles (lorries, vans, buses) registered, which was 35 per cent of all vehicles. The milk float was one of the more lasting.

The lawnmower industry flirted early on with electric power on some contraptions. And ever willing to try something new, the industry has also employed steam to power lawnmowers!

Embracing change and being prepared to learn new ways will be fundamental to all of us – otherwise we shall be left behind.

Looking to the future, factors that drive the market will be increased: leisure time, disposable income, life expectancy, increased TV coverage, and higher player expectations. Golf is a game for life.

For greenkeepers, factors driving our needs will be led by environmental pressure by way of regulation, consumption of resources (water, fuel), and emissions (air, water, noise). Added to this will be the issue of labour – its cost, availability and quality.

Future power sources we might see as well as battery and electric power include hybrids (petrol/diesel plus electric), alcohol fuel distilled from corn, solar power/regeneration, and rechargeable energy cells.

New materials used in the manufacture of products will bring benefits through new lighter weight, stronger plastics that also give fuel savings, ceramics for the hardest of mower blades, fibre optic cables, and recycled and recyclable compounds.

Grasses and fertilisers will both be part of this change process, with new grass hybrids that resist disease, heat and cold and can be cut shorter without stressing the plant. Grasses with a deeper natural green colour will be among other advances.

New fertilisers will include those that can be applied in micro-doses through irrigations systems.

Computers will revolutionise the greenkeeping industry and become part of everything a greenkeeper does. Some ways in which they will save time and money are:

- Linking irrigation systems to national weather centre computers to control watering.
- Measuring a machine's performance and self-diagnosing problems before they arise.
- Using bar coding as part of your spare parts usage, for automatically reordering replacements.

