The importance of education will be, as it always has been, recognised as one of the defining goals of greenkeeping in the 21st century. The successful establishment of a large number of existing colleges that offer turf grass management courses is to be welcomed. The future of such centres is assured as we strive to better understand our turf grass environment.

The golf course machinery manufacturing industry is another area that will continue to develop. This industry will probably follow common manufacturing trends whereby under increasing pressure from market forces we will hopefully • Advice • Application • Supply • Training

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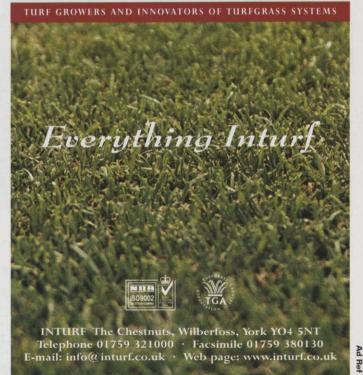
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ger of damaging s single living grass plant. Such systems would enable students to practice different techniques within differing parameters of budgets, staff numbers, climate and soil structures.

The need for continued investment in education must run parallel with the advances of scientific exploration in matters relating to the study of the turf grass plant. If there is to be any dramatic advances in turf grass management it is probable that it will come from this field. Investment in this area will undoubtedly bring great Institute of Professional Soil Scientists will undoubtedly provide key developments in our industry.

The scientific advances of these institutions include IGER's research into a mutant gene in festuca pratensis that may well lead to the development of 'evergreen grass' which stays green even in dormancy. Similarly, at Nova Scotia Agricultural College and other institutes, there are attempts to develop greens quality cultivars of poa annua. Another very worthwhile area for investigation is that of biological control of turf grass



rewards. We are already witnessing the successful results of new strains of resilient turf grasses which are providing greenkeepers with greater assurance than ever before. Advances in genetic engineering will probably be of greatest consequence for the future. The various institutes that currently exist for research such as the Sports Turf Research Institute, the Institute of Grassland and Environmental Research and the

witness greater competition

pests and diseases. Research that contributes to the development of cultural practices and biological controls which can alter the turf grass environment such that it favours the antagonistic microflora. These are just some of the many areas currently being investigated. Such developments though are unlikely to produce permanent solutions to our problems, that is why it is vital that we maintain and extend our investment strategies in these institutions and encourage interaction between the scientists and ourselves.

That education is perhaps the single most important arena for development in the future is not in question. The existence of centres of excellence for the study of turf grasses will become increasingly important especially if current trends on the restrictions of chemical usage continue. In such circumstances it will be to the past that we will turn in order to lay foundations for the future. It is vital that we uncover, record and research the many and varied cultural practices that were employed in the early 20th century greenkeeping profession before such information is lost forever. Many of these practices may

While machinery will be able to do many more complex and varied tasks it will also do so more safely and in an increasingly worker friendly environment. The use of alternative energy sources to power golf course machinery will obviously be pertinent in future years. The likelihood of any monumental changes that will irreversibly change the way we manage turf grasses is perhaps insignificant. It is more likely that we may employ the concept of evolution in the context of future developments in the greenkeeping profession.

have previously been so labour intensive that chemical solutions which achieved the same result were considered far more practicable. However, with the advent of so many advances in the manufacture of labour saving machinery it is conceivable that we can now re-employ these previously disregarded practices.

The golf course machinery manufacturing industry is another area that will continue to develop. This industry will probably follow common manufacturing trends whereby under increasing pressure from market forces we will hopefully witness greater competition which will result in more robust labour saving devices which will perform an ever increasing number of tasks. It is likely that the 21st century will see the successful transfer from inflation tyres to minimal compaction tracks. Advances in equipment such as the Hydroject and Verti-draining will bring enormous benefits. While machinery will be able to do many more complex and varied tasks it will also do so more safely and in an increasingly worker friendly environment. The use of alternative energy sources to power golf course machinery will obviously be pertinent in future years.

The advances in matters relating to turf grass management as outlined above are becoming increasingly evident in the last year of the present millennium. For the turf grass man-

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hatever their sport, players deserve a surface that can absorb all they dish out and bounce back for the next fixture. From rugby pitches to golf courses, Johnsons grass playing surfaces can cope with the best of British sport – and the worst of British weather. Our new range of seeds gives you all the benefits of one and a half centuries of breeding. So when you want to bring new life, strength and disease resistance back to your playing surface, Johnsons will deliver the goods, season after season.

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ager the stresses brought about by increasing regulations from the European Union and other bodies, especially in matters relating to conservationism, vis a vis Pesticide, Health and Safety and Labour regulations, will become more prevalent in the next century. Increasing bureaucracy will necessitate additional skills for the turf grass manager, therefore computer literacy and a good working knowledge of related legal matters will become increasingly important along with good diplomacy skills. Increasing reg-ulations will also advocate the continued trend towards conservationism. It is probable that golf courses will someday have to become virtually self sustaining, especially in matters of water recycling and effluent disposal.

It is arguable that the next century will bring with it increasing pressures for the Golf Course Manager. What may be dismissed as gimmicks by some may someday become commonplace. Recent developments have seen the construction of indoor golf courses as well as the possibility of providing twenty four hour golf by means of extensive floodlighting systems. In a similar context market forces will pressurise golf clubs to place greater emphasis on achieving extended targets for the number of rounds possible per annum. If such developments do

ever increasing popularity of the sport will continue to tax the industry. Such pressure is inevitably going to take its toll, but the successful adoption of continued evolutionary developments in all facets of the supporting industries should overcome these problems. It should be

The development of centres of academic and scientific excellence will undoubtedly bring with them numerous benefits. Such centres will devise computer training programmes that will simulate an endless variety of golf course environments that will facilitate both tried and tested turf grass management techniques as well as offering the potential to employ new experimental ideas without the danger of damaging s single living grass plant.

occur across the spectrum of golf courses it will inevitably lead to greater difficulties for the Golf Course Manager as course presentation will inevitably suffer.

Golf course management is undoubtedly going to face numerous challenges in the next century. The noted that golf course management techniques will essentially not change, what we do now is what we have done in the past and what we will continued to do in the future, and that is to apply the knowledge and machinery in the best possible manner. For information and an entry form for the BIGGA Essay Competition 2000, please call Ken Richardson, Education and Training Manager on 01347 833800 or email: ken@bigga.co.uk



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Six of the country's top men give their views on how course closures can affect their club

Course Closures

Compiled by Malcolm Huntington MBE



Name: Course: Region: Course Type: Staff:

Name:

Course:

Region:

Steve Dixon Kingsknowe GC, Edinburgh Scotland Parkland Course Manager plus four



Mark Mennell The Fulford GC, York Northern Parkland and heathland Head GK plus five, plus one part-timer Course Type: Staff:



Name: Course: Region: Course Type: Staff:

Name:

Course:

Region: Course Type:

Staff:

Name: Course:

Region:

Staff:

Course Type:

Adrian Porter Greetham Valley, Oakham Midland Mixture of parkland and links-type Head Greenkeeper, plus seven and two casuals in summer for 45 holes

Kevin Green The Kendleshire, Bristol South West and South Wales Parkland Course Manager plus six



Stefan Antolik Cooden Beach, Bexhill-on-Sea South East Seaside Course Manager plus four



Name: Course: Region: Course Type: Staff:

Clem Beattie Allen park Golf Centre, Antrim Northern Ireland Parkland Head Greenkeeper plus four, plus one part-timer in summer. Also three part-timers on the driving range.

1. Under what circumstances does your golf course close?

1. Severe flooding and heavy snow. Our course is in a valley and if we get excessive rain it tends to flood.

1. We close because of flooding or snow. Really the course closes itself in these circumstances. We go on temporary greens in very frosty weather.

1. Snow is the only reason we really close. The course is well-drained and takes water well, while we play on temporary greens in frost.

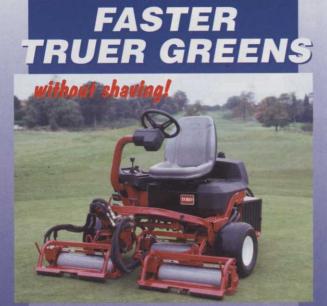
1. We close because of adverse weather conditions or waterlogging, snow and sometimes heavy frost. We have seven temporary greens on the back half of the course so members can play some golf when the rest of the course is closed.

1. It floods regularly, particularly at high tide when the sea comes over the boundary wall. We had 100 acres under a foot of water at one time.

1. We close mainly because of waterlogging as we are on heavy ground. Also because of snow and when we spray.

HEADS

	5		
2. Is the decision left solely to you or do other people have an input?	3. On average how many days is your course closed per year?	4. What arrangements are made to inform the membership of a closure?	5. Is there any one main reason why your course closes and if so what is planned to improve the situation?
2. It is mainly my decision, although I have to inform my greens committee Chairman about the closure.	3. We were closed for five days in 1999 and there have been times when snow has caused us to close for a week. I would say it is five to 10 days on average over the last eight years.	4. We have a general notice board next to the pro's shop and near the 1st tee where we can slot in course closures and also when there is any disturbance such as spraying, verti-cutting or top dressing.	5. Kingsknowe has a drainage programme for the next three years where we will upgrade everything. The low lying areas are verti-drained weekly and overall there is hardly a day goes by when we don't verti-drain.
 It is solely my decision whether to close the course. I tell the professional who informs the General Manager, or vice versa. 	3. I remember we closed for five weeks because of heavy snow a few years back. I would say we are not normally closed for more than 10-12 days each year.	4. We have "Course Closed" signs at the entrance gate to the course in the car park; next to the pro shop and also at the back of the 1st tee. I also use a mobile phone to inform the pro shop.	5. The main reason we close is flooding after heavy rain. We verti-drain a lot and have drained every bad spot on the course in the 10 years I have been Head Greenkeeper. But we are luckier than many because if we have had heavy rain in the morning and it stops by noon, then by 3pm it is playable once more because of the good drainage.
 I make closure decisions. Our course is proprietor-owned and sometimes he comes down to suggest we close, but never to say we stay open. 	3. We closed on seven days last year, but I would say the average is five to 10 days each year.	4. We announce closures on the notice- board in our car park near the changing rooms and also telephone the Seniors' Captain on Mondays or the Lady Captain on Tuesdays if we have to close.	5. Snow is the only major problem, but we also occasionally close to do hollow- tining and top dressing for a day. When everything looks a bit tired in winter we might give one of the courses a rest for a day or two.
 It is solely up to me on whether we close. I am responsible to the Directors so I would inform one of them and also the pro shop. 	 Our course is only three years old so we protect it whenever we can so that it doesn't suffer. At the moment we are closed on average 25 days per year but I would hope that this will be reduced to 10-12 days when we get thoroughly established. 	4. We have a "Course Closed" sign in the car park and if there is a chance of re- opening after rain members are kept informed on an hourly basis at the pro shop where they would book in to play.	5. Flooding is the main reason why we would close. We have a schedule of aeration, solid tining and slitting in spring, summer and autumn to improve matters. This is done on a frequent basis, particularly on the walk-on, walk- off areas near the greens and tees.
 Closure is left solely to me, or my Deputy if I am not there. We get no committee interference. In our case closure is self-explanatory. 	3. We closed for 17 days last year, but haven't been closed yet this year. I would say 15 days is the average.	4. We inform the pro shop by 8am on the day of closure. Similarly if there is a need to ban trolleys or buggies.	5. Our course is very flat and it floods regularly near the top end close to the sea. We have 11 kilometres of dykes and have created 16 ponds in the eight years I have been there. We also have a new reservoir and we can pump 3,000 gallons of water a minute off the course. Occasionally we get tide-locked.
2. I decide when we close because of flooding, but if it is 50-50 on a frosty day the Manager has an input and we decide between us.	 Because our course is on clay land it tends to get very wet after heavy rain and we have been closed 14 days during one year. Quite often we close a number of holes and leave some open. 	4. We have a "Course Closed" sign at the entrance to the course and also halfway up the driveway. Reception is informed so that members can telephone in and be told of the situation.	5. As I said our ground is very heavy and we are doing all we can to improve matters by installing an improved pipe drainage system. We also aerate, slit and solid tine as often as possible.

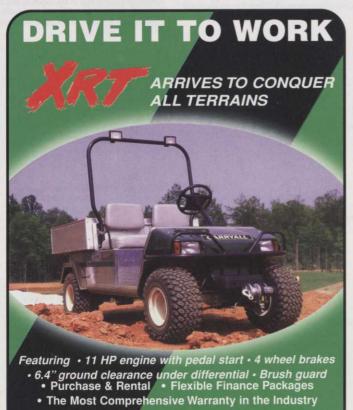


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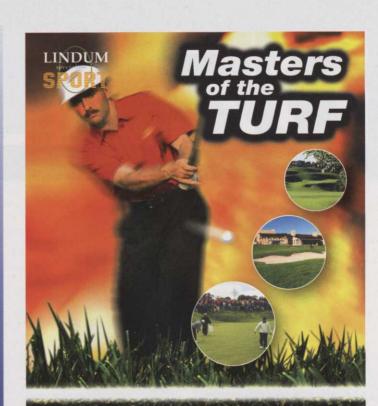
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Noel MacKenzie of the STRI discusses the intricacies of cutting your turf to the correct height.

I A close

Since the first Budding's lawn mower was manufactured in 1832 there has been a steady development of mowing technology by manufacturers which has helped to develop highly accurate machines capable of cutting in excess of 200 cuts per metre travelled. In addition, modern machines are fitted with a variety of "whistles and bells" such as groomers, brushes, etc., all designed to enhance the final finish. Used correctly the modern mower can produce the highest standards of finish that players have ever experienced. Furthermore, these high standards of cut are found from the elite championship courses with the highest aspirations through to the local clubs with less demanding players because the machines capable of achieving such high stan-dards are now basic items of maintenance equipment.

However, whilst greenkeepers now enjoy the latest state-of-the-art equipment it is still common to find mowing equipment and the basic operation of mowing being insufficiently considered.

The intention of this article is to highlight matters relating to the height of cut since this is probably the area where most misjudgement occurs. For the purposes of this discussion we must assume that the mower is well maintained, has sharp and accurately adjusted blades and an operator fully aquainted with effective and safe use of the machine.

What's your height of cut?

During advisory work I will always ask the height of cut being employed by the greenkeeper. Whilst many greenkeepers can answer my question to a fraction of a millimetre I must confess to being amazed by the number of answers which indicate no knowledge of the height of cut or only a vague indication. Where vagueness is noted the common response is, for example, "About 3/16 of an inch." Inspection of the mower, however, may reveal a height of cut totally different to that perceived by the greenkeeper. In one such instance I was informed that the greens were being cut at 5 mm but checking the mower found the height of cut set at just 3 mm!

Another common response is to refer to "notches" which are encoun-

tered when the operator adjusts the machine. Don't get me wrong, the height of cut may create the optimum finish when the mower is set to the "third notch" but the point to get across is that this is a qualitative statement rather than an exact measure and could therefore be open to interpretation. An accurate measurement gives a quantitative value to the cutting height in operation which is more easily communicated to different staff members. Additionally, most courses are cut with more than one machine or the machine may have three cylinders so there may be differences between the height of cut obtained with the third notch for example on one machine or cylinder unit compared with another. This could have a noticeable effect on the speed and finish on the greens out on the course.

Setting the height of cut and mower gauges

The mower gauge is the tool for this task and is simplicity itself to use, though there are different designs. Mower gauges will normally be supplied with a machine when

shave

purchased. If you do not have one then order a device from the mower manufacturer.

A good greenkeeper should check the height of cut frequently, ideally every time the greens are cut, along with whether the blades are set correctly, lubricant levels, etc.. Often such checks are not made and this is where many problems may start which can result in poor quality of finish and damage to the greens. These checks are best done in the afternoon before the sheds are locked up for the day. By preparing the machinery the night before use the minimum amount of time is lost in fueling, lubricating and adjusting machinery first thing in the morning when time is pressing to get ahead of play. In addition, if a machine has a problem it is better to find this out before you need it rather than when you need it, remember; "An ounce of prevention is better than a pound of cure!". Furthermore, fiddling with temperamental machinery in the cold of morning is an experience few people enjoy so better to avoid this and do any fiddling in the warmer hours of the previous afternoon.

What should your height of cut to be?

This is a real "How long is a piece of string?" question. What may be appropriate on one course might be totally unsuitable for another even under apparently identical conditions and this may have potentially disastrous consequences.

Let's start at the beginning with text book values for greens:

Summer time = 5 mm (3/16 in.). Winter time = 6-8 mm (1/4 -5/16 in.).

However, whilst these might be ideal text book values it is common to find heights of cut varying considerably from these. For example, a course with firm greens might cut with machines set at 4 mm in summer and only 5 mm in winter whereas a softer, clay-based parkland green may struggle to cope with much below 5 mm in summer and less than 8 mm in winter.

There is not scope within this article to discuss in depth what your height of cut should be in every instance. In practice the heights of cut normally employed are dependent on:

- Experience of the Course Manager/Head Greenkeeper.
- Weather/climate conditions (both current and forcast).
- · Frequency of mowing.
- Recent mowing and maintenance operations.
- Machine type employed (ride-on or pedestrian), flat or grooved front roller, floating or static head design.
- · Usage of the course.
- The agronomic composition of the greens e.g. fescue intolerance of mowing below 4 mm or so.
- Sward Vigour.
- Tolerance of greens to drought stress.Sward stress tolerance and disease
- susceptibility e.g. anthracnose susceptibility in close mown P. annua swards.
- Firmness of greens (related to thatch content, drainage and construction).
- Irrigation system efficiency and effectiveness.
- Topography of surface.
- Emphasis placed on other operations to maintain green speed e.g. verti-cutting, grooming, rolling, etc.

If you are an experienced greenkeeper then you may take some of these factors into consideration without even thinking about it, but it still doesn't do any harm to have a look at the list above from time to time with fresh eyes to make sure you've not neglected any item. Like all maintenance operations on the course make sure records are kept of cutting heights.

If you are a trainee or less experi-

enced greenkeeper then don't be afraid to ask your supervisor/manager why he/she has chosen the height of cut employed. He/she may not always be able to answer this accurately but if you can understand the basis of the decision based on experience then that is a good start. As you progress through your career you will gather the knowledge of others and use it to make your own decisions in the future.

Having decided on the height of cut to employ you can go ahead and set up your machine in the workshop.

You've set your height of cut... but what's your height of cut?

Now your mower is set at the desired height of cut you are ready to cut the greens, or are you?

Beware, the cutting height set on your machine does not always equate directly to the grass length produced. For example, its winter on a wet golf green and there is some thatch presence which makes the surface soft. The mower has been set for 6 mm but the weight of the machine makes it sink into the surface by 2-3 mm. The result is that the green is being cut too closely, the actual cutting height being 3-4 mm (which might be lower than summer height!), which will stress the grass considerably and reduce the quality of the playing surface. Under the above conditions it may be necessary for mowing to be postponed until the surface has dried or, if this is not an option, raising the mower cutting height setting by a further 2-3 mm to achieve the desired results.

Knowledge is a powerful tool and unfortunately the greenkeeper has not, until relatively recently, been able to assess the actual cutting height on the green. Nowadays though, mowing prism gauges are available to allow assessment of the cutting height on the ground to be made. For example, at STRI we have



age is changing the height of cut by about 10%.

Through the year conditions change and the greenkeeper must be ready to adjust the mowing regime to achieve optimum results. In the springtime great care must be taken not to push the grass too hard too soon by cutting close before growth is properly established. On coastal courses proper growth may establish sooner than on inland sites, especially on those inland courses with wetter greens based on clay which take longer to warm up and allow growth. As a general rule of thumb keep the height of cut up in the spring until growth is properly underway before slowly lowering it for the main summer season.

Summary

Remember, changing the height of cut even by a small measurement has a sudden and dramatic effect on turf being maintained at 5 mm or less. Furthermore, the mowing height set on your mower seldom, if ever, is accurately reflected in the length of grass after cutting. Mowing constitutes the main management tool used in greens maintenance and its importance in sward health, agronomic composition and wear tolerance are often overlooked.

There is often a great deal of demand for pace but we should remember that the average golfer can find putting on fast greens very difficult indeed. In addition, windy sites really become very difficult to play if greens are too fast i.e. over about 10 feet using a stimpmeter. Consistency of putting surface is more important than pace (within reason). On courses with varied green construction mowing practices may need to be considered very carefully, especially if sward species composition is different also. Such situations may even require one mower to be set up differently for particular greens in order to maintain consistency in the playing surfaces from green to green. Try to avoid stressing grass through overly close mowing and too frequent application of other treatments in pursuit of pace which may cause

uneven growth, additional inflorescence (flower) production from Poa annua, pest invasion e.g. moss, pearlwort, etc., disease and even loss of grass cover. It should also be remembered that other maintenance inputs can be adjusted to reduce the stress of mowing practices e.g. irrigation, frequency of verti-cutting and grooming, etc.

Take care when selecting heights of cut, especially during the changing seasons of spring and autumn when the grass growth can be unpredictable. Is a consistent height of cut ever right?. In essence, probably not since no two days are identical. However, the weather and wear pressures which the grass is exposed to can be broadly consistent and therefore the height of cut can be set at a certain level for short periods, but I would urge you to review cutting heights regularly.

Noel MacKenzie B.Sc. (Hons), MBPR, is the Turfgrass Agronomist for the STRI's Southern Office.

seen examples of a pedestrian mower set at a height of cut of 3 mm but using a prism gauge we find that the sward is left at 2 mm. These differences may seem very small, after all we're only talking about a millimetre or so aren't we?

Well a millimetre might be rather small to you and I but try to imagine you are only 3 mm tall and someone wants to take 1 mm off you, not a pleasant thought is it!? In per-centage terms this equates to 33%, or about a third of the plant. Even if the height of cut was set at 5 mm but came out at 4 mm this would still equate to 20% removal of the plant's leaf material! These large percentage reductions in leaf area must cause significant stress to the plant by reducing photosynthetic productivity and therefore plant vigour. Conversely, if a sward is under stress we can see what a big difference raising the height of cut by even half or one millimetre can make.

These thoughts become even more relevant when we consider that a green's surface can soften or dry dramatically within 24 hours and this could have a major impact on the real cutting height imposed on the turf. Nowhere is this more relevant than on overly thatchy or poorly drained greens. Turf nursery greens provide an opportunity to check mowing heights with a prism before going out onto the course (provided your turf nursery area is very similar in construction to your greens).

Changing the height of cut

When changing the height of cut the amount of millimetres should not, in my opinion, be the only measure of the change. I would suggest instead that greenkeepers think in terms of percentage change alongside the actual measured change. Realistically, for turf mown at 5 mm and with control of cutting heights almost impossible at less than 0.5 mm increments the best we can man-



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