

**Dr Stephen Baker, Head of Soils and Sports Surface Science at the STRI, looks at the current and future research on golf course agronomy with particular emphasis on the problem of winter wear**

## Into the 3<sup>rd</sup> Millennium

The parties are over, the hangovers have receded and, yes, we are into the year 2000. In the December 1999 issue of *Greenkeeper International*, I considered aspects of research on golf course agronomy through the last century. As we move into the new millennium it is appropriate to review the implications of current research projects and to identify some of the many areas where future work is needed.

On the evidence of the last century, the needs for research with respect to golf course agronomy progressively change. This results from both factors within the game (e.g. increased play, more winter use, expectations of the golfer) and external factors, for example changes in pesticide legislation, increased demands on water resources throughout society and in the longer term climatic change, with its potential impact on turf irrigation, grass selection and the incidence of disease.

The R&A's Golf Course Advisory Panel has identified key strategic issues likely to affect golf in the future. These include:

- (i) Climatic change
- (ii) Water use and conservation
- (iii) Environmental issues
- (iv) Demographic/planning issues
- (v) Chemical inputs and outputs
- (vi) Implications of increasing usage

Greenkeeping staff also have strong views on the practical problems they encounter. As part of an R&A strategy to identify research priorities, greenkeepers were asked, through a questionnaire in *Greenkeeper International* (June 1998), to indicate priorities for research particularly with respect to condi-

tions on their course. The five main problem areas were identified as: i) the control and management of annual meadow-grass, ii) traffic management/winter wear, iii) the control of earthworm casting, iv) rabbit control, and v) wear by golf trolleys.

In an article of this length, it would be unrealistic to address all the issues where research needs have been identified. Instead, I wish to focus on the topical issue of winter wear on golf courses, in particular on two areas where we are currently carrying out research work and two areas where we consider that future research would be profitable.

### **Green construction**

One of the main factors affecting the quality of greens in winter (or necessitating the frequent use of temporary puffing surfaces) is the poor soil physical characteristics of many greens. In the R&A sponsored survey of 74 golf courses between 1993 and 1994, we found that 43% of greens had water infiltration rates below 10 mm/hr and 41% of greens had less than 5% air-filled pore space. Such values mean the greens are slow draining, prone to water logging and may suffer from restricted root development. In most cases, this resulted from the use of existing soils with relatively high silt and clay contents.

To achieve more free-draining and firmer putting surfaces through the winter, sand-dominated rootzones are now widely used in green construction. However, in the past comparatively little research work has been undertaken to examine the performance of different rootzones supporting fescue/bent turf. In June 1995, thanks to R&A funding, we

established a trial at Bingley examining the performance of 18 different rootzone materials formed from combinations of two sands (medium and medium-coarse), three amendment materials (sandy loam topsoil, organic fensoil and sphagnum peat) and three mixing ratios of sand amendment. Each of the rootzones was installed as a 300 mm deep layer overlying a 50 mm blinding layer of 1-4 mm grit and a 5-10 mm diameter drainage layer.

The trial has received simulated wear since July 1996 and this has allowed us to examine changes that occur over time. Soil physical properties have been strongly influenced by rootzone composition and recent results are shown in Table 1. Infiltration rates were inevitably highest on mixes incorporating coarse sand with low quantities of amendment. Infiltration rates were higher for the mixes containing peat than those with topsoil or fensoil. After deliberately flooding the surface, water drained quickly from the pore space of all mixtures meaning that air-filled porosity was satisfactory for all rootzone materials. However, moisture contents were highest on the medium sand and for the 70:30 mixes. They were also higher on the fensoil and peat mixes than on mixes incorporating sandy loam soil. The firmness of the putting surface was also influenced by rootzone composition. In particular the rootzones containing peat gave the softest surface and firmness decreased as the amount of amendment material was increased from 10% to 30% by volume.

The plots were originally sown with a mix of 40% Chewing's fescue, 40% slender creeping red fescue and



20% browntop bent but our most recent botanical analysis (September 1999) indicates average values of 53% bent, 33% fescue and 12% annual meadow-grass (plus 2% dead or bare). Annual meadow-grass is higher on the more moisture-retentive medium sands and higher when topsoil was used as the amendment material, particularly for the coarser sands.

As part of the same project, we have also examined the effects of a range of alternative organic amendment materials on the soil physical properties of rootzone mixes. Materials have included green waste, coir (derived from coconut shells), sewage and straw, rape residue and wood fibres. When mixed with a suitable sand, it was possible to formulate mixtures that met with USGA criteria for hydraulic conductivity, total porosity, air-filled porosity and capillary porosity for all the amendment materials.

The work on rootzone mixtures is still continuing but in the relatively near future we should be in a position to publish guidelines, supported by scientific data, on the optimum rootzone materials for UK conditions.

#### Earthworms and casting

The problems of earthworm control and winter wear are often closely linked, as smeared casts are one of the main factors contributing to muddy fairways and tees. We have just had another mild, wet autumn and many courses have either suffered from heavy casting or spent often thousands of pounds on pesticides that give only short-lived control. Last year, we published two articles in *Greenkeeper International* outlining the work that has been carried out on earthworm control and steps that can be taken to reduce casting. It has to be stressed that, in

the absence of pesticides such as chlordane (the use of which has been illegal since 1992), there are no single solutions to the problems of earthworm casting, indeed total control is unlikely. However, casting can be reduced by sound greenkeeping practices such as the use of acidifying fertilisers, avoidance of lime-rich top dressing and, where appropriate, the removal of grass clippings.

Our current research on casting control has four main themes:

a) Further examination of the use of sulphur for soil acidification. In particular this is being directed at predicting the most suitable application rates for a range of soils, whereby casting is reduced as much as possible without detrimental effects on the sward.

b) Mowing practices and fertiliser application based on ammonium sulphate to reduce casting on fairway-type turf.

c) Use of horizontal barriers in the soil to restrict burrowing activity. We recently carried out a detailed survey of 32 golf courses to examine population distribution of earthworms in the UK. We identified 13 different species altogether, but three species (*Aporrectodea longa*, *A. caliginosa* and *Lumbricus terrestris*) made up 87% of the 8,000 earthworms that we sampled. *A. longa* and *L. terrestris* in particular have deep burrow systems that can reach one metre or more into the soil. Clearly any barrier would stop earthworms coming to the surface to eject soil taken from the deeper soil horizons. However, of greater long-term importance is the fact that these species use the burrows to escape the effects of drought or heavy frost. If earthworms cannot migrate downwards at times of unfavourable weather conditions, their chances of survival and subsequent reproduction are small. There is a precedent for this approach in the literature of the pre-war years with references to layers of coarse sand, iron filings or broken glass to discourage earthworms, but we are instead examining different grades of plastic mesh material at depths of 100 mm and 200 mm and also the effects of a coarse, angular grit layer.

It would, of course, be disruptive and impractical to use this approach on existing areas but where there is any re-construction it may be an option to be considered, although the implications on water movement and deep aeration work must also be considered.

d) Our other current avenue of

research has been to examine the effect of the injection of compressed air into the soil. Equipment such as the Robin Dagger or Air-Jet 2000 have been used for relieving compaction in the soil by releasing a pulse(s) of air at pressures of around 150 psi. Under the right conditions, this causes considerable heaving of the ground and this may have implications for soft-bodied creatures such as earthworms. This autumn we have been looking at effects on the survival of earthworms and casting rates, and results should be available next spring. (Incidentally, if any readers have observations on casting activity following air injection work, we would be interested in details.)

#### Wear by golf trolleys and buggies

The issue of trolleys and buggies on golf courses is a sensitive one and has always raised debate within golf clubs. Such equipment has clearly allowed many older or less mobile golfers to continue enjoying the game of golf for much longer periods. However, in the winter months in particular, trolleys and buggies can contribute to wear on the golf course. Thankfully, the use of narrow-wheeled trolleys has now ended and most trolleys have a wheel width of at least 70 mm. This means the ground pressure of a trolley with a full bag is reduced to about 13 kPa, which is only half that of a player standing with both feet in contact with the ground and considerably less than the force exerted during walking. This is typically in the order of 70 kPa with even higher values as

Soil physical properties four years after construction

Assessment date (1999)	Infiltration rate (mm/hr)	Moisture content 1 hour after flooding 0-100mm (%)	Hardness (gravities)
	March 15	March 22	March 22
<b>Effect of sand type</b>			
Medium sand	86	26.2	74
Medium-coarse sand	110	21.8	71
<b>Effect of amendment</b>			
Sandy loam soil	88	21.0	75
Fen soil	91	25.6	73
Peat	114	25.2	69
<b>Effect of mixing ration</b>			
90:10 (sand:amendment)	116	20.4	75
80:20	97	24.2	72
70:30	80	27.1	69



the heel makes contact with the ground. However, trolleys and buggies have the disadvantage that their use tends to cause golfers to be channelled along specific routes on the golf course and it is here that the effects of wear become more apparent. Furthermore, the very fact that golfers do not have to carry their own bags over their shoulder does increase the temptation to fill the bag with extra items, thus contributing to soil compaction. For powered equipment, the possibility of wheels spinning on slopes in wet conditions must also be considered, as this is potentially a significant source of damage, particularly at times of the year when the turf will be slow to recover.

There is very little independent scientific information on the effects of trolleys (unpowered and powered) or buggies on turfgrass wear, and this is an area where we believe work would be of considerable benefit. In particular, there should be detailed assessments to develop criteria defining conditions when trolleys or buggies are likely to cause significant turf damage and conversely when their use is perfectly acceptable.

#### Alternative spikes

There is increasing evidence from the United States that the wide range of plastic spikes and studs causes less wear on putting greens (and indeed other areas of the golf course such as teeing mats, wooden steps and bridges) than conventional metal spikes. However, there are also concerns that traction or grip may be affected by changes of spike type.

This may be particularly relevant in Britain where golf continues throughout the winter and grip on steeper slopes and banks may be affected by wet conditions or, for example, mud arising from earthworm casts. Similarly, wet grass clippings may also affect traction properties, therefore the interaction between spike design, weather and management practices needs to be examined.

Most of the American work that has been carried out has been on creeping bent greens on which the grass, because of its lateral growth habit, is particularly prone to "plucking" type damage. This may be less relevant on British greens where the predominant grass types are brown-top and Highland bent, fescue and annual meadow-grass. However, until research is carried out, there will be many unanswered questions and, as the use of alternative spikes has safety as well as wear implications, work is needed to assess whether their use should be encouraged on British golf courses.

I have focused on just four topics connected with winter wear. Future development work on for example mechanical treatments, black layer control and turfgrass breeding is also relevant to the problems experienced through the colder, wetter months. The last century brought about vast improvements in our knowledge of golf course management and the range of equipment available to exploit that knowledge. There is no reason that these improvements should not continue through the 21st century.

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**Brian Turner, Course Manager at Sunningdale GC, takes a look at the stresses involved with the everyday running of a golf course and offers some advice**

# Stress.

## All part of the job?

The very meaning of the word stress is the physical, emotional and mental pressure which is experienced by most people in the modern day work place. In greenkeeping management stress is becoming more and more apparent, and part of this is due to the very high standards we set ourselves.

BIGGA was formed in 1987 to bring the profession of greenkeeping the respect it deserves.

**If the green is not dark green there must be something wrong with it**

**If the greens are not receptive and do not make a big pitch mark you are not putting on enough water**

**And when the greens become waterlogged and covered in disease, the golfer demands to know why you have ruined the greens**

We are not merely grass cutters, and turf management is essential for the success of a course.

Although we have come a long way since then, we still have not broken the barrier of respect we deserve.

Since the early 1970's after Tony Jacklin had won the British and US Opens, golf has boomed, and our presentation standards have risen

dramatically, with green speeds going crazy. I can remember working at Wentworth in the 70's when we cut the greens at 5mm once a day during tournaments. Today Chris Kennedy tells me the greens are cut three to four times a day at 3mm height of cut. This is stress, not only on the greenkeepers, but to the grass plant as well. These mowing heights cannot be maintained for long periods without the grass plant suffering from thinning out and disease.

Televised tournament golf has made our job more demanding, as golfers expect these playing conditions all the time, which is impossible as we know, but the golfer does not fully understand the reasons why.

Green speed seems to be the most important and talked about subject on the golf course. Why is it when a golfer says to us the greens are slow we take it as a criticism, yet when they say the greens are quick we take it as a compliment? I know that some golfers are as comfortable on slow greens as some are on fast. It does not matter how good your course presentation is or how good your tees and fairways are, the bottom line is if your greens are not quite perfect the course is not up to scratch.

You may have noticed that I have not mentioned bunkers. This is another contentious issue. I am sure we have all experienced the complaints that the sand is the wrong type and particle size, there is too much or not enough sand and it is unevenly distributed.

Water and fertiliser management can come under question by the golfer. If the green is not dark green there must be something wrong with it, and if the greens are not receptive

and do not make a big pitch mark you are not putting on enough water. On the other hand when the greens become waterlogged and covered in disease the golfer demands to know why you have managed to ruin the greens.

Aeration is the one task that causes most complaints, but I feel is the most important task in turf management. When is the right time to aerate? Never if the golfer has his way. This one operation gives the greenkeeper his biggest headache, especially if he is hollow tining or verti-draining.

Turf management is not an exact science, and in greenkeeping we experience peaks and troughs. Our aim should be to make these peaks and troughs into small ripples with sound management programmes that satisfy all parties within the golf club. This is not easy to do, but we must get across to golfers the importance of all tasks involved with sound practical greenkeeping management.

Good greenkeepers through experience, training, knowledge, and gut feeling know when to carry out particular work programmes, and how to peak their course for special events, giving all golfers a fair chance, and not tricking the greens up to ridiculous speeds.

To ease stress in greenkeeping management, sound policies must be laid down by the greenkeeper and committee and carried out with conviction and confidence, and with no fear of retribution from golfers.

In America many people have their personal 'shrink' to help them get through a stressful week. I wonder when the greenkeeper will be joining them.

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