Most of the research work that is carried out on golf course construction and agronomy is based on replicated experimental plots, for example on the trials grounds at the Sports Turf Research Institute. This gives the necessary controlled conditions so that the effects of different treatments, e.g. grass type, fertiliser rate or pesticide application can be studied in conditions where all other aspects of construction and maintenance are held constant. For instance, in a construction trial the rootzones may vary but all plots on the trial area will be sown with the same seeds mixture, receive the same amount of fertiliser, top dressing and aeration and all plots will be subjected to artificial wear at the same times.

This careful scientific approach is essential if we are to understand in detail the response of turfgrasses to different forms of management and to make meaningful comparisons between different products so that the best possible advice can be passed on to golf clubs. However there is also a need to monitor what is actually happening on golf courses as this allows a wider range of environmental conditions to be considered, it can provide some additional information on interactions between different management procedures and it also gives information of long term development of golf greens by selecting greens that have been established for many years.
Monitoring of the performance of a large number of golf greens also gives an indication of any commonly occurring problems that should be addressed by additional research work.

In 1993 the Royal and Ancient Golf Club of St Andrews agreed to finance a national survey of golf greens. Many of the objectives of the monitoring work are listed above but there was a particular need to identify performance requirements for golf greens, especially for playing quality. The need to examine performance requirements has been brought about in part by work by the European Committee for Standardisation (CEN) which is developing standards for sports surfaces, including golf greens. However, from a research point of view it is also essential to develop a range of measurement techniques to characterise the performance of a golf green and to identify ranges of values that provide an acceptable compromise between the needs of the golfer and the needs of the greenkeeper. This gives objective methods for assessing all future trials on golf green management.

The measurements of playing quality and development of performance standards will be discussed in a later issue of Greenkeeper International, but in this article I wish to consider some of the findings particularly with respect to soils, grasses and management.

THE SURVEY

Over a seventeen month period between June 1993 and October 1994 my colleagues Tim Lodge, Phil Hind, Jonathan Hunt, Daniel Binns and I visited 74 golf clubs around the country. To minimise travel costs there was an inevitable concentration on northern and central England but the overall geographical coverage was from south-west England to the north of Scotland (Figure 1). We tried to select different types of course roughly in proportion to their numbers in the country as a whole. As a result 55% of the courses visited were classified as parkland, 14% as meadowland, 11% as golf links with smaller numbers of moorland, upland, heathland and seaside courses. At each course testing took place on two greens selected by the greenkeeping staff as being one of their best and one of their poorest greens. This gave a total of 148 greens with a variety of construction types and ranging in age from six months to over 120 years.

Our measurements were varied including soil physical and chemical properties, grass cover, species composition, thatch depth and playing characteristics (green speed, hardness and the stopping distance of balls fired at the turf simulating five iron and nine iron shots). At each course the greenkeeper kindly filled in a detailed maintenance questionnaire and questionnaires were also filled in by players so we could get an impression of the performance of each green.

The main results and principal findings are given below.

SOIL: PHYSICAL PROPERTIES

We did not specifically choose courses where the greens had modern sand dominated root-zones (although some were included in the study), so the greens were developed on a number of soil types. For the lower 100-150mm depth 47% of the greens had a sand or loamy sand textured soil, 35% were on sandy loam soil and 18% on heavy sandy clay loam or clay loam soils. Rootzone amendment and whatever the season, whatever the weather, this greenkeeper cuts a fine swathe through thick, uneven turf to produce the perfect fairway.

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NATIONAL SURVEY OF GOLF GREENS

that hold water, any surface
ponding will normally be short
lived. In the study 43% of greens
had infiltration rates c10mm/hr
and almost one third had values
less than 5mm/hr. This situation
is far from ideal. It must be
remembered however that half of
the greens were deliberately
selected as being amongst the
worst on the course and poor
drainage would have been one of
the factors influencing greenkeep-
ers’ nominations of greens to
study. Indeed infiltration rates
were significantly higher on those
greens classified as “good” by the
greenkeeper, averaging 14mm/hr
compared to 8mm/hr on greens
classified as “poor”.

The other noteworthy physical
characteristic is the air-filled
porosity. In the laboratory we
measured air-filled porosity at
two levels of suction: values mea-
sured at a water potential of
-400Pa are probably the most useful
as this gives an indication of the
amount of soil air present through
much of the winter period. Using
measurements from all the greens
in the study, the air-filled porosity
of the 10-90mm depth averaged
6.8% and the corresponding fig-
ure for the 100-180mm depth was
6.9%. This is below the figure of
10% air-filled pore space which is
sometimes quoted as being a
desirable minimum value. Indeed
41% of greens had values <5%.
Again it must be remembered
that the sample of greens was not
fully representative as greenkeepers
deliberately selected half the
greens as being poorer ones from
their course, nevertheless when
taken in conjunction with the
infiltration figures it does suggest
that many greens have far from
desirable soil physical characteris-
tics.

SOIL: CHEMICAL PROPERTIES
Greenkeepers were asked to fill in
a questionnaire on maintenance
and this included information of
the fertiliser that they had put on
in the preceding twelve months.
Most greens received between 75-
225 kg/ha of nitrogen, which
would seem satisfactory in view of
the range of soils at different sites.
There were however some cases
where we calculated the rate to
be over 300 kg/ha which is cer-
tainly on the high side even for a
sand based green. No phosphate
was added on 61% of greens and
on 56% of greens no more than
40 kg/ha of potassium (as K2O)
was applied. Phosphate levels
were very variable and there was
no relationship between the
amount of phosphate applied and
measured values in the soil. This
almost certainly reflects unneces-
sarily high levels of phosphate
nutrition in the past and the lack
of mobility of this element in the
soil. In spite of the fact that no
phosphate was applied on 61% of
the greens, over half the greens
had P2O5 levels >50 mg/l.

There was a significant, albeit
relatively weak, relationship
between the amount of potassium
applied and levels recorded in the
soil. For the main rooting depth
(10-90mm) almost one third of
the greens had potassium levels
classified as very low and for the
100-180mm depth half the greens
had nutrient levels falling into this
category.

Potassium is relatively mobile
within the soil and normally
between 60-150 kg/ha of K2O
should be added on an annual
basis, depending mainly on the
texture of the rootzone. In the
light of the figures that were
recorded it would appear that
potassium is being under applied
on a fairly high percentage of
greens.

GRASSES
Averaged over the 148 greens
in the study, annual meadow-grass
was by far the dominant grass
type with three quarters of greens
having an annual meadow-grass
content exceeding 50% (Figure 3).
Bent was the most common of the
desirable grass species but fescue
was recorded on less than half
the greens in the study, with
the highest fescue contents being
found on relatively new greens
less than five years old and on
links courses. There were signifi-
cant relationships between species
composition of the greens and the
soil physical properties, for exam-
ple annual meadow-grass
increased as the clay content
became heavier. Fescues on the
other hand were more common
where sand content was greater
and where higher levels of air-
filled pore space were recorded.

SOME CLOSING THOUGHTS

The survey has highlighted the
fact that greens developed on all
but the sandiest of natural soils
will not have the soil physical
properties generally thought nec-
essary for ideal conditions of
growth. Heavier soils are
invariably more water retentive
and this tends to give poorer
growing conditions which, along
with a variety of other factors,
will encourage annual meadow-
grass invasion into the sward. It is
a credit therefore to the green-
keeping staff at the courses visited
that they generally managed to
produce excellent putting surfaces
in spite of the unfavourable soil
conditions that many were having
to work with.

MY NEW YEAR'S RESOLUTION IS:

"To appear in Greenkeeper
International more often in
'96 than Richard Barker"

Tim Allard, Charnwood Forest GC