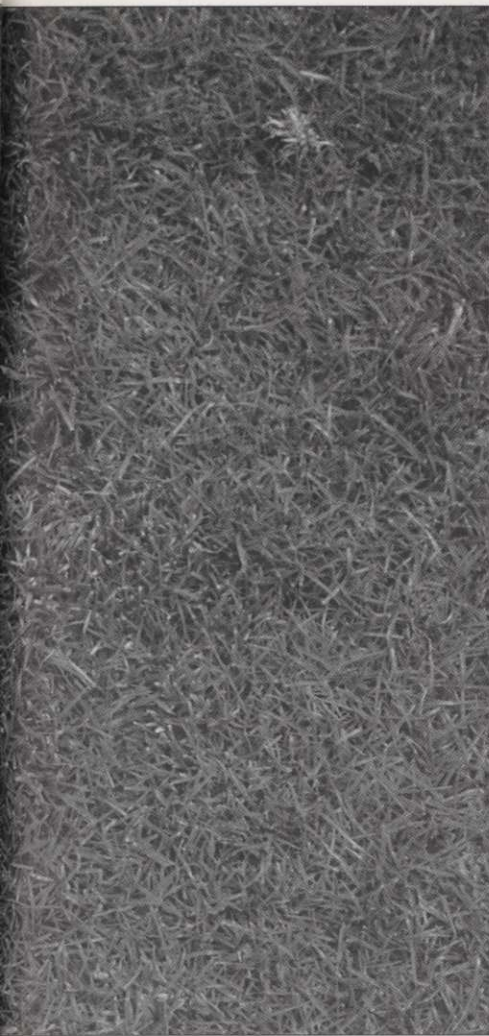


The appliance of science





Robert Laycock assesses the scientific evidence of the effect of soil phosphate on annual meadow grass

When a statement is repeated often enough and is rarely challenged, it takes on an air of respectability that it may not entirely deserve. The effect of soil phosphate on annual meadow grass is a case in point. Is there scientific evidence to support what is widely believed to be established fact? How many people have actually read the scientific papers which, it is claimed, demonstrate the phosphate-*Poa annua* link?

How many greenkeepers have stopped using phosphatic fertilisers on their greens without at the same time improving their aeration or surface drainage? A decrease in annual meadow grass under these circumstances could just as easily be due to relieving compaction as by reducing the phosphate input.

To verify and study in more detail an effect observed on the golf course a trial should be set up under strictly controlled conditions. For example, to study the effect of soil phosphate on the annual meadow grass content of golf green turf, an artificial green should be constructed and a range of levels of phosphate added, including one treatment to act as a control with no added phosphate. There

should be several replications or repeats of each treatment.

Variations among treatments are carefully recorded and the results subjected to statistical analysis. This shows the likelihood of any difference in annual meadow grass content among the plots being due to chance rather than a true effect of the treatments. Conversely, applications to a green can be stopped (without altering any other management practice) and the decline – if any – in meadow grass content monitored over time.

From 1895 to the present day, researchers have been applying fertiliser in various combinations to turf plots and carefully recording the results. The University of Rhode Island were first; later came the Board of Greenkeeping Research, later to become STRI, with a series of long term trials. Individual researchers such as Sprague and Burton in the 1930s and Juska and Hanson in the 1960s also performed similar work.

It was in the 1950s that the idea of a relationship between phosphate and *Poa annua* was first raised in a non-technical article in the USA. The idea took hold, but in the few scientifically conducted trials reported since

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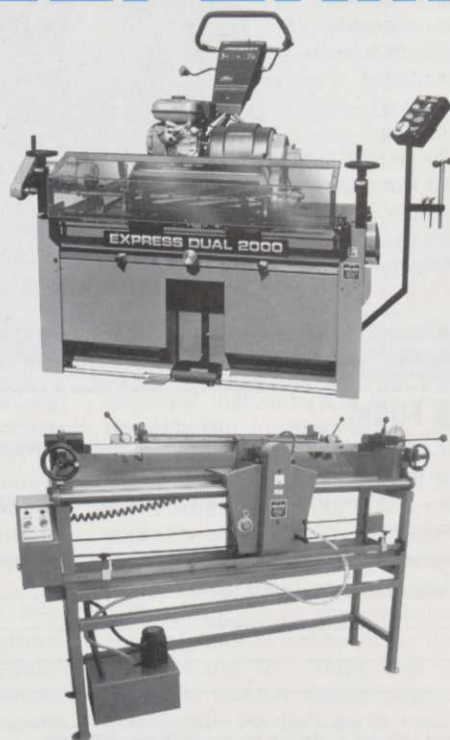
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then, firm scientific evidence for the claimed relationship has not been shown. Two widely quoted papers from the USA report research by Goss and by Waddington and their co-workers. Both papers are claimed to support the link between high soil phosphate levels and *P.annua*.

Goss's paper, published in the 1975 STRI Journal described a trial conducted using a variety of fertiliser combinations on an area of *Agrostis tenuis* turf which had been established in 1959. Part of the trial received no phosphate between then and when final assessments were made in 1974. The remainder of the plots received the very high rate of 8.6gm² P per year, but no intermediate levels. As well as phosphate, the plots also received combinations of potassium, nitrogen and sulphur.

Plots were assessed by eye for *Poa* content on 1-10 scale of five occasions between 1971 and 1974. These results were then subjected to analysis of variance. This type of analysis should not really be used with this kind of data, but it was and so we will consider the published results.

Before the trial had commenced and in 1966, the meadow grass was uniformly distributed among the plots. The final assessments of the nine pairs of treatments (with and without P) showed four of the phosphate treatments to have significantly more annual meadow grass than their zero P equivalents. The remaining five pairs did not show statistically significant differences and some zero P treatments contained more annual meadow grass than those with P. It is interesting to note that the treatment with one of the highest incidences of meadow grass was the one which had received no fertiliser whatsoever! This does not seem to me to be conclusive proof of the claimed relationship.

Waddington's work was conducted on a ten-year old area of 'Penncross' creeping bent over a six year period. Agian, a variety of fertiliser types were used and the *Poa annua* content recorded. In this trial there was a range of phosphate levels, all high, and the plots were assessed by eye for percentage *Poa annua*. No lime was added to the plots, but the calcium content of the water was high enough to be remarked upon.

During the course of the trial, meadow grass content of the treatments varied up and down. Unfortunately, even before the trial had begun the plots which were to receive phosphate had a higher content of annual meadow grass than the no phosphate plots. Little wonder, then, that those which had received phosphate contained, on average, more *Poa annua* at the end of the trial. However when the average meadow grass content of the zero phosphate treatment was 5% and that of the high phosphate treatment after six years of treatment was only 8%, did it really matter?



'If we look at the behaviour of phosphate in the soil there is even less reason to believe that stopping its use could cause a decrease in annual meadow grass'

— ROBERT LAYCOCK

More recently, the STRI conducted research on the effects of various nutrients on fescue-bent turf, in trials financed by the R&A. In their series of trials no relationship between soil phosphorus and the annual meadow grass content of greens turf has been published except in the presence of lime.

It is true that relationships have been found between phosphorus and the growth of individual plants of *Poa annua*, even under laboratory conditions. But no one has conclusively proved that phosphorus applications increase annual meadow grass in greens turf. I hear of pure fescue greens with a high

phosphorus content. Why have not these been taken over by annual meadow grass?

The conclusion of all this is that it is important sometimes to reassess those things which have come to be taken for granted. The trials most often cited as demonstrating the relationship between phosphate and *Poa annua* are clearly not conclusive and are, some would say, flawed by their subjective assessment methods and inappropriate use of statistical techniques.

Phosphorus is one of the three major plant nutrients obtained from the soil which is classed as essential for the healthy growth of plants and therefore must be made available to them. But just because the evidence for its relationship with *Poa annua* is non-existent or, at best, shaky, it should not be applied haphazardly in large amounts to golf greens. A far better reason not to apply phosphate is because in most cases it is already present in the soil in greater than necessary quantities.

Surveys of the phosphorus content of established greens in the UK, West Germany and the mid-West of the USA have all shown that in the vast majority of cases there is an over-supply of phosphorus in the rootzone material. (It is interesting to note, incidentally, that a recent survey of agricultural grassland in the UK came to the same conclusion).

If we look at the behaviour of phosphate in the soil there is even less reason to believe that stopping its use could cause a decrease in annual meadow grass. Phosphates are strongly bound in the soil. They leach away very slowly even on the most sandy of root-zones. In fact their presence is used by archaeologists to detect the activities of man thousands of years ago.

A greenkeeper is going to have to wait decades before the phosphate levels of his greens fall away significantly. And all that time it will be available to the annual meadow grass. Ceasing to apply phosphate under these circumstances can have no significant effect on the amount of *Poa annua* in a golf green.

Before deciding on which fertiliser to use it is always wise to have a soil test performed and to consult a knowledgeable adviser about the implications of the results. It will probably not be necessary to apply phosphate to old greens. When present the fescues and bents found in old golf greens have a low requirement. But if it is necessary to apply phosphatic fertiliser, scientific research has not demonstrated conclusively its effect on the annual meadow grass population.

Phosphate can be applied without fear of encouraging *Poa annua* unless the fertiliser also contains lime. Using lime really does appear to increase annual meadow grass in greens turf – but that's another story.

● Turfgrass scientist Robert Laycock runs his own agronomy consultancy.