Doing the Math

Martyn Jones switches on his calculator and explains how to work out nutrient requirements of turfgrasses and application rates of fertilisers.

A myriad of products is now available that claim to enhance the growth and health of turfgrasses and many are given names and descriptions that suggest that they are something other than a form of nutrient supply. Turf tonics, soil conditioners, organic dressings, biostimulants, seaweed derivatives, bio-conditioners, growth enhancers and biological disease suppressants are just a few of the terms given to some of them.

Some such products can contain appreciable quantities of plant nutrients; in some cases, as much as 5% or more of nitrogen. Often, nitrogen is added to products to stimulate an obvious turfgrass response and convince the greenkeeper that it is beneficial.

Disease outbreaks can be a consequence of inappropriate applications of nutrients

There can be observable amounts of other major nutrients, apart from nitrogen, in some of the products. Phosphorus and potassium may also be present. Some provide a source of iron, magnesium, manganese or other micronutrients; while some purporting only to contain specific micronutrients actually contain appreciable quantities of nitrogen. A number of them probably entirely owe their stimulating effects to the presence of the nitrogen.

These are, in fact, fertilisers. But because they are given other names, they do not include the nutrient content on their packaging. So beware! Inappropriate use of some such products can lead to disastrous results; unexpected and severe disease outbreaks, scorch, low temperature kill, or weed invasion.

Some greenkeepers claim to use virtually no fertilisers on their greens. However, on further discussion, it emerges that these same greenkeepers are using quite high quantities of some of these 'alternative' materials. Strangely, they don't recognise them as fertilisers because they are not applying them as a nutrient source.

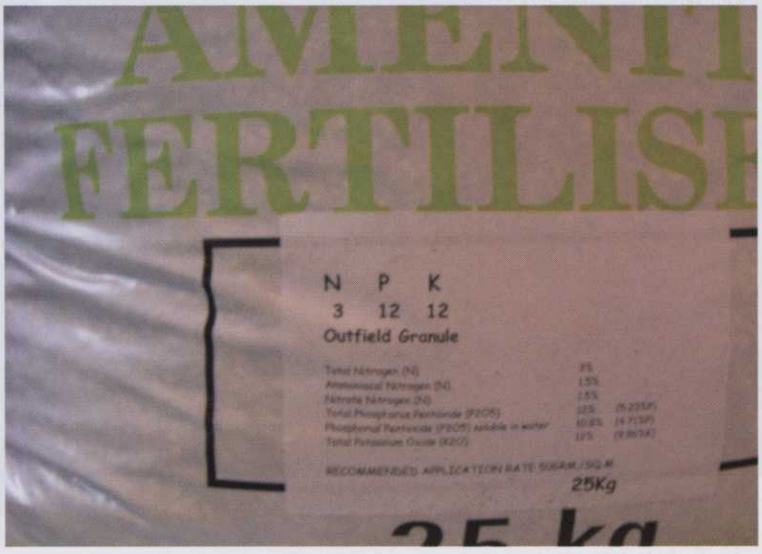
This is particularly the case with the use of organic dressings. It would seem that, to them, fertilisers are only nutrient sources derived from synthetically produced chemicals. Some even refuse to acknowledge 'lawn sand' or ammonium sulphate in the general term fertiliser. Experienced and knowledgeable greenkeepers know that a nutrient source is still a fertiliser by any other name.

When offered a product, it is prudent to ask for a nutrient analysis and copies of independent research data that may substantiate or disprove any claim. Expensive 'secret recipes' should be dismissed. Things that seem too good to be true usually are.

UNDERSTANDING WHAT IT SAYS ON THE BAG

Having determined if a product is a fertiliser or whether it is totally unrelated to nutrient provision, there are a number of other points to appreciate before we can calculate the amount required. This is assuming that you want control of the fertiliser programme and that you don't just accept the recommended application rates as they appear on the bag.

The first stage of understanding fertiliser calculations is to understand some of the terminology associated with fertiliser materials.



Interpreting the nutrient content of fertilisers is a vital part of greenkeeping

RATIO

This term refers to the relative quantities of the primary nutrients in a fertiliser product. For example, a 10:10:10 fertiliser has a ratio of 1:1:1, as would a 20:20:20. A 20:5:10 product has a ratio of 4:1:2. Ratio provides little information about the actual amount of nutrients in the bag. It is the analysis that provides the most useful information about the fertiliser.

ANALYSIS

This term refers to the percentage by weight of nutrients present in the fertiliser product. The analysis will be shown on the bag, either in prominent numbers on the front of the fertiliser package, or listed as part of the label. Nitrogen (N) is expressed on an elemental basis, whereas Phosphorus (P) and Potassium (K) are generally expressed as phosphorus pentoxide (P_2O_5) and potassium oxide (K_2O).

Therefore, a 10:10:10 fertiliser product contains by weight 10 percent N, 10 percent P_2O_5 and 10 percent K_2O. Consequently, a 25 Kg bag of this product will contain 2.5 Kg N, 2.5 Kg P_2O_5 and 2.5 Kg K_2O.

A frequent mistake is to interpret the analysis as though the last two numbers refer to percentages by weight of elemental P (phosphorus) and K (potassium). This can lead to large errors in the calculation of fertiliser requirements.

Some, but not all, manufacturers include a converted equivalent for P_2O_5 and K_2O. Care must be taken that the following conversions are always used when fertiliser calculations involving P and K are made.

P_2O_5 contains 44 %P
K_2O contains 83 %K

CALCULATION 1 - CALCULATING THE AMOUNT OF NUTRIENT IN A BAG

A 25 Kg bag of fertiliser has an analysis of 20:5:10. How much N, P and K does this bag contain?

$$25\text{Kg} \times \frac{20}{100} = 5\text{ Kg N}$$

$$25\text{ Kg} \times \frac{5}{100} = 1.25\text{ Kg } P_2O_5$$

$$25\text{ Kg} \times \frac{10}{100} = 2.5\text{ Kg } K_2O$$

The amount of elemental Nitrogen (N) has been calculated to be 5 Kg, but another step is required to determine the amount of Phosphorus (P) and Potassium (K).

$$1.25\text{ Kg } P_2O_5 \times \frac{44}{100} = 0.55\text{ Kg P}$$

$$2.5\text{ Kg } K_2O \times \frac{83}{100} = 2.075\text{ Kg K}$$

Therefore, the bag of fertiliser contains 5 Kg of N, 0.55 Kg of P and 2.075 Kg of K.

CALCULATION 2 - CALCULATING THE AMOUNT OF FERTILISER TO APPLY

A second more useful type of calculation is used to determine how much fertiliser needs to be applied to a particular area to supply the grasses with a certain amount of the nutrients.

How much of a 20:5:15 fertiliser product would have to be applied to 500 sq. metres of green to supply the grasses with 150 Kg of N per hectare (10,000 sq. metres) per annum?

Note that 150 Kg per hectare per annum can also be expressed as 150 Kg h-1 yr -1.

The application rate of 150 Kg per Hectare of N is already known, therefore:

$$150 \times \frac{100}{20} \times \frac{500}{10000} = \text{37.5 Kg of fertiliser is required for the 500 sq. metres}$$

37.5 Kg of the fertiliser product will supply 500 metres^2 of green with N at the rate of 150 Kg h-1 yr -1. This quantity will, of course, be applied to the green in a number of increments during the year.

Calculating the quantity of P and K that the fertiliser product applies may also be required to determine a fertiliser programme. In these cases, the following additional calculations are made.

37.5 Kg of the 20:5:15 fertiliser product will also supply the 500 metres^2 with:

$$37.5\text{ Kg} \times \frac{5}{100} \times \frac{44}{100} = 0.825\text{ Kg P}$$

$$37.5\text{ Kg} \times \frac{15}{100} \times \frac{83}{100} = 4.669\text{ Kg K}$$

These figures will equate to application rates per hectare of:

$$0.825 \times \frac{10000}{500} = \text{16.5 Kg per hectare P (16.5 Kg h-1 P)}$$

$$4.669 \times \frac{10000}{500} = \text{93.38 Kg per hectare K (93.38 Kg h-1 K)}$$

Therefore, 37.5 Kg of the fertiliser product will supply the 500 metres^2 of green with Nitrogen (N) at the rate of 150 Kg h-1, Phosphorus (P) at the rate of 16.5 Kg h-1 and Potassium (K) at the rate of 93.38 Kg h-1.

If a nutrient application rate of 150 Kg h-1 N, 40 Kg h-1 P and 120 Kg h-1 K is desired, a further 23.5 Kg h-1 P and 26.62 Kg h-1 K are required from other fertiliser sources.

In the case of P, if Triple Superphosphate (48% P_2O_5) is to be the P source:

$$23.5\text{ Kg h-1} \times \frac{100}{48} \times \frac{100}{44} \times \frac{500}{10000} = \text{5.56 Kg of triple superphosphate will need to be applied to the 500 m2 to satisfy the additional P requirement}$$

Accurate application of nutrients helps produce high quality surfaces

In the case of K, if Potassium sulphate (50% K2O) is to be the K source:

$$26.62 \text{ Kg h-1} \times \frac{100}{50} \times \frac{100}{83} \times \frac{500}{10000} =$$

3.21 Kg of Potassium sulphate will need to be applied to the 500 m^2 to satisfy the additional K requirement.

Insufficient nutrient can result in thin, weak turf

To summarise the example, if 500 m^2 of green is to be fertilised at a desired rate of 150 Kg h-1 N, 40 Kg h-1 P and 120 Kg h-1 K with a 20:5:15 fertiliser product as the principal source of nutrients, 37.5 Kg of the product would need to be applied to satisfy the nitrogen (N) requirement.

In addition, further dressings of 5.56 Kg of Triple Superphosphate and 3.21 Kg of Potassium sulphate would be required to satisfy the overall phosphorus (P) and potassium (K) requirements.

So, the next time you are contemplating using fertilisers or other products on any area of your golf course, be sure that you know exactly what you are using and that you are applying the quantity of nutrients that you want.

Remember, you can't take it off once you have applied it. By then, the damage may have already been done.

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