

FERTILISER APPLICATION IN LAND REGENERATION

Geoffrey Sellers

BPG

NOTE 7

Best Practice Guidance
for Land Regeneration

Introduction

With the increasing pressure to develop brownfield sites for housing and commercial development, more attention is being turned to creating greenspace within these areas to improve the general environment for the people who live and work there. This inevitably means establishing vegetation in less than ideal environments where attention has to be given to the fundamentals of growing plants if the restoration is going to be sustainable.

Brownfield sites often contain soils that feature a number of drawbacks.

- They are often infertile so basic nutrients, such as nitrogen, potassium and phosphorus may need to be applied as a matter of course within the initial establishment period if the trees are to avoid becoming nutrient deficient (see for example Figure 1).
- There is often a lack of organic matter, which is needed to hold in any nutrients that may be supplied as fertiliser.
- Contaminants may also be present which either compete with mineral nutrients for binding sites on the soil matrix or may prevent uptake of plant nutrients.

Fertiliser categories

There are two broad categories of fertilisers: mineral fertilisers and organic fertilisers.

Mineral fertilisers

Mineral fertilisers are manufactured fertilisers that tend to be released into the soil quickly, especially nitrogen (N), although potassium (K) and phosphorus (P) release can be slower. Their advantage is that growth response effects are relatively fast and can be used to solve an immediate fertiliser deficiency. It is also possible to apply fertilisers at specific plant growth stages or times of the year where extra fertiliser would be beneficial. Their disadvantage is that, if no organic matter is present (as is often the case with brownfield soils), the fertiliser will not be held in the soil and will leach away from it before benefiting the plant. This may occur after heavy rainfall or movement of water on the site, or if the plant root systems are too underdeveloped to utilise the fertiliser. This is important because there is a risk that mineral fertiliser that leaches may pollute water that flows off the site. It is important to make sure that environmental quality standards set for water are not exceeded through the overapplication of mineral fertiliser.

Table 1 shows the different formulations available for N, P and K.



Figure 1 Mineral nutrient deficiency in conifer branches.

Table 1 Range of formulations for N, P and K mineral fertilisers.

| Mineral fertiliser | Formulation | Typical % composition |
|--------------------|--------------------------|-----------------------|
| Nitrogen (N) | Ammonium nitrate | 34 |
| | Ammonium sulphate | 21 |
| | Urea | 46 |
| Phosphorus (P) | Superphosphate | 19 |
| | Triple superphosphate | 47 |
| | Ground mineral phosphate | 30 |
| Potassium (K) | Muriate of potash | 60 |

Organic fertilisers

Organic fertilisers are usually formed from waste by-products such as animal, green and human wastes and are generally slow release fertilisers compared to mineral fertilisers. They can be an important source of plant nutrients and organic matter and are covered in BPG Note 6: *Application of sewage sludges and composts*.

When to apply fertiliser

Mineral fertilisers are mainly applied at planting or just post-planting; they can also be used as a top dressing to solve any mineral deficiencies that may arise later. The best way to decide whether further applications are necessary is to send some foliar samples away for analysis. For most plants and trees, organic fertilisers should be applied just before or at planting/sowing as they are difficult to apply later.

How to take soil and foliar samples

Before deciding to apply mineral P or K to a brownfield soil it is best to sample the soil and have it analysed because appreciable amounts of available P and K may already be present.

Soil sampling

Soil sampling should be based on the method recommended in the Defra fertiliser recommendations RB209. This can be summarised as follows:

- It is important to have a uniform sampling depth; the recommended depth is to 7.5 cm for grass and to 15 cm for other crops/trees.
- The soil sample must be representative of the area sampled. Areas known to differ in some important respects should be sampled separately and small areas known to differ from the majority of the land should be excluded from the main sample and be treated separately.
- A sample composed of 25 individual sub-samples (cores) is adequate for a uniform area. The sub-sample points must be selected systematically, with an even distribution over the whole area. This is usually achieved by following a letter W pattern and taking sub-samples at regular intervals.
- When sampling areas other than grassland a gouge corer or screw auger should be used. In grassland areas only a gouge or pot corer that can take an even core of soil throughout the sampling depth can be used. This is not possible using a screw auger in grassland situations.
- Sampling is recommended at the beginning of planting/sowing and then at four-yearly intervals except on acid soils where more frequent testing may be needed for grassland land-uses.

Foliar sampling

Foliar sampling is based on the method recommended by the Forest Research sampling instructions. It is only appropriate for trees. All other vegetation should be tested using soil sampling as recommended by Defra.

- The problem area to be sampled should be divided into sub-areas of poor and good growth and then samples taken from both sub-areas so that a comparison can be made. The sampling procedures for conifers and broadleaves are different so care should be made to send the right kind of sample for analysis.
- Conifer samples should consist of a composite of five current years' shoots. Samples can be collected from the first week in October to the end of the second week in November, except for deciduous conifers which need to be treated like broadleaf trees and sampled in late July to August. For each species, five typical dominant trees should be sampled. Only shoots of the current year should be sampled and needles should not be stripped off the shoot. The sample shoots should be cut from the first whorl below the leader.
- Broadleaf trees should be sampled from late July to the end of August. The sample should consist of fully expanded undamaged leaves from just outside the crown. Enough leaves to cover an A4 sheet of paper should be taken from large or well-established trees, but if it is necessary to sample from young trees then this might not always be possible so a composite sample should be taken from 5–10 trees of each species. However, there is little point in sampling trees until after two growing seasons as the tree will need to reach an equilibrium with the site rather than reflect the nutrient regime of the nursery where it was initially raised.

Application rates

The sample analysis report will contain a fertiliser recommendation for the site if based on foliar analyses from trees or will have an soil index rating, possibly accompanied by a fertiliser recommendation based on the Defra fertiliser recommendation tables (RB209). If the soil sample analysis results only come with an index rating then the necessary fertiliser inputs can be found at the website given in References and further information, page 4.

However, sometimes it will not be possible to take samples for analysis due to time constraints or for cost reasons. If this is the case, then a general recommendation for infertile sites for mineral P and K, based on Forestry Commission recommendations for trees and Defra recommendations for poor soils sown to grass, is an application of about 100 kg K ha⁻¹ and about 60 kg P ha⁻¹ to the soil at planting/sowing. However, it is recommended that at least a soil sample analysis is carried out at the beginning to obtain a soil index rating if possible.

On poor sites the Forestry Commission has a mineral nitrogen fertiliser recommendation for trees of 150 kg N ha⁻¹ to be applied at planting. For grass, Defra gives a mineral fertiliser recommendation for N of 60 kg ha⁻¹ to be applied at sowing. This may need to be supplemented with further yearly mineral fertiliser applications of N in the spring of 50–60 kg ha⁻¹ to get a good overall cover if no N is being supplied by an organic slow release fertiliser. There is no recommendation to apply N in any form, mineral or organic, to a wildflower meadow.

Further applications should be based on foliar or soil analysis results but it should be remembered when making applications of nitrogen that there are environmental quality standards for the protection of watercourses and groundwater.

Calculating the application rate for fertilisers

Fertilisers are typically badged with exact information about how much N, P or K will be supplied in a given application. For example a 19:10:10 fertiliser contains 19% N, 10% P and 10% K. Some common formulations are 0:24:24 (0 % N, 24% P and 24% K) and 34.5:0:0 (34.5% N, 0% P+K).

From this information, a simple calculation can say how much fertiliser of a given formulation to add. The calculation is

$$\frac{100}{\% \text{ Nutrient in formulation}} \times \text{Recommended rate}$$

Example 1

In a 34.5:0:0 formulation for N with a recommended rate of 150 kg ha⁻¹, the amount of fertiliser that needs to be applied is:

$$\frac{100}{34.5} \times 150 = 434.8 \text{ kg ha}^{-1}$$

P and K usually come together as a compound fertiliser so the calculation is based on the nutrient that is most deficient or has the greater recommended rate. This invariably means that one of the nutrients will be oversupplied but since P and K are relatively insoluble, this is not a problem.

Example 2

With a recommended rate of 100 kg ha⁻¹ K and 60 kg ha⁻¹ P using a formulation with 0:24:24 N:P:K then the amount of fertiliser that needs to be applied is:

$$\frac{100}{24} \times 100 = 416 \text{ kg ha}^{-1}$$

This will oversupply the P but will correctly supply the K recommendation.

References and further information

Bending, N.A.D, McRae, S.G. and Moffat, A.J. (1999). *Soil-forming materials: their use in land reclamation*. The Stationery Office, London.

DEFRA (2010). *Fertiliser Manual (RB209)*. TSO, Norwich.

Taylor, C.M.A. (1999). *Forest fertilisation in Britain*. Forestry Commission Bulletin 95. HMSO, London.

Further information on foliar sampling can be found on Forest Research's Foliar Analysis Service webpage:
www.forestry.gov.uk/fr/INFD-5UWPMC