Applying fertilisers

Fertiliser application

Fertilisers may be straight fertilisers, containing a single nutrient, or multi-nutrient fertilisers, containing two or more nutrients.

There are three types of multi-nutrient fertilisers:

- complex fertilisers – chemical compounds made by chemical reaction
- compound fertilisers – made by chemical reaction, blending or a combination of both
- blended fertilisers – made by mixing two or more dry substances. No chemical reaction is involved.

Both straight and multi-nutrient fertilisers may be applied in a number of ways:

- field applied - fertilisers may be mixed into soil or potting compost before sowing or planting (base dressing) or spread on the soil surface around the plants, normally at the start of the growing season in the spring (top dressing).
- fertigation - fertiliser is mixed with water being used to irrigate the crop. It is most commonly used for cash-crops rather than broad-acre or arable crops.
- foliar - fertilisers are sprayed on to a crop. Primary and secondary nutrients are sprayed at key growth stages of the plants. The method is also particularly useful for accurately applying relatively small quantities of micronutrients.

Figure 1 This piece of equipment is used at Washington State University to research fertigation.

Release of nutrients

Some fertilisers release their nutrients quickly; others release their nutrients more slowly. There are benefits and drawbacks to both types of release.

	Description	Benefits	Drawbacks
Fast release	• solution, often called a liquid fertiliser • readily soluble solid	• nutrients available immediately and so effect on plants is rapid	• may be rapidly leached from the soil and therefore, wasted • leaching may also contaminate ground water and surface water • if the amount applied is high it can damage plants, usually through 'burning'
Slow release	• organic substances broken down in soil by microbial activity • slowly soluble or coated substances	• nutrients released over a period of time • fewer applications may be needed	• nutrients may not be available in sufficient quantity when they are needed • some slow release formulations may be expensive

Some fertilisers are designed and made in such a way that they release their nutrients in a controlled way. They are called controlled release fertilisers. More often than not they are inorganic water-soluble fertilisers encased in a partially permeable coating such as sulfur or a synthetic resin. Water diffuses through the coating and dissolves the fertiliser. This solution passes through the coating into the soil where is becomes available for absorption through plant roots.

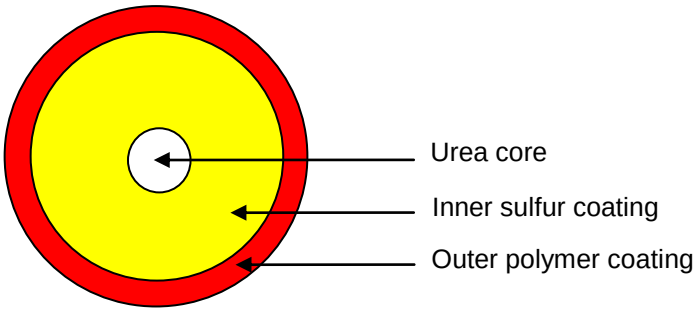

Figure 2 A slow release fertiliser granule.

The warmer the soil, the faster the two-way diffusion process. This happens, therefore, when plants grow more quickly and need nutrients. The rate of release can also be controlled by varying the thickness of the coating.

Hydrolysis of urea

With environmental concerns about the use of ammonium nitrate, the use of urea as a nitrogen fertiliser has increased.

Urea is a slow release fertiliser. It is not used directly by plants. Instead it is hydrolysed in the soil by microbial activity to produce ammonium ions that are soluble in soil water and are absorbed through a plant's roots. The hydrolysis is catalysed by the enzyme urease.

$$(NH_2)_2CO(s) + (2)H_2O(l) \rightarrow 2NH_3(aq) + CO_2(aq) \quad \text{or} \quad (NH_4)_2CO_3(aq)$$

Following this a number of reversible reactions happen:

$$NH_3(aq) + H_2O(aq) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$$

$$CO_2(aq) + H_2O(aq) \rightleftharpoons HCO_3^-(aq) + H^+(aq)$$

$$HCO_3^-(aq) + H_2O(aq) \rightleftharpoons CO_3^{2-}(aq) + H^+(aq) + H_2O(aq)$$

The action of urease may be inhibited by heavy metal ions such as Pb^{2+}.

Finding out

Find out more about how fertilisers are applied by considering these examples:

- a cereal crop such as wheat being grown in a field;
- potatoes being grown in a field;
- tomatoes being grown in a glasshouse;
- fruit trees in an orchard.

How might the release of nutrients from a fertiliser be determined?

What are the consequences of urease inhibition and how might the inhibition of urease activity be investigated?