

The function of plant nutrients

Whenever a crop is harvested, nutrients are removed from the soil and will at some time need to be replaced. This quick guide gives a whistlestop tour of the most important plant nutrients: what they do, how to supply them and how to recognise deficiencies in the plant. Nitrogen, Phosphorus and Potassium are often thought of as the most important because they are required in the largest quantities, but other ('micronutrients') can be just as essential but required in smaller amounts.

Nitrogen

What does nitrogen do?

Nitrogen is needed for synthesis of all proteins in plants. These are needed for the synthesis of enzymes which control all the essential processes in any living organism (eg photosynthesis, respiration, growth).

What happens when a plant runs short of nitrogen?

The first visible symptom is the plant starting to pale green then yellow. This happens because the plant slows down the production of chlorophyll which keeps the leaves looking green. The plant will grow more slowly and produce smaller leaves. This can happen for other reasons too eg if a plant is waterlogged. It is also very easy to feed a plant too much nitrogen. This can result in an excess of leafy lush growth making the plant more susceptible to attack by pests and diseases. It can also decrease the amount of fruit, tuber or root production.

Key features of nitrogen

- Nitrogen is often thought of as the most important nutrient for plant growth.
- Plants short of nitrogen look pale and stunted
- It is easily washed out of the soil
- Green manures, animal manures, liquid feeds and garden compost are good sources of nitrogen



These potatoes are running short of nitrogen producing a stunted yellow canopy.



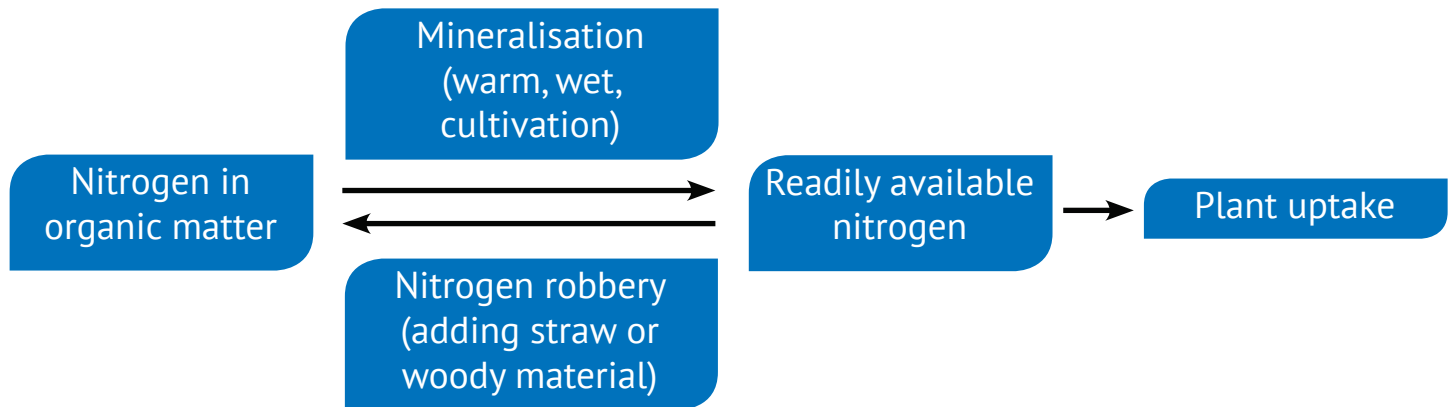
These potatoes received too much nitrogen and produced a tangled mass of dark green leaf growth.

Properties of nitrogen

Nitrogen is present in a number of different forms in the soil:

- The readily available form (nitrate or ammonium) is the only form taken up by plants. This form is the most soluble of the plant nutrients and only binds weakly to the soil particles. Therefore although it is rapidly taken up, it is very easily washed out of the soil, especially sandy soils. This can cause problems with polluting ground water.

- It is also present bound up in organic compounds (eg plant residues and organic matter). The plant cannot take up this nitrogen, it can slowly be converted to more readily available forms. This process is known as mineralisation.
- Mineralisation is encouraged by rain, warm weather and by cultivating the soil. The reverse process can occur if a high quantity of organic residues with a high carbon content (especially straw or wood shavings) are added to the soil – readily available nitrogen becomes locked up. This is sometimes termed 'nitrogen robbery'.



Acceptable sources of nitrogen

Nitrogen can be present in many sources and should be carefully applied, as too much results in excessive sappy leaf growth.

- **Green manures and plant residues** – the foliage of green manures is high in nitrogen, and once it is incorporated into the soil, it will break down and release the nitrogen for the following crop. It will be released more quickly if the soil is warm or wet. More leafy sappy growth (especially legumes) will release nitrogen much more quickly than more fibrous material (eg grass stems).
- **Liquid feeds** – these can be made from nettles or comfrey. The plants can take these up rapidly, so they are good for correcting a short term deficiency, but the nitrogen can easily be washed out if too much is applied.
- **Animal manures** – these vary widely in nitrogen content. Care must be taken that they have rotted down before applying, otherwise they can scorch plants. Chicken manure is very high in nitrogen and should be added in moderation. Some materials, especially horse manure mixed in with bedding or straw have a much lower nitrogen content.
- **Garden compost.** Again this can vary widely in nitrogen content. Mixes made with more green things (eg vegetable waste, young grass clippings) will contain a lot more nitrogen than compost made a higher content of brown things (eg bark, newspaper, straw).
- **Green waste compost from the council.** This often has a high proportion of chipped woody prunings, so has a low readily available nitrogen content, although it will gradually release nitrogen over time.

Phosphorous

What does phosphorous do?

Phosphorus is essential for the functioning of all plants: it is part of the process for manufacturing energy, and it is also a component of all cell membranes. Plants also need phosphorus for good root development.

What happens when a plant runs short of phosphorous?

Plants that are deficient in phosphorus start to show a purple tinge to the leaves, and they can start to feel leathery. The large leafy cabbages such as spring greens can be susceptible.

Properties of phosphorous

Like the other nutrients, phosphorus is present in the soil in a number of forms.

- Soluble – this is the form which plants can take up.
- Bound – this is bound to soil particles, especially if there are iron, aluminium or calcium present. In many cases, there is plenty of phosphorus present in the soil, but it is not in a form that the plants can take up.
- Organic – phosphorus is contained in many organic compounds present in organic matter or plant residues.
- Phosphorus is not washed out of the soils like nitrogen. It is lost when soil particles are washed away by run off or erosion. Relatively small amounts can cause pollution in rivers.

Acceptable sources of phosphorous

Garden or green waste compost is the most sustainable source of phosphorus. Although some sources of rock phosphate are permitted in organic systems, there is concern over their use as it this is a finite resource, that is becoming increasingly limited in availability. Bonemeal is also a good source of phosphate if you have no objection to using abattoir products.

Key features of phosphorous

- Phosphorus is essential for all plant functions and root development
- Plants short of phosphorus show a purple tinge to the leaves with a leathery feel
- Maintaining the supply of phosphorus should be thought of as a long term strategy rather than just feeding one crop
- Green waste, garden compost and animal manures are a source of phosphorus



Cabbage leaf running short of phosphorous

Potassium

What does potassium do?

Potassium is present in the solution of all plant cells and is important in regulating their water balance. It is also essential in the development of fruits including tomatoes and cucurbits. Plants that are producing fruit often benefit from a later potash feed especially those growing in pots that quickly exhaust their nutrient supply.

Key features of potassium

- Often also known as potash, this element is particularly important for fruit development (including tomatoes)
- Plants short of potash start to show yellowing on the edges of the leaves followed by brown patches
- Potassium is depleted slower than nitrogen from the soil. Clay soils generally have a higher potassium content than sandy soils.
- Comfrey liquid is a particularly good source, but green waste compost and wood ash also contain potash.

What happens when a plant runs short of potassium



These potatoes are running severely short of potash

The most obvious signs of potassium deficiency are yellowing of the leaves at the edges. These later turn brown and extend to other parts of the leaves. It can be confused with wind burn or frost damage. Fruits especially tomatoes can have a poor flavour if they run short of potash.

Properties of potassium

Potassium in the soil is present in four different forms:

- Soluble potassium is in the soil solution and can be taken up by plants. This pool can become rapidly depleted.
- Exchangeable potassium is bound loosely to the soil particles and releases potassium into the soil solution.
- Fixed potassium is bound within soil particles, especially clay. Clay soils have a larger reserve of fixed potassium than sandy soils.
- Structural potassium is present in the parent rock. Although this contains the largest quantity of potassium, it is only released very slowly by weathering.

Acceptable sources of potassium

In a garden situation there are a few sources of potassium that are acceptable in the organic garden:

- Comfrey liquid is a very good source of potassium as the comfrey plant has a deep root that actively mines it from the soil. It can be used to provide a supply of potash to fruiting plants in pots later in the season.
- Green waste compost is a good source of slow release potassium over a longer period
- Wood ash is a concentrated source of potassium and should be mixed in with compost first. Don't use ash from a coal fire (it is too acidic).

Other nutrients

There are many other nutrients that are essential to plant growth but needed in much smaller quantities. In many cases, plants suffer a nutrient deficiency not because there isn't enough in the soil but because the condition of the soil prevents it from being taken up readily. (eg pH, soil structure or watering).

- **Magnesium** – essential for the manufacture of chlorophyll. Deficiency shows up as dark patches between the veins but is often a result of drought or excess potash rather than soil deficiency. If it is a severe problem, plants respond well to a foliar spray of epsom salts.
- **Calcium** – this is a component of plant cell walls and regulating biochemical processes. Calcium is not very mobile in the plant, so a deficiency often manifests itself as brown lesions within or at the far ends of large structures eg blossom end rot of tomatoes, bitter pit in apples and internal rust spot of potatoes. Deficiency is more often a result of insufficient or irregular watering than lack of calcium in the soil. It can also be a result of the soil being too acidic. This can be corrected by adding Gypsum. Be careful to add this at the recommended rate, as adding too much can lock up other plant nutrients.
- **Iron** – again this is needed for chlorophyll production and in many biochemical plant processes. Deficiency shows up as pale leaves with brown margins – it is more common in fruit bushes. Most often the deficiency is a result of the soil being too chalky so the iron is not in a form that can be taken up by the plant. In severe cases, the plant will respond by applying a foliar feed of seaweed and chelated iron.
- **Manganese** – this is necessary for many plant biochemical processes. Deficiency will show as brown spots on the leaf veins and is most common on soils with very high organic matter such as peat fen soils. It can be corrected with a foliar spray of seaweed with added micronutrients, or manganese sulphate.

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