

FERTILISERS

Topics covered in this section

- Soil pH • Plant nutrients and nutrient deficiencies. Quick diagnosis of nutrient deficiencies
- Types of fertilizer

Additional useful references: 'The Garden Expert' and other books from 'The Expert' series

Soil pH

A clear understanding of soil pH will explain why some plants grow well in certain soil types and why plants are prone to nutrient deficiencies in different soils.

The term pH is one which is used to describe the acidity or alkalinity of a substance. The pH scale runs from 0 to 14. pH 7 is neutral - anything below this is acid, anything above alkaline. Most garden soils will not have a pH lower than 4.5 to 5 (this is quite acidic in terms of soil pH) or one higher than 8 to 8.5. Plants tend to prefer a slightly acid growing medium (about 6.5), but there are exceptions to this, in particular ericaceous plants such as rhododendrons and many heathers, which like more acid growing conditions. Brassicas, on the other hand, grow better in an alkaline soil.

pH and nutrient availability

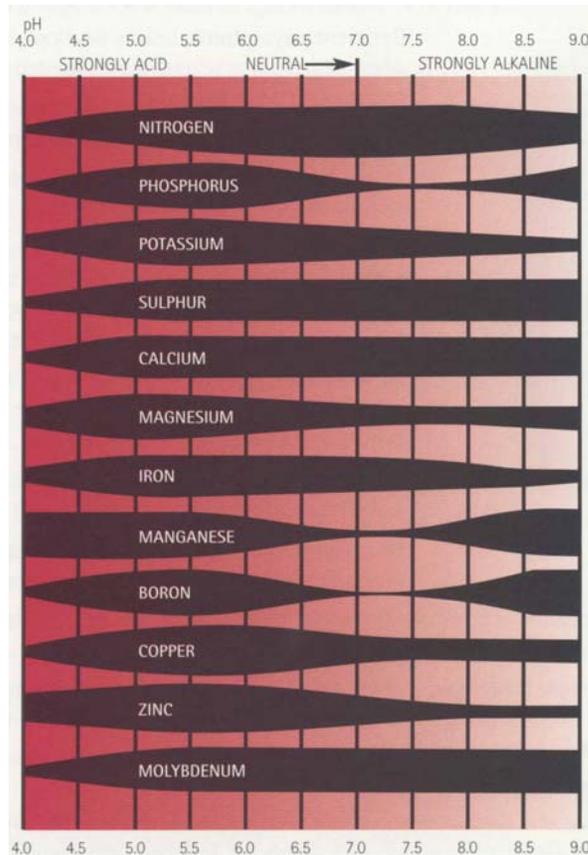
The availability of plant nutrients is strongly affected by the pH of the soil or growing medium. Diagram 7.1 clearly shows the effect of pH on plant nutrients and in most situations the ideal pH is 6.5.

pH testing

The easiest (and cheapest) way to test whether a soil is acid, alkaline or neutral is to use a proprietary testing kit. Alternatively, a pH meter may be used.

Altering soil pH

Garden lime is used to make a soil less acid (or more alkaline). Increasing soil acidity is less easy but the recommended approach is as follows: dig in moss peat or acid organic material and use fertilisers based on sulphates, rather than nitrates (eg sulphate of ammonia rather than ammonium nitrate). Some ericaceous fertilisers will also help to 'acidify' soil.



THE EFFECT OF SOIL pH ON PLANT NUTRIENT AVAILABILITY

Plant nutrients and deficiency symptoms

MAJOR PLANT NUTRIENTS

Nitrogen, phosphorus and potassium are the major plant nutrients. Plants need them in relatively large quantities and it is necessary to provide these by adding the right fertiliser. Deficiency symptoms and other relevant information about these nutrients is given below.

Nitrogen (N)

Nitrogen is an essential nutrient in most plant functions; it is the key constituent in proteins and in chlorophyll and thus is especially important for healthy growth of leaves and other green parts of plants. Good leaf growth is essential for good yields.

Deficiency symptoms: Stunted growth, pale green/yellow leaves and general lack of vigour. Symptoms appear on older leaves first.

Plants affected: Leafy plants, especially brassicas, are prone to deficiency but most plants will show signs of nitrogen deficiency unless fed regularly.

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Problem soils: No matter what the soil type is, nitrogen deficiency can occur. Soils which are particularly prone are sandy or free draining soils and those low in organic matter, especially those in high rainfall areas. On peaty soils, plants can grow well with lower nitrogen levels.

Treatment/prevention: Apply a high nitrogen fertiliser where deficiency is suspected, preferably as a foliar feed if deficiency is severe.

Phosphorus (P)

Phosphorus, normally expressed as phosphorus pentoxide (P_2O_5) on the label, is important for many plant functions, particularly healthy root growth. It also plays a significant role in encouraging good germination of seeds, seedling development and fruit ripening.



PHOSPHORUS DEFICIENCY IN TOMATOES

Deficiency symptoms: Leaves develop blue/green or purplish tints; dead leaf tissue can occur when deficiency is severe. Leaves are reduced in size. Older leaves are the first to be affected and may drop prematurely.

Plants affected: Root vegetables, seedlings and young plants, fruit crops.

Problem soils: Clay soils, chalky soils, acid soils, free draining soils, especially in high rainfall areas.

Treatment/prevention: A general purpose fertiliser, applied prior to planting or sowing, will suffice in most cases. Bone Meal is also useful as a pre-sowing or planting fertiliser, being particularly high in phosphorus. Extra dressings may be applied to root crops when the roots are developing in order to increase yields.

Potassium or Potash (K)

Potassium, expressed as potassium oxide (K_2O) on the label, plays a major role in ensuring high quality and abundant fruit and flowers.

Deficiency symptoms: Older leaves are the first to be affected. Symptoms are brown or purple leaf edges and the leaf margins may curl up or downwards.

Plants affected: Plants which have an especially high demand for potassium include leafy vegetables, potatoes, tomatoes, beans and many fruits.

Problem soils: Potassium is commonly deficient in sandy, chalky or peaty soils. Crops grown on clay soils may also become deficient if crop demand for this nutrient is high.

Treatment/prevention: Where crops show deficiency symptoms or if plants are coming into flower or fruit, apply a high potash fertiliser such as a tomato fertiliser. For flowering plants either rose food or a flower fertiliser is recommended. General purpose fertilisers also contain high levels of potash.

SECONDARY PLANT NUTRIENTS

Calcium, magnesium and sulphur, which are needed in moderate quantities for healthy plant growth, are often referred to as secondary nutrients. Deficiencies usually only affect the first two since sulphur is an atmospheric pollutant in industrial areas and traces of it are present in most composts and fertilisers.

Calcium (Ca)

Identifying calcium deficiency is difficult as the symptoms vary greatly between plants. Very often there may be sufficient calcium in the growing medium but it may not reach the right part of the plant. This is what happens with bitter pit of apples or blossom end rot of tomatoes. These symptoms are due to a localised lack of calcium through the plant failing to move the calcium internally to the part that needs it, rather than a deficiency in the soil or compost.

Deficiency symptoms: These can include water-soaked areas (e.g. blossom end rot), internal browning or brown, pitted areas (e.g. black heart of celery, internal browning of Brussels sprouts, bitter pit of apples).

Pre-disposing factors: Acid peats and light, free draining soils are the most likely types to suffer from lack of availability or loss of calcium. Erratic watering or lack of ventilation in glasshouses impedes movement of water within the plant and hence calcium to the fruit. This is the most common reason for blossom end rot occurring in tomatoes, peppers etc.

Treatment/prevention: If soil is acid, lime (calcium carbonate or magnesium calcium carbonate) areas to a pH of 6.5 where susceptible plants are to be grown, but do not over-lime. Ensure an adequate supply of water and good ventilation for tomatoes and other greenhouse crops prone to blossom end rot. Bitter pit may be alleviated by spraying fruit with solutions of calcium nitrate or calcium chloride at a rate of 2g/litre to 6g/litre. This may need to be repeated three to four times from mid-June onwards. Some general purpose and tomato feeds contain calcium.



CALCIUM DEFICIENCY IN APPLES

Magnesium (Mg)

Deficiency symptoms: Magnesium deficiency causes the leaves to yellow, with the veins staying green. It is the older leaves that are affected first.

Plants affected: Roses and tomatoes are especially prone to magnesium deficiency.

Problem soils: Light, acid and sandy soils are the most likely to be deficient, especially in high rainfall areas - magnesium is easily leached through the soil profile.

Treatment/prevention: Rose food and tomato fertilisers contain higher levels of magnesium, as these plants are the most prone to magnesium deficiency. For rapid treatment of deficiency a high volume spray of Epsom Salts is recommended.

TRACE ELEMENTS

Micronutrients or trace elements are only needed in very small quantities and unless the soil is very acid, alkaline or free-draining, availability of these should not cause problems. Iron deficiency is the most common of all the trace element deficiencies.

Most soluble general purpose fertilisers contain a good range of trace elements.

Iron (Fe)

Although iron is not generally lacking in the soil itself, it is often in a form which is not readily available to plants, especially in alkaline soils.

Deficiency symptoms: The foliar symptoms of iron deficiency are very similar to those shown when magnesium is deficient i.e. interveinal yellowing. In the case of iron deficiency, however, the symptoms are first apparent on the younger, rather than the older leaves.

Plants affected: All ericaceous (acid-loving) plants are prone - azaleas, rhododendrons, camellias etc., as well as hydrangeas and soft fruit such as raspberries and strawberries.

Problem soils: Chalky or alkaline.

Treatment/prevention: Do not over-lime areas where ericaceous plants are to be grown. If soil is chalky, plant ericaceous plants in containers filled with ericaceous compost or in a raised peat bed. Apply a fertiliser containing sequestered or chelated iron.

Boron (B)

Like calcium, boron affects different plants in different ways.

Deficiency symptoms: Blackening or death of young growing points of leaves and shoots. Corky patches on and inside fruit (eg corky pit of apples and pears). Rough patches on skin surface and water-soaked or black patches within root tissues (eg beetroot, swede and turnips). It can also cause hollows and brown patches on cauliflowers, cabbage and Brussel sprouts.

Plants affected: Apples, pears, cauliflowers, Brussel sprouts, celery, beetroot, swede, turnips.

Problem soils: Free draining, sandy soils.

Treatment/prevention: Work organic matter into free draining soils. Apply a fertiliser which contains boron.

Manganese (Mn)

Deficiency symptoms: Similar to magnesium deficiency - interveinal yellowing of the older leaves. Manganese deficiency is less common, but can occur on alkaline sands.

Plants affected: Beetroot, brassicas, parsnips, peas, beans, potatoes, spinach.

Problem soils: Poorly drained or compacted soil. (Note that magnesium deficiency tends to be more of a problem on free-draining soils (alkaline sands).

Treatment/prevention: Apply a fertiliser which contains manganese.

Molybdenum (Mo)

Deficiency symptoms: Narrowing of leaves - causes condition known as 'whiptail' of cauliflowers.

Plants affected: Cauliflowers, broccoli.

Problem soils: Acid soils.

Treatment/prevention: Lime soil if it is very acid (to around pH 7 for brassicas) and apply a fertiliser which contains molybdenum.

Copper (Cu)

Deficiency symptoms: Blue/green coloration of leaves.

Plants affected: Onions, peas, beans, tomatoes.

Problem soils: Peaty or very alkaline soils.

Treatment/prevention: It is very unlikely that copper will be deficient in most soils. If this does occur apply a fertiliser which contains copper.



MAGNESIUM DEFICIENCY IN TOMATOES

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Quick diagnosis of nutrient deficiencies

If you suspect that a plant may be suffering from a nutrient deficiency, but are not certain which nutrient it is, use the symptoms below as a quick reference.

To confirm the diagnosis, look up the more detailed descriptions of the symptoms and problem soils etc. under the separate heading for the individual nutrients.

- Leaves pale green, plants stunted - Nitrogen
- Leaves with purple or bronze tints - Phosphorus
- Marginal discolouration/scorch - Potassium
- Leaves yellow, veins green - Iron, magnesium (also see manganese)
- Dark water-soaked areas on fruit, brown pitting, internal browning, brittle tissue - Calcium or boron
- Narrowing of leaves (brassicacae) - Molybdenum

Types of fertiliser

Fertilisers are available as solid, liquid or soluble formulations. They may either be quick acting or have a slow or controlled release mode of action. The differences of each type and when to use them are explained below.

Solid fertilisers are available in powder or granular form. Growmore is an example of an inorganic granular fertiliser. They release nutrients readily - but are not quick acting. Organic fertilisers such as blood and bone meal and fish and bone meal are slower acting since they need to be broken down by soil bacteria before the nutrients are available to the plant. Solid fertilisers are generally used as pre-sowing or planting fertilisers or routine top dressings. They are less useful where plants are suffering from a nutrient deficiency because of the time it takes for plants to be able to absorb and then use the nutrients.

Solid fertilisers require good soil moisture to transport the nutrients to plant roots. Thus, in dry periods, watering will be necessary. The main benefits of solid fertilisers are their familiarity, ease of application and the fact that they are usually cheaper per unit of nutrient.

Liquid or soluble fertilisers are quicker acting, especially if they can be applied as a foliar feed. This is an important consideration when treating nutrient deficiencies. They are a better option in dry weather although in wet weather, the nutrients can be more easily leached through the soil.

'**Straight**' Fertilisers, which contain one key nutrient (see table below) are suitable if a gardener needs a particular plant nutrient in preference to others, either because of a deficiency problem or if a crop has a particularly high demand for an individual nutrient. These fertilisers are relatively inexpensive and are often used by 'traditional' gardeners.

Houseplant fertilisers are available in different formulations to suit different types of users. Some are available as concentrated liquids or soluble powders for dilution by the user. These tend to be more cost effective. Some are available ready diluted, for speed and ease of use. Others (eg spikes or tablets) will supply nutrient for several months and are ideal if a user tends to be forgetful about feeding their plants.

Controlled release fertilisers are becoming extremely popular with gardeners - they are easy to use and effective, provide plants with nutrients for a whole season and release nutrients at times when plants have the greatest demand for them. They are particularly good for containers and hanging baskets. They are put into the containers at planting time and perform well throughout the season, without the need for supplementary feeding.

NOTES

SINGLE-NUTRIENT FERTILISERS

Nutrient	Name	Chemical formula	% Key nutrient(s)	pH properties
Nitrogen	Sulphate of Ammonia	NH_4SO_4	21% N	Acid
Nitrogen	Nitrate of Soda	$\text{NaNO}_3 + \text{H}_2\text{O}$	16% N	Alkaline
Phosphate	Superphosphate	$\text{Ca}(\text{H}_2\text{PO}_4)_2 + \text{CaSO}_4$	18% P_2O_5	Acid
Potassium	Sulphate of Potash	K_2SO_4	52% K_2O	Acid
Potassium	Potassium Nitrate	KNO_3	44% K_2O 13%N	Alkaline
Calcium	Ground Limestone	CaCO_3	50% CaO	Alkaline
Magnesium	Epsom Salts	$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$	16% MgO	Acid
Iron	Ferrous sulphate	Fe_2SO_4	21% Fe	Acid