Growing food at home series

Fertilising soil

Pack C Notes 4

Plants gain their nutrients primarily via the soil through their roots. Fertilising is about keeping a consistent supply of nutrients essential for growth available for plant use. There are a number of factors that affect plant nutrient uptake and plant growth which are covered in this series. These notes contain information about fertilisers to assist the home produce gardener in growing healthy plants to provide good nutrition.

What are fertilisers?

Fertilisers are anything added to the soil that supplies essential nutrients to the plants to be healthy. They can supply multiple or single nutrients at a time, and can be organic or chemical.

Organic fertilisers come from the remains of plants and animals, and from rock sources, and supply multiple nutrients. Examples of organic fertilisers from plants and animals used by gardeners are:

- Manures and urine
- Compost
- Decomposed leaves including plants from the sea
- Dried ground bones
- Dried blood (often sold together with ground bones as "blood and bone")

Organic fertilisers that supply minerals include: crushed rock, dolomite, gypsum, limestone, rock phosphate, sulphur and wood ash.

Chemical fertilisers are man-made in factories and can supply multiple or single nutrients. They are fast acting, convenient to use and store. Numerous are available either to be used:

- To supply specific nutrient needs when there is a deficiency as in Boron, of Iron
- To supply multiple nutrients to supply specific plant needs such as lawns, rose, orchids, azaleas etc
- In hydroponics
- For potted plants where they are very convenient for indoor plants

Examples of single nutrient chemical fertilisers include: Ammonium sulphate, Boron, Copper, Iron, Magnesium, Manganese, Molybdenum, Phosphorus, Potassium and Zinc.

Examples of multiple chemical fertilisers are: Osmocote Tomatoes Vegetables and Herbs; Thrive All Purpose; Nitrosol

What are differences between organic and chemical fertilisers?

From a plant's perspective all nutrients are chemicals. The main difference is nutrient availability - being the percentage of total nutrients that are immediately dissolved in water (plants uptake nutrients though their roots in liquid form). Most of the chemical fertilisers are completely soluble in water and, therefore are easily and quickly available to plants. Chemical fertilisers can assist in overcoming specific nutrient deficiencies in the soil to increase plant health. Most organic fertilisers are slow release fertilisers, only a few are immediately soluble in water. Organic fertilisers additionally benefit soil structure by adding organic matter, which provides food for soil life- fungi, bacteria and small animals. Refer to Pack C Notes 5.

To supply your plants with all the nutrients they need to flourish using a combination of organic and chemical fertilisers may be best. Such as when making compost at home adding Nitrogen fertilisers (e.g. Urea) will promote greater production of humus – slow release nutrient, or when growing in pots.

There are many factors that affect plant health including watering, soil structure pH (which impacts particular plant's ability to take up certain nutrients). Refer to Pack C Notes 3 for more information. To understand your specific soil and gain recommendations of what fertilisers you need to use to produce healthy plants you can get your soil analysed.

Building living soils

We recommend that you build levels of organic matter in the soil because typical of Australian soils, levels in City in Salisbury soils are low, and you are also feeding the soil ecology which has extended benefits to the general ecology in feeding lizards and birds.

Why do we need to add fertilisers?

Like us plants need nutrition to survive. They gain theirs from both water and nutrients in the soil, and the air and water around them. The soils in our region don't have the complete combination, or levels required of nutrients for the plants we wish to grow as food sources, as most of these plants come from other regions of the world where the soil is different. Though many plants are very adaptable to conditions, to ensure good plant health we need to make additions to our soils when establishing our produce gardens. If you are growing in pots, the mixes that meet Australian Standards have enough fertiliser to last a few months to a year depending on the plants grown in them, then need to be resupplied.

As the plants grow, they take nutrients from the soils. Also, nutrients are leaching into soils below as it rains or we water, and being lost to the atmosphere. If we want continuous crops will need to replenish the soil with some fertiliser to replace what is lost. Different plants have different nutrient needs: some are heavy feeders and need large amount and will need a top up through their life; some will be adequately fed on a single application of fertiliser at the beginning of their season; and others need more at different stages of their growth. Refer to Pack D Notes 1 for more information on different plants requirements.

What fertilisers to use?

It's as personal preference whether you use chemically or organically derived fertilisers, or a combination of both. We encourage organic practices as much as possible because of the additional soil's health benefits and associated practices of increasing biodiversity in your garden and for the local ecology, and reducing run off pollution and energy production.

If you are growing in pots, either multi-nutrient slow-release, or liquid fertilisers are easier to use to avoid burning the roots. When growing in the ground you also need ensure a good supply of the main essential nutrients of Nitrogen, Phosphorus and Potassium (seen on fertiliser packaging as N:P:K) for plant growth. This can be done either chemically or organically in forms such as granules, powders, crystals, pellets or liquids. Composts and manures are organic forms. Most solid fertilisers bought in bags have similar nutrients, and are applied through spreading on moist soil or lightly digging in, then watering. Powers, liquid and crystal forms are fast acting. Coated chemical slow-release pellets or granules last from 6-9months. Organic pellets last between 1-2 months generally. Further details on application follow later. But firstly, a revisit of what makes up soil, and an explanation of the organic matter component.

Soils are made of:

- Mineral particles
- Organic materials (humus, decomposing plant and animals)
- Water
- Air
- Living organisms

The organic matter is a part of the organic material of soils and is comprised of:

- Plant and animal residues at different stages of decomposition
- Cells and tissues of soil organisms – bacteria, fungi and soil animals
- Substances formed by soil fauna, microbes on the surface and in the soil

Organic matter levels are typically low in Australian soils and it needs to be added via compost, manures and organic mulches, to build up nutrient supplies and a supportive soil structure for our food plants. Adding organic matter will in time build levels of the slow releasing nutrient humus. Humus is the substances remaining from the decomposition of plant and animals. It's a valuable component of soils as it:

- Improves soil structure which allows water and air circulation around plant roots
- Forms stable associations with clay soils (not sandy soils) to hold essential nutrients (mainly carbon, hydrogen and oxygen nitrogen, sulphur and other elements) near the plant's roots where they can be utilised
- Is a slow release fertiliser of essential nutrients, which results in better plant growth, soil structure and reduces the need to dig

Plants receive most direct benefit from added organic matter in first couple of years, so it will need to be reapplied.

So commonly referred to are Nitrogen, Phosphorous and Potassium (N:P:K) a bit more information on them is warranted. On fertiliser packaging under the title Analysis you will see these written as expression of their weight such as 20:10:5, meaning 20% Nitrogen; 10% Phosphorous; and 5% Potassium. These are three of the seventeen essential elements or nutrients for plant survival, these other elements those contained in that particular fertiliser will also be written and their portions far smaller. There are over 80 nutrients that plants can utilise.

Nitrogen (N)

Is required for leafy growth; for plants to photosynthesise (convert sunlight energy to produce sugars from water and carbon dioxide) and they need a regular supply throughout their growing season. It promotes large and thick leaf growth, so is a nutrient especially important for leafy vegetables such as spinach, lettuce. In most top soils 95% of the Nitrogen is present in organic matter, and needs to be converted by microorganisms to be available to plants. The microorganisms are releasing Nitrogen from organic matter that is applied from between a 1-5 year period, and whether this slow releasing supplies enough for the plants needs depends on the amount of Nitrogen in the organic matter in the soil, its nitrogen content and rate of decomposition. Additional supplies may be needed and sourced through products such as Blood and Bone, Seasol, Sulphate of Ammonia or Urea.

Phosphorus (P)

Used in plants energy supply systems, and to develop normally- form new cells to produce strong roots, flower, fruit and make seeds. Most soils in Australia are deficient in phosphorus. Plants take it up exclusively in an inorganic form therefore; it will need to be supplied, particularly for fruiting food plants like tomatoes where it's essential to get their flowers to set to fruit. It can be supplied as superphosphate, reactive rock phosphate, or poultry manure. It's difficult to supply enough Phosphorous in homemade composts so add one of its sources (listed above) if making at home, but be warned too much is toxic.

Potassium (K)

The names potash and potassium are interchangeable. This elements helps plants move water and sugar improving flowers and fruit, strengthen plant stems. This is readily sourced from decomposing plant residues, and is available when adding organic matter; rich sources being legumes and poultry manure. However, compost, cow manure and seaweed that have been sitting around for months are not good sources. It can be purchased in crystalline form to dissolve in water, and in a granular, slow release form which you sprinkle directly around plants.

All purpose or "complete' chemical fertilsers with cover most needs of these nutrients for most plants.

How much fertiliser to use and when to add it?

This will depend on a variety of factors including: the type soil you have (refer to Pack C Notes 2 and 3); whether you are starting a new veggie patch,; what type of crops you are growing; and what has grown in the same spot before-hand. Always use the recommended amount, and apply on moist soils. Gauging how much is difficult when using organic fertiliser such as manures or home-made compost as we don't know there nutrient levels. Deficiencies will show up in plant leaves, and will need to be looked into.

When adding fertilisers little and often is a better approach, as is monitoring the plants growth and supplying food as needed.

Early on a plant is establishing its roots then it puts on new leaf growth, this is when it needs more Nitrogen. New seedlings especially can be burnt by too much Nitrogen.

Caution on over fertilising

The more concentrated the fertiliser the smaller the amount to be added at one time. Over use of any highly soluble fertiliser, whether organic or chemical, is a mistake that will cause problems such as:

- A build-up of excess soluble nutrients (common problem for plants in pots) causing high salinity which damages soil animals and plants. Excess fertilisers will need to be flushed out
- Stopping or reversing the flow of water through osmosis. Seen when plant top wilts or burns, the plant will die unless the salts are diluted in extra water

Excessive Nitrogen will result in:

- Extra shoot growth and decreases root growth
- Fast, sappy growth (lots of leaf) which attracts aphids and other sap sucking pests
- A flush of growth which allows no time to pick up other nutrients
- Reduced flowering in flowering and fruiting plants
- A population explosion of soil organisms which depletes the soil oxygen and produces toxic gasses in the soil: not good for the plant roots thus not good for the plants

Fish waste, blood and bone, lawn clippings, fresh horse and poultry manures are high in Nitrogen. If you add these to the soil surface or dig them in, you may need to wait 6-8 weeks for the soil organisms to settle down before planting. Age them before adding to the soil by leaving in a covered pile for a few months. Cow, sheep and pig manure are more moderate in Nitrogen, though still fairly high.

Too much poultry and pigeon manure can lead to a build-up of phosphorus in the soil that is the same as an over use of superphosphate.

Prevention is best, and where instructions for a particular fertiliser say to use only a certain amount and to water in, make sure you do, and that your soil is not water repellent.

General recommendations for establishing new garden beds involves applying organic fertilisers in the form of composts, and some chemical fertilisers to address specific deficiencies. It is better to get an analysis of your specific soils to guide you; however, general recommendations such as those below from Kevin Handreck's book Gardening Down-Under may well bring good results.

Initial soil preparation for growing vegetable and herbs

1. Bring pH to neutral in alkaline soils by: applying agricultural sulphur for most of Salisbury's soils
2. Applying gypsum in clay soils, and clay to sandy soils to improve structure
3. Add as much compost as you can
4. Add concentrated fertilisers to overcome deficiencies
   a) Sandy soils add gypsum to supply soluble (sulphate) sulphur
   b) Phosphorous deficiency: add superphosphate at 60gm per square metre
   c) If there is a major Potassium deficiency, apply an initial application of potassium sulphate at 15-30gm per square metre, and water in thoroughly

Composts (with manure in it) or manures will usually supply enough of the other trace elements so add them liberally. As compost is commonly low in Nitrogen and most that it contains is slowly available add to soils e.g. pelletised poultry manure such as Dynamic Lifter (assuming a 2-4 % of Nitrogen) apply at 300g/square metre or less. Read instructions on product.

#Note In areas where the water is salty avoid using fertilisers that contain chloride.

Tips for fertilising clay soils

- At planting for all vegetable crops apply a multi nutrient fertiliser or make your own to N:P:K 5:6:4 and apply 60gm per metre of row
- May need more phosphorus than lighter texture soils require. Add superphosphate regularly
- Leafy vegetables are likely need 1-2 side dressing of high Nitrogen fertiliser during growing season e.g. at 5% apply 180gm per square metre

Tips for fertilising sandy or loam soils

- At planting for all vegetable crops apply a multi nutrient fertiliser or make your own to N:P:K 8:4:9 at and apply 60gm per metre of row
- If soil phosphorus reserve is high use a low phosphorus fertiliser e.g. one for lawn

A yearly application of well-rotted quality good balance of nutrients (refer to Pack F Compost) at 5-10 cm thick is likely to last the year.

Fruit trees are covered in fruit tree notes in Pack I

Organic fertilisers

We encourage the use of organic fertilisers which come in many different forms including compost, liquid, manures, pelletised manures and minerals. Some are considered general soil improvers, such as compost and mineral fertilisers while others can be used to specifically target your crops growing needs if there is a deficiency in the soil e.g. gypsum supplying calcium. Plant nutrients are available in readily soluble and slow release forms in composts, vermicompost and animal manures. Examples of commonly used organic fertilisers for the home gardener include:

- Compost
- Mushroom compost
- Manures: poultry, sheep, cow and zoo
- Blood and bone
- Liquid fertilisers
- Minerals
- Trace elements

Organic fertilisers will feed plants more slowly in colder weather, therefore apply these to the top layer of soil where it is warmer.

Fertilisers can be applied in solid or liquid form. Both are easy to use, though liquid will need to be used more frequently.

SOILD FERTLISERS

This is the most common form in which fertilisers are used to build soil fertility. Examples are composts, worm casting and animal manures which provide readily soluble and slow release forms of nutrients.

Compost

Compost is an important fertiliser that improves soil structure as well. Good quality compost is dark and moist, with a sweet, earthy smell, and is broken down to the point where you cannot tell what materials it is made from. Compost is full of bacteria and fungi that are part of plant's means for gaining food from the soil and part of healthy soil ecology. The black stuff is humates which improve soil's ability to retain water and hold onto fertiliser - stopping them from leaching out of the soil. It is also fabulous worm food so earthworms will feast on it, improve it as a plant food and mix it into your soil. No necessary digging by you! The fertiliser value of a compost is dependent on the quality of materials it was made from. Most Australian soils are deficient in phosphorus and it's difficult to supply it through compost unless it contains poultry manure, so this may need to be added additional to compost. Or if making compost yourself, include a small amount of phosphorous material. Refer to Pack F Compost.

Recommendations from Kevin Handreck's book Gardening Down-Under follow.

Applying compost tips

- Most benefits to the soil structure come from applying relatively fresh compost (before it is uniformly fine)
- Application depend on what is being grown, its feeding requirements and length of growing season. Apply once only at the beginning of the season, or feed throughout the season after the initial feed
    - Annual application of about 5-10cm applied at the beginning of the season over soil surface
    - For heavy feeders or long season plants, at beginning of season apply 2-4cm layers on the soil surface, then feed through the season spreading 2-4cm layer over soil surface
    - Or if digging in, when preparing an annual bed dig in a 5cm layer of mature compost
- Aways water in and cover compost with a mulch e.g. straw - the thickness of the mulch depends on the season - lightly in winter up to ½ to 1 cm and spring 1-2 cm, and progressively thicker as summer heats up

Mushroom compost is mainly used compost from growing mushroom, overall alkaline and high salt content from the soluble nutrients used in mushroom growing, be cautious about user use and using it in alkaline soils.

Worm cast

Vericompost or worm cast (and worm juice) are some of the best fertilisers, which like compost, are full of good bacteria, fungi, and humates that feed both plants and soil. Part way through the growing season, crumble and spread in a layer of 2-4cm of worm cast over soil surface, water in and cover with mulch.

Compost and worm casts are two fertilisers with moderate nitrogen that will stay in the soil and feed plants gradually.

Manure

We recommend that all manures are composted to reduce the Nitrogen levels, avoiding the effects of over fertilisation and to increase their fertility. Cow, sheep and pig manure are more moderate in Nitrogen, though still fairly high in soluble (not very stable) form and can be lost quickly. Fresh horse and poultry manures are high in Nitrogen, not very stable so can be lost quickly, and if you add these to the soil surface or dig them in, you may need to wait 6-8 weeks for the soil organisms to settle down before planting. Instead of composting you can also age them before adding to the soil by leaving in a covered pile for a few months.

Bagged manures can be used at same rate as matured composts. The age and method of processing affects amount of soluble Nitrogen, and as often there is little information on the label about the contents and their nutrient rates it's hard to assess the amount needed. They may also affect soil pH so you may need to check this regularly. Composting of these is also recommended as if the Nitrogen levels are high the plants can be burnt.

Pelletised compost fertilisers

Pelletised poultry fertilisers such as: Yates Dynamic Lifter, Neutrog's Rooster Booster, though high in Nitrogen are composted which means that they release their Nitrogen gradually and thus continually feed the soil and plants.These can be used Instead of manures, as they are readily available and easily applied if you don't have your own compost supply. Yate's Dynamic Lifter, is basically the same as Neutrog's Rapid Raiser. Neutrog's Rocket Fuel has more minerals and is better for sandy soils. Neutrog's Gyganic is good for fruiting vegetables such as pumpkin and tomatoes as well as fruit trees. To use them:

- Water the soil until its moist
- Add pellets to the surface (rake the soil, then shake pellets on sparingly)
- Add a quality compost and worm castings as well if available
- Water in
- Cover with mulch

Pellets for young plants

Young plants do not need a lot of fertiliser to get going. For plants that are "gross feeders" such as the cabbage family (Brassicas), corn, tomatoes and melons pellets can be placed for future growth, and as these plants grow their roots find the extra food when they need it.

- Apply lightly and evenly from 5-20 cm away from the plant
- Or bury in trenches at 4-6 cm deep, 10-15 cm away from the plant

Blood and bone

Blood meal contains slow release nitrogen, and the bone meal is full of calcium and phosphorus. It can be added to compost or sprinkled over soil surface when adding compost. As it lacks potash, this needs to be added separately with a form such as sulphate of potash.

Mineral fertilisers

These are particularly important for sandy soils. Granite and basalt rock dusts are good mineral fertilisers and may come with other rock minerals such as rock phosphate, potassium and mineral rich clays such as zeolite or bentonite. Mix with compost at the soil surface as they need organic matter to gradually break down and supply their nutrients. They are often sold as 'Rock Dust'.

Trace elements

These are called micronutrients required in small quantities. They can be gained from organic matter in the soil, and good compost. Individual trace elements can be purchased in small quantities for home gardener to address deficiencies one detected.

Gypsum

This is considered a "soil conditioner" as it opens up clay soils. It is also a fertiliser of calcium and sulphur, both important for healthy soil organisms and plants. It can be sprinkled on at the soil surface in small amounts and watered in. For very sticky clay use up to 1 kg per square metre area, dug in to the top 10-15 cm of soil. Reapplication may be necessary in some soils.

Liquid fertilisers

It's not necessary to foliar feed if you feed your soil with well-balanced compost. In certain circumstances it can be useful to build plant health by supplying readily available essential nutrients.
For best results spray:

- When humidity is high – early morning or late afternoon
- To both top and bottom leaf surfaces

According to Kevin Handreck the circumstanced were foliar feeding can be helpful include:

- On seedlings when transplanting
- When plants are competing with more aggressive going plants
- On plants that are under nourished use 5-10gm urea with 1ml dishwashing detergent per litre
- In cold areas to stimulate growth spray .5% -1% urea 5-10gm m2
- As a tonic use liquid seaweed fertiliser or worm casting throughout the growing season

Chemical or organic fertilisers can be used

- Iron, zinc and maganese can be put directly on leaves if growing alkaline soils 146-147
- Urea for plants that are under nourished
- Liquid fish waste is useful to help start plants off. Apply weekly at half strength
- Seaweed solutions can be applied when transplanting seedlings to reduce transplant shock and weekly at half strength especially those taken from open trays

Worm cast liquid
Worm casts are full of good bacteria, fungi and humates that feed both plants and soil, and can be applied in a diluted form as a liquid feed. To make a liquid feed

- Mix a walnut sized ball per 9 litres of water
- Dilute to the colour of weak tea
- Apply these weekly to the plants or the soil

Mulch

Mulches play a very important role in soil fertility by keeping living fertilisers such as compost or worm casts from drying out. They can also water flow across the soil down and increase the percentage of water seeping into the soil, which helps plants with nutrient uptake They need to be applied all year around- less is necessary in winter. Organic mulches will decompose, leaching nutrients into the soil as they do which will supply nutrients to plants, and need to be reapplied annually. If Urea or Ammonium sulphate are mixed with 10-20 gm per square metre of soil surface under organic mulches, they produce more humus contributing to slow release fertilisers. Refer to Pack G Mulch.

Produce from Paralowie Communal Garden for the Jack Young Centre kitchen meals

Complied by Shannan Davis, August 2020
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