

Managing your soil

Crop rotation and soil amendments

Crop rotation

Cover crops

Rotating between cash and cover crops provides multiple benefits to your soil and crop health. Cover crops reduce soil erosion, break disease cycles, provide competition against weeds, and add organic matter and nutrients to the soil.

Cover crops are generally slashed or mulched prior to incorporation into the soil. As they break down, gums are produced that assist in binding the soil particles together to form stable soil aggregates with pores between them. This stabilises the soil and increases the water and nutrient holding capacity.

Cover crops can include grasses or cereals, such as oats and ryecorn, or legumes such as cowpeas and vetch. Cereal crops build organic matter, while legumes fix atmospheric nitrogen and convert it to a form which can be used by subsequent crops. Cereal and legume crops can also be grown together to get the benefits of both, for example a combination of ryecorn and peas.

Rotation with cover crops also helps to break the cycle of pest and disease build up, which can occur with continued planting of the same crop.



Ryegrass cover crop

To hear more about the benefits, application and issues of cover crops in Australian horticulture watch this webinar presented by Dr Kelvin Montagu and Julie Finnigan: <https://www.youtube.com/watch?v=kd8lvoV73SE>

IMPROVE YOUR SOIL HEALTH BY:

- Rotating cash crops with cover crops. Cover crops can help to build organic matter, break disease cycles and reduce weed competition.
- Adding compost, mulch, animal manures and biochar to build soil organic carbon
- Using lime or dolomite to reduce soil acidification
- Using soil gypsum to reduce soil sodicity

Biofumigant cover crops

Increasingly, biofumigant cover crops are being used as a methods of decreasing the incidence of soil borne disease, while also providing the benefits of a green manure crop. Much research is being done to evaluate their use as an alternative to chemical soil fumigation.

Biofumigant crops are species (particularly mustards and other Brassicas) that produce high levels of compounds call isothiocyanates (ITCs) when the plant tissue breaks down. The ITC compounds act as biocidal fumigants that can kill, or suppress, soil borne pathogens and weed seeds, much like chemical fumigants. There are several different commercially available biofumigant species, which have varying activities against a range of pathogens and weeds.

The biofumigant crop is grown as a cover crop, and is incorporated into the soil at flowering, but before seed is set, when the levels of the compound that is the precursor to the ITC is highest. In order to release the ITC fumigant compounds, the crop must be finely macerated and quickly incorporated into moist soil. The soil is then rolled, or

Crop rotation and soil amendments



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covered, to contain the ITC compounds which are volatile gases, similar to chemical fumigants.

To read about a vegetable grower's experience of using Caliente (a biofumigant cover crop) click here: <http://www.soilwealth.com.au/imagesDB/news/New-Leaf-the-Caliente-Story.pdf>



Macerated biofumigant crop

Soil amendments

Good soil management practices, such as reducing compaction, returning organic matter to the soil and improving surface drainage, will often reduce the need for costly soil amendments.

Increasing soil organic matter, and therefore organic soil carbon, helps sustain healthy biological activity by providing a nutrient source for the soil's microbiological population. Soil biological activity is responsible for mineralising nutrients in soil organic matter and making them available to plant roots, as well as contributing to improved soil structure.

By increasing soil organic carbon, using carbon-rich soil amendments such as compost, mulch, animal manures and biochar, the physical, chemical and biological properties of a soil can be improved.

Soil amendments can also be used to address specific soil limitations such as a lack of nutrients, soil acidification or alkalinity, and sodicity.

Soil amendments

Compost

Compost is stable aerobically decomposed organic matter. With regular use, compost will build soil nitrogen and carbon, increase soil cation exchange capacity, increase water holding capacity, reduce bulk density and stabilise pH (Paulin, 2005).

Many commercial compost producers are members of Compost Australia, and should be able to provide information about their compost, such as a specification data sheet based on average quality measurements.

Not all composts are well suited to fresh fruit production, depending on the source of the organic material and processes used, and selecting a supplier should be based on the suitability of their products for use in your situation. For example, the Freshcare Code of Practice requires composted organic material to be produced in accordance with an Australian standard (AS4454-2012 Composts, soil conditioners and mulches), in order to be used on food crops that are consumed as fresh produce, without a 45-90 day withholding period.



Spreading compost

To hear from a vegetable grower on their experience of using compost click here: <http://www.soilwealth.com.au/resources/videos-and-apps/compost-use-in-vegetable-production-a-growers-perspective/>

For more information on using compost click here: <https://www.freshcare.com.au/resources/compost-factsheets/>

Crop rotation and soil amendments

Manures

Pasteurised and pelletised animal manures, particularly poultry manures, are commonly used as a pre-planting, slow-release fertilizer. Manures can be useful sources of carbon-rich organic material, to improve soil structure and health, in addition to providing nutrients for crops. As with composts, animal manure products must comply with AS4454.

Seaweed extracts and bio-stimulants

Seaweed extracts have been reported to assist plants in many ways, and are increasingly used as an aid to plant establishment. Benefits can include:

- Enhanced crop yield
- Improved root structures
- Improved plant development – flowering, leaf development, fruit set
- Enhanced disease and stress resistance

There are also benefits to soil structure, water holding capacity and improved soil microbiology.

Biochar

Biochar refers to carbon-rich charcoal produced by pyrolysis (heating in the absence of oxygen) of biomass, either plant material or animal manures. There is interest in biochar as a soil amendment to improve and maintain soil fertility, and increase soil carbon sequestration. Biochar can sequester carbon in the soil because of its stable nature and long turnover time in the soil.



Application of biochar / compost mix

Current methods of biochar incorporation use surface application, then mechanical incorporation into the topsoil, a method suitable for most annual and semi-permanent crops.

The adoption of biochar for use in strawberry production will depend in part on the extent to which increases in crop yield can reliably be achieved. At this stage there is little evidence as to the effect of biochar on the yield of horticultural crops.

Addressing specific soil problems

Acidification - lime or dolomite

Soil acidification can lead to reduced availability of nutrients and lower yields. At a pH of 5 many nutrients in the soil are not available to plants, and in some cases toxicities can also occur. Soil acidity can be naturally occurring and can be made worse by prolonged and heavy use of nitrogen fertilisers like sulphate of ammonia and MAP (mono-ammonium phosphate).

The speed at which soil becomes acidic depends on many factors, including soil type, soil texture (sandy soils become acidic more easily), organic matter, cation exchange capacity and the type of fertiliser used.

Lime or dolomite is usually added to maintain soil pH within a desirable range and can reverse the acidifying process in surface soils. Soil testing can help determine the correct rate to apply. Over-application can take years to remedy and can decrease uptake of nutrients by plants. It is easier to apply lime before planting with thorough incorporation improving results.

Soil acidity can also develop under drip irrigation where soils are highly leached. Flow-able lime that can be delivered through drip irrigation could be considered to maintain pH.

Nitrates are highly mobile under the influence of high rainfall or over-irrigation and will readily leach in permeable soils. This process can increase soil acidification. In addition, some nitrogen fertilisers can acidify the soil as the nitrogen is converted to a form the plant can take up. The potential of different fertilisers to cause acidification is as follows:

- Severely acidifying – ammonium sulphate and mono-ammonium phosphate (MAP)
- Moderately acidifying – di-ammonium phosphate (DAP)

Crop rotation and soil amendments



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- Slightly acidifying – urea and ammonium nitrate, and
- Non-acidifying – potassium nitrate, calcium nitrate and composted poultry manure

Further information on acid soils and how to manage them can be found here:

<http://agriculture.vic.gov.au/agriculture/farm-management/soil-and-water/soils/acid-soils>

Soil sodicity - gypsum

Sodic soils are not able to form stable aggregates as the clay particles cannot interact and hold together, causing an unstable structure. These soils are often called 'dispersing clays'. Sodicity can cause poor water infiltration, decreased ability to hold water, surface crusting, waterlogging and increased erosion. Run-off from sodic soils carries clay particles into waterways and dams, causing turbidity, or cloudiness.

Calcium, in the form of gypsum, is added to sodic soils to improve their structure. Gypsum can be applied to riplines to help stabilise fracture lines, or broadcast and either incorporated or left on the surface. The best option depends on the nature, depth and extent of soil sodicity. Other factors to consider are soil pH, soil salinity, irrigation water quality, drainage and irrigation systems.



Sodic soil

Gypsum adds to the overall salinity of soil water so under pre-existing saline conditions, large applications should be made after completion of the growing season. It is better to apply smaller amounts annually rather than large, infrequent

applications; this reduces opportunities for structural decline. The amounts required depend on the quality of irrigation water and soil type.

Because there are many factors to consider when dealing with sodic soils, it is advisable that you seek professional advice.

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Standards Australia www.standards.org.au