



characteristics and production factors and it is important that salinity and nutrient levels (particularly nitrogen) as well as a range of other factors are considered before application. Your compost supplier will be able to provide you with a recent analysis of the compost which should include salinity measures (EC), nutrient levels, carbon to nitrogen ratio and phytotoxicity index. Cross check this against your soil analysis to make sure you are applying the right materials for your farm.

Compost application

Apply compost to the poorer performing areas of your farm first to maximise the benefits provided by compost. Manure spreaders are frequently used to apply compost and then typical cultivation methods are used to incorporate compost into soil. Compost needs to be applied before seed bed preparation and sowing. If your plot requires additional fertiliser, only add this after compost has been applied. While compost can be applied at any time of the year, it is recommended to apply compost during dry weather to avoid compaction.

The amount of composted soil conditioner to apply per hectare varies considerably with the type of soil, the crop, and the climate. Depending particularly on soil NPK levels, application rates will probably be in the range of 20 – 80 tonnes per hectare, however your local agronomist can advise on quantities.

Looking for more information?

For more specific information on using compost to suppress disease, read the other fact sheets in this series:

- compost and disease suppression - Pythium
 - compost and disease suppression - Rhizoctonia
 - compost and disease suppression - Fusarium
- or contact the Department of Environment, Climate Change and Water, NSW.

Bibliography

- 1 F.R. Magdoff, Soil Organic Matter in Sustainable Agriculture, (Taylor & Francis, 2004)
- 2 Harry Hoitink, 'Compost use for disease suppression', in On Farm Composting Handbook <<http://plantpath.osu.edu/faculty-and-staff/faculty-directory/hoitink-harry-a-j/>>
- 3 Recycled Organics Unit 'Compost use for pest and disease suppression in NSW', (2006)
- 4 G. Stirling, 'Biologically active soils help suppress nematode pests' in Soil health: the foundation of sustainable agriculture, Proceedings of a workshop on the importance of soil health in agriculture, ed by R. Lines-Kelly (June 20-21 2001), Wollongbar Agricultural Institute, NSW Agriculture, Bruxner Highway Wollongbar 2477.
- 5 Harry Hoitink, 'Impacts of compost on soil and plant health', <<http://plantpath.osu.edu/faculty-and-staff/faculty-directory/hoitink-harry-a-j/>> (2008).

Compost and Disease Suppression

Studies dating back to the late 19th century¹ show that compost can reduce the occurrence and severity of common plant diseases caused by fungi, nematodes and bacteria²⁻⁴.

More recent research has shown that **all significant diseases affecting vegetable production in New South Wales** can be suppressed by the use of compost³.

These plant diseases include:

- wilt caused by *Fusarium* spp. (species)
- damping off caused by *Fusarium*, *Pythium*, *Rhizoctonia* and *Sclerotium* spp.
- stem and root rot caused by *Fusarium*, *Rhizoctonia*, *Pythium*, *Sclerotium* and *Aphanomyces* species.

While the effectiveness of compost at suppressing disease can vary according to compost types and application rates used, in some cases compost has reduced disease severity by up to 90 percent³.

All significant diseases of vegetables in NSW can be suppressed by compost



How does compost suppress disease?

Adding compost to soil improves soil physical and chemical properties and increases the number and diversity (different types) of bacteria and fungi in soil³. These changes encourage healthier plants that are better able to withstand diseases while limiting disease-causing microbe populations.

compost also protects your plants against disease.

Increases in yield are often an added benefit of using compost in your cropping systems.

Improving soil and plant health

The relationship between compost and healthy soils and healthy plants has been shown in many studies². Compost contributes to healthy soils and plants in at least three important ways:

1. By increasing the soil organic matter (soil carbon) that is vital for good crop growth
2. By improving soil structure and moisture retention, making water available for your plants when they need it, and
3. By increasing the amount of nutrients that are available to plants and steadily releasing nutrients over time.

Healthy plants are better able to resist diseases. So, by improving soils' ability to produce healthy and robust plants,

Compost encourages healthy plants that are better equipped to fight off disease and increases in yield are often an added benefit of improving soil and plant health

Boosting soil microbe numbers

Amending your soil with quality compost that conforms to the Australian Standard (AS4454) will boost the populations of naturally-occurring bacteria and fungi that can suppress the organisms that cause disease³. These helpful microbes are called biological control or biocontrol agents. Biocontrol is the use of natural predators, parasites or pathogens to control pests.

Biocontrol agents suppress plant diseases in four main ways.

- **Competition** is the most common method of disease suppression. Beneficial organisms out-compete disease-causing plant pathogens in the search for nutrients or colonisation space in specific habitats such as the root zone². Increased competition prevents pathogens from becoming established and multiplying to levels that cause plant disease.
- **Antibodies and secretions produced** by some microorganisms inhibit the growth of plant pathogens^{2,4}.
- **Predation and parasitism** of plant pathogens by biocontrol agents (where beneficial microbes use pathogens for food).

Quality compost naturally contains a range of bacteria and fungi which can suppress plant diseases

- **Induced systemic resistance** caused by beneficial microorganisms activating a plant's disease defences. Plant defences against disease can include thickening of the cell walls in plant roots and foliage to make it more difficult for pathogens such as fungi to get into plants². Induced systemic resistance is the least common form of biocontrol.

Biocontrol: general suppression

General suppression is disease suppression caused by the combined action of a wide range of microorganisms. It is the most common form of disease suppression, and 90 percent of mature composts will provide general suppression against root rots caused by *Phytophthora* and *Pythium* species⁵.

90 percent of mature composts can suppress *Phytophthora* and *Pythium* which cause plant root rots

Biocontrol: specific suppression

Sometimes plant pathogens may be suppressed by the presence of just one species of biocontrol agent or a select group of biocontrol agents working together. This 'specific suppression' is less common and more difficult to engineer than general suppression². Only twenty percent of composts provide specific suppression of *Rhizoctonia* root rots⁵.

What kind of compost should I apply to combat disease on my farm?

Applying good quality compost on your farm will improve the health of your soil and plants. This is the first step in disease suppression as healthy plants are more effective at fighting off disease. While research is still underway to tailor composts to combat specific diseases, the key factors that influence the effectiveness and duration of disease suppression from compost are known. These include compost ingredients and type of processing, moisture, salt and nutrient content and compost maturity.

Compost ingredients

Decaying organic matter provides the ideal conditions for beneficial microorganisms to grow, but not all types of organic matter are equal when it comes to disease suppression. Different compost ingredients (feedstock) can give different results - choose the feedstock that matches your needs and talk to your compost processor about choosing ingredients specifically for disease suppression.

Woody materials that degrade slowly can give long lasting disease suppression (more than 3 years) as they release nitrogen, potassium and phosphorus slowly into the soil. Carbon-rich composts are good at suppressing plant parasitic nematodes because they support fungi which are antagonistic to these nematodes⁴. Pyrolised bark particles are particularly inert and will not suppress disease².

Slowly degrading woody materials can give long lasting disease suppression

Composting process

Generating and maintaining the high temperatures needed to kill pathogens (and weed seeds) is an important part of the composting process. This is called 'peak heating'. To give your compost the best disease suppressive properties, beneficial microorganisms can be added to compost after peak heating to provide an advantage over plant pathogens in the competition for space and nutrients².

Since poor management and handling of compost can lead to early colonisation by plant pathogens, it is important that compost is managed and handled correctly. It is a good idea to take a tour of your compost processor's facilities to make sure you are satisfied with their composting materials and methods and handling procedures.

The particle size of composted materials also affects disease suppression. As particle sizes decrease, the disease suppressive impact increases and disease suppressive duration decreases². Particle size also impacts on soil structure and water infiltration so make sure that the particle size of your compost meets the needs of your soil as well.

Salinity and nutrient levels

High salinity causes plant stress and increases susceptibility to disease. It can also nullify the natural disease suppressive effects of compost. Using livestock and poultry manure as compost ingredients can increase the salinity of compost and soil. High salinity compost ingredients can be balanced by your compost processor by blending with low salinity feedstocks to dilute the salinity of the final product. Applying compost well ahead of planting to allow salt leaching can also be effective, although it is important to consider the surrounding environment's sensitivity to leached salts. Composts with a high salt content can encourage *Phytophthora* and *Pythium* species, particularly if applied in warmer seasons.

Nitrogen is a key nutrient in disease suppression and nitrogen deficiencies can make plants susceptible to disease. The availability of mineral nitrogen can vary greatly between composts - your compost supplier should provide you with a recent analysis of the compost which will include nitrogen levels. High nitrate (NO_3) levels can increase the impact of some diseases, while immature composts (unprocessed or limited processing of organic material) with high microbial activity can immobilise nitrogen, making it unavailable to plants².

Compost maturity

It is essential that any compost applied has been composted according to the Australian Standard (AS4454) as this ensures that all material has been composted for a minimum of six weeks, has undergone peak heating and is free from weed seeds and plant pathogens.

Applying fresh green material or immature compost can increase the severity of plant diseases^{2,5}. Diseases caused by *Pythium*, *Phytophthora*

and *Rhizoctonia* spp. are particularly aggravated by shredded raw wood mulches². As fresh organic matter breaks down, sugars are released which can provide food for plant pathogens and also immobilise nitrogen. Disease suppression can vary with changes in compost maturity. This relationship is influenced by many other factors and is not straightforward. As a result, general guidelines and recommendations have not yet been developed in this area.

How can I use compost to suppress disease on my farm?

Choosing the right compost for disease suppression in your vegetable crop will depend on your specific needs.

One of the first steps is to make sure you know what is causing the disease on your property!

Talk to your local agronomist or send diseased plant samples for identification to the relevant government agency. Once you know exactly what you are dealing with, you can start to choose the right compost for your needs.

As a general guide, apply compost 4 - 6 weeks before sowing to allow time for the microbial population to colonise and enhance disease resistance². If you are using composts that have high salinity, or your crop is particularly susceptible to saline conditions, applying compost earlier will allow salts to leach before planting begins.

It is also important to test your soil prior to compost application. Compost can impact on a wide variety of soil