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Soil Wealth
NURTURING CROPS



**Integrated
Crop Protection**
PROTECTING CROPS



ORGANIC SOIL AMENDMENTS

KEY MESSAGES

- ✓ 'Organic material' originates from living organisms (plants or animals), now dead and decomposed.
- ✓ Research shows that more carbon is retained in the soil when organic wastes are composted (e.g. composted manure vs raw manure).
- ✓ 'Organic waste is a valuable resource. Recycling it through composting returns carbon and plant nutrients to the soil.
- ✓ Organic amendments are mostly applied pre-planting to cash or cover crops.
- ✓ The main expected benefit from using organic amendments is a positive effect on general soil health, the soils physical, chemical and biological condition.
- ✓ Improved soil health can in turn have benefits such as disease suppression and reduction of inputs (water, fertilisers, chemicals).
- ✓ The effect on the soil and crop will vary with the type and quality of amendment, existing environment, application variables, and other management practices (i.e. tillage, cover crops, grazing management, type and use of machinery).

GLOBAL SCAN AND REVIEW

How do you know if information is reliable?

Tired of searching the internet to find the answer to that problem?

Our global scan and review series provides leading, research-based information from around the world to Australian vegetable growers and advisors.

- ✓ Organic amendments have the potential to sequester carbon (increase the amount of stable soil carbon) and gain access to carbon credits.
- ✓ It's important to consider the risks (e.g. food safety), quality, and costs when deciding which organic amendment to use; always check out which feedstock was used, how long the material was composted and how hot it got in the process; get a compost analysis for the batch you are buying.
- ✓ There are a range of future research, development and extension needs relating to soil biology, soil chemistry and other factors such as regulation, biosecurity, contamination and quality assurance.

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**Hort
Innovation**



RMCG

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WHAT ARE ORGANIC SOIL AMENDMENTS?

'Organic material' originates from living organisms (plants or animals), now dead and decomposed.

Organic soil amendments are not necessarily suitable for the production of certified organic vegetables, unless this is explicitly stated.

Amendments are inputs to soils used to improve the biological, chemical or physical condition of the soil. They come from composting a range of sources, including farm waste, household food and garden wastes, manures, municipal green waste and sludges (biosolids).

In this document, the focus is on soil amendments from recycled organics, especially compost. **A composted product is defined as having undergone a controlled aerobic and thermophilic (higher temperature) biological transformation that results in a stable and mature product.**

Produce and food processing waste, some manufacturing wastes and sludges are also used to produce organic soil amendments. **This organic material is a valuable resource**, containing both carbon and plant nutrients. Recycling it through composting and anaerobic digestion helps return these valuable resources to the soil from which they were originally derived (Gilbert et al. 2020a). It should be noted that anaerobic digestion of organic matter and the resulting product, anaerobic digestate, are not currently widely used in Australia.

The composition, maturity, stability, quality (for agriculture), inherent risks, benefits and function of different forms of organic amendments can vary greatly depending on feedstocks and processing/treatment.

Composition

Compost is the main organic soil amendment used in vegetable production in Australia. It can be considered a 'soil improver' rather than a fertiliser replacement. The nutrient content can be highly variable. It is only high if manures or biosolids are included as feedstocks. Usually, there is greater consistency with higher levels of processing and maturity (aging) of composts. The more consistent the nutrient levels and other properties, the more predictable the effects on crops.

Pure compost provides too little nitrogen to reduce applied fertiliser in the short-term. However, if compost is consistently applied it will very likely provide some nutrients via the compost itself, but more importantly through improvement in nutrient holding capacity and nutrient cycling.

Often composted products are supplemented with nutrients to achieve a desired range and balance. Application of composted products can decrease the amount of fertiliser nutrients that need to be applied over a growing season.

A range of other recycled organic products than compost can be used; they are listed in the glossary in the Appendix.

To improve soil health, an organic amendment should have a high level of EOM (effective organic matter - the stable organic matter or humus that remains in the soil after one year of application) and be generally low in nutrients. Digestate (from anaerobic digestion), biosolids (from wastewater treatment) and composted manure will add nutrients but little EOM (Gilbert et al. 2020a).

EOM is a major driver of soil health improvements via compost.



Table 1 The benefits of adding amendments to soil - regularly applying quality organic materials to soil can result in the following physical, chemical and biological benefits - all of which are interrelated

WHAT EFFECT DOES COMPOST APPLICATION HAVE?	WHAT IS THE MECHANISM?	WHAT IS THE RESULT?	WHAT DO YOU SEE ON-FARM?
Increased soil organic matter content / improved soil structure	the 'stable' humus fraction in compost is the main contributor	reduced organic matter loss (i.e. carbon is sequestered)	fewer erosion effects (reduced soil loss), improved tillage and workability
Improved water retention/ water holding capacity	improved soil structure and increased pore space	improved capacity of soil to retain water	reduced flooding during wet weather episodes, improved water use efficiency, less need for additional irrigation
Improved soil temperature regulation	increased soil pore size means more air in the soil and the soil is effectively better insulated; mulches can also act to insulate the soil from temperature extremes	less stress on soil organisms and crops	better soil and crop health
Increased cation exchange capacity (CEC)	organic matter particles have large quantities of negative and positive charges, i.e. high CEC (higher CEC when more decomposed)	helps bind nutrients (and creates a long term nutrient 'bank')	reduced inorganic fertiliser run-off losses, reduced need for additional fertiliser applications over time
Increased soil pH (liming effect)	reduced soil acidity	helps release micronutrients	increased micronutrients available for plant uptake
Increased biological activity and microbial and invertebrate biomass	improved soil physical structure, increased carbon and nutrient availability - all contribute to increased available food for soil fauna	increased micro- and macro-fauna improved nutrient cycling and availability to crops for uptake	improved plant health, increased disease suppression
Suppression of plant pathogens	some composts can help suppress the growth of some phytopathogens	notable decreases in commercially significant pathogens, such as <i>Fusarium oxysporum</i> and <i>Pythium</i> spp. have been documented	crops may suffer less damage from significant plant pathogens

Adapted and summarised from Diacono, M. and Montemurro, F. (2010). Cited in: Gilbert et al. (2020a).



All organic amendments may contain, depending on feed sources and treatment, **the following components in different amounts, forms and combination:**

- carbon (always) – this may cause a drawdown of nitrogen (N), if the C:N ratio is above 25-30)
- nutrients (N, P, S, K, Ca, Mg, trace elements) – to be analysed and included in the crop nutrient budget
- potentially beneficial microbes
- potentially contaminants such as heavy metals, salts, pesticide residues, microplastics
- potentially plant, animal or human pathogens
- potentially visible or very small foreign objects like glass, metal or plastic.

Good compost does have no detectable levels of pathogens, very low levels of contaminants and no visible foreign objects. Only good quality, mature compost should be used in vegetable production.

WHY ARE GROWERS INTERESTED IN SOIL AMENDMENTS?

The main expectation is that organic amendments have a positive effect on general soil health. There is an anticipation that increased or more balanced soil life can be achieved via amendments and that they may provide productivity and sustainability improvements. The numerous benefits of adding soil amendments, including compost, to soil have been summarised by Gilbert et al. (2020a), as shown Table 1, and Celestina et al. (2019), see text box.

The benefits of soil amendments vary depending on soil type, climate and the way in which the land is used. **Not all organic amendments have equal benefits.** In general, compost will contribute to increased soil health (and indirectly contribute to increased plant nutrient availability), while organic fertilisers (and particularly anaerobic digestate) directly contribute

to increased plant nutrient availability and may only indirectly contribute to improved soil health.

There has been considerable research demonstrating the positive effect of compost on soil organic matter content and also soil health. **Studies show that repeated compost application can increase soil aggregate stability and soil porosity, reduce compaction, increase water holding capacity, increase soil microbial biomass and activity, as well as build up a nutrient store** (Gilbert et al. 2020a).

This translates to potential advantages for growers that include: reduced irrigation, increased resilience to drought and floods (and reduced soil loss) and reduced application of certain fertilisers (see also Table 1).

Anecdotally, trials have found harvest periods of crops like capsicums or cucumbers can be prolonged through increased crop longevity. Fruit was more consistent, larger, healthier and of higher quality and shelf life which in turn lowered harvesting and packhouse labour costs (Soil Wealth 2019).

Crop yield responses to organic amendments: the effect of nutrients vs soil improvements

Organic amendments are often reported to influence crop performance through the amelioration of soil constraints (i.e. improving soil physical, chemical and biological properties and restoring degraded soils) and/or through plant nutrients contained in the amendments.

Celestina et al. (2019) conducted a review of experiments where control treatments were able to distinguish the effect of different factors on crop yields. These experiments showed that nutrients contained in organic amendments and inorganic fertiliser can be equally effective at increasing crop yields on depleted soil when the nutrient content is balanced and meets crop needs.

Nutrient content depends on whether the feed stock includes manure, biosolids or fertilisers - a more common practice in Europe and the US.



Some claims of increased yields are debatable, e.g. when compost has been used to remediate a degraded soil. The addition of compost has then brought the yield back to an economically sustainable level. Compost should however, be used mostly to maintain soil quality and high levels of marketable yields.

HOW ARE ORGANIC AMENDMENTS USED?

Compost is usually applied pre-planting to cash or cover crops. It is broadcast over the entire paddock, on beds only or band placed and worked into the soil. Compost may also be applied to the soil surface to suppress weeds or reduce the effect of sandblasting and erosion.

Sometimes compost or other organic amendments are applied post planting, but side dressing is usually not feasible unless the amendment is pelletised or is part of a fertiliser compound or mix. Some liquid amendments can be applied post-planting. See Appendix 1 for a glossary describing types of soil amendments used in agriculture.

By first recycling organic wastes through composting and anaerobic digestion, it has been shown that more carbon is retained in the soil than if the organic waste is applied directly without composting (e.g. composted manure as opposed to raw manure) (Gilbert et al. 2020a).

Depending on the origin, treatment and intended use of soil amendments from recycled organics, regulations or codes of practice apply to their use.

The objective of regulations is to protect:

- the environment from eutrophication or contamination, and
- people and/or animals from diseases and exposure to toxic substances (food safety).

See 'Specific Considerations' for discussion of regulatory and food safety considerations.

WHAT EFFECT DO ORGANIC AMENDMENTS HAVE ON SOILS, CROPS AND CLIMATE?

The knowledge scan and review of the effect of organic amendments on soils and vegetable crops found that effects vary. Outcomes depend on many factors such as:

- the type of amendment
- the crop and its production environment (soil, weather, disease pressure)
- the timing, volume and frequency of application
- types and frequency of other crop management inputs.

Effect on soils

Apart from changing levels of abovementioned components in the soil, amendments will have an effect on a range of soil properties. The magnitude of the effect depends on a range of factors. The main soil properties affected include:

1. pH and EC / nutrient availability
2. sodicity / dispersibility / slaking
3. infiltration / wettability, water holding capacity and permeability / drainage
4. texture / porosity / bulk density
5. biological activity and composition / respiration / nutrient cycling.

The soil properties under dot points 1 and 2 can be checked relatively easily via conventional soil testing. The physical (dot points 3 and 4) and biological attributes (dot point 5) need to be measured via specialised tests.

Land managers may notice positive effects on:

- soil workability
- irrigation needs
- fertiliser needs
- drainage after heavy rain

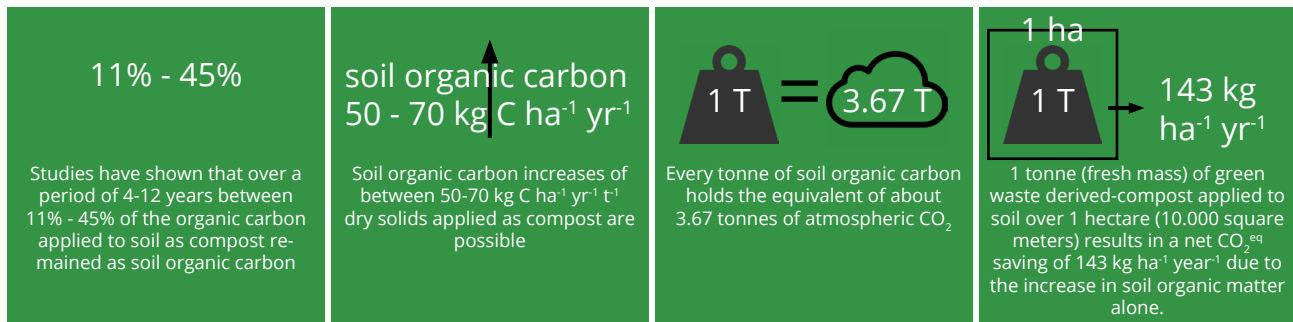


Figure 1. The potential of compost to sequester carbon (adapted from Gilbert et al. 2020a)

- level of worms and critters.

Effects on crops

Effects of organic amendments on crops depend on how, how much, where and when they are used. The effects may be amplified, reduced or negated through other management inputs and activities such as tillage, nutrition, irrigation, pest, weed and disease control.

Positive effects reported by researchers and observed by land managers are:

- **better consistency and quality of fruit**, resulting in easier harvest and lower labor cost (Soil Wealth 2019)
- **increased quality and size of fruit** (Sustainability Victoria 2015)
- **pest, disease and/or weed suppression**, reduced pesticide use
- **reduced fertiliser inputs**
- **improved rooting depth and root distribution** (Celestina et al. 2019).

Effect on climate

Soil is an important reservoir of carbon, storing more than the atmosphere and terrestrial vegetation combined. The main value of compost is its capacity to store carbon in soil.

The main benefits of applying compost to soils are thought to be realised in the first 20 years, around

which time a new organic matter equilibrium is reached, i.e. the soil organic carbon concentration stabilises (Gilbert et al. 2020b)

An international review (Gilbert et al. 2020b) summarises the potential for compost to sequester carbon (Figure 1) which helps mitigate the impacts of climate change. In an Australian context, AORA (2019) suggests that compost can build carbon in soils and sequester 0.5t CO₂ equivalents per tonne of applied compost.

From work done in South Australia, the estimated carbon content of AS4454 accredited compost blend using garden and food waste is 27% and, providing that compost application rates and practices were maintained continually over time, a sequestration rate of 10% could be achieved. However, the conditions under which carbon is sequestered is highly dependent on:

- environmental influences
- inherent soil properties, and
- soil and crop management practices.

The climate benefits in terms of emission reduction stem from both the reduced need for fertiliser and the carbon stored/sequestered in the soil (Biala 2011).

Both these factors can lead to economic benefits

through reduced production costs and risks, good quality vegetables and the potential for sequestration accreditation (Gilbert et al. 2020b).

Compost application enhances emissions reduction and carbon sequestration which **offers an opportunity for carbon neutral farming**. There are two main pathways for receiving recognition of carbon neutrality:

1. **accessing carbon credits** (Australian carbon credit units [ACCUs]) through the soil carbon project administered by the Climate Solutions Fund (previously the Emission Reduction Fund).

or

2. **secondary marketable or completely voluntary accreditation** such as Gold Standard's Verified Emissions reduction (VER) and Certified Emissions Reductions (CER).

(See References and Resources for links.)

Rates of organic amendments

Given the multitude of organic amendments, reasons for their use, crops and production systems, a one-size-fits-all approach for rates, timings and placements



cannot be recommended. Rates and use patterns have to be site specific and the following needs to be considered:

- nutrient content as part of an overall nutrient budget and plans for repeat applications
- product quality / purity and consistency
- soil conditions / fertility
- C/N ratio
- timing of application and planting
- type of application and placement (e.g. banding vs broadcast)
- risks such as leaching into waterways
- available spreading equipment.

SPECIFIC CONSIDERATIONS

Deciding what organic amendment to use

Three main points you should consider when selecting an organic amendment for use are:

- Is it **young** (pasteurised and stable) or **mature**? This tells you how long the amendment is likely to stay in soils and when not to use it in your production system. Mature composts are thought to be better at increasing soil organic matter levels than fresh or immature composts due to higher concentration of stable carbon (Gilbert et al. 2020a).
- Did it have a lot of **nitrogen-rich** input or **carbon-rich** input? This gives you an indication of the nutrients (in particular nitrogen) that will be immediately available to the production system to allow adjustment of other farm inputs such as fertilisers. Nitrogen rich inputs usually contain other nutrients as well; testing is required.
- What are the **predominant particle sizes**? This provides guidance on how to use the compost. Smaller particle sizes are appropriate for incorporation, whereas large particles are more appropriate for mulching.



Risks

The main risks and concerns with organic amendments are associated with:

- **Use of composts before they are pasteurised and stabilised by an adequate composting process;** they can contain human and or plant pathogens
- **Poorly made products with unacceptable levels of impurities and contamination.** Feedstocks used to produce amendments can be a source of heavy metals, pathogens, weed seeds, plastics and other waste material. Inappropriate and insufficient management during manufacturing can lead to organic amendment products with unacceptable levels of contaminants.
- **Consistency of the products.** Feedstock availability can vary across the year resulting in some organic amendment manufacturers being unable to provide a consistent line of product all year round.
- **Inappropriate matching of a compost product for the intended use.** Product maturity and timing of application for vegetable production is very important. A young active carbon-based soil amendment product applied at planting can cause microbes to draw nitrogen from the soil to break down the compost and will starve the plants of that nutrient.

Other risk considerations for growers are electrical conductivity (EC) and pH of organic amendment products. Most amendments have a neutral to slightly alkaline pH, however this can vary. Amendments tend to have EC values in excess of those in soils.

To avoid these risks, organic amendments should be sourced from reputable suppliers. The highest form of guarantee is sourcing product from suppliers who are certified. Certification means the compost is produced in accordance with Australian Standard (AS) 4454-2012. Testing of individual compost batches is essential to managing risks.

Food safety and quality

A simple decision tree to help guide the use of soil amendments within food safety programs is usually available. Key considerations to note with using amendments under, for example, the Freshcare certification, include:

- certified compost (AS 4454-2012) can be used without restriction
- where composting treatment cannot be verified, it should be managed as an untreated manure
- untreated manures (including soil amendments mixed with untreated manures) need to have a minimum period pass between application and harvest, this is at least 90 days if the soil potentially contacts the harvestable part of produce that may be eaten uncooked.

Cost of organic amendments

The costs associated with amendments can be determined by several factors. This includes:

- type and quality of the material
- water content of the material
- freight costs based on distance
- spreading/incorporation costs, which depend on:
 - application rates
 - type of compost
 - machinery required – travelling time
 - scale of the work.

It is important to also consider labour and financial costs associated with other practices that may need to change in conjunction with amendment application, such as tillage, nutrition, irrigation and crop protection requirements.

RESEARCH, DEVELOPMENT AND EXTENSION NEEDS

Soil biology

- A better understanding of and ability to predict the role of soil biology (e.g. certain groups of soil life) in processes such as availability and cycling of nutrients and suppression of disease.
- Improved understanding / classification of major groups of soil amendments, soil conditioners, microbial 'inoculants', in solid and liquid form, in different production environments, which claim to positively influence soil biology and through that, physical and chemical soil properties, resulting in crop responses (yield, quality, pest and disease tolerance or suppression).
- How can abovementioned soil and crop responses to 'biologically active inputs' be best tested in a manner that allows comparisons and the selection of 'fit for purpose' inputs?
- Better understanding of the contribution that soil biology may make to healthy, nutritious food.

Soil chemistry

Soil chemistry research currently receives the largest proportion of soils RD&E funding. There is a strong focus on soil nutrition with fertiliser being 15-20 percent of input costs for many producers. Research gaps include:

- understanding the effects on soils and crops of new 'stable' organic amendment products with known composition and relatively predictable effect on soil fertility with the potential to reduce input costs such as struvite (nutrients extracted from organic waste), composts and biochar, and
- better standards and descriptions and full life cycle analysis are needed for some existing and all new soil amendment type products.

Other needs

- Address biosecurity issues for import and transport of some organic amendments.
- Develop quality assurance systems for biologically active soil amendment products.
- Reach consensus regarding consistent analytical techniques for product and soil biological testing (e.g. Australasian Soil and Plant Analysis Council [ASPAC] accreditation of methods used in testing).
- An improved capacity for the interpretation of soil and plant tests (chemical, biological and physical) in a production systems context.
- An improved capacity for using monitoring data to make decisions about soil and crop management inputs.
- Better predictability of effects of soil amendments given certain monitoring results.
- Improved extension of soil biology information to better understand how management practices might be adjusted to improve the availability of nutrients and reduce the impact of pests and diseases.
- Soilborne pests and diseases should be considered part of soil life, not a separate discipline.
- National standards for metagenomics testing of soils.

The study of genetic material recovered directly from soil samples (metagenomics) and multidisciplinary approaches may provide information to help link soil and crop management actions to functional soil properties. For example, operations and inputs could then be selected and timed to favour beneficial soil organisms or to suppress disease.



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Climate Solutions Fund - how to measure soil carbon sequestration in agricultural systems - <http://www.cleanenergyregulator.gov.au/ERF/Pages/Choosing%20a%20project%20type/Opportunities%20for%20the%20land%20sector/Agricultural%20methods/The-measurement-of-soil-carbon-sequestration-in-agricultural-systems-method.aspx>

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APPENDIX 1: GLOSSARY

The following table lists the main organic amendments used on farms as soil conditioners. It does not describe the multitude of highly processed, altered manufactured solids (e.g. based on pelleted animal manures and composts), mainly used as fertilisers or liquid products containing humic or fulvic acids, microbes and/or seaweed extracts and/or nutrients.

MATERIAL / TERM	DESCRIPTION / SPECIFICATION (AS AVAILABLE)
GENERAL	
Inorganic fertiliser	Materials of natural and synthetic origin that are applied to soils or to plants (usually the canopy in liquid form) to supply one or more plant nutrients essential to plant growth or alter the chemical, biological and physical condition of soils (liming materials, gypsum).
Organic materials (Organics)	Chemical compounds existing in or derived from plants or animals, and other compounds of carbon.
Organic (or natural) soil amendments also called Soil conditioner, Soil improver, Soil additive, Organic fertiliser	Organic (biological) inputs to soils used to improve the biological, chemical or physical condition of the soil. The inputs can be in solid, sludge/slurry or liquid form. Composted or pasteurised organic materials including vermicast, manures and mushroom substrate that are suitable for adding to soils. This includes processed/manufactured solids and liquids and excludes polymers that do not biodegrade such as plastics, rubbers and coatings. Solid soil conditioners have not more than 20% by mass of particles with a maximum size above 16 mm. Products with greater particle size are used as mulches.
CATEGORIES OF ORGANIC or NATURAL SOIL AMENDMENTS	
Raw natural material obtained from natural deposits	
Peat	Accumulation of decomposed vegetation or organic matter. Degree of decomposition varies depending on the origin of the peat and its age. Peats are used as a soil conditioner or substrate. Nutrient rich peat bogs or moors are developed from wetland vegetation including small trees that decayed in pools of stagnant water connected to groundwater. Sphagnum peat consists of moss residues that have accumulated on acid soils with poor drainage or on peat bogs, they sit above the groundwater level and are low in nutrients.
Brown coal	Brown coal and products made from brown coal used as a carbon rich soil conditioner. Some brown coal products have been enriched with nutrients to mimic the composition of humus.
Raw waste organics	
Manures	Animal excrement (urine, dung) which may contain various amounts of bedding such as sawdust, tree bark or straw.
Manure slurry	Animal excrement and water with only small amounts of bedding.
Waste organics, bio-waste (biodegradable waste)	Any waste that is suitable for undergoing anaerobic or aerobic decomposition (= composting), such as food and organic agricultural waste, paper, cardboard and waste from forestry (sawdust, wood chips) or municipal parks (tree cuttings, branches, grass, leaves – with the exception of street sweepings), and other wood waste not treated with heavy metals, pesticides or organic compounds, textiles made from natural fibres.
Municipal solid waste	Solid waste from households that is not necessarily made up entirely of organic materials. It may contain minerals or processed/manufactured solids.



MATERIAL / TERM	DESCRIPTION / SPECIFICATION (AS AVAILABLE)
Garden/green waste	Waste entirely made up of plant/organic materials (no minerals or processed/manufactured solids).
Biosolids	Organic solids or sludges produced by municipal sewage treatment processes. Solids become biosolids when they come out of an anaerobic digester or other treatment process and can be beneficially used. Until such solids are suitable for beneficial use they are defined as wastewater solids. The solids content in biosolids should be equal to or greater than 0.5% weight by volume (w/v). The solids component of biosolids is rich in organic matter and essential plant nutrients such as nitrogen and phosphorus. Thus, biosolids can be used as input materials for compost production. The term biosolids does not include untreated wastewater sludges, industrial sludges or the product created via the high temperature incineration of sewage sludge. It should also be noted that many other solid waste materials are not classified as biosolids, e.g. animal manures, food processing or abattoir wastes, solid inorganic wastes, and untreated sewage or untreated wastes from septic systems/sullage wastes.
Treated, processed, or refined waste organics	
Pasteurised/sanitised organic material	An organic product that has undergone pasteurisation but is relatively immature and lacking in stability. Pasteurisation is a process whereby organic material is treated to significantly reduce the numbers of plant and animal pathogens and plant propagules.
Composts	All types of recycled, organic materials, which are completely decomposed (biodegraded, rotted, humified) so that they are amorphous i.e. without a cellular structure characteristic of plants or animals. During the correct composting process, organic materials are pasteurised, microbially transformed and stabilised under aerobic and thermophilic conditions for a period of not less than 6 weeks (Gilbert et al. 2020a). Composts are destined for use as soil amendment, either as a fertiliser because of their nutrient content, and or as soil conditioner because of their positive effect on soil structure, biology and chemistry (in addition to the nutrient value). The Australian Standard (AS) 4454-2012 applies to composts, soils conditioners and mulches; it includes specified levels of maturity (pasteurisation and stabilisation) requirements including their relationship to quality assurance schemes for agricultural produce. <u>Compost maturity</u> The degree of decomposition, pasteurisation and stabilisation at which compost is not phytotoxic or exerts negligible phytotoxicity in any plant growing situation when used as directed. <u>Compost stability</u> The degree of decomposition at which the rate of biological activity under conditions favourable for aerobic biodegradation has slowed and microbial respiration will not resurge under altered conditions, such as manipulation of moisture and oxygen levels or temperature.
Anaerobic digestate	Nutrient rich substance produced by anaerobic digestion that can be used as a fertiliser. Digestate can be considered an “organic fertiliser” and should be low in effective organic matter (EOM) and high in nutrients. The main benefit of digestate is its high nutrient content. The benefits to soil organic matter are less clear and thought to be negligible in the long-term (Gilbert et al. 2020a).
Blood and bone	Dried animal blood mixed with bonemeal.
Vermicompost	Material that is egested from earthworms as casts then further decomposed and matured in a vermicomposting system.
Mulch	Any pasteurised or composted organic product (excluding polymers which do not biodegrade such as plastics, rubbers and coatings) that is suitable for placing on soil surfaces. Fine mulch has more than 20% but less than 70% by mass of its particles with a maximum size above 16mm. Mulch has at least 70% by mass of its particles with a maximum size of greater than 16mm.
Biochar	Biochar is charcoal made from organic materials via pyrolysis. It is a stable solid, rich in carbon, and can endure in soils for long periods.



Related materials and terms

MATERIAL / TERM	DESCRIPTION
Organic bio-stimulants	The definition is still evolving: any substance or microorganism, in the form in which it is supplied to plants, seeds or the root environment with the intention to stimulate natural processes of plants benefiting nutrient use efficiency and/or tolerance to abiotic stress, regardless of its nutrient content, or any combination of such substances and/or microorganisms intended for this use.
Compost extract	The filtered product of compost (including vermicompost) mixed with any solvent (usually water), but not fermented. This term has been used in the past to define water extracts prepared using a very wide range of different methods. In the past, the terms “compost extract”, “watery fermented compost extract”, “amended extract”, “compost steepage” and “compost slurry” have all been used to refer to non-aerated fermentations. “Compost extract”, “watery fermented compost extract” and “steepages” are approximate synonyms defined as a 1:5 to 1:10 (v:v) ratio of compost to water that is fermented without stirring at room temperature for a defined length of time. “Amended extracts” are compost extracts that have been fermented with the addition of specific nutrients or microorganisms prior to application
Compost tea	The product of showering recirculated water through a porous bag of compost suspended over an open tank with the intention of maintaining aerobic conditions. The product of this method has also been termed “aerated compost tea” and “organic tea”. In the past, the term “compost tea” has not always been associated with an aerated fermentation process. It is important to distinguish between compost teas prepared using aerated and non-aerated processes, therefore the terms aerated compost tea (ACT) and non aerated compost tea (NCT) are used in this review to refer to the two dominant compost fermentation methods. ACT refers to any method in which the water extract is actively aerated during the fermentation process. NCT refers to methods where the water extract is not aerated or receives minimal aeration during fermentation apart from during the initial mixing.

