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How to compost on farm

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This publication provides the basic information you need to make thermophilic compost from your farm organic wastes.

If you wish to create compost for sale, aim to meet the quality criteria of Australian Standard AS 4454-2012 Composts, Soil Conditioners and Mulches, you should also contact the NSW Environmental Protection Authority and your local council for further advice and to determine your legal responsibilities.

What is composting?

Composting is the breakdown of any organic material (ingredients) into a crumbly, dark, soil-like product in which none of the original material can be easily identified. Various organic waste materials produced by farming such as husk, effluent, vegetable waste and stubble can be used to produce compost. Types of composting include:

- **vermicomposting**, which involves using composting worms
- **passive composting** is the slow degradation of plant waste, such as adding mulch to the soil
- **thermophilic composting** is the rapid breakdown of organic material where the compost pile gets hot and sterilises seeds and pathogens.

When is compost ready to apply?

Do not use any compost before it has finished composting (Figure 1), whether you make your own or not. This is one of the most common pitfalls of using compost. It is especially important because nitrogen will be temporarily taken by the decomposer organisms as they continue to break down organic matter in/on the soil. This makes nitrogen unavailable to the plants and the beneficial organisms will not have established, negating the benefits from using compost.

The composting process takes longer if there is insufficient water or too much carbon-rich material (e.g. wood).

Good quality compost should take about 8 weeks to form; macadamia husk can take up to 12 weeks. When the compost is ready it should have the following distinct characteristics:

- **smell**: nice earthy smell, with no bad (sour or rotten) odours
- **feel**: moist and earthy, not wet and sloppy or dry and powdery
- **appearance**: the pile contains dark soil-sized particles, the original organic materials are not distinguishable
- **temperature**: the pile stops getting hot
- **C:N** between 15:1 and 20:1 (a laboratory test for this costs about $35).

Figure 1. Fully composted material ready for spreading. Photo: Jeremy Bright.

What you need to make good compost

The rules of composting are the same whether you are making a small pile for your garden or a large windrow for commercial production. The key elements needed when making good thermophilic compost are:

Aeration

To ensure air can move in the compost heap it is important to turn the pile regularly and include a range of different sized and shaped materials. Remember that large pieces of woody material will take much longer to break down than smaller chips.

Moisture

Ideally, water content should be 50 to 60% (it should feel like a moist sponge, but no water comes out when you squeeze it with your fingers). To make sure the pile stays wet enough during the composting process, you may need to add water. See also 'Trouble shooting' on page 5.

Organic ingredients

Good compost must have a balance of carbon-rich (woody material) and nitrogen-rich (green leafy matter or manure) materials (Table 1). Select the correct mix to give a carbon:nitrogen (C:N) of about 30:1 at the start of the composting process.

Carbon:nitrogen is important and can be determined easily when you know the C and N values and weight of the products you are using. To calculate the C:N, divide the total carbon percentage of your selected materials – or ingredients – by the total nitrogen percentage of your materials. You can have as many materials as you like.

$$C{:}N = \frac{(\text{Weight ingredient 1} \times \%C) + (\text{Weight ingredient 2} \times \%C)}{(\text{Weight ingredient 1} \times \%N) + (\text{Weight ingredient 2} \times \%N)}$$

For example, if you use 4 t macadamia husk + 500 kg broiler litter + 50 kg blood and bone, and using the figures given in Table 1, then:

$$C{:}N = \frac{(4 \times 50) + (0.5 \times 38) + (0.05 \times 42)}{(4 \times 1.3) + (0.5 \times 2.7) + (0.05 \times 13)} = 31{:}1$$

A suitable area

You will need to dedicate an area for at least 8–12 weeks. This area should be relatively flat and free of stones, tree stumps, drainage lines and weeds (especially bulbous weeds). In addition, you can make a good base for the compost pile using crushed blue metal dust. There should be enough room for machinery to turn the compost. The pile should be located so it will not contaminate adjacent land or waterways via wind drift and water run-off.

Cover

You may need to cover your pile if there is excessive rainfall.

Machinery

If making a large amount of compost, you will need machinery to turn the pile. A front-end loader or excavator is ideal. Alternatively, you may consider using a contractor.

Table 1. Approximate carbon and nitrogen content of some common farm wastes.

Material		%C	%N
Carbon-rich	Biochar	Highly variable depending on original feedstock; test to be sure	
	Coffee hulls	48	1.1
	Hardwood sawdust	50	0.06
	Macadamia husk	50	1.3
	Newspaper	25	0.04
	Non-legume hay	42	1.3
	Softwood sawdust	50	0.1
	Straw	56	0.7
	Tree prunings	50	1.0
Nitrogen-rich	Blood and bone	42	13
	Broiler litter	38	2.7
	Cattle (dairy) manure	48	2.7
	Grass clippings	58	3.4
	Horse manure	48	1.6
	Vegetable waste	30	3.0

How to create good compost

Constructing a pile

Mix all materials and construct a pile that is between 1.5 and 2 m high and 2 to 3 m wide. It can be as long as you need. Every 1 m in length will make about 3 cubic metres (m^3) of compost at these dimensions.

Add water so the pile is wet through but not soaked. Check a sample of material from the pile; if it glistens with water but does not drip excess water then it is wet enough.

Monitor the temperature closely

Keep monitoring the temperature and turn the pile after the correct temperature has been reached each time. During the first week, check the temperature in the pile daily. It should be between 50 and 65 °C. You will probably notice steam rising (Figure 2) and the compost should feel uncomfortably hot (this is now considered a thermophilic compost). This heating up can happen very quickly.

Using a shovel, dig a hole in the middle of the pile and check the temperature with either a thermometer or a data logger that transfers the information to a computer.

When the temperature is right (between 50 and 65 °C), turn the pile. If the temperature is above 70 °C, turn the pile immediately and reduce the pile height to a maximum of 1.5 m.

Important: temperature in the compost pile must reach between 50 and 65 °C to kill any unwanted pathogens and weed seeds, and to break down all the material properly. It must not get hotter than 70 °C as this will reduce the nutrient and carbon value of your compost and kill beneficial decomposer organisms.

Turning the compost pile

When turning the compost pile, ensure the materials from the outside are placed on the inside. This can be achieved by rolling the pile over using a front-end loader or lifting the pile and dropping it again using an excavator.

The pile will probably need to be turned at least five times before the compost is ready for use, but may need up to 10 turns before the temperature is stable, depending on the materials used. Once the pile has stopped producing heat, let it 'cure' for at least 2 weeks before use. Do not skip the curing stage, which can take up to 3 months, but is critical to stabilise the organic materials in the compost. Maturing compost also prevents it from damaging plants once it is applied and reduces nitrogen drawdown – the temporary lock-up of nitrogen caused when an excess of carbon-rich organic materials stimulates decomposition by soil organisms which also increases their nitrogen use. See 'Trouble shooting' on page 5.

Figure 2. A compost pile still composting, notice steam rising from the top of the pile. Photo: Jeremy Bright.

Benefits of compost

There are many benefits of using compost. One of the most important is the addition of organic matter as this provides food for soil life. It also increases the stability of the soil so it becomes more resistant to erosion and compaction and holds more moisture. Compost also:

- adds organic carbon
- protects soil from erosion
- increases soil structural stability
- improves moisture holding capacity
- increases water infiltration and reduces water run-off
- adds nutrients (as slow release)
- encourages a wide range of soil organisms.

Trouble shooting

Problem	Cause	Solution
Excess water running off	Too wet	Add dry materials or let the pile dry out a little
Bad smell	Anaerobic conditions	Add larger materials and turn more often
Ammonia smell	C:N ratio too low	Add extra high-C materials
Clumping	Compost is too wet	Add dry materials and turn
The pile will not get hot after set up; the composting process does not appear complete	C:N too high	Add high nitrogen materials but avoid fertilisers such as urea
	Moisture content incorrect	Adjust accordingly
	Too little oxygen	Turn pile
Pile too hot	Too much heat being trapped	Reduce pile height; pile should be twice as wide as it is high
	Too dry	Add water but also aerate; failure to aerate can increase microbial activity and add further heat, to the point of combustion

Further information

Australian Standard AS 4454-2012 Composts, soil conditioners and mulches, 4th edn, Standards Australia, https://infostore.saiglobal.com/en-au/standards/as-4454-2012-121773_SAIG_AS_AS_267608/

NSW Environment Protection Authority website, *Protection of Environment Operations Act 1997*, https://www.epa.nsw.gov.au/licensing-and-regulation/legislation-and-compliance/about-the-poeo-act

NSW Environment Protection Authority website, recycling and reuse pages, https://www.epa.nsw.gov.au/your-environment/recycling-and-reuse

NSW Environment Protection Authority. 2016. Resource Recovery Order Part 9, the compost order, https://www.epa.nsw.gov.au/~/media/EPA/Corporate%20Site/resources/wasteregulation/RRO16-compost.ashx

Reference number: PUB21/280.