COMPOSTING GUIDELINES

NASAA CERTIFIED ORGANIC

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Background

Well-made compost effectively applied to soil is a strategic management tool used for building long-term soil fertility in organic production systems.

AS 4454 (2012) - The Australian Standard for Composts, Soil Conditioners and Mulches, defines composting as "the process whereby organic materials are microbiologically transformed under controlled aerobic conditions to achieve pasteurization and a specified level of maturity". Mature compost has a high degree of stability and exhibits low levels of phytotoxicity, which simply means that when the compost is applied to the soil it will not have a negative impact on plant growth.

The following Information is provided as a guidance document for NASAA members and NCO producers who produce compost for their own or on-farm use – it does not form part of the NASAA Standard and is for information purposes only.

National and State regulations will apply to any compost made that is then used for farm production purposes. Commercially produced compost will require testing to ensure end product does not contaminate certified land and/or produce with substances not permitted under the NASAA and National Organic and Biodynamic Standard.

Organic standard definitions & requirements

The NASAA Standard[1] indicates proper composting techniques involve the right balance of carbon to nitrogen ingredients, aeration, moisture and temperature to achieve heating sufficient to kill pathogens and weed seeds and to break down materials to form humus.

While the **National Standard for Organic and BioDynamic Produce[2]** defines compost as "the end result of the conversion of organic materials (e.g. vegetation, manure and waste products permitted under this Standard) into humus colloids". Both Standards have a list of permissible compost ingredients listed in their Annex/Appendix for Soil conditioning/fertilizing.

Sheet composting as indicated under the National Standard, is the practice of applying animal manure to an area of land, lightly cultivating this into the soil and sowing the area down to a green manure crop – preferably with as wide a mix of plant varieties as possible.

While still at optimum growth, the green manure crop is then mulched and incorporated into the soil and a second green manure crop planted. Once the second green manure crop is ready it is also turned into the soil with the result being a highly fertile, humus-rich and relatively weed free area ready for growing your commercial crop.

Unlike the application of compost which is restricted to a shallow surface soil application, correct sheet composting develops a deeply structured soil with humus formation to the depth of the green manure crop root zone.

It is an ideal way to prepare for new areas of plantings, and with slight modification, it can also be used when preparing new perennial crop plantings, substituting the second green manure crop with sowing down permanent pasture, which once established and maintained (ie regular slashing) provides a perfect base for planting out a new orchard or vineyard.

Creating a good compost

Careful selection of input materials, mixed in right proportions and maintained to optimize microbial activity will result in a rich, moist, crumbly, dark coffee coloured, sweet smelling humus teaming with microbes and plant growth supporting enzymes, catalysts and nutrients.

Risk Management of Imported (off-farm) ingredients

Under the requirements of the NASAA and National Organic and Biodynamic Standard any ingredient used for making compost must not contain or contaminate certified land or product with substances not permitted under the Standards.

[1] NASAA Organic and Biodynamic Standard, 2016 [2] National Standard for Organic and Biodynamic Produce Edition 3.7, 2016

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Ingredients need to be assessed for their potential contamination risk and testing of ingredients and/or end product compost may be required as part of the Risk Management process. Your Risk Management process needs to be documented as part of your Organic Management Plan (OMP).

Certified operators must obtain a signed statement from the supplier of any off farm ingredients confirming the non-GMO status of those ingredient(s) [NASAA Standard clause 3.2.2]. Where this cannot be provided by the supplier, the operator needs to make a risk assessment decision on whether to source the material in question.

Particular care needs to be taken if using conventional chicken or feedlot manure, as in both of these cases the manure is very likely to also contain spilt feed which may contain GMO grain or meal.

The general rule to apply when undertaking GMO risk assessment for an input/ingredient is the National Standard for Organic and Biodynamic Produce Standard clause 1.3.3: Inputs….. and ingredients shall be traced back one step in the biological chain to the organism from which they are produced to verify that they are not derived from genetically modified organisms. If you apply this rule to a supply of conventional chicken manure known to be fed GMO grains, **provided the manure is free from any spilt grain**, then the manure could be used since the "one step back" assessment is the chicken (non-GMO) who provides the manure (input/ingredient).

Site Selection

Ideally your compost making area should be shady and protected from excessive winds to prevent the heap from drying out. If a heap is allowed to dry the bacterial activity ceases. The area also needs to be accessible to any machinery that will be used.

As well, the site should also be reasonably flat and not prone to water logging. Dig off any pasture/plant cover from the area where the heap will be built prior to making the compost heap so as to prevent plant roots from robbing the compost material - the dug area should be larger than the heap itself.

Ingredients

Good composts will result from a combination of carbon -rich (also called brown) material and nitrogen-rich (also known as green) material in a ratio of between 25:1 to 30:1.

The Carbon:Nitrogen (C:N) ratio can be determined if you know the C and N values and weight of the materials you are using. You can use as many materials as you like or have access to.

Ingredients formula:

$$C:N = \frac{(\text{weight ingredient 1 x \% C}) + (\text{weight ingredient 2 x \% C}) \text{ etc.}}{(\text{weight ingredient 1 x \% N}) + (\text{weight ingredient 2 x \% N}) \text{ etc.}}$$

Approximate carbon and nitrogen content of some common farm wastes are indicted below.

HIGH IN CARBON	%N	%C
Non-legume hay	1.3	42
Tree pruning's	1.0	50
Straw	0.7	56
Soft sawdust	0.1	50
Hardwood sawdust	0.06	50

HIGH IN NITROGEN	%N	%C
blood and bone	13	42
vegetable wastes	3	30
broiler litter	2.7	38
grass clippings	3.4	58
dairy manure	2.7	48

Using ingredients from the above list as an example for calculating the C:N ratio of a compost made from 200kg tree prunings + 5t softwood sawdust + 6t dairy manure:

$$C:N = \frac{(0.2 \times 50) + (5 \times 50) + (6 \times 48)}{(0.2 \times 1) + (5 \times 0.1) + (6 \times 2.7)} = \frac{548}{16.8} = 32.6:1$$

As this ratio falls outside of the ideal range ie 25 to 30 :1, either the amount of sawdust must be reduced, or more dairy manure added, or blood and bone could also be added to improve the C:N ratio.

If we add 100kg of blood and bone to the above ingredients we get a C:N ratio within the ideal range:

$$C:N = \frac{548 + (0.1 \times 42)}{16.8 + (0.1 \times 13)} = \frac{521}{18.1} = 28.8:1$$

Particle size and Aeration

The size of the material used to create your compost heap will also have an influence on how well the heap transforms into compost. Where possible, shredding brown materials before putting into the heap is recommended.

However, if the particle size is too fine the pile will compress and turn anaerobic. Material that is too big results in too much air in the pile and may tend to create too much heat. Also, large sized material will restrict bacterial activity and take too long to decompose.

Good aeration is achieved by thoroughly mixing all the ingredients together and ensuring there is a range of different sized materials. If using green waste such as grass clippings, these can be dried a day or so before use since directly adding to the heap after cutting can lead to the grass clumping together forming silage (anaerobic) pockets within the heap, which is far from our ideal goal.

Moisture

Moisture content of the heap is also a critical factor to support conditions that allow the bacterial and fungal activity to transform the raw material into a rich earthy and life supporting humus.

Moisture content should be kept between 50 to 60%. This will feel moist but no water should come out when you squeeze together a handful from the heap. If the heap is too wet it will not allow enough air and anaerobic conditions could be created.

If the heap is too wet you will need to remake it adding more dry ingredients. The heap will also need to be protected from heavy or prolonged rain periods. If the heap is too dry, then water can be added by creating a trough along the top of the heap and allowing the water to slowly and evenly soak through the contents.

Temperature

The most rapid composting occurs between temperatures of 45 and 55°C. In colder areas, you may need to insulate the heap in winter to retain its warmth.

Heaps that are too small (eg. $< 1\ m^3$) will not heat up. Heaps that are too large become too hot and may even catch on fire. The optimum size of a heap depends on the materials being composted, space and equipment available.

Correct temperatures are also important in ridding the heap of any pathogens, parasites and/or weed seeds that may be present in the ingredients. In a well-regulated heap, composting should go through three distinct temperature phases.

Mesophilic: 20 - 40°C.

This is the first real phase of composting. Mesophilic organisms thrive at these temperatures. Their activity of breaking down sugars, fats, starches and proteins releases heat which activates the pile. With correct air, moisture and C:N ratios, this process lasts one to two days.

These microbes produce endospores which are resistant to heat, so they can survive the next hotter phase of composting allowing them to become active again later when the temperature cools. Most of these organisms will also be present in healthy topsoil.

Thermophilic: 40 - 65°C.

Predominant bacteria include *Arthobacter sp Pseudomana sp, Streptomyces* and other *actinomyctes.* The metabolic heat produced from the digesting activity of these microbes increases the heat of the pile producing temperatures high enough to kill off pathogens and weed seed that might be present in the ingredient material.

These first two stages of heat should take place rapidly. Properly made, a compost heap should heat up to 57°C at its centre in 24 to 72 hours. If the heap does not heat up, it needs to be turned (to add oxygen).

If that does not work, add fresh green material, fruit pulp or even diluted molasses, all of which provide easy to digest sugar for the microbial population. Commercial compost inoculums can also be added to the pile to stimulate this process, however they will still require the right mix of ingredients to feed them.

The Australian Standard for Composting (AS4454-2012) requires the heap be turned a minimum of three times (outside to inside) with the internal temperature reaching at least 55°C for three consecutive days before each turning to ensure adequate pathogen destruction.

As part of your Organic Management Plan (OMP) for compost making temperature needs to be monitored and recorded along with your compost turning activities.

Never let the heap get hotter than 68°C as this will burn off carbon and you will also lose valuable nitrogen. Before the heap gets too hot turn it – yes, turning encourages both heating and cooling. If turning does not solve the problem add more water or carbon material.

Any watering or modification to the compost heap should also be recorded as part of your compost making records.

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Third or Maturation phase

As the compost matures, the microbial activity and temperature starts to decrease. Mesophilic organisms begin to replace the thermophilic ones. During this phase the most resistant plant component (lignin) is finally broken down thanks largely to the activity of *actinomycetes* (chain like bacteria that resemble fungi).

As part of their process of digesting the cellulose, lignin, chitin and proteins, it is the *actinomycetes* that produce the earthy smell associated with good compost.

To maximize this process the heap should be maintained around 40°C. There is also a strong fungal activity during this last phase of composting.

Towards the end of this process, as the compost "cures", larger decomposers also become active - nematodes, springtails, centipedes, snails, slugs, ants and of course worms whose mucus also provide soil-binding properties.

The heap should cure for about two weeks before being used.

When is the compost ready?

After three turnings under the controlled and monitored conditions described above and having passed through all three temperature phases your pile should be compost.

The end result is a rich brown earthy substance that no longer resembles the original ingredients. Any remaining course materials should easily breakdown when rubbed between your fingers. Depending on the ingredients used, the compost heap can reduce in size by as much as 60% during the composting process.

Smell test

If the end product smells bad (like putrefying matter or vinegar) it contains anaerobic organisms and their by-products. You should also not be able to smell any ammonia.

Bad smelling material should NOT be used since adding it to your soil will be detrimental to the soil life you are wanting to develop and support. Any bad smelling material needs to be aerated for a few more days before undertaking another smell test.

Good compost should smell like fresh soil - earthy and clean.

You can also do a bioassay test

This is where you plant something in the compost. Good compost supports plant growth. If the heap has not yet sufficiently been broken down into a humus rich, neutral plant food, the material will be toxic to plant growth resulting in either no or sickly plant growth.