On Farm Composting

How to make simple, low labour & high-quality compost.

What is compost?

Composting essentially involves the use of certain practices and methods to manage decomposition and effectively turn organic residue into a valuable product that is used to benefit plant growth.

What you need to know about decomposition:

- .Decomposition is a naturally occurring process that is important for the health of terrestrial ecosystems.
- There are various populations of micro organisms that consume and incorporate the dead organic materials that end up on the surface of the soil.
- In the process:
- The materials are broken down and inherent nutrients are liberated, making them available to be utilized by biology once again.
- Remaining organic matter is reduced to minute humus fractions that are all important for soil structure, moisture retention and nutrient holding capacity.
- Numerous biochemical compounds are produced by the various microbiological populations that stimulate surrounding biology, induce pest and disease resistance and promote plant growth
- In natural environments, this is a gradual and ongoing process that is very much dependent on availability of materials and prevailing conditions.

Not All Compost Is Created Equal - Characteristics to look for when assessing the quality of compost include:

- Smell: a pleasant earthy aroma
- Colour: a dark, rich chocolate colour
- Mature: well broken down without any recognisable parent material
- Consistent: uniform in texture
- Structure: light and crumbly
- Bolus: can be moulded like soft putty

Australian Standard

Certified compost products must be within certain thresholds when it comes to things like chemical contaminants, plant propagules, pathogens, the occurrence of glass, metals, plastics and stones etc.. In order for compost to qualify and be branded for sale as a certified product it must comply with Australian Standard 4454.

Setting the Scene

Compost Building Site Considerations

- **Space:** is there enough space for stockpiling of materials and equipment.
- **Access:** can we get to and move around everything with ease.
- **Proximity:** is it close enough to feedstocks, equipment, paddocks or where you want to take it.
- **Water:** Is there a readily available source of water on hand
- **Drainage:** is the site free from waterlogging
- **Protection:** is it protected from the sun, wind and rain.
- **Weeds and pests:** are there problematic weeds or pests in the area that could impact operations
- **Neighbours:** feedstock materials can be smelly and the movement of machinery is noisy so must be suitably distanced from neighbours.
- **Surrounding Environment:** nutrient rich runoff can negatively affect wetland systems and traffic may impact on sensitive wildlife
- **Regulations:** each state has different regulations that need to be adhered to in WA land managers must follow the DWER Regulation Guidelines

Equipment needed may include:

- Pitchfork/shovel...
- Machinery - tractor, turner, mulcher...
- Garden hose/firefighting unit...
- Mixing buckets, backpack sprayer, watering can...
- Tarp, weedmat etc...
- Thermometer
- Infrastructure - pallets, wire mesh etc...
- PPE - gloves, mask etc...

Feedstocks are the raw ingredients needed to make your compost. Some things you want to consider when sourcing feedstock materials are:

- C:N ratios
- Quality
- Cost
- Availability & Accessibility
- Particulate size
- Contamination - biological, physical, chemical
- Diversity
- Ease of Handling

Making Compost

To make compost well, we need to provide the microorganisms involved with a good balance of the food, air and water they require, and suitable living conditions.

To break it down further, the composting process is all about how we manage the following areas:

- Feedstocks
- Additives
- Mixing
- Pile Construction
- Moisture Level
- Aeration
- Temperature control
- Protection

Microbial Foods

- **Carbon based materials** provide the energy that fuels microbial activity. Sources include woodchips, prunings, clippings, crop residue, shredded newspaper, bran etc...
- **Nitrogen rich materials** are integral for building the protein required by microbial biomass. Sources include manure, animal matter, blood and bone, legumes etc...
- **Fresh plant and animal materials**, while not essential, bring a range of active microbes, vitamins, hormones and enzymes that contribute to the overall diversity and health of the biology in the compost heap. Sources include greens, fresh pruning's, weeds, grass clippings, crop waste, seaweed etc...

Additives can be included along with bulk foodstocks, when making compost, that have qualities known to enhance favourable characteristics of compost .

These include things like:

- Rock Minerals
- Calcium Sources
- Trace Elements
- Ash
- Diatomaceous Earth
- Biochar
- Bonemeal
- Zeolite
- Inoculants
- Clay (powder)
- Seaweed (liquid or powder)
- Zeolite
- Inoculants
- Seaweed (liquid or powder)

Generally speaking, 50-60% carbon-based materials, 10-20% nitrogen rich materials and 20-30% green plant materials by volume and 5-10% additives by weight are reliable ratios to work with.

A good visual analogy for quantities of different types of ingredients to use in compost is a pasta dish. On your plate you generally have a decent amount of spaghetti (carbon based ingredients), with some pasta sauce topping (nitrogen rich ingredients), a side salad (fresh plant materials) and a sprinkling of salt and pepper (additives).

Building the Heap

When assembling a compost heap it is important that the different types of materials are either layered in repeated sequences and/or mixed well beforehand so that microbes have ready and even access all the feedstocks. This makes for a homogenous product in a shorter time frame.

Adequate material bulk is necessary if you want to create thermophilic conditions. However, if piles are too high, it is prone to getting too hot and lower layers may compact. With such composting, an appropriate height would be in the vicinity of 1.2-1.5m. Bulk volume is achieved with succinct stacking of rows or piles or the use of a bay or cage to contain the materials.

Protection:

- Exposure to extreme weather can be problematic so it may best to set up your compost in a somewhat sheltered spot.
- Providing a semi permeable (to allow for gas exchange) protective covering reduces evaporative water loss and generally helps to regulate conditions within the heap, making for more uniform decomposition.

Water:

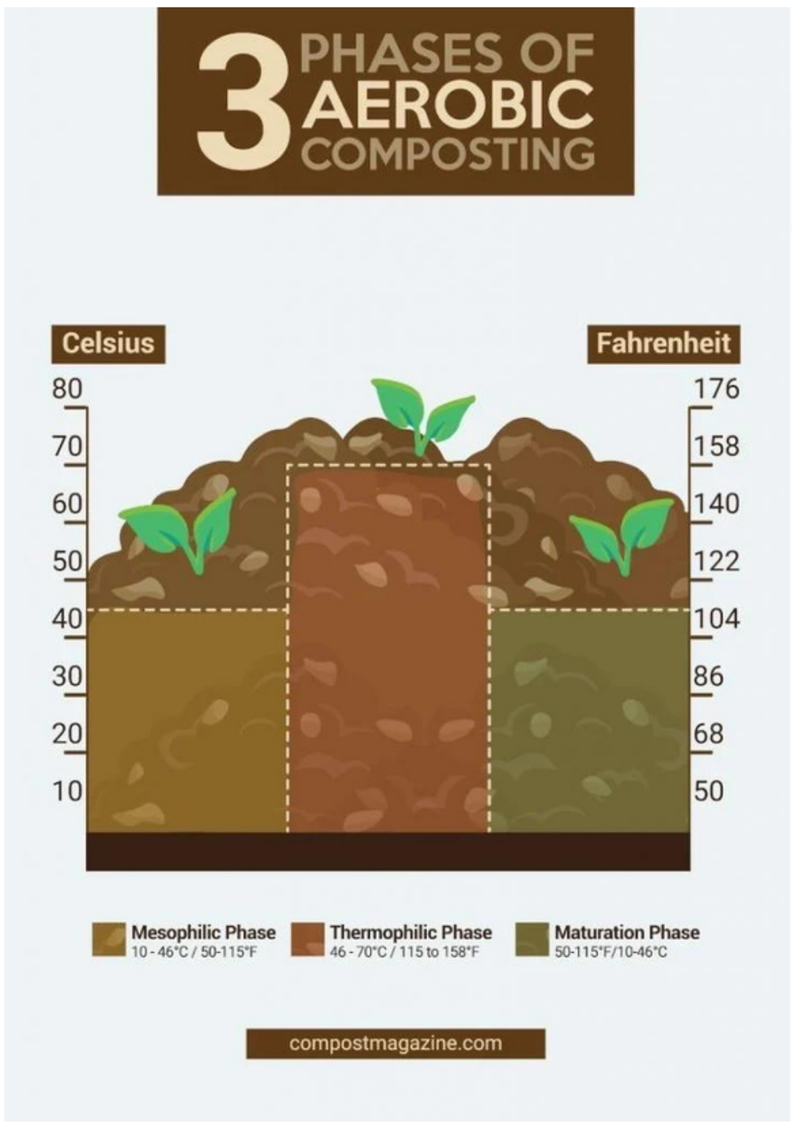
- When making compost, dry ingredients should be wetted, and throughout the life of a heap, moisture levels must be monitored and maintained to prevent it from drying out.
- Some micro-organisms and worms, don't fare so well in hard / saline / chlorinated water. If you're going to get serious about making compost it might be worth checking your water quality.

Air:

- If oxygen is not replenished as fast as it is used, the inherent oxygen quota can be exhausted, creating less favourable, anaerobic conditions. This is most likely to occur with larger volumes of, or compacted, material as movement of air to the inside of the heap is somewhat restricted.
- Compost can be systematically turned during this phase to maintain oxygen levels.

Temperature:

- When a compost heap is assembled, it doesn't take long for things to hot up to what is referred to as thermophilic conditions (>50C).
- If sufficient heat is generated, undesirable pathogens and weed seeds are destroyed. All material needs to have been maintained above 55C for a minimum of three days to achieve this sterilisation standard. However, at temperatures above 65C, many beneficial microbes are destroyed.
- Over the maturation phase (<40C), a broad community of microbes slowly decompose - strong fungal colonisation is possible at this stage and disturbance should be minimised.
- At below 30C composting worms can be introduced to the heap.



The Phases of Common Composting

In each phase of composting, specific substrate components are degraded and a varying product quality is achieved.

Mesophilic Phase: Acid- forming bacteria and sugar-utilising fungi.

Thermophilic phase: a species change takes place to a less broad range of thermophilic bacteria and actino- bacteria and only a couple of thermophilic fungi.

Maturation Phase: fungi in particular prevail; as they are adapted to the substrate components which are less degradable and to the substrate humidity that tends to be lower.

Regardless of the chosen method, in many ways the art of making good compost lies in our ability to manage these different stages of decomposition so that the various microbe groups can do their thing and turnover a quality product.

Different types of composting systems:

Aerobic Thermal:

- Involves routine monitoring and systematically turning the heap in accordance with temperature and duration thresholds .
- A standard recommendation is to turn within three days at temperatures between 55-60C, turn within 48 hours at between 60-65C and turn immediately if above 65C.

Static Aerated:

- Involves a structural component that enables good airflow to replenish the oxygen used by respiring microbes during the more active phases of decomposition.
- Oxygenation and temperature are self-regulated, therefore these systems don't require any turning.

Contained Environment Fermentation

- Contrary to common compost practice, airflow in fermentation systems is purposely restricted, and moisture is maintained at higher levels.
- Materials are normally wetted, inoculated with a starter culture, combined, and then contained or covered to restrict the supply of oxygen.

Vermiculture

- The principle behind continuous feed vermiculture systems is that you only add smaller amounts of feedstock material at a time to keep them from getting too hot for worms.
- Alternatively, larger amounts of material can be partially composted first to get past the thermophillic phase before worms are added.

Compost Method	Pros	Cons
Aerobic Thermal	Heat kills pathogens and weed seed, takes less time, can process large amounts of material.	High management/maintenance, loses a higher amount of carbon, nitrogen and water
Static Aerated	Easy, low maintenance	Doesn't adequately heat all material, low volume, takes longer
Fermentation	Low maintenance, uses less water	Doesn't adequately heat all material
Vermiculture	Can continuously feed, high humus	Doesn't heat sterilize material, slow turnover

Getting the Most Value Out of Compost

- Target applications to benefit plant growth for the subsequent benefits that come from having heathy plants in the system
- Using compost, and slurries/extracts of, at planting to coat seeds, for in furrow liquid applications or as a seedling dip is very economical as only small amounts are required to aid the establishment of a healthy plant microbe biome from the start.
- We can stimulate microbial activity and boost populations with the addition of biostimulants and foods prior to application.
- Compost can be mixed and applied with water to improve distribution, coverage and infiltration.
- The timing and placement and method of application can be targeted to maximise efficiency and/or tailored to desired outcomes
- Some fertilisers can be mixed and applied with compost to improve availability, uptake and stability
- It is best to carry out compost applications in favourable conditions and avoid extreme weather events to prevent loss of or compromise qualities of the applied product.

Compost is generally used to improve:

- biological activity
- plant nutrition
- pest and disease resistance
- soil structure
- nutrient and water holding capacity

Compost Application Rates:

Soil Amendment	Seasonal Top Dressing
5-50 tonnes/10-100m3 per hectare	0.5-5 tonnes/1-10m3 per hectare
Banded/In-Furrow	**Slurries / Extracts / Teas**
100 kg – 1 tonne/0.2-2m3 per hectare	1-10 kilos per hectare

Compost Extract/Slurry/Tea Recipes

Well matured compost and/or vermicast contains a diversity of micro-organisms and bio-chemical compounds that have been shown to promote healthy plant growth, stimulate biological activity and improve pest & disease resistance.

A thick slurry made from compost/vermicast can be used to coat seeds before or at planting to support the establishment of a healthy plant microbiome in the rhizosphere.

A more diluted compost/vermicast extract can be used as a seedling dip, applied in the planting furrow and sprayed onto the soil or foliage of plant, to introduce beneficial microbes and stimulate biological activity.

Small amounts of compost that was produced using the thermal aerobic method can also be aerobically brewed along with foods to grow a large population of microbes that can then be sprayed over the foliage of plants, fostering beneficial microbiology colonisation on leaf and stem surfaces.

As only little amounts of actual compost/vermicast are used in slurrys, extracts and teas, they are very economical to produce.

Making a Johnson-Su Bioreactor

Johnson-Su Bioreactors are fairly cheap and simple to construct using readily available materials and a few basic tools. Once you built a bioreactor, it can re used many times with minor maintenance.

Fermentation Compost Inoculant

For use in a no turn, Static Pile Inoculated Compost system

This Factsheet provides a simple recipe for making an inoculant for use in a no-turn or minimum turn, covered fermentation composting systems. This inoculant can also be used as a conditioner for soils and for odour control in manures, compost sites and intensive animal operations.

What are Inoculants?

Inoculants are products that contain living micro-organisms such as bacteria, yeasts and fungi. Micro-organisms play important roles in the environment including helping to decompose organic matter, cycle nutrients and in plant health. Inoculants can be used to add beneficial micro-organisms to a situation to get a specific biological process. For example a well known inoculant product in agriculture is a bacteria called *Rhizobia*. This product is added to legume seeds to help fix nitrogen into agricultural soils from the air as a legume crop grows.

Fermentation Compost Inoculant

The Fermentation Compost Inoculant is a biological product that contains micro-organisms that help to decompose and compost organic materials. It can be made and stored easily on the farm. The inoculant is applied to the materials that are to be composted as you are setting up a no-turn or minimum turn compost pile.

Finished SPIC Compost: Far North Queensland

The compost inoculant is a fermentation based product. This means the micro-organisms in them can live in low levels of oxygen. These are the conditions that exist in a Fermentation Compost system where a cover is used to control the level of air and the pile is not turned. The aim of using the inoculant is to help control the process of composting in the pile and ensure that the right community of micro-organisms are doing the composting process. This results in a quality compost product.

The Recipe has 2 parts

Mixture 1 – Lab Serum - Also known as EM, this is a base mixture which contains a concentration of microbes. You need to make this first.

Mixture 2 – Compost Inoculant - This mixture is made from Mixture 1 mixed with a range of other ingredients to broaden its effectiveness. Mixture 2 is what you apply to compost.

Adding inoculant to compost feedstock: Armidale Regional Council, NSW

Guidelines are downloadable via the full online article 'On Farm Composting'. To access please go to https://lower-blackwood.shorthandstories.com/on-farm-composting/index.html

This document is a downloadable summary of the online article & content hub **'On Farm Composting'**. The article was produced by 'Talkin' After Hours', the Lower Blackwood Landcare's Online Community & Information Hub, and written & collated by Mark Tupman from Productive Ecology. The aim of the article is to assist land managers to build their knowledge and skills to make and use compost.

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