Dairy Australia

DAIRYING FOR TOMORROW

Making compost on dairy farms

Compost production and its application to land can be used as a method of refining and improving on-farm use of organic residues. There is increasing interest in the cost effectiveness of compost on dairy farms, as an alternative or supplement to conventional chemical fertilisers or as a means of recycling nutrients and organic matter in wastes back onto the farm.

Aerobic composting – a biologically dynamic process

The composting process has two distinct phases; the first is known as the thermophyllic (heat generating) phase. During this period organic residues rapidly decompose, leading to the production of heat.

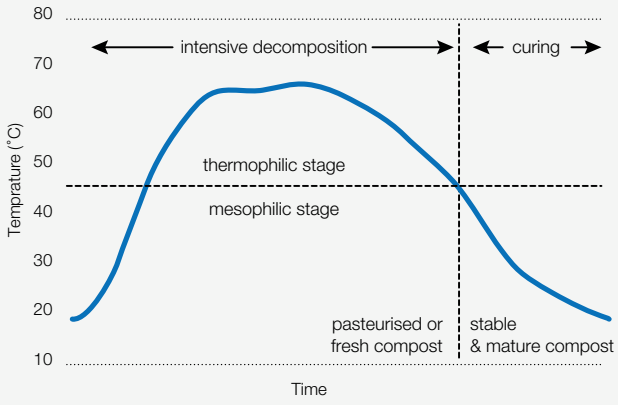
It is important during the thermophyllic phase to manage temperature so that beneficial composting microbes are not destroyed, while sufficient temperatures are attained to effectively pasteurise any pathogens or diseases and weed seeds.

The second composting phase is the mesophyllic or low temperature phase. This phase is seen when all the readily available substrates have been degraded by the microbes and the compost matures.

The production of compost centres on the microbial breakdown of degradable organic substances. By managing three main parameters throughout the process microbial degradation proceeds, generating heat and leading to the production of a humus rich product-compost:

1 carbon to nitrogen (C/N) ratio
2 moisture
3 aeration.

Temperature development and stages in aerobic composting



Source *Recycled Organics Unit Information Sheet No. 5–3, Composting Science for Industry, University of New South Wales, Sydney.*

Examples of compostable resources used in the Western Dairy Composting Project

Compostable Resource	C/N Ratio	Moisture (%)
Calf Bedding Material (Used)	14:1	3%
Dairy Solid Effluent (Stockpiled)	15:1	23%
Dairy Solid Effluent (Sediment Trap)	15:1	59%
Ryegrass Straw	105:1	8%
Discarded Cereal Straw	37:1	21%
Hardwood Sawdust	700:1	22%

1 Carbon to nitrogen ratio

In order to maximise microbial activity and facilitate the composting process, raw materials are combined to achieve a C/N ratio of the mix to within the range of 30–40:1. By developing a recipe that optimises microbial food sources the composting process will proceed quickly and enable a high quality compost to be produced. All organic residues contain carbon and nitrogen; however the amount of each can vary between types of organics. Woody materials (typically non-legume based plant materials) tend to have a high carbon percentage, whereas high nitrogen materials are generally animal based (e.g. manures) or have high legume content (e.g. clover hay).

To accurately assess the C/N ratio of each material, a sample should be analysed if possible by a reputable laboratory for total carbon and total nitrogen, allowing the calculation of an optimum mix of materials to be composted.

2 Moisture

The microbes in the composting pile require moisture to operate efficiently. In most systems, additional water needs to be added periodically to ensure that the composting process is optimised. Piles that become too dry will have slow microbial activity and will fail to achieve adequate temperature levels to pasteurise and fully compost the starting materials. Too much moisture in the piles will also slow microbial activity due to reduced gas exchange leading to odorous compounds being produced. Aim to achieve a moisture level of 54–65% throughout the composting process.

3 Aeration

Oxygen needs to be replenished on a regular basis during the composting process as the microbial activity continually depletes oxygen levels inside the pile.

There are a number of methods by which compost heaps can be aerated. Generally the most common method involves using a specialised compost turner or front-end loader to physically mix and turn over the composting material. Forced aeration systems are also used in some instances; these systems operate by pumping air through a static pile by means of a fan and a distribution system.

When considering aeration techniques, pile porosity is also important in aiding gas exchange. Dense materials tend to impede gas exchange and therefore piles constructed with fine dense materials can become anaerobic (devoid of oxygen), causing the composting process to slow and the pile to develop unpleasant odours. Materials that aid in the structure of the compost pile can help with gas exchange and sometimes products such as green waste, wood chips and other large carbon-based materials are used to keep the pile open and improve porosity.

Summary of composting parameters to maximise microbe activity

Measurement	Range	Additional notes
Carbon Nitrogen Ratio	30–40:1	Ensure that all raw materials are characterised before determining your final mixture
Moisture Content	45–65%	Squeeze tests are used to assess moisture
Oxygen Concentrations	>5%	Oxygen concentration can also be assessed by measuring CO_2 concentrations
Temperature °C	55°C	To fully pasteurise a compost pile all sections of the pile need to be exposed to 55°C for three consecutive days

Site selection

One important topic that is overlooked by many is the location of on farm compost sites. Composting is a controlled process and therefore sites should allow for easy access and monitoring.

Environmental awareness

It is of utmost importance that potential composters are aware of their environmental responsibilities. While well-managed composting operations have limited problems, site selection needs to guard against unforeseen circumstances. When selecting a site consider the potential for runoff, odour, groundwater reserves and movement of windborne particles.

Machinery access

Composting requires the use of heavy machinery and sites should enable access for trucking, spreaders and loaders. Sites with excellent road access and a good, hard working base are paramount to the success of the process. Select a site where raw materials can be easily deposited with good access for tractors and spreaders so that finished product can be utilised.

Ease of monitoring

A good compost site needs to be easily monitored all year round and be close to water and effluent sources.

Secure a good hard surface without waterlogging problems all year round for your compost site. Try to

use an area with some runoff options; a gentle slope is ideal. If compost is made in winter and the area is muddy and waterlogged, turning the piles will be very difficult and the microbiology will be hard to manage.

Access to water

The composting process consumes relatively large quantities of water or effluent. Ensure that your site is located in position where water or liquid effluent is available.

Fire safeguards

Because composting processes generate a fair amount of heat, it is important that composting sites take into account the potential for fire. Sites should be clear of combustible material and have a fire action plan in case of the unlikely event that a fire should take hold.

Managing the composting process

Calculating the recipe

Once the compostable resources have been identified and characterised, you need to work out the proportions of each product to be added and the amount of moisture required. Some of the composting companies sell recipe formulation programs or compost consultants can help with the determination of your recipe.

On-farm ratios are basically 1/3 liquid manure + 1/3 hay/silage/carbon source (e.g. laneway woodchips, calf bedding etc.) + 1/3 solid effluent manure.

Almost all types of organic waste can be used in composting: old silage; hay; woodchips; laneway scrapings; feed pad wastage; lead feed holding area manure and wastage; calf rearing holding area and wastage; general manure; dead cows and calves. It is important to avoid rocks or toxic materials such as treated pine posts from entering the pile.

Making the piles

Lay out all waste into rows of 1.5m high by 1.5m wide. The length of the rows can vary depending on your site. Set up rows with enough space to do tractor work.

Compost piles will reduce in size by about 50–70% as they cure. You can build them back up to 1.5m by 1.5m by shortening rows or incorporating two rows into one to reduce turning time.

Mixing the ingredients

It is important when starting your compost pile to ensure that the finished mixture is homogenous. By mixing thoroughly, you will enable microbes to have access to all substrates and food sources, allowing an immediate activation of your compost pile. It is also important to ensure that added water is evenly distributed throughout the pile, again maximising microbe efficiency. So, once your piles are mixed, soak them with water and turn the wet manure in, bringing the dry manure to the outside.

Monitoring the compost pile

Temperature

Assuming that pile construction and recipe determination have been achieved, temperatures in the pile start to rise as microbial activity increases. Temperatures within the active compost pile should be 55–65˚C to allow the destruction of pathogens and weed seeds within the composting materials. To achieve this, use a combination of turning and moisture addition to ensure that gases are exchanged effectively and microbe activity is not impeded. A compost thermometer is required to assess the activity of the pile and daily temperature readings should be taken. The compost probes are readily available on the internet and can be used to assess the temperature of the shell (outside) and the core (inside) of the compost pile.

Moisture

While a number of moisture meters are available on the market, they tend to be extremely sensitive and expensive. A hand assessment of moisture is widely used within the composting industry and is accepted as an easy and effective determination of moisture content.

Acceptable moisture content of the compost pile is achieved when the compost can be squeezed in the palm of the hand and it holds its shape without showing any visible moisture. When free moisture is produced, the compost is too wet; if the compost crumbles and falls apart following squeezing then it is too dry. It is important to understand that moisture needs to be replenished during the composting process as the heat generated from microbial activity will dry out the compost pile.

Turning the composting pile

As previously mentioned, regular turning of the compost pile or windrow is important to exchange gases and control temperature during the composting process. Turning also provides a release for heat, continued mixing of ingredients and destruction of any lumps that may have been present in the original mixture. Turning also has the important task of repositioning any outside materials to the inside of the heap allowing all of the mixture to be exposed to high temperatures for pasteurisation of pathogens and weed seeds. It is important that the turning method allows the repositioning of shell (outside) materials to the core (inside) of the heap.

Assessing moisture content of compost

Source *'Composting Spoiled Hay' by Declan McDonald, Kevin Wilkinson and Sally Stead, Victorian Government.*

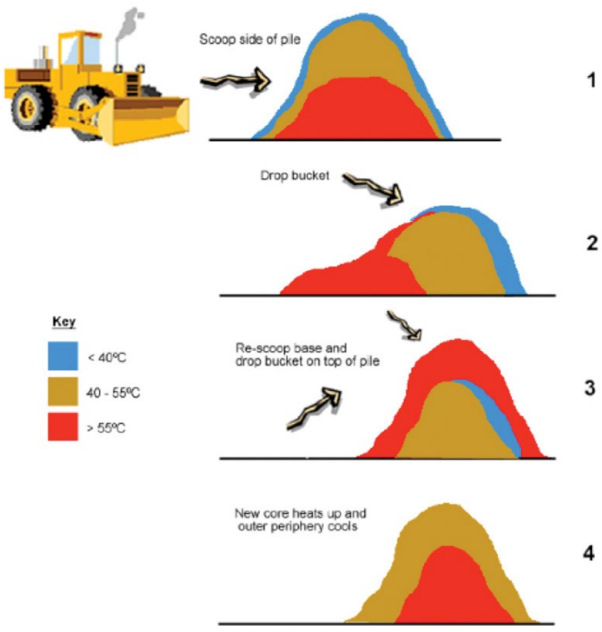
A compost turner will accelerate the composting process by more effectively aerating the pile compared to using a front-end loader. If there is hay or silage in the waste, it may be easier to turn the wet manure in with a four-prong fork rather than the bucket.

Maintaining the pile

Continue to soak and turn the piles every 10–14 days. Microbiology inoculant can be added to speed the breaking down process. The use of inoculant is important if there is only one source of manure (e.g. only feed pad dairy manure). If there is more than one source of manure (e.g. hay, silage, calf bedding, laneway scrapings etc.) the inoculant will help to increase bio-levels, but it is not absolutely necessary.

After about six weeks of soaking and turning, test and record the pile temperatures every three days. Continue soaking and turning every 10–14 days, until the temperature remains cool. This means microbial activity has stopped and the compost is ready, which should take about 8–12 weeks and 5–7 turnings.

Now it is time to nutrient test your compost, add any nutrients based on what your target paddock needs and apply the tailored compost to that paddock.



Turning compost with a front-end loader

Source *Recycled Organics Unit (2003) Information Sheet No. 2–7 Composting, University of New South Wales, Sydney.*

Problems?

Troubleshooting your compost pile

Symptom	Assessment	Remedial action
Compost fails to heat up initially	Check recipe	Add additional raw materials if required
	Check moisture	Add moisture if too dry or re-turn if too wet
	Check mixing effectiveness	Re-turn to ensure mixture is homogenous
Compost is hot (>65°C)	Turn pile to release heat	Continue to monitor daily to ensure acceptable temperature range
Compost fails to maintain temperature	Assess moisture	Add moisture if too dry or re-turn if too wet
	Assess porosity of heap	Turn to improve aeration

Publications and websites

DairySA

dairysa.com.au

Composting on dairy farms—is it for my farm?

Dairying for Tomorrow

dairyingfortomorrow.com

Mortality Composting Fact Sheet and Training Manual

DEPI Vic

depi.vic.gov.au/agriculture-and-food/dairy/managing-effluent/composting-spoiled-hay

Testing services

Compost nutrient value test

Compost Capac 01 Test Environmental Analysis Laboratory Southern Cross University

PO Box 157 Military Road
Lismore NSW 2489
Ph: 02 6620 3678
scu.edu.au/eal

Compost biology value tests

Microbe Wise (code MWSC) & Compost Maturity Test (MAWC) Microbiology Laboratories Australia

PO Box 230
Melrose Park DC SA 5039
Ph: 08 7127 8982
microbelabs.com.au

Recipe suggestions

Cornell Waste Management Institute
compost.css.cornell.edu

Acknowledgment: Information in this factsheet was adapted from Western Dairy's 'The Power of Compost' by Matt Evans

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4168.8 | Mar 2022