Information Sheet
On-farm Composting

Recycled Organics Unit

Information Sheet
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What is on-farm composting?

Surplus organic materials such as crop and animal residuals (e.g. grape marc, prunings, manure, straw, hay and spoiled grains) produced on-farm can be recycled into valuable *soil conditioners* and *mulch* products through composting.

Composting involves the managed breakdown of organic materials in piles or extended piles (*windrows*), whereby hot conditions (50-60ºC) accelerate the breakdown of organic matter into *humus*.

Machinery used to compost materials at a farm site normally includes common agricultural machinery, such as tractors fitted with buckets, and tractor-towed windrow turning equipment.

Understanding the basics of common on-farm composting techniques permits producers to manage a controlled composting process for recycling these otherwise wasted materials, and for producing quality products for improving soils and crop growth on the farm.

How does composting work?

When organic materials are piled into heaps, bacterial and fungi present in the material start to generate heat as they break down the organic matter into humus.

Temperatures often rise to above 50-60ºC, which is important to destroy any microbial *pathogens* capable of causing disease in animals and humans (e.g. often in manure), and also for destroying weed seeds or plant propagules.

Thermal destruction of pathogens and weeds seeds is referred to as *pasteurisation*.

The composting process needs to be provided with moisture, air and nutrients in order for hot conditions to be obtained, and this can be achieved by turning (e.g. with a tractor fitted with a bucket, or a specialised windrow turner towed by a tractor) and through sprinklers.

A diagram of the inputs and outputs of a composting process can be seen in Plate 2 over page.

Plate 1. Picture of a typical on-farm composting operation. This producer composts a range of crop residues (straw and spoiled grain), poultry manure and sawdust / shavings bedding materials.

Plate 2. Process diagram for composting systems. All composting processes are based on the same principles. O_2, oxygen; CO_2, carbon dioxide. Modified from Rynk et al., (1992).

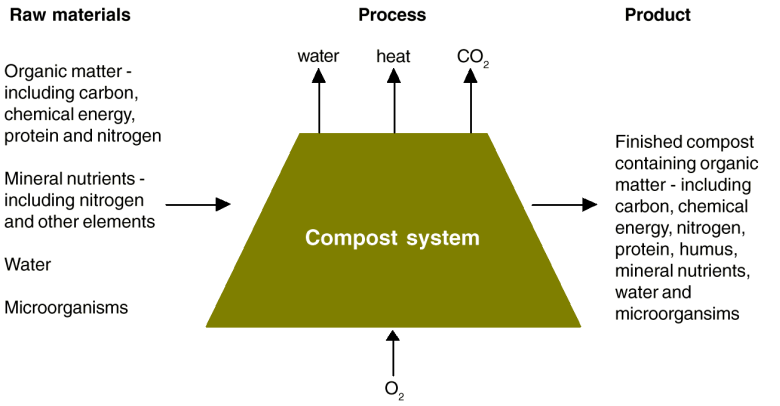


Plate 3. A poultry manure windrow composting operation. Pictured here is a low cost tractor-pulled windrow turner which serves to mix and aerate the compost, and ensures the cooler parts of the outside of the windrow are exposed to hotter conditions in the interior to ensure pasteurisation occurs.

Depending on the management and types of materials processed, a windrow — which is a long pile of heaped organic matter — may take up to 12 to 16 weeks to fully compost.

Usually, towards the end of the composting process, temperatures reduce from about 50ºC to ambient. This indicates that the bacteria and fungi in the pile have completed the decomposition process, and that the *compost* is often safe to use on crops etc.

Temperatures can also drop due to inadequate air penetration, and from too much or too little water. Temperature is only an indicator of maturity under suitable oxygen and moisture conditions in the pile.

More detailed information on the science of composting, and types of technologies available can be found in Recycled Organics Unit (2001a).

Advantages of on-farm composting

Surplus organic materials such as grape marc, manure from intensive animal industries, and straw or other residues from harvested crops can be converted into valuable products for providing organic matter and nutrients to soils.

The application of compost products to soils as a mulch can conserve water by reducing the rate of evaporatory water loss from the soil surface.

Finer composted soil conditioning products, on the other hand, can supply nutrients to crops by slowing releasing nutrients at a rate which does not exceed the demand of the plant (unlike many synthetic fertilizers which are often applied in excess).

As such, products made from ordinary waste materials on the farm can partly substitute for inputs you buy in, such as fertilizer, and in many cases today, water.

In light soils with low clay content, composted products can help retain fertilizer nutrients that would otherwise be leached from the soil profile by heavy rain or irrigation.

Guidelines on how to successfully use a range of composted products can be found in Recycled Organics Unit (2001b).

Importance of process control

To protect the environment around the composting operation, and to produce a quality product, *process control* measures need to be in place for on-farm composting operations.

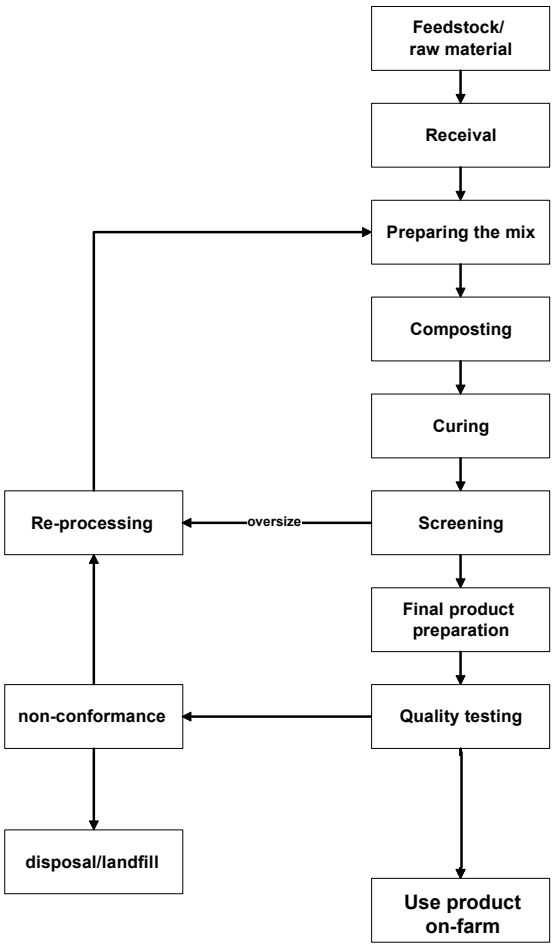
Site planning, construction and regulatory issues that need to be considered are addressed elsewhere, and readers are encouraged to consult the guide to *Establishing a Licensed Composting Facility* (Recycled Organics Unit, 2001c).

Key process control steps in an on-farm composting operation are shown in Figure 1, and this includes:

- Selection of feedstocks to process
- Receiving and storing materials prior to composting
- Preparing the composting mix
- The composting process
- Curing the compost to achieve a greater level of stability
- Screening (if a coarse or fine product is needed)
- Quality testing; and
- Use of the product.

Further details on developing process control procedures for an on-farm composting activity can be found in *Developing a Process Control System for a Composting Facility* (Recycled Organics Unit, 2002).

Figure 1. Components of a process control system for manufacturing compost from organic materials on-farm.



Getting the mix right

Preparing a composting mix before piles or windrows are formed is essential to achieve good composting.

A well structured mix with a mix of particle sizes between 5 and 50 mm is essential to achieve adequate surface area for decomposition to take place, whilst maintaining structure so that air can diffuse into the pile between turnings.

Achieving a balance between the high and low nutrient components is essential to ensure controlled breakdown occurs without odour generation.

Importantly, starting with a good moisture content is also critical to ensure controlled decomposition takes place. Depending on the feedstock components in the mix, a moisture content of between 50 and 60% is ideal.

Please see *Composting Science for Industry* (Recycled Organics Unit, 2001a) and *Guide to Developing a Process Control System for a Composting Facility* (Recycled Organics Unit, 2002) for more information on preparing the composting mix.

Monitoring the composting process

Controlling the composting process is necessary to ensure that:

- good temperatures are maintained in the material (50-60ºC);
- adequate moisture is available (50-60%), usually not beyond field capacity; and
- the composting windrow or pile is adequately aerated by turning.

Regular monitoring of temperature (e.g. weekly) should be performed to ensure that the composting pile or windrow has reach hot conditions (i.e. 50-60ºC), which is required for pasteurisation and sanitation of the product.

Secondly, the moisture content should be checked, for example, by using the 'squeeze test'.

Thirdly, monitoring the piles for odour. When piles are generating odour, this indicates that they aren't getting enough oxygen and need to be aerated through turning more frequently. This will serve to speed up the composting process.

Further information on simple field tests for monitoring the performance of composting piles or windrows can be found in *Producing Quality Compost (*Recycled Organics Unit, 2001d).

Successfully using the composted product

Specific improvements in soil chemical and physical properties following the surface application or incorporation of compost products will depend on the nutrient value of the compost, crop requirements and other inputs used (e.g. fertilizers, herbicides etc).

The range of potential benefits and quality issues associated with application of composts is covered in the *Buyers Guide for Recycled Organics Products* (Recycled Organics Unit, 2001e).

General guidance to the use of a range of products which can be manufactured from compost is given in *How to Use Recycled Organics Products* (Recycled Organics Unit, 2001b).

This publication covers the use of a range of pasteurised and composting products, for either use a surface mulch or for incorporation of finer products for soil conditioning purposes.

As with any new on-farm practice, some level of experimentation with compost products should be performed.

This may be needed to enable the product to fit in with your production and management schedule, and to obtain the desired response in terms of plant growth or improvements in overall general soil conditions.

Notes:

Definitions*

Soil conditioner
Any composted or pasteurised organic material that is suitable for adding to soils. This term also includes 'soil amendment', 'soil additive', 'soil improver' and similar terms, but excludes polymers which do not biodegrade, such as plastics, rubber and coatings. Soil conditioners may be either 'composted soil conditioners' or 'pasteurised soil conditioners'. Soil conditioner has not more than 15% by mass of particles with a maximum size above 15 mm.

Mulch
Any pasteurised organic product (excluding polymers which do not degrade such as plastics, rubber and coatings) that is suitable for placing on soil surfaces. Mulch has at least 70% by mass of its particles with a maximum size of greater than 15 mm.

Humus
The dark or black carbon-rich relatively stable residue resulting from the decomposition of organic matter.

Composting
The process whereby organic materials are pasteurised and microbially transformed under aerobic and thermophilic conditions for a period not less than 6 weeks. By definition, it is a process that must be carried out under controlled conditions yielding mature products that do not contain any weed seeds or pathogens.

Windrows (with or without aeration)
System of composting involving the aeration of horizontally extended piles formed by a front-end loader or windrow turner. Extended piles are generally 1.5 to 3 m in height, and length is limited by the size of the composting pad. Aeration can be achieved by mechanical turning and/or the delivery of air from the base of the windrow (see aerated static pile).

Compost
An organic product that has undergone controlled aerobic and thermophilic biological transformation to achieve pasteurisation and a specified level of maturity. Compost is suitable for the use as soil conditioner or mulch and can improve soil structure, water retention, aeration, erosion control, and other soil properties.

Pasteurisation
An organic product that has undergone controlled aerobic and thermophilic biological transformation to achieve pasteurisation, but is relatively immature and lacking in stability compared to compost.

Pathogen
Microorganisms capable of producing disease or infection in plants or animals. Pathogens can be killed by heat produced during thermophilic composting.

Process control
Process control refers to the management system employed to regulate the production of a 'product' consistently to defined specifications. A process control system uses procedures to control a given process whenever their absence would prejudice product quality, jeopardise worker safety or harm the environment and public health.

* Recycled Organics Unit, (2000).

Important references[1]

- Recycled Organics Unit (2000). Recycled Organics Industry Dictionary & Thesaurus: standard terminology for the NSW recycled organics industry. Recycled Organics Unit, internet publication: http://www.rolibrary.com
- Recycled Organics Unit (2001a). *Composting Science for Industry.* Recycled Organics Unit, internet publication: www.recycledorganics.com
- Recycled Organics Unit (2001b). *How to Use Recycled Organics Products: A guide on the proper use of recycled organics products.* Recycled Organics Unit, internet publication: www.recycledorganics.com
- Recycled Organics Unit (2001c). *Establishing a Licensed Composting Facility: A guide to siting, designing, gaining approval and a licence to develop and operate a composting facility in New South Wales*. Recycled Organics Unit, internet publication: www.recycledorganics.com
- Recycled Organics Unit (2001d). *Producing Quality Compost: Operation and management guide to support the consistent production of quality compost and products containing recycled organics.* Recycled Organics Unit, internet publication: www.recycledorganics.com
- Recycled Organics Unit (2001e). *Buyers Guide for Recycled Organics Products*. Recycled Organics Unit, internet publication: www.recycledorganics.com
- Recycled Organics Unit (2002). *Guide to Developing a Process Control System for a Composting Facility.* Recycled Organics Unit, internet publication: www.recycledorganics.com
- Rynk, R., van de Kamp, M., Willson, G.B., Singley, M.E., Richard, T.L., Kolega, J.J., Gouin, F.R., Laliberty Jr., L., Kay, D., Murphy, D.W., Hoitink, H.A.J. and W.F. Brinton (1992). On-Farm Composting Handbook. Natural Resource, Agriculture, and Engineering Service. Ithaca, New York, USA.

[1] All publications by Recycled Organics Unit are freely available from http://www.recycledorganics.com

Produced by:

Recycled Organics Unit
PO Box 6267
The University of New South Wales
Sydney Australia 1466

Online contact details:

ROU	Angus Campbell
Internet	www.recycledorganics.com