Vegetable R&D
Your national vegetable levy at work

vegenotes ISSUE 3 2007

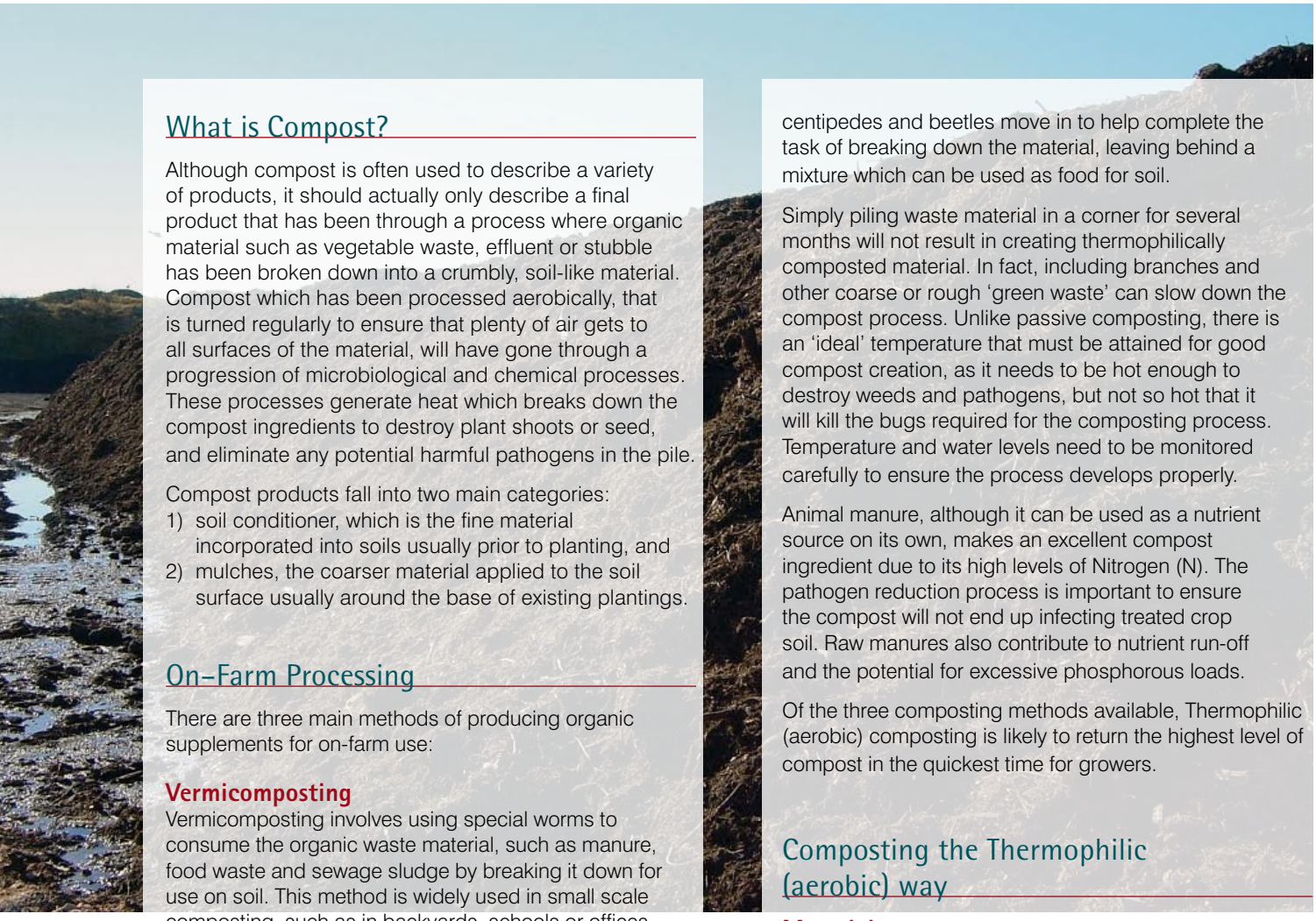
Composting On-Farm

As growers continue to seek ways to make the best use of resources and recycling waste, more attention is being focused on using compost as a soil conditioner to revitalise soil structure, texture and water-retaining capability.

There is general agreement that plants grown in fertile soils with sufficient water are healthy and have a good pest and disease resistance. In addition, composting crop waste is a simple way to reuse on-farm waste, allowing growers to maximise the value of their resources. Time will need to be allocated to gather on-farm waste and manage the compost process.

The bottom line

- Compost is an effective and practical way to build soil quality and water holding capacity
- Thermophilic (aerobic) composting is likely to return the highest level of compost in the quickest time for growers
- To compost materials for the best effect, the temperature, air flow and moisture content all need to be managed accurately



What is Compost?

Although compost is often used to describe a variety of products, it should actually only describe a final product that has been through a process where organic material such as vegetable waste, effluent or stubble has been broken down into a crumbly, soil-like material. Compost which has been processed aerobically, that is turned regularly to ensure that plenty of air gets to all surfaces of the material, will have gone through a progression of microbiological and chemical processes. These processes generate heat which breaks down the compost ingredients to destroy plant shoots or seed, and eliminate any potential harmful pathogens in the pile.

Compost products fall into two main categories:
1) soil conditioner, which is the fine material incorporated into soils usually prior to planting, and
2) mulches, the coarser material applied to the soil surface usually around the base of existing plantings.

On–Farm Processing

There are three main methods of producing organic supplements for on-farm use:

Vermicomposting

Vermicomposting involves using special worms to consume the organic waste material, such as manure, food waste and sewage sludge by breaking it down for use on soil. This method is widely used in small scale composting, such as in backyards, schools or offices. Although the technique is now being explored for more commercial use, growers may find the process too limited to make full use of farm waste. Vermiculture requires careful ongoing management because worms are sensitive to temperature and moisture levels.

Passive 'composting' (not strictly composting)

Passive 'composting' (not strictly composting) involves piling waste such as grass cuttings, kitchen refuse (no meat products) and shredded plant cuttings or branches on one spot to decompose, which can take between six months to two years. Because little more than adding fresh material is required for the breakdown process to occur, it may offer an option for growers unable to dedicate much effort to maintaining a compost process. However, the longer period of time involved and low yield of compost from the pile may not be viable for a grower's short term requirements. Also, as there is no disinfection during the process, the process can perpetuate existing weed or pest infections by transferring pathogens to crops via the compost.

Thermophilic (aerobic) composting

Thermophilic (aerobic) composting, similar to passive composting, essentially involves piling suitable material in a heap and allowing naturally occurring bacteria, fungae and algae to initially consume the material before worms, centipedes and beetles move in to help complete the task of breaking down the material, leaving behind a mixture which can be used as food for soil.

Simply piling waste material in a corner for several months will not result in creating thermophilically composted material. In fact, including branches and other coarse or rough 'green waste' can slow down the compost process. Unlike passive composting, there is an 'ideal' temperature that must be attained for good compost creation, as it needs to be hot enough to destroy weeds and pathogens, but not so hot that it will kill the bugs required for the composting process. Temperature and water levels need to be monitored carefully to ensure the process develops properly.

Animal manure, although it can be used as a nutrient source on its own, makes an excellent compost ingredient due to its high levels of Nitrogen (N). The pathogen reduction process is important to ensure the compost will not end up infecting treated crop soil. Raw manures also contribute to nutrient run-off and the potential for excessive phosphorous loads.

Of the three composting methods available, Thermophilic (aerobic) composting is likely to return the highest level of compost in the quickest time for growers.

Composting the Thermophilic (aerobic) way

Materials

To compost materials for the best effect, the temperature, air flow and moisture content all need to be managed. Both the N–rich (green material) and Carbon (C)–rich (brown material) levels need to be monitored, as too little N will cause the material to break down too slowly but too much will cause the compost heap to overheat, reducing the nutrient value of the compost and killing beneficial decomposer organisms.

To ensure the material will compost properly, a ratio of approximately 25–40:1 (25–40 – C, 1- N) will be required.

Good C material ingredients include:
- → Sawdust
- → Tree prunings
- → Straw
- → Stubble and other stalk crops residues
- → Newspaper

Good N material ingredients include:
- → Grass clippings
- → Blood and bone
- → Cattle and horse manure
- → Vegetable waste

While branches and other bulky materials can make good C ingredients, it is important that they are shredded, as larger items will slow the compost process.

Piling the materials

An easily accessible area for machinery will need to be allocated for the compost process. To ensure optimum results, it will need to be reasonably flat, free of stones, tree stumps and weeds. The pile should be located so it will not affect waterways or additional land through wind drift and water run-off.

Construct a pile between one and a half to two metres high and two to three metres long, dousing it lightly with water as you go. The pile needs to be wet through (but not too soaked) to encourage the initial bacteria and fungi's growth.

Initially, the pile should be left to begin the process. This will involve the fungi and bacteria growing and start the breakdown process. The aim of the initial piling will be to generate heat, which should be evident in the centre of the pile after a couple of days. The pile should feel uncomfortably hot and the temperature can be checked with a thermometer by digging a hole in the centre of the pile.

Ideally, the temperature in the centre of the pile should be at least 50 ºC and no more than 68 ºC. The temperature needs to reach 50 – 55 ºC to ensure harmful micro-organisms and plant propagules in the pile are killed off. If the temperature is above 70 ºC, the pile should be turned immediately to avoid killing off the beneficial organisms in the compost pile.

In addition to monitoring the temperature of the pile, it is advisable to monitor the moisture levels in the pile (please see the further information section for recommended information sources).

Turning the compost pile

Throughout the process, it is important there is airflow through the pile, which can be ensured by regularly turning the material.

Turning larger piles will probably require an excavator to lift the pile and drop it or use a front end loader to roll the pile over. It's important to ensure the materials on the outside of the pile are rotated in towards the centre of the pile, allowing them to be fully absorbed by the composting process.

If the pile is heating properly, the first turning should occur approximately one to two weeks after establishing the pile. After the first temperature reading is taken, the pile can be turned approximately three days after the temperature has reached 55 ºC. It can take several months for the temperature to begin cooling, depending on the materials being composted.

As the material needs to maintain a level of dampness throughout the process, it's advisable to water the pile before and while turning it, to allow a good level of moisture in the new centre of the pile.

After the pile has been turned, it should heat up again, requiring another temperature check after approximately seven days. Once it has heated properly, it can be turned again. This process may need to be repeated as few as three times and as many as six times, depending on the materials in the pile, to ensure the material is properly composted.

Compost is ready when dark soil sized particles have formed; Compost in development (image left)

While turning the pile is important to ensure air circulates through the pile, it also serves to prevent flies breeding on the material near the soil surface (a problem which has been encountered in Western Australia). Covering the pile can also help minimise flies while also protecting the pile from rain, which may make the moisture levels too high. Covering the pile may also increase the speed in which it heats, so more frequent checks may be advisable.

When the pile stops producing heat, it needs to be left unmoved for at least two to four weeks, to ensure it cools and sits properly. The temperature should stabilise at approximately 20 – 25 ºC.

Compost is ready when it has the following characteristics:

- Smell — nice earthy smell, with no bad (sour or rotten) smells
- Feel — moist and earthy, not wet and sloppy or dry and powdery
- Appearance — dark soil sized particles; original organic materials are not distinguishable
- Temperature — pile stops getting hot
- C:N ratio — between 15:1 and 20:1 (a laboratory test to determine this can be purchased)

The composting process takes longer if there is insufficient water, or too much bulky carbon-rich material.

Once the compost is ready, it can be dug into the crop beds, usually to a depth of approximately five centimetres. Once applied, more nutrients will become available to the plant as the organisms in the compost begin to break down the organic material. Repeated use of compost will be required to achieve maximum benefit for the soil.

Compost pile troubleshooting

- **Compost is too wet**
  Add dry materials such as sawdust or shredded newspaper to help absorb moisture, and turn regularly.
- **Not heating**
  Add a source of nitrogen, such as animal manure or blood and bone meal or vegetable scraps.
- **Too dry**
  Water lightly.
- **Fly or cockroach breeding**
  Fully enclose the compost. Make sure the compost is hot in the centre and turn regularly to 'cook' fly and cockroach eggs.
- **Too hot**
  If the mixture goes grey and smokes, turn and spread it out to cool the compost down.
- **Smell**
  All compost releases some smell when it is turned. Reduce smell by keeping the compost damp but not wet.
- **Ammonia smell**
  C:N ratio too low. Add extra high-C materials.
- **No heat to the centre**
  The C:N ratio may be too high, the pile is getting too little oxygen or there is a problem with the moisture level.

Purchasing compost

Growers may choose to purchase compost rather than generate it themselves. To ensure the compost will be satisfactory, the grower can enquire if the compost meets the Australian standard (AS 4454-2003). The standard has been established to ensure compost is not contaminated or harmful to plant growth; however it is not mandatory for a supplier to comply with the standard.

It's a good idea to ask for additional information such as the compost's ingredients and the nitrogen content of the compost.

Organic growers must also ensure the compost is approved for use by their organic certifier.

Further reading

Jenkins, A & Van Zwieten, L June 2003, 'Soil sense: How to compost on-farm', *Agnote DPI-448*, New South Wales

Wilkinson, K, Meehan, B, Issa, J, Cullis, P & De Bassi, M May 2007, *Best management practices for composting dairy processor waste*, Victoria

Paulin, R & O'Malley, P, *Compost Production and Use in Horticulture*, Department of Agriculture and Food Western Australia

Ekman, J January 2004, 'Organic materials in horticulture – their safe use' (revised), *Agnote DPI-414*, New South Wales

Hoffman, H & Paulin, R 2005, 'Compost, manure and flies', *Gardennote*, no.52, Western Australia

See also the following web sites:
www.recycledorganics.com
www.environment.nsw.gov.au/education/RecycledOrganics.htm
www.ea.gov.au

Images supplied by Department of Primary Industries, New South Wales.

An easily accessible area is required for compost piling and turning; Final product of compost, cover image

ISSN: 1449 – 1397

vegenotes is produced by: AUSVEG Ltd
PO Box 563, Mulgrave VIC 3170
T: (03) 9544 8098 | F: (03) 9558 6199

vegenotes was facilitated by HAL in partnership with AUSVEG and was funded by the National Vegetable Levy. The Australian Government provides matched funding for all of HAL's R&D activities.

AUSVEG

HAL
Know-how for Horticulture™