CASE STUDY

Burnett Mary Regional Group

Making Compost

Improving soil health

A compost windrow at Mundubbera, Queensland

BACKGROUND – SIGNIFICANCE OF COMPOST TO AGRICULTURE

Compost is decomposing organic material used as a natural fertiliser for growing plants. Composts can be made using a range of organic (carbon based) materials from both plant and animal origin. Applications of compost is one of many strategies available to rejuvenate soils. Field results have shown that compost use can increase yield, productivity and profitability. The timeframe in which to expect to see benefits from compost will vary, but generally it will take longer to see changes compared to conventional fertilisers. Often fertiliser will still need to be used with compost to ensure complete nutrition of the crop or pasture is met. However, composts can also include improvements in soil structure and greater moisture retention which fertiliser doesn't usually address.

THE COMPOSTING PROCESS

Site selection

Selecting the right site for making compost is essential. Key factors which need to be considered are:

1. Surface drainage - select a site with adequate drainage so the site will not turn to mud as soon as it rains.
2. Infiltration - site should be on a soil type with a lower infiltration rate.
3. Proximity to waterways – site must not be too close to waterways. Runoff can potentially be controlled with filter grasses.
4. Manoeuvrability of machinery - Trucks and tippers need room to deliver the raw products and machinery will require space to turn windrows.
5. Visibility & odour drifts – need to consider neighbours as sites can be unpleasant.
6. Fenced off from livestock.

Materials & quality control

Consistency and a quality product will start with the selection of good quality raw materials and following a strict process in making the final product. Composts are made up of various raw materials. Some plant sources commonly used include council green waste, urban waste, woodchip, sawmill dust and waste material from agriculture (e.g. citrus waste). Animal sources commonly include manures from feedlots, dairies, poultry and pigs. Rock mineral products including basalt and calcium silicate can also be added. Quality parameters surrounding the original raw materials must be complied with to ensure correct particle size and absence of foreign matter (e.g. stones, plastic, metal pieces). Particle size of materials should be under 5cm to allow for adequate aeration. Materials should be appropriately screened to remove the pieces that are too large to break down. Having physical consistency (moisture content, bulk density, odour, particle size, etc.) and being relatively pathogen free is fundamental to the quality of the finished product and final plant/soil response. The windrows should have adequate moisture content. A simple test is to grab some of the compost with your hand and squeeze into a ball. If the compost is moist enough fingers will leave an imprint. If there is water dripping out of the compost when squeezed, then there is too much moisture in the compost.

Windrow construction

Windrows built on farm should be in a long pile that will heat from the inside. The warm air will rise and escape through the top, pulling cooler air in from the sides. If built too big, there will be inadequate aeration due to the weight of material inhibiting air flow. Ideally, the windrow should start at 2m – 3m in height, expecting it to drop about 1/3 of the height as it settles down. The windrows should be built in a way to suit the machinery available to turn them. If using a tractor with a front-end loader, the implement must be able to reach the height of the windrow to allow for adequate turning. The shape of the windrow should be built to shed water whether it is from rain or added water to aid the decomposition process. See figure 1 below.

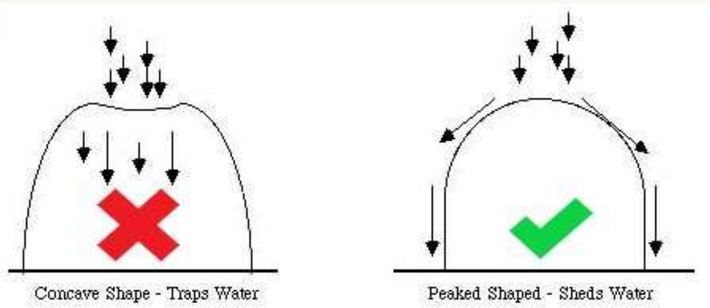

Figure 1 – The peaked shape on the right is ideal as it is built to shed water.

Temperature monitoring

Temperature monitoring of the windrows should occur to keep an eye on the microbial changes and maturing phases. Heat produced by the activities of the microorganisms is an indication that the raw materials are being actively decomposed. A compost windrow is described as having 3 heat zones, as shown in figure 2 below.

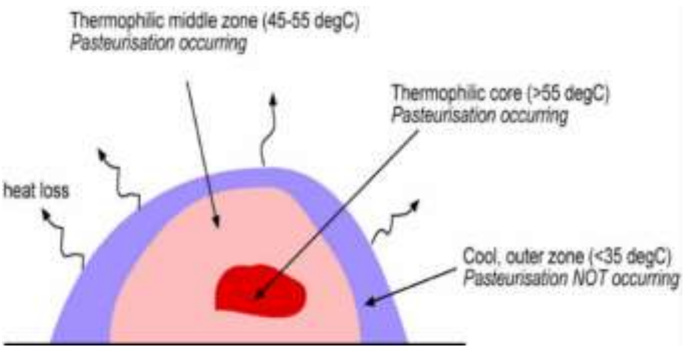

Figure 2 - The general temperature profile of a compost windrow in cross section.

Maintaining the windrow temperature at levels above 55°C is critical for the control of pathogens and weeds. Between 55-65°C seems to be the optimal temperature in a compost windrow where pasteurisation is occurring. If the temperature falls below this then the process will slow and if above this, the beneficial organisms required for decomposition of the raw material will start to die off. If the temperature rises too high fire becomes a real risk, too.

The temperature of the windrow is easily measured throughout the composting process with the use of a long-stemmed thermometer, as seen in figure 3 below. The thermometer is pushed into the decomposing material at various places along the windrow to measure the "middle zone". The temperature of the windrow should be measured at least at 5 different spots and then averaged to give an indication as to its general state of activity.

Figure 3 - Long stemmed thermometer to measure windrow temperature and composting activity.

Turning the windrow

After checking the temperature and ensuring pasteurisation has been reached in the core, the windrow should be turned to allow the cooler zones to also reach pasteurisation. Turning the windrow can be achieved as simply as with a tractor and bucket. The windrow should be pushed to the side creating another windrow as per the stages in figure 4 below. This will ensure a thorough mixing of material in the windrow. Simply pushing the windrow to the side will not produce an evenly mixed and matured composted product. By mixing the product during the move it allows fresh oxygen to move into the material and cool it down. This is a good opportunity to add more water as the moisture will quickly be lost at the high temperatures desired for pasteurisation.

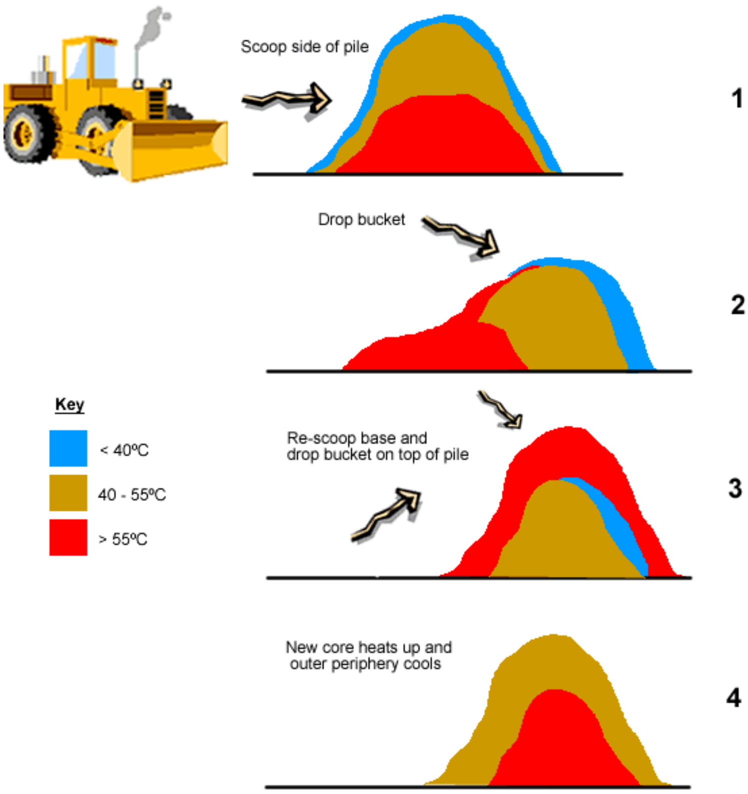

Figure 4 - Mixing the various zones of the windrow after pasteurisation temperature has been reached.

If there is sufficient moisture, decomposition will start again almost immediately after mixing and the inner heat will start to build. This cycle of heating, pasteurisation and turning will continue for a period of weeks. Once there has been a substantial drop in temperature in the overall windrow; not because of low moisture or oxygen levels, then it is reasonable to conclude that most of the high energy simple organic compounds have been converted and that the product is now in the final ‘’curing phase”. In the curing phase, compost is stable and mature. Figure 5 below outlines the microbial changes in the compost at different temperatures.

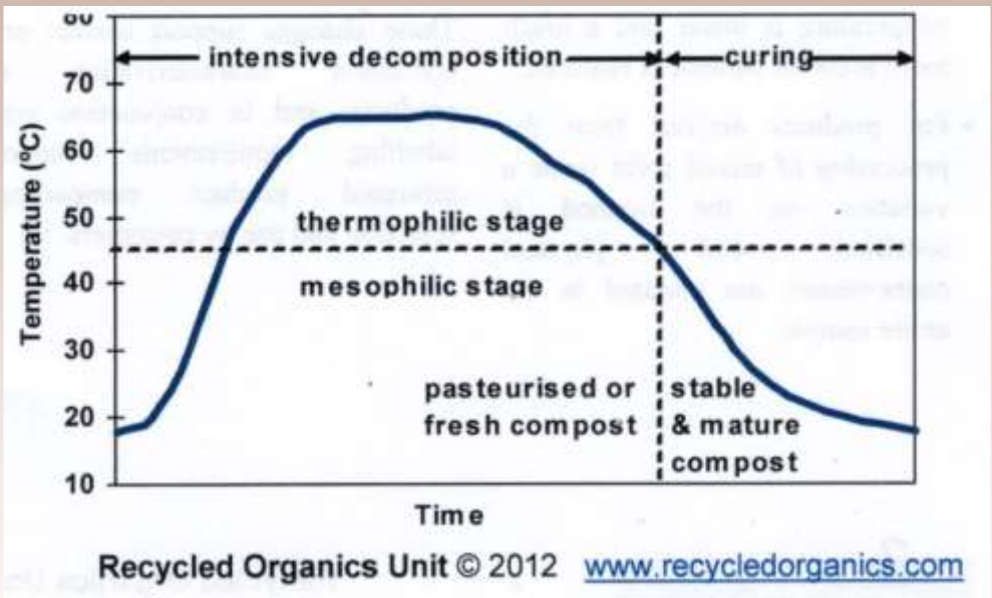

Figure 5 - Microbial changes during the ccomposting process.

Composting time

Once the average temperature of the windrow has been maintained above 55°C consecutively for at least three days, pasteurisation will begin to occurr. It is recommended to turn the compost every three days to move the outer material to the inside of the windrow so the whole mass is subject to pasteurisation. For materials such as manure, animal waste, food or grease trap wastes the core temperature of the compost mass should be maintained at 55°C or higher for 15 days or longer. During this period, the windrow needs to be turned a minimum of five times, with turning happening every three days. It is important that the raw materials being decomposed be allowed sufficient time to form a “mature compost”. This has occurred when the biological activity associated with breaking down the large complex compounds, has reduced. The curing phase is very important and should not be cut short in the need for space or moving of product. If the material being decomposed is removed from the windrows too early, and hasn’t fully pasteurised, it’s regarded as an “immature compost”. Immature compost can have adverse effects on plant growth, as the microorganisms responsible for this decomposition can draw oxygen and nitrogen from the soil for their own requirements, depriving the plants.

If selling or supplying a composted product to others, Australian standard AS 4454 needs to be followed, as there is an obligation to ensure the pasteurisation process happens throughout the entire windrow.

Testing the compost

The composted material being applied should be sampled at the end of the process to give the best idea of what level of nutrient availability it has. Several samples should be collected from around the windrow or piled into a bucket, then mixed up to finally provide a 2 kg sample that is sent to the laboratory. Composts can be analysed for the major nutrients like nitrogen, phosphorus and potassium as well as trace elements. Like soil, it is useful to know the level of trace elements and pH of the material. In some cases (especially for organic growers) it may be worth knowing the level of heavy metals (cadmium, mercury, lead, etc.) and any other organic contaminants such as bacterial levels, dieldrin or DDT chemicals.

ENVIRONMENTAL CONSIDERATIONS

Though the compost processes present little environmental risk when carried our correctly, potential risks should be known. Measures must be taken to control the following risks;

- excessive levels of nutrients reaching waterways, specifically nitrates and phosphates
- eutrophication in waterways causing blue-green algae
- emission of gases in harmful quantities such as ammonia, nitrous oxide and methane
- emission of bacterial and fungal spores affecting air quality
- nutrient overload and imbalances affecting plant growth
- leachate water from manure piles reaching waterways
- contamination from raw manures spread directly onto paddocks growing food
- antibiotics, hormones, heavy metals, persistent organic pollutants and prions reaching humans and/or the environment

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