Smart thinking

Composting the microbial way

By ALASDAIR SMITHSON

Soil is the foundation for all land-based living organisms, including the crops that farmers grow to generate an income. As vegetables are food for us, compost is food for soil organisms, which are an important part of the soil food web. The controlled microbial composting (CMC) method concentrates on maintaining aerobic conditions during composting. It is a widely used process for quickly making high-quality compost on farm. Using good compost provides the following benefits:

- nutrient provision;
- greater water retention;
- improved soil structure;
- disease suppression;
- increased pest tolerance; and,
- elevated yields

SITE SELECTION

The first thing to consider is the composting site. If you are using a paddock site to set up windrows the land should be well drained to avoid waterlogged compost. Ideally, it should be a slightly sloping concrete base (about 4 degrees) close to the main growing operation. This will allow movement of machinery without damaging the soil. It will also prevent excessive moisture accumulation, ensure that monitoring is carried out regularly and reduce time travelling to and from the windrow for turning.

CHOOSING MATERIALS

The quality of your compost will depend on the quality of material that is used in the process. Farmers should always choose organic residues from farm sources; manure and feedlot waste, packhouse waste and old tomato plants are all suitable ingredients, as is green waste from parks and woodlands. If bringing non-farm waste on to the farm for composting it is important that all the associated regulatory and organic standard requirements be met.

The carbon (C) to nitrogen (N) ratio and the moisture content of the starting material will have a bearing on the success of the composting process. The ideal C:N ratio is between 20:1 and 40:1. The moisture content of the selected materials should ideally be 50-65%. See Table 1.

Good compost should contain the highest possible diversity of food resources to stimulate the highest possible diversity of beneficial organisms. It is crucial to add some clay – no clay humus crumb can be built without it. Application of ready-made compost (up to 10%) and some soil will also help to facilitate the process and help ensure that the desired organisms are present. A microbial inoculant often referred to as a starter can be applied within two days of composting. This is a mixture of microbes to speed up the composting process.

WINDROW DESIGN

When deciding where to situate the windrows, thought should be given to the most efficient way of moving the machinery. Windrows are usually 50 metres long and should not exceed 2.5m in height and 1.2m in width. Research has shown these dimensions to be the most effective for making good CMC, helping to develop a homogenous, well aerated and odour-free heap. A bobcat or front-end loader is the most efficient way of building windrows. The turning of them should be performed by a specialist piece of windrow-turning equipment. These tend to be self-propelled or tractor-mounted implements, the latter of which requires a creep gear box. The initial layering of the windrow will vary depending on the material used. The values in Table 2 can be used as a guide.

The windrow should be covered with a Gortex-type breathable cover to prevent rainwater entering but allow in oxygen. This prevents the leaching of nutrients in rainy weather and allows carbon dioxide to disperse outwards from the windrow.

THE BREAKDOWN PROCESS

After the windrows have been set up temperatures rise, and within five days can climb to 60°C or higher. It is important that the windrow be monitored frequently with a temperature probe. The temperature should not exceed 65°C because valuable carbon sources can be burnt up and beneficial organisms be killed off. If care is not taken the windrow can ignite itself. An overheating pile should be turned to cool it down again. During the first seven days of the process temperatures should

Table 1: C:N ratio and moisture contents of compost ingredients. Source: *On farm Composting Handbook*. Values are representative.

MATERIAL	C:N RATIO	MOISTURE %
Vegetable matter	11:1 to 13:1	75
Cattle manure	11:1 to 30:1	67 to 87
Horse manure	22:1 to 50:1	59 to79
Laying hens	3:1 to 10:1	62 to 75
Grass clippings	17:1	82
Hay	15:1 to 32:1	8 to 10
Straw	48:1 to 150:1	4 to 27
Paper pulp	90:1	82
Sawdust	200:1 to 750:1	19 to 65

Figure 1: Well-made compost.

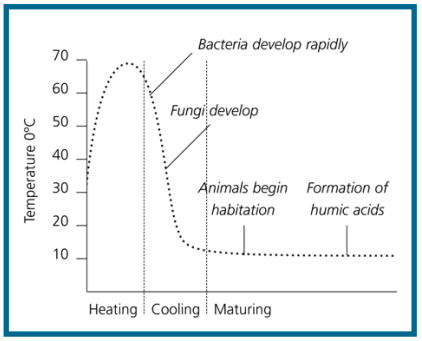

Figure 2: The compost cycle.

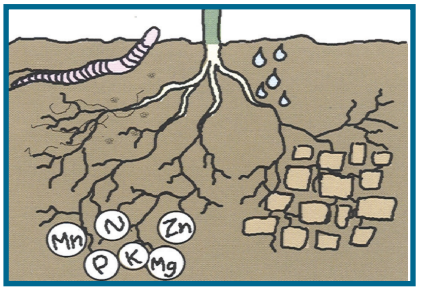

Figure 3: Compost increases trace elements, improves soil structure and promotes water retention.

be maintained between 55°C and 65°C to ensure that all weed seeds and plant pathogens are killed. This is the thermophilic stage of the composting process. During the first few weeks daily turning may be required. After about 14 days the temperature will start to drop as organic matter is broken down.

THE BUILD UP PROCESS

In the second phase, known as the mesophilic stage, new groups of organisms colonise the heap, feeding on the heat-loving organisms. It is during this phase that long-chain humic acid substances develop, binding to clay particles in the heap to form the clay-humus crumb. The key measure in assessing that the process is finished is temperature. After the initial rise, temperatures will fall before stabilising at the ambient temperature. With the right combination of ingredients and regular turning the active composting phase can be finished in six to eight weeks. See Figure 1.

THREE MANAGEMENT INDICATORS

As a guideline, turning may be required on a daily basis at the beginning of the process, reducing to once weekly as the process nears completion. Turning moments depend on results of measuring temperature, CO_2 and moisture. It is therefore essential that both temperature and CO_2 probes be used. CO_2 is released in both the thermophilic and mesophilic stages of the process. If allowed to build up it will sink to the bottom of the pile and intoxicate desired aerobic organisms. It is therefore important that CO_2 levels do not reach more than 20%. Controlling and maintaining the right moisture levels is a third management indicator. Water is required by the organisms in the heap to metabolise organic matter. Biological metabolic decomposition results in high heat, which in turn changes the water in the piles to steam. Protected coverings will help to retain moisture but if levels fall below 60% in the first three weeks then moisture needs to be added by spraying the pile during the turning process.

THE FINAL PRODUCT

After the composting process is completed the compost should resemble and smell like a forest soil. It should be:

- humified, adding to the soil's 'bank of fertility';
- biologically very active, to suppress plant diseases;
- free of weed seeds;
- free of human pathogens, such as *E. coli* and *Salmonella spp*;
- free of plant pests, such as plant parasitic nematodes; and
- free of plant pathogens, such as *rhizoctonia*, *sclerotinia* and *fusarium*.

It will also contain macro and micro nutrients, organic nitrogen, phosphorus and potassium (NPK). Compost is an especially good supplier of trace minerals such as boron, cobalt, copper, iodine, manganese, molybdenum, and zinc. The more varied the materials used to make the compost, the greater the variety of nutrients the compost will provide. See figure 3.

CONCLUSION

Compost production is not cheap but it can be justified for high value crops, such as vegetables. Producing a consistent, high-quality compost requires investment in suitable machinery and commitment of management time. Compost-turning equipment ranges from about $11,000 to $300,000. Costs of breathable covers, monitoring equipment, staff time and a concrete base (if required) also need to be considered. However, the benefits are more than worth the investment, extending beyond mere NPK input. Improved soil structure, water holding capacity and disease suppression alone justify the investment. There may be potential for relationships with local councils who want to get rid of green waste. Compost sold to other farmers could provide a new income source. ■

Table 2: Windrow composition

LAYER	MATERIAL	COMMENT
1 (bottom)	Straw or wood shavings	High carbon to nitrogen ratio
2	Manure/feedlot waste	Ideally not more than 30%
3	Ready made compost	Approximately 10% if you are learning the process
4	Vegetable/green waste	Low carbon to nitrogen material
5 (top)	Soil and clay	Small amount to add to the diversity of organisms and bind particles
6	Starter	Microbial inoculants to get things going