
Up close and personal with saprophytic fungi in a mature compost sample.

Few things have stood the test of time like the practice of turning organic material into compost that can be used to benefit plant growth. We are continually discovering more about the wonderful properties of good old compost and it remains a most important input, that growers have at their disposal.
So what is this amazing stuff and how do we make it?

There is a diversity of micro-organism populations that consume and incorporate dead organic materials.
In the decomposition process:

- organic materials are broken down and inherent nutrients are liberated, making them available to be utilised by biology once again.
- free living nitrogen fixing bacteria use energy derived from organic matter to fix atmospheric nitrogen.
- organic matter remains are reduced to minute humus fractions that improve soil structure, water retention and nutrient holding capacity.
- microbes release biochemical compounds that stimulate surrounding biology, induce pest and disease resistance and promote plant growth.

In natural environments, this is a gradual and ongoing process that is very much dependant on availability of materials and prevailing conditions. Composting essentially involves the use of certain practices and methods to manage decomposition and effectively turn organic waste into a valuable resource.

To make compost, we need to provide the various composting microorganisms with a good balance of the food, air, water they require and suitable living conditions.

Standard foods include:

- Carbon based materials: straw, clippings, woodchips, crop residue, shredded newspaper etc…
- Nitrogen rich materials: manure, blood and bone, fish emulsion, leguminous matter etc…
- Green plant materials: greens, fresh prunings, weeds, grass clippings, crop waste, seaweed etc…

Carbon based materials provide the energy that fuels microbial activity. The cellulose, hemicellulose and lignin content of plant materials may favour certain bacteria, actino-bacteria and fungi profiles.

Nitrogen rich materials are integral for building the protein required by microbial biomass. Bacteria, in particular, require large amounts of nitrogen. Over time, resident heterotrophic bacteria can also fix significant amounts of atmospheric nitrogen.

Fresh materials, while not essential, bring a range of active microbes, vitamins, hormones and enzymes that contribute to the overall diversity and health of the biology in the compost heap.

For a standard compost mix, 50-60% dry carbon-rich materials, 10-20% nitrogen rich materials and 20-30% green plant materials, by volume, are reliable amounts to work with.

Other additives that may have useful qualities include rock minerals (basalt, rock phosphate, lime, dolomite, gypsum), crushed seashells, diatomaceous earth, bone meal, trace elements clay, ash, zeolite, biochar, fish hydrolysate, liquid seaweed, molasses…

These can comprise around 5-10%, by weight, of the total materials.

The micro-organisms involved in compost decomposition are generally ubiquitous in the surrounding environment and feedstock materials. However, certain species or populations may be introduced at times to favour different types of decomposition. Commonly used examples include EM/bokashi culture, quality compost, biodynamic preparations, manure etc….

The smaller the feedstock particulates, the greater the amount of surface area the microbes can access. Chopping up vegetative matter or using a mulcher and breaking up clumps of material makes for more rapid decomposition. Conversely, you want to avoid adding too much fine material as it tends to pack down and restrict air flow.

When assembling a compost heap it is important that the different types of materials are layered in repeated sequences and/or mixed well beforehand so that microbes have ready and even access all the feedstocks. This makes for a homogenous product in a shorter time frame.
Adequate material bulk is necessary when you want to create thermophilic conditions, however, if piles are built up too high, lower layers may get compacted. With such composting, an appropriate height would be in the vicinity of 1.2 - 2m. Bulk volume is achieved with succinct stacking of rows or piles or the use of a bay or cage to contain the materials.

Hydration is a must for microbial activity and movement, otherwise they go dormant, or die. When making compost, dry ingredients should be wetted, and throughout the life of a heap, moisture levels must be monitored and maintained to prevent it from drying out. On the flip side, if it gets too wet, air supply is compromised and soluble nutrients are prone to leaching. Ideally compost materials should be moist but shouldn't any release water without applied pressure. Microbes don't fare so well in hard water and chlorinated water. If you're going to get serious about making compost and especially compost extract, it might be worth getting your water tested.

Exposure to extreme weather can be problematic so it's best to site your compost in a somewhat sheltered spot. The use of a protective covering reduces evaporative water loss and generally helps to regulate conditions throughout the heap.

Oxygen is critical for the respiring organisms that participate in the highly active decomposition that takes place when there is a stack of fresh food and adequate air and moisture on hand. However, if oxygen is not replenished as fast as it is used, the inherent oxygen quota can be exhausted, creating less favourable, anaerobic conditions. This is most likely to occur with larger volumes of, or compacted, material as movement of air to the inside of the heap is somewhat restricted.
If this is the case, maintaining adequate oxygen levels requires active management, especially in the early stages when microbial activity is high. Compost can be systematically turned during this phase to maintain oxygen levels. Another approach is to set up compost systems with physical and/or mechanical components that insure sufficient aeration throughout the heap without turning.

When the microbes really get going they burn lots of energy which generates heat. The greater the volume or density of the materials, the longer it takes for heat to diffuse out of a compost heap. When a decently sized compost heap is assembled with suitable feedstocks, it doesn't take long for things to hot up. Thermophilic conditions (>50C) can be handy, because if sufficient heat is generated, undesirable pathogens and weed seeds are destroyed. All material needs to have been maintained above 55C for a minimum of three days to achieve this sterilization standard. However, at temperatures above 65C, many beneficial microbes are destroyed.

The same conditions that predispose compost heaps to restricted gas exchange also lead to higher temperatures, and in this way, the temperature provides some indication of oxygen status.
Most commonly, aerobic thermal compost systems are turned regularly during the thermophilic phase to release heat and replenish oxygen, as well as rotate materials through the hotter centre of the heap.

Alternative composting methods such as static aerated, contained environment fermentation and continuous feeding systems are less conducive to thermophilic conditions.

As the supply of high-energy foods diminishes, activity slows, accompanied by cooler conditions (<40C) that eventually stabilise at ambient temperatures.
Over this maturation phase, a broad community of bacteria, fungi, protozoa and nematodes slowly decompose more persistent organic materials. Strong fungal colonisation is possible at this stage and disturbance should be minimised in order to avoid damaging their fragile hyphae.
When the temperature is goes below 30C, composting worms can be introduced to the heap to further the decomposition process.

Eventually, all remaining organic matter is broken down into minute fractions that are increasingly resistant to further decomposition. These are the humus fractions that adhere to finer soil particles in long lasting organo-mineral complexes that underpin the formation of micro aggregates.

Regardless of the chosen method, the art of making fine compost lies in our ability to manage these different stages of decomposition so that the various microbe groups can do their thing and turnover a quality product.