Ecological Alternatives

The Production and Use of Organic Composts

Composting is a term that has been most recently associated with organic gardening but, in reality, has been around for thousands of years. Few forest and conservation nurseries use composts at the present time, although several nurseries have made small composting trials in recent years. However, there are new reason why both bareroot and container nurseries should take another look at the benefits of composts:

Container Nurseries

Organic Component in Growing Media.
Peat moss, the standard organic component of most artificial growing media, is already too expensive in some regions. Composting offers tremendous opportunities for generating locally-made organic materials for use in growing media.

Suppressive Media. Growing media that contain composted organic materials can help control soilborne diseases. While all composts have some suppressive benefits, it may soon be possible to custom-inoculate growing media to combat specific pests.

Bareroot nurseries

Soil Amendments. Propagation of bareroot seedlings is hard on soils, and even the best nursery soil loses some of its original productivity after several crops. Organic composts can improve soils in several ways but one of the most important is its positive effect on soil structure. The composting process increases soil porosity because gums, which result from the decomposition of organic matter, and fungal mycelia bind soil particles together into crumbs *(Figure A).* Composts are superior to raw organic soil amendments because they do not cause the severe nitrogen tie-up that so often results after application.

Seedbed Mulches. Composted organic materials make ideal mulches for covering fall-sown seed, overwintering seedlings, or protecting young

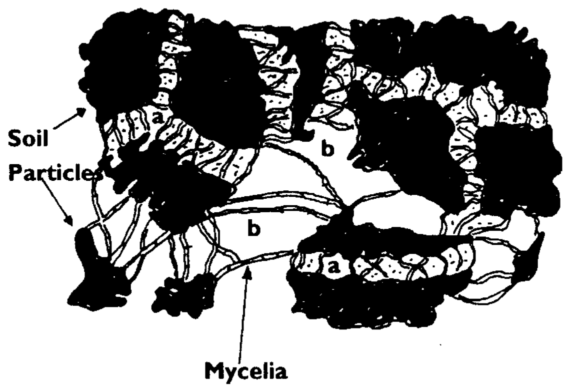

Figure A. Soil particles bound together by mycelia and gums. The smaller cavities (a) are filled with retained water, the larger ones (b) with air.

IPM Substitute for Methyl Bromide. In recent years, bareroot nurseries have been searching for ways to deal with the probable loss of methyl bromide fumigants. Although they cannot directly control pathogens, organic soil supplements can contribute in several way to an overall IPM program. Experiments and small field trials have shown that creating a suppressive soil with organic amendments can help control disease organisms and reduce the need for fumigants and other pesticides. The challenge will be to accomplish this on an large-scale operational basis.

Both Container& Bareroot Nurseries

Eco-friendly Waste Disposal. Composting is an ideal way to dispose of cull seedlings and other organic refuse that accumulate around the nursery. Disposal of all types of waste is becoming more difficult and expensive, and many landfills are putting restrictions on the dumping of organic materials. Nurseries are viewed as "green" industries, and should provide a good example by recycling all their organic wastes.

Source of mineral nutrients. Composts are an ideal way to supply mineral nutrients in a safe organically-bound form. Although they alone cannot maintain the high macronutrient levels needed for intensive nursery culture, organic forms of nutrients resist leaching and are therefore more available to plants. This makes organic composts particularly attractive for micronutrients, because providing the proper level and balance of micronutrients can be challenging.

Improved Community Relations. Nurseries can become local composting centers. Even if they don't offer plants for retail sales, forest nurseries can provide a valuable public service by accepting municipal organic wastes for composting. Although this may not be cost effective, it's impossible to put a dollar value on these types of good community relations.

The Composting Process

Okay, you want to give composting a try but don't know much about it. The process is really quite simple. Composting is the controlled decomposition of organic matter by microorganisms in a warm moist, aerated environment *(Figure B).* Organic decomposition will take place all by itself but the objective is to accelerate the process by carefully management and end-up with a useful product.

Organic wastes. Although any organic material can be composted, decomposition will be hastened by having a mixture of materials that will result in the proper carbon:nitrogen (C:N) ratio. The microorganisms which drive the composting process require a C source to provide energy and materials for new cells, along with N to manufacture cellular proteins. The C:N of the original mixture should be in the range of 25:1 to 35:1 *(Figure B).* The simplest and most economical way to adjust the C:N is to use of mixture of materials with different carbon and nitrogen contents. Municipal waste composters recommend a mixture of "green" and "brown" materials. Green materials have a high proportion of nitrogen compared to brown materials which have relatively more carbon. You should know the C:N ratio of the materials that you want to use in your compost. For example, sawdust with a C:N of 500:1 should be mixed with manure with a C:N of 25:1. Otherwise, the nitrogen to help breakdown the sawdust will have to be supplied with inorganic fertilizer at a rate of 0.25 lb/ft3 (4 kg/ m3), which can make the entire composting process uneconomic.

Particle size. The individual pieces of organic material must be small enough so that they have a greater surface area for microbial attack. On the other hand, small particles of the same size tend to pack tightly together, reducing the supply of oxygen, and hindering the release of carbon dioxide. Therefore, a mixture of particle sizes in the 0.4 to 2.0 in. (1 to 5 cm) range is recommended. For aerated compost piles, particles can be at the smaller end of the range.

Moisture content. Microorganisms require water to breakdown the organic matter and reproduce *(Figure B).* However, if the moisture content is too high, the pores become waterlogged which prevents good air exchange. The optimum moisture content in the compost pile should be between 50-60%. Very dry components may need to be moistened to start the composting process, and additional watering may be required in dry climates or in aerated composted systems.

Aeration. The microorganisms that breakdown organic matter are aerobic, but the necessity of supplying enough air during composting is probably the least understood aspect of the process. All areas of a compost pile must have good aeration to supply oxygen for microbial respiration and flush out the carbon dioxide that is produced *(Figure B).* Poor aeration favors

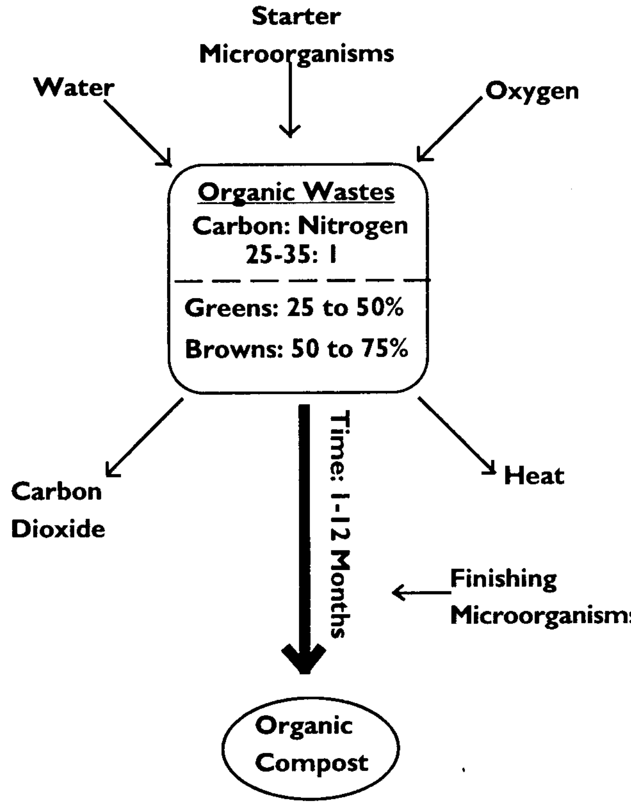

Figure B. The Composting Process

anaerobic microorganisms which can lead to acidic conditions, leaving you with silage instead of compost. Proper air exchange can be achieved by either turning the compost heap or providing natural or forced ventilation. Regular agitation will insure that no part of the compost heap will be more than 30 in. (75 cm) from an air source for an extended period. With natural aeration, compost should be piled no more than 8 ft high and 5 ft wide (2.5 m x 1.5 m). In addition to releasing the carbon dioxide and water that is produced by decomposition, providing a regular source of air also removes heat which can be very important in large-scale composting operations.

Temperature. Some of the chemical energy in the organic matter is given off as heat during decomposition *(Figure B).* Compost must reach the proper temperature range to start the decomposition process and so, during cold weather, compost piles may need to be initially covered. Once conditions are optimum, however, the temperature follows a typical curve during the composting process *(Figure* C). The temperature rises rapidly as bacteria and fungi breakdown the easily decomposable green materials. When the temperature reaches approximately 140 °F (60 °C), the fungi and some of the initial bacteria die off and actinomycetes and rod-forming bacteria take over. This is the pasteurization phase in which most plant pathogens are killed but beneficial microbes survive. All parts of the compost heap should be kept in this temperature range for at least 3 days. After most of the easily decomposable organic material has been broken down, the compost pile begins to cool and then fungi and actinomycetes begin to work on the more resistant materials such as hemicellulose and cellulose. As the pile cools further, competition increases between microorganisms, antibiotics are released, and larger organisms like earthworms move in. The compost is ready for use when the temperature stabilizes.

Microbial additives. Supplementing composts with a special mixture of microorganisms is generally not needed if the proper mix of organic materials has been selected. The composting process can be accelerated, however, by adding aged manure or compost from a previous batch at a rate of about 3% by volume. Relatively sterile organic materials like fresh sawdust start composting much more rapidly if they are inoculated with special cellulose-decomposing fungi like Coprinus ephemerus.

Well, that's a brief introduction to composting. In the July, 1994 issue of FNN, we will look at the practical and economical aspects of composts in forest and conservation nurseries.

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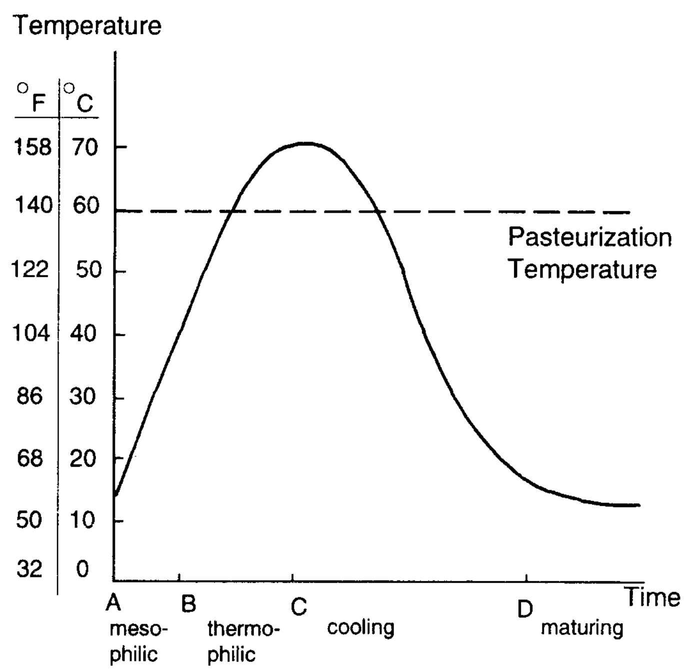

Figure C. Temperature variations in a compost heap.