

COMPOSTING

continued from preceding page

may be added in moderate amounts if additional nitrogen is added. Approximately one pound of actual nitrogen (six cups of ammonium nitrate) is required for 100 pounds of dry sawdust.

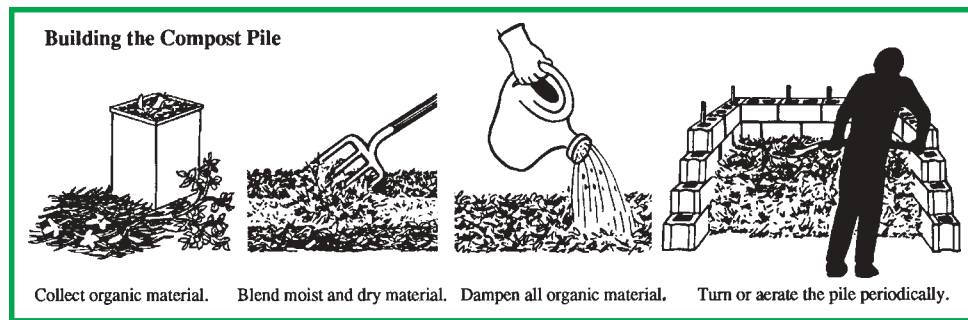
Certain organic materials should not be used to make compost because they may pose a health hazard or create a nuisance. Do not add pet feces since they may transmit disease. Meat, bones, grease, whole eggs and dairy products should not be added because they can attract rodents. Most plant disease organisms and weed seeds are destroyed during the composting process when temperatures in the center of the pile reach 140° to 150° F. However, in most compost piles, it is impossible to mix efficiently enough to bring all wastes to the center. Consequently, large amounts of weeds with seeds or diseased plants may create problems.

Carbon-to-Nitrogen Ratios

All living organisms are made of large amounts of carbon (C) combined with smaller amounts of nitrogen (N). The balance of these elements in an organism is called the carbon-to-nitrogen ratio (C:N). This ratio is an important factor determining how easily bacteria can decompose organic waste. The microorganisms in compost use carbon for energy and nitrogen for protein synthesis. The proportion of these two elements used by the bacteria averages about 30 parts carbon to one part nitrogen. Given a steady diet at this 30:1 ratio, bacteria can work on organic material very quickly.

Most materials available for composting don't have the ideal ratio. So, to speed up composting, the numbers need to be balanced. For instance, a mixture of one-half brown tree leaves (40:1 ratio) could be used with one-half grass clippings (20:1 ratio) to make a pile with the ideal 30:1 ratio. This will work best on a weight rather than volume basis. Mixing materials of different sizes and textures also helps to provide a well-drained and well-aerated compost pile.

A pile that is too high in carbon will stay cool and compost slowly. A pile too high in nitrogen will decompose too fast and smell like ammonia gas. In both instances, the decomposition process is working. If you have the time to wait and



the space to keep these materials, you'll eventually be rewarded with compost.

Making a Compost Bin

To save space, hasten decomposition and keep the yard looking neat, contain the compost pile in some sort of structure. Composting structures can be made from a variety of materials. They can be as simple or complex as desired.

Yard wastes can be composted either in simple holding units, where they will sit undisturbed for slow decomposition, or in turning bins, which produce finished compost in six to eight weeks. Holding units are simple containers used to store garden waste in an organized way until these materials break down. A holding unit is the easiest way to compost. It only requires placing wastes into a pile or bin as they are generated. Non-woody materials such as grass clippings, crop wastes, garden weeds and leaves work best in these systems. Decomposition can take from six months to two years. The process can be hastened by chopping or shredding wastes, mixing dry and wet materials and maintaining proper moisture. Since yard and garden wastes will be added continuously, the stage of decomposition will vary from the top to the bottom of each compost pile. Generally, the more finished compost will be found near the bottom of a pile and partially decomposed materials near the top. Once the compost at the bottom of a pile is finished, it can be removed and used.

Turning units are typically a series of bins used for building and turning active compost piles. A turning unit allows wastes to be conveniently mixed for aeration on a regular basis. This speeds composting by providing bacteria with the oxygen they need to break down materials. Turning systems require frequent maintenance and preparation of

the wastes to be composted.

Composting in these units is most efficiently done in batches. Materials should be stockpiled until there is enough to fill the bin. These bins should be monitored and turned after temperatures have peaked (90°–140° F) and begun to fall. This occurs four to seven days after pile construction. Turn a second time when the temperature peaks again, four to seven days later. Compost processed this way will be ready in six to eight weeks.

Location

The compost pile should be located close to where it will be used and yet not offend neighbors. The pile will do best where it is protected from drying winds.

Building the Compost Pile

A compost pile should be large enough to hold heat and small enough to admit air to its center. As a rule of thumb, the minimum dimensions of a pile should be three feet by three feet by three feet (one cubic yard) to hold heat. The maximum to allow air to the center of the pile is five feet tall by five feet wide and as long as you wish.

Microorganisms can only use organic molecules dissolved in water. A moisture content of 40–60 percent provides adequate water without limiting aeration. The "squeeze" test is an easy way to gauge the moisture content of composting materials. The material should feel damp to the touch, with just a drop or two of liquid being released when the material is tightly squeezed in the hand. The compost pile can initially be prepared in layers. This will facilitate decomposition by insuring proper mixing. To build a compost pile, start with a four to six inch layer of chopped brush or other coarse material set on top of the soil. This will let air circulate under the

base of the pile.

Next, add a three to four inch layer of low carbon organic material such as grass clippings. This material should be damp when added to the pile. On top of this, add a four to six inch layer of high carbon organic material (leaves or garden waste) which should also be damp.

On top of this, add a one-inch layer of garden soil or finished compost. This layer will introduce the microorganisms needed to break down the organic matter.

Mix the layers of high carbon organic matter, low carbon organic matter, and soil before adding another layer to the pile. This will ensure a speedy and even composting of the organic matter. Repeat the "layering" process until the composting bin is filled.

Using Compost

Finished compost is dark brown, crumbly, and is earthy-smelling. Small pieces of leaves or other ingredients may be visible. If the compost contains many materials which are not broken down, it is only partly decomposed. Allow partly decomposed compost particles to break down further or separate them out before using compost around growing plants.

Compost can be blended into soil mixes and is suitable for most outdoor planting projects. It is typically mixed with other ingredients such as peat moss, shredded bark, sand, or loamy topsoil when used as an outdoor planting mix. Mixing ratios vary; but 10 percent compost is considered to be a minimum, 30 percent optimum and 50 percent maximum in planting shrubs and trees.

Compost has its greatest value when rototilled directly into the soil. One cubic yard of compost covers 108 square feet at three inches, 216 at two inches, and 324 at one inch. The rule of thumb is to spread compost no more than one-third the depth of the rototiller. A one-inch layer of compost should be tilled in three inches, a two-inch layer tilled in six inches, and a three-inch layer tilled in nine inches. Making two or more passes with the tiller helps blend the compost with the topsoil and break up any clumps of material.

Compost Equipment

- stiff-tined garden fork
- compost thermometer
- garden hose
- containment structure (optional)

STUDENT PROJECTS

continued from preceding page

What is the effect of forced aeration (with an aquarium pump or similar apparatus) on the temperature profile in a soda bottle or a two-can bioreactor?

Try mixing the same ingredients in a large outdoor pile, a two-can bioreactor and a soda bottle bioreactor. Which system reaches the hottest temperatures? Which remains hot the longest? How does this affect the compost produced?

What is the effect of layering versus mixing organic ingredients on the compost pile temperature profile?

Worm Composting

Do organic wastes in compost break down more readily in the presence of worms than through composting that depends solely on microbial decomposition?

In some experiments, plants have not shown increased growth when planted in fresh worm castings. Does aging or "curing" worm castings increase their ability to enhance plant growth? Are there chemical differences between fresh and older worm castings? Should worm compost be mixed with soil before being used to grow plants?

How do different food sources affect reproductive and growth rates of red worms (*Eisenia fetida*)?

Red worms grow best in wastes with

pH between 5.0 and 8.0. How sensitive are their cocoons to pH? Will they hatch after being exposed to extreme pH? How sensitive are they to extreme drought or temperatures?

Effects of Compost on Plant Growth

Some leaves, such as those of black walnut or eucalyptus trees, contain chemicals that inhibit growth of other plants. Are these compounds broken down by composting?

Finished compost is near neutral pH. Can you design an experiment to answer one or more of the following questions: Is compost detrimental to use on acid-loving plants such as blueberries or azaleas? Does compost buffer the soil pH, making it harder to provide acidic conditions? How does it compare to peat moss in this regard?

Water in which compost has been soaked (often called compost tea) is said to be beneficial to plants. Can you design experiments to test whether different types, concentrations and amounts of compost tea enhance plant growth?

In China, farmers dig parallel trenches and fill them with organic wastes mixed with cocoons of *Eisenia fetida*. Soybeans planted in rows between the trenches are highly productive. Can you design and test a planting system using vermicompost? (DJ)

Birds that Compost

In Australia, there is a bird called the Brush-turkey (*Alectura lathami*) that builds compost piles to incubate the eggs so they won't have to sit on them! They build mounds of decomposing vegetation, and the heat produced by the microbial decay maintains the eggs at about 92° F, 59° F warmer than the ambient air temperature.

Because each nest generates more than 20 times the heat production of a resting adult Brush-turkey, many more eggs can be incubated this way than if they relied on warmth from the parent birds. Initially, the adult birds tend the composting nest, occasionally mixing and either adding or removing vegetation as needed to regulate the temperature, which they sense through their bills. After this initial adjustment, the nests require little attention, and larger ones can stay warm for several weeks without tending.

The largest nests are on Kangaroo Island in South Australia, where the

average mound measures about 13.9 cubic yards and weighs about 14,991 pounds. Scientists have constructed a computer model using data on mound size, ambient temperature and the nest's rate of heat production, water content, dry density and thermal conductivity. The model predicts as little as 0.39 inch of litter added to the mound will raise the core temperature about 1.8° F.

