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Backyard Composting

Composting is the natural process of decomposition and recycling of organic matter into a rich soil amendment known as compost. Natural decomposition of organic materials will eventually occur, but slowly. The process of composting accelerates decomposition and makes it more efficient. The primary objective in composting is to create an optimum environment for the microorganisms that break down organic matter so decomposition proceeds faster. The microorganisms in the compost pile require the same basic essentials of most living organisms: nutrients, air, and water. Increasing microbe abundance will cause the compost pile to decompose more rapidly.

Materials. What materials can go into a compost pile? First, they must be of biological origin such as wood, paper, kitchen trimmings, garden wastes, weeds, manure, and grass clippings. A combination of green, moist, high nitrogen materials (e.g., grass and food scraps) and dry, brown, high carbon materials (e.g., leaves and woody matter) provides an ideal, nutritionally balanced mixture for microbes. The best mixture is a range of one or two parts of green to three or four parts of brown. This mixture decomposes more efficiently than a single material source. If more than one material is used, there is also less chance of matting, which is when materials clump. Matting may cause the pile to go anaerobic and emit odors. Matting and odors are especially common when composting grass clippings without high carbon materials.

Composting is accelerated by chopping the material into smaller pieces to provide more surface area for the microbes. Running over the materials with a lawnmower or using a leaf shredder are effective.

Some materials should not be placed in a compost pile. Meat, grease, and dairy products create odors which attract animals to the pile and should be avoided. Dog and cat feces and diseased plants with harmful pathogens may survive the composting process and should also be avoided. Weeds containing seeds may survive the high temperatures created during the composting process and eventually germinate in the garden. Aggressive garden weeds such as ivy, Bermuda grass, and morning glory should also be avoided to prevent their spread.

There are several inoculants or “starters” on the market, but independent tests indicate that no benefit is gained from these products. The microbes that do the

decomposing are already on the surfaces of the materials to be composted and will flourish under the proper conditions. Adding soil to the compost pile is also unnecessary because it contains the same microorganisms that are already present in the materials that will be composted.

High nitrogen fertilizers, such as blood meal or urea, are sometimes added to a compost pile to speed decomposition of materials with a high carbon/nitrogen ratio such as leaves. Experiments at The Connecticut Agricultural Experiment Station demonstrated that, while these fertilizers gave the piles of leaves an initial boost in temperature, unfertilized piles attained the same temperatures a few days later and there was no difference in the overall composting time.

Temperature. There are two populations of bacteria in the compost pile that flourish at different temperature ranges. Mesophilic bacteria are dominant at temperatures up to 105^{o}F and thermophilic bacteria thrive at temperatures from 105 to 160^{o}F. It is important for the temperatures to reach beyond 105^{o}F because thermophilic decomposition is faster and more efficient. High temperatures also are more likely to kill weed seeds and plant pathogens. If conditions are favorable, the interior of the compost pile warms rapidly from the activity of the decomposing microbes. The thermophilic stage (105^{o}F) usually occurs in 2-3 days. The temperature in the center of the pile normally stabilizes at 140-150^{o}F for several days or weeks and then gradually cools to ambient temperatures as the material in the center of the pile is consumed. When the temperature at the center falls to ambient levels, the pile should be turned to introduce fresh, undecomposed material to the center of the pile where most of the composting takes place. The pile then reheats as the fresh material decomposes. Several turnings may be required. Generally, each turning cuts the composting time by about a half.

Special thermometers with long probes are used to measure temperatures in the center of the pile. The temperature can also be checked by hand. The material should start to feel warm 6 or 8 inches below the surface. At elbow depth, the composting material is almost too hot to touch if it is in the thermophilic range.

Volume. To maintain temperatures in the thermophilic range, the heat generated from microbial activity in the center of the pile must be retained. The minimum size to hold the heat is 3 x 3 x 3 ft. (27 cu. ft.). Smaller piles can be used to make compost, but will take longer.

Several commercial containers are available on the market for composting or a bin can be constructed from wood, snow fencing, wire mesh, or concrete blocks. There are many advantages of using a bin. It is possible to have a taller pile providing a larger reactive area near the center. Some commercial bins are rodent resistant and generally look neater. On the other hand, an advantage of unconfined compost piles is ease of turning. Although there are compost tumblers on the market, their volumes are generally not large enough for sufficient heating to occur.

Oxygen. There are two kinds of microorganisms in a compost pile: those that require oxygen (aerobes) and those that do not (anaerobes). Under aerobic conditions, carbon dioxide and water are the primary breakdown products. Under anaerobic conditions, odor forming organic acids are produced. How do you aerate your compost pile to insure that the microorganisms are receiving enough oxygen? The pile is

aerated whenever the pile is turned. Poking the pile with a pitchfork may also help aerate the pile. Another way to provide oxygen is to thrust a board (2 X 4), sticks, or a pole into the middle of the pile, withdrawing it a little at a time to allow air into the middle of the pile.

Moisture. Water is essential for all the organisms in the compost pile to live and provide mobility. Moisture also maintains nutrients in solution for microbes to assimilate. Unless there is sufficient moisture to keep ammonia in solution, it becomes a gas, evaporates into the air, and creates odors. The lost of nitrogen by ammonia evaporation also lowers the nutrient value of your compost. The moisture content in the compost pile should be as high as possible, while still allowing air to filter through pore spaces. The optimum moisture level is 50 to 60% or about as moist as a wrung out sponge, i.e. no water should drip from a sample squeezed by the hand. If the moisture content exceeds 60%, many of the air spaces will be filled with water - limiting oxygen supply for the aerobic organisms. Moisture becomes limiting when it falls below 45 to 50% by volume. Bacterial activity ceases at 12 to 15%.

If autumn leaves are dry when collected, they should be moistened during the formation of the pile. Rainfall alone is usually not adequate because the surface of the pile sheds the water and the center of the pile, where most of the decomposition occurs, gets too little moisture. Water can be added as the pile is formed and then the top covered with a water-resistant tarp or plastic garbage bags to slow evaporation and to prevent too much rainwater from seeping into the pile.

Compost Problems. The two important problems encountered in a compost pile are failure to heat and a foul odor. Solutions to these problems are summarized here:

If your compost pile fails to heat:
- *the pile may be too dry* - moisten the pile while turning
- *the pile may be too small* - collect more material and mix into the pile to increase it to at least 3 x 3 ft
- *the pile may lack nitrogen* - mix in an higher nitrogen source such as fresh grass clippings, manure, or food scraps

If your compost pile emits foul odors:
- *the pile has too little air* - turn the pile to aerate it, provide a mixture of least two materials in the pile, and make sure that the pile is not too wet

Compost Maturity. There are several ways to tell if the compost is fully mature. Compost should not contain recognizable pieces of the original material and be homogeneous, like a dark rich crumbly soil. In addition, the pile should no longer be warm to the touch. If the compost is not fully mature, applying it to the soil several weeks before planting would minimize any adverse effects.

Leaf Mulching or Sheet Composting. In sheet composting, undecomposed material, such as leaves, compost directly in the soil where crops will grow. The whole or chopped leaves are placed in a layer or sheet 4 to 6 inches thick on the surface of the soil and then incorporated into the soil by rototilling or discing. Sheet composting can be done in fall or spring. Crops are then planted directly into the amended soil. The leaves will decompose by late June.

The advantage of this method is that no space is needed to form a compost pile and

time and labor are saved. The benefits to the plants are, however, not as great as when mature compost is used.

Nutrients in Compost. Compost has little fertilizer value because its nitrogen, phosphorus, and potassium (N-P-K) contents are relatively low. Depending on the materials used, the nitrogen concentration of finished compost can vary from 0.5% (leaf compost) to 2+% (manure or biosolid compost). Although these concentrations are low, the amount of nitrogen added to the soil can be high compared to a fertilizer. Since 1-inch of compost is equivalent to 50 T/A, the nutrient contribution becomes significant because, even for leaf compost, an application of 50 T/A supplies 500 lb N/A. Unlike inorganic fertilizers, most of the naturally occurring nutrients in compost are not immediately available to plants but are released slowly at a rate used most efficiently for optimum growth. Soil microbes release more nutrients from compost when temperatures are warm and crops are actively growing. In addition, since compost is basically highly concentrated plant material, compost provides all the minerals that plants need, in very favorable proportions.

Summary. Composting is a simple and inexpensive way to dispose of and recycle food scraps and yard waste that would otherwise enter the waste stream. Building a compost pile is not a complicated or time-consuming task. Composting can be most rewarding because it provides you with a free soil amendment to improve your plants by improving your soil.