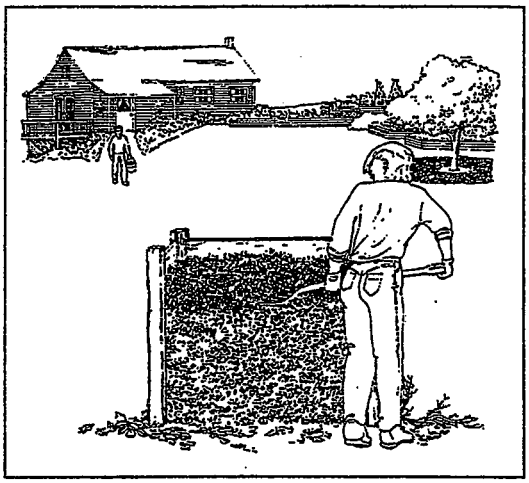
MAKING AND MAINTAINING A COMPOST PILE

From: Composting to Reduce the Waste Stream
Available from Cornell Cooperative Extension



This fact sheet discusses materials, construction, maintenance, and troubleshooting for a compost pile. These principles can be applied to turning units, holding units, and heaps. Turning a compost pile weekly can yield compost in one to two months with the right combination of materials an moisture content. Without turning, decomposition takes six months to two years. Excellent-quality compost can be made either way. When selecting a composting method, consider economy, neatness, permanence, need for finished compost, and time available for maintenance.

MATERIALS

Almost all natural, organic material will compost, but not everything belongs in the compost pile. Some wastes attract pests; others contain pathogens that can survive the compost process, even if the pile gets hot.

As shown in Table 1, fatty food wastes, such as meat or bones, should be avoided. They attract rodents, raccoons, dogs, cats, flies, and other pests; and they can cause odors. Cat and dog manures can contain harmful pathogens that are not always killed by the heat of the compost pile.

The art of composting is discovering the mix of materials that will provide the best environment for the compost process.

Plants harboring diseases, or suffering severe insect infestations, should not be added to the compost pile, Certain pernicious weeds, including morning glories, buttercups, and grasses (such as quack grass) with rhizomatous root systems, may not be killed if the pile does not heat up. Piles containing these types of weeds must be turned to encourage the high pile temperatures that will kill them.

Another consideration in choosing materials to go into the compost pile is the time they need to break down. Woody materials, such as wood chips, branches, twigs, and paper, can take up to two years to break down unless they are finely chipped or shredded. Their high C:N ratios indicate that they require a lot of nitrogen to decompose, so they may slow the decomposition of other materials. Other materials that break down slowly include: corn cobs, husks, and stalks; sawdust; straw; apple pomace; and some nut shells. These materials should be cut into small pieces to increase their surface areas and mixed with high-nitrogen materials, such as manure or fresh grass clippings.

TABLE 1

MATERIALS THAT SHOULD AND SHOULD NOT BE A IN COMPOST PILE

Yes		No	
Aquatic weeds	Leaves	Butter	Mayonnaise
Bread	Paper	Bones	Meat
Coffee grounds	Sawdust	Cat manure	Milk
Egg shells	Straw	Cheese	Oils
Evergreen needles	Sod	Chicken	Peanut butter
Fruit	Tea leaves	Dog manure	Salad dressing
Fruit peels and rinds	Vegetables	Fish scraps	Sour cream
Garden wastes	Wood ash	Lard	Vegetable oil
Grass clippings	Wood chips		

Materials that break down slowly should be mixed with easily decomposed materials to allow the pile to get hot. If a high-nitrogen source is not available, high-carbon wastes should be used as mulches. While materials such as wood chips and straw break down slowly, they also are bulking agents that improve the pile structure, allowing air circulation. If composting dense, high-nitrogen materials, such as manure, the addition of a bulking agent may be required to facilitate the process.

The art of composting is discovering the mix of materials that will provide the best environment for the compost process. Mixing materials of different sizes and textures helps to provide a structurally stable and well-drained compost pile. Diverse material also helps maintain the right C:N ratio and an efficient process.

Some gardeners are concerned about composting grass clippings that have been treated with pesticides. Table 2 lists the persistence of some common lawn herbicides in soil. Composting, as an accelerated decomposition process, biodegrades many compounds faster that soil degradation. If yard waste has been composted at least one year, pesticide residues should not be a problem when the compost is used.

TABLE 2

PERSISTENCE OF SOME COMMON HERBICIDES IN SOIL

Common Name	Trade Names	Longevity in Soil (Months)
Benefin	Balan, Balfin	4-8
DCPA	Dacthal	4-8
Bensulide	Betasan, Prefar	6-12
Glyphosate	Roundup, Kleenup	<1
2, 4-D	(many formulations)	1-2
MCPP	(many formulations)	1-2
Dicamba	Banval	3-12

Source: Rosen, et. al., 1988.

ADDITIVES

Inoculants, activators, and lime are compost pile additives. Inoculants are dormant microorganisms; activators contain sugar or a nitrogen source, such as ammonium sulfate; and lime increases compost pile pH. Inoculants are rarely needed, since earth, leaves, kitchen

scraps, and finished compost already contain ample bacteria that can work readily on their own. The only activator that may be needed is a nitrogen source, since nitrogen is usually the limiting nutrient. Nitrogen accelerates the decomposition process if the materials to be composted do not include a material with a low C:N ratio, such as manure or grass clippings. Other nutrients added through the application of organic or chemical fertilizers will have little effect on the composting process.

If additional nitrogen is needed, approximately 0.15 pounds actual nitrogen per 3 bushels (approximately 4 cubic feet) of leaves should be added. Table 3 lists estimated amounts of particular nitrogen sources that should be added to leaves. For instance, 7 ounces (about 1 cup) of ammonium nitrate is equivalent to 0.15 pounds. The nitrogen source is usually mixed with water and sprinkled on a compost pile as it is constructed.

During the initial stages of decomposition, the compost pile produces organic acids and the pH may drop. However, since composting organisms perform best at a pH between 4.2 and 7.2, it is best not to add lime to adjust pH. Adding lime converts ammonium nitrogen to ammonium gas, creating an odor problem. As the compost matures, pH will rise, typically to between 6.0 and 8.0 for finished compost.

TABLE 3

AMOUNTS OF VARIOUS NITROGEN SOURCES NEEDED

To Apply 0.15 Pounds (2.4 oz) Nitrogen

Nitrogen Source	%Nitrogen	Ounces to Apply
Ammonium nitrate	33	7.0
Calcium nitrate	15	16.0
Urea	46	5.2
Dried blood	12	20.0
Fish meal	10	24.0

LOCATION

A good location is helpful for a successful compost pile. Direct sunlight in the summer dries the pile. Exposure to high winds can dry and cool the pile, slowing the decomposition process. The pile location should not interfere with lawn and garden activities. Water should be readily available. There should also be enough space for temporary storage of organic wastes. Good drainage is important; otherwise, standing water could impede the decomposition process. The compost pile should not be located against wooden buildings or trees; wood in contact with compost may decay.

VOLUME

A 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 3 feet x 3 feet x 3 feet (1 cubic yard) to hold heat. The maximum dimension to allow air to the center of the pile is 5 feet x 5 feet x any length.

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If space is a limiting factor, the pile sides should be insulated so that higher temperatures can be maintained in a much smaller volume. Smaller, commercially available units can be insulated with foam board. Piles larger than 5 feet tall and wide may need to be turned to prevent their centers from becoming anaerobic. As the material decomposes, the pile will become smaller.

PILE CONSTRUCTION

Compost piles can be in batches or by placing materials in the piles as they become available. The batch method accelerates the composting process if the combined materials have the right C:N ratio and if the materials are mixed.

PILE MAINTENANCE

Maintenance of the compost pile involves turning the pile and adding water to maintain conditions conducive to the composting process. If the pile is not turned, decomposition will occur, but at a slower rate. The following maintenance procedure will yield compost in the shortest time.

About a week after construction of the compost pile, the pile should be opened to the air and any compacted material should be loosened. Then the pile should be reconstructed; material previously on the top and sides of the pile should be moved to the center.

Maintenance of the compost pile involves turning the pile and adding water to maintain conditions conducive to the composting process.

At the second turning (after about another week), the material should be a uniform coffee-brown color and moist. The relatively undecomposed outer layer can be scraped off and turned back into the center of the pile. The center material should be spread over the outer layer of the reconstructed pile. By the third turning, the original materials should not be recognizable. At each turning, the moisture content should be checked using the squeeze test. The material should feel damp to the touch, with just a drop or two of liquid expelled when the material is tightly squeezed in the hand. Water should be added, if necessary.

During the first few weeks of composting, the pile should reach a peak temperature of about 140°F. If temperatures surpass 140°F, the pile should be turned to cool it off. Extremely high temperatures can kill many beneficial organisms. If the pile does not reach at least 120°F, more nitrogen or water may be needed. Cold weather can also prevent the pile from heating. Piles that give off strong ammonia smells contain too much nitrogen, and may need more high-carbon ingredients.

Simple carbohydrates and proteins provide most of the energy for the initial, rapid stages of decomposition. When the more resistant materials, such as lignins and cellulose, become the main food sources, the activity in the pile will slow down. Less heat will be produced, and the temperature will begin to fall to about 100°F. Even after the temperature falls, the compost will continue to stabilize slowly.

The compost will be finished when the pile cools off and decreases to about one-third of its original volume (depending on the original ingredients). It will be dark, crumbly, and have an earthy odor. The C:N ratio will be less than 15.1, approaching the value of humus in soil, and the temperature usually will be within 10°F of ambient air temperature. Unfinished compost can be phytotoxic, especially to seedlings and newly established plants. Compost must be allowed to decompose thoroughly before use.

AVOIDING PESTS

Given a comfortable, or even nourishing, environment, rodents and other animals may be attracted. Rats are probably the most undesirable pests. In a hospitable environment with plenty of food, they can multiply very quickly and can become disease transmitters. Therefore, it is crucial to keep high-protein and fatty food wastes out of the compost pile in areas where pests may be a problem. Meat and fish scraps, bones, cheeses, butter, and other dairy products should be excluded if pests are a problem. Bread and other high-carbohydrate or high-sugar wastes can also attract pests.

Many flies, including houseflies, can spend their larval phase as maggots in compost piles. To control their numbers, compost piles with food in them must be turned frequently to encourage heating (larvae die at high temperatures). Piles should also be covered with finished compost or a dry material that has a lot of carbon in it, such as straw. Food waste can be incorporated into soil to avoid pest problems in compost piles. Pest-proof sides and covers may also be installed on compost units to help control pests.

FACTORS AFFECTING THE COMPOSTING PROCESS

All natural organic material eventually decomposes. The length of the composting process depends on a number of factors:

- carbon and nitrogen contents of the material
- amount of surface area exposed
- moisture
- aeration
- temperatures reached during composting

Carbon to Nitrogen Ratio
Microorganisms in compost digest (oxidize) carbon as an energy source, and ingest nitrogen for protein synthesis. The proportion of these two elements should approximate 30 parts carbon to 1 part nitrogen by weight. C:N ratios within the range of 25:1 to 40:1 result in an efficient process with rapid decomposition.

Blending of materials to achieve a workable C:N ratio is part of the art of composting. Table 1 is provided as a guide.

TABLE 1

CARBON TO NITROGEN RATIOS FOR SELECTED MATERIALS (By Weight)

Material	C:N
Materials with High Nitrogen Values	
Vegetable wastes	12-20:1
Coffee grounds	20:1
Grass clippings	12-25:1
Cow manure	20:1
Horse manure	25:1
Horse manure with litter	30-60:1
Poultry manure (fresh)	10:1
Poultry manure (with litter)	13-18:1
Pig manure	5-7:1
Materials with High Carbon Values	
Foliage (leaves)	30-80:1
Corn stalks	60:1
Straw	40-100:1
Bark	100-130:1
Paper	150-200:1
Wood chips and sawdust	100-500:1

Surface Area/Particle Size
The surface area of material to be composted can be increased by breaking it into smaller pieces. Increased surface area allows the microorganisms to digest more material, multiply faster, and generate more heat. Although it is not essential to break materials into small pieces for composting, it does accelerate the process.

Aeration
Rapid aerobic decomposition can only occur in the presence of sufficient oxygen. Regular mixing or turning of the pile fluffs up the material and enhances aeration.

Moisture
A moisture content of 40-60 percent provides adequate moisture 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 expelled with the material is tightly squeezed in the hand.

Temperature
Heat generated by microorganisms as they decompose organic material increases compost pile temperatures. Pile temperatures between 90° and 140° (32°-60°C) indicate rapid composting.

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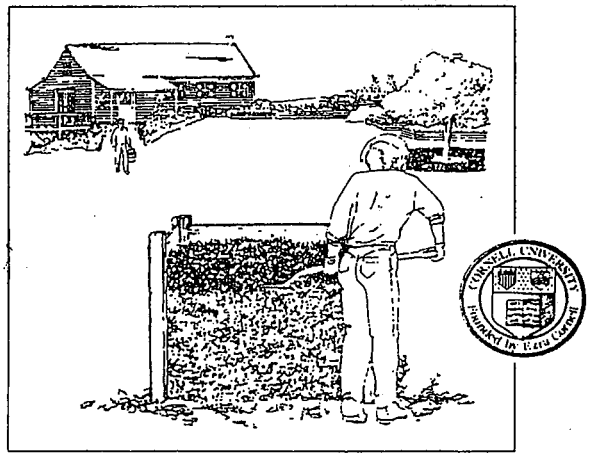

TABLE 6

COMPOST TROUBLESHOOTING GUIDE

PROBLEM	POSSIBLE CAUSES	SOLUTION
ROTTEN ODOR	• excess moisture (anaerobic conditions)	• turn pile, or add dry, porous material, such as sawdust, wood chips, or straw
	• compaction (anaerobic conditions)	• turn pile, or make pile smaller
AMMONIA ODOR	• too much nitrogen (lack of carbon)	• add high carbon material, such as sawdust, wood chips, or straw
LOW PILE TEMPERATURE	• pile too small	• make pile bigger or insulate sides
	• insufficient moisture	• add water while turning pile
	• poor aeration	• turn pile
	• lack of nitrogen	• mix in nitrogen sources such as grass clippings or manure
	• cold weather	• increase pile size, or insulate pile with an extra layer of material such as straw
HIGH PILE TEMPERATURE (> 140°F)	• pile too large	• reduce pile size
	• insufficient ventilation	• turn pile
PESTS rats raccoons insects	• presence of meat scraps or fatty food waste	• remove meat and fatty foods from pile, or cover with a layer of soil or sawdust, or build an animal-proof compost bin, or turn pile to increase temperature

From: COMPOSTING TO REDUCE THE WASTE STREAM
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