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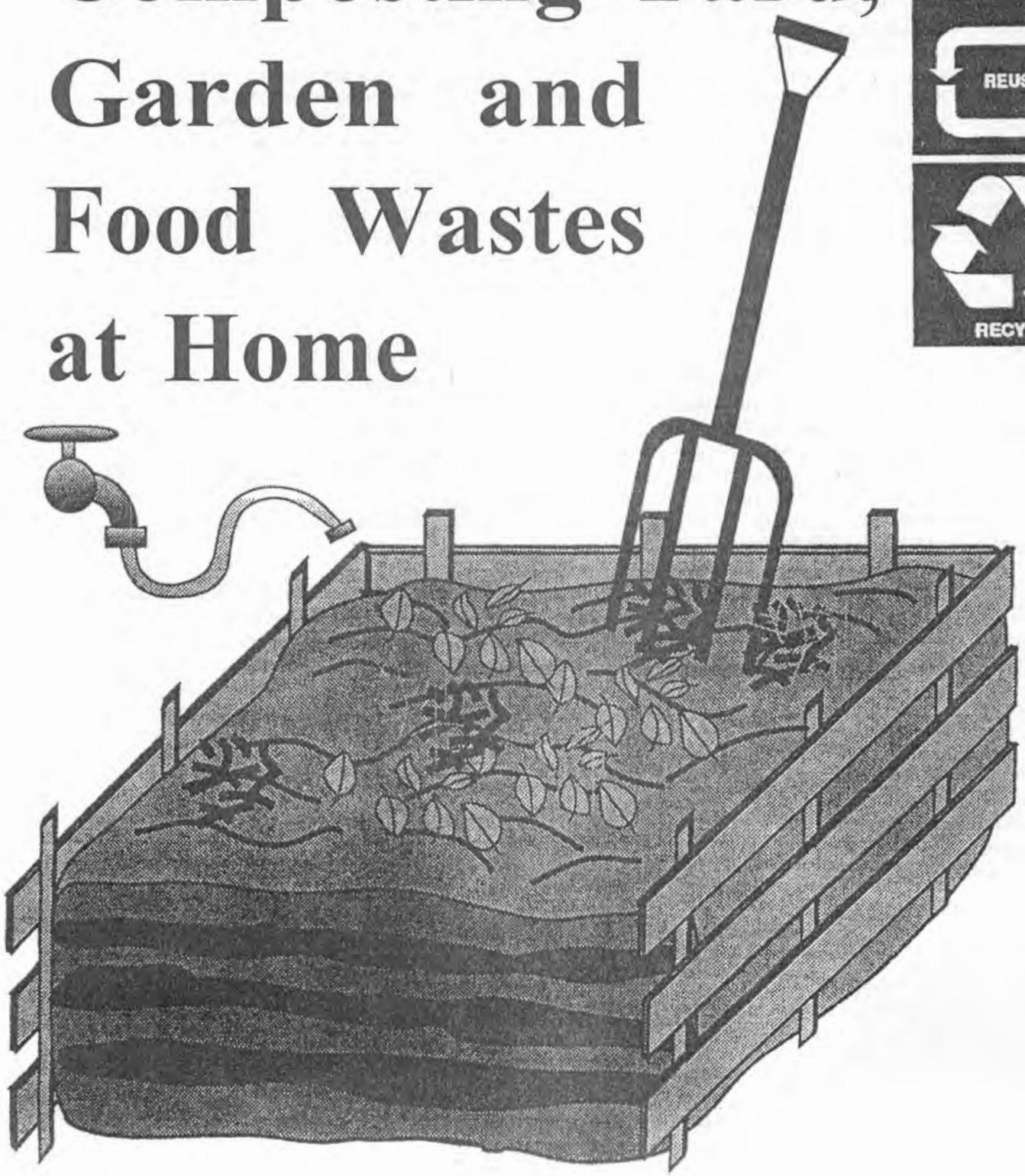
Composting Yard, Garden and Food Wastes at Home



Composting Yard, Garden and Food Wastes at Home

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Composting yard, garden and some food wastes creates a valuable soil amendment and mulch, while reducing the amount of solid wastes transported to the landfill. Presently, yard and garden wastes in the United States make up more than 20 percent of the residential solid waste stream, while food wastes account for about 9 percent. Composting at home is a very effective means of reducing the amount of solid wastes filling our landfills.

Composting is the biological decomposition of organic matter by a managed process. This breakdown of yard, garden and food wastes by microorganisms "mirrors" nature's way of recycling plant and animal materials.

Compost

Compost is a mixture of residues of organic materials that have been piled, watered and have undergone decomposition. Mature compost, which is almost fully decomposed, is the desirable end product to use in the landscape or garden. Compost benefits soils in several ways. It serves as a soil conditioner, enriching soils and improving their structure. Compost can be used to dilute clay. When thoroughly mixed with clay, compost particles bind with the smaller clay particles to loosen the soil. Surface water and plant roots can then move quickly into the more porous soil. When compost is mixed with sandy soils, these soils hold more water and nutrients. Compost attracts and supports earthworms and other desirable soil microorganisms. As earthworms burrow, they aerate soils, transport minerals essential for plant growth and help convert organic matter to humus. Many microorganisms release essential plant nutrients as they break down organic materials.

Compost is also an effective mulch when spread over the soil surface around annual and perennial flowers and under trees and shrubs (Figure 1). As little as 1/2 inch of compost broadcast over the soil surface helps conserve moisture, reduces erosion, buffers the soil surface from temperature extremes, adds nutrients to soils and suppresses weeds.

The Composting Process

When "raw" yard, garden and food wastes are available to naturally-occurring microorganisms (i.e. bacteria, fungi, actinomycetes and protozoa) and invertebrates (i.e. earthworms, insects, millipedes, mites, snails and sow bugs) in the presence of oxygen, composting begins. As the composting process continues, heat generated by these composting organisms rises from the top of the compost pile. This, in turn, pulls fresh air into the pile. In addition to heat, aerobic composting also produces water, carbon dioxide and a dark, crumbly "mature" compost (Figure 2). Decomposing waste usually loses from 50 to 80 percent of its original volume and from 30 to 50 percent of its original weight during the composting process. Mature compost weighs approximately 700 to 1200 pounds per cubic yard.

Managing the Process

Composting requires time. Under ideal conditions and with frequent turning (i.e. every three to five days), the compost may be finished in as little as four weeks. Active composting organisms (aerobic decomposers) require oxygen, carbon, nitrogen, water and an appropriate pH and temperature.

Factors affecting the composting process include:

Aeration

Turning the compost pile with a pitchfork or shovel and thoroughly mixing the materials will aerate the pile and help prevent unwanted odors and gases. If oxygen is limited, the decaying material may smell like rotten eggs (sulfur dioxide gas) or may produce methane gas. In addition, organic acids may be released as bacteria and fungi decompose organic wastes. These weak acids may accumulate if the compost

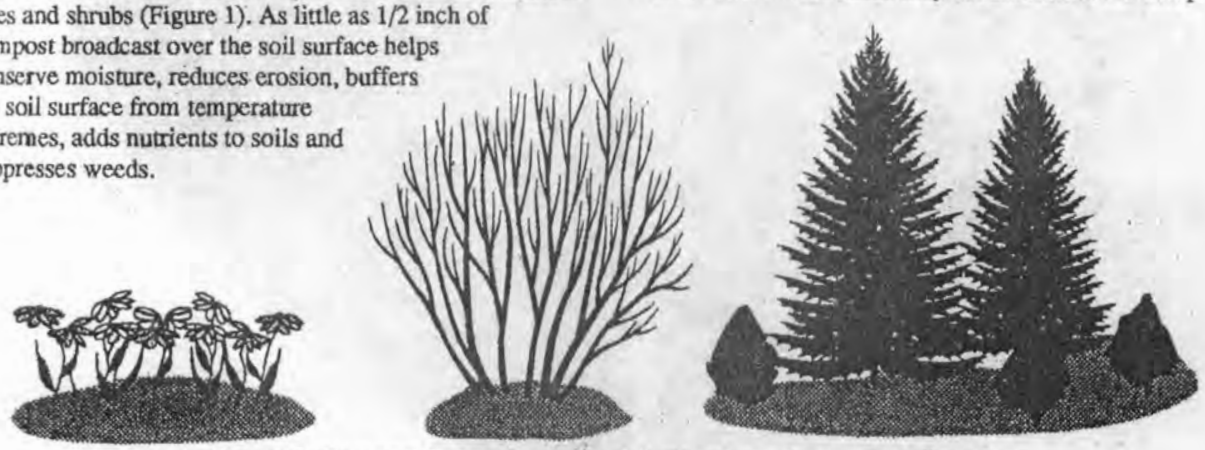

Figure 1. Compost is an effective mulch when spread over the soil surface around flowers and under trees and shrubs.

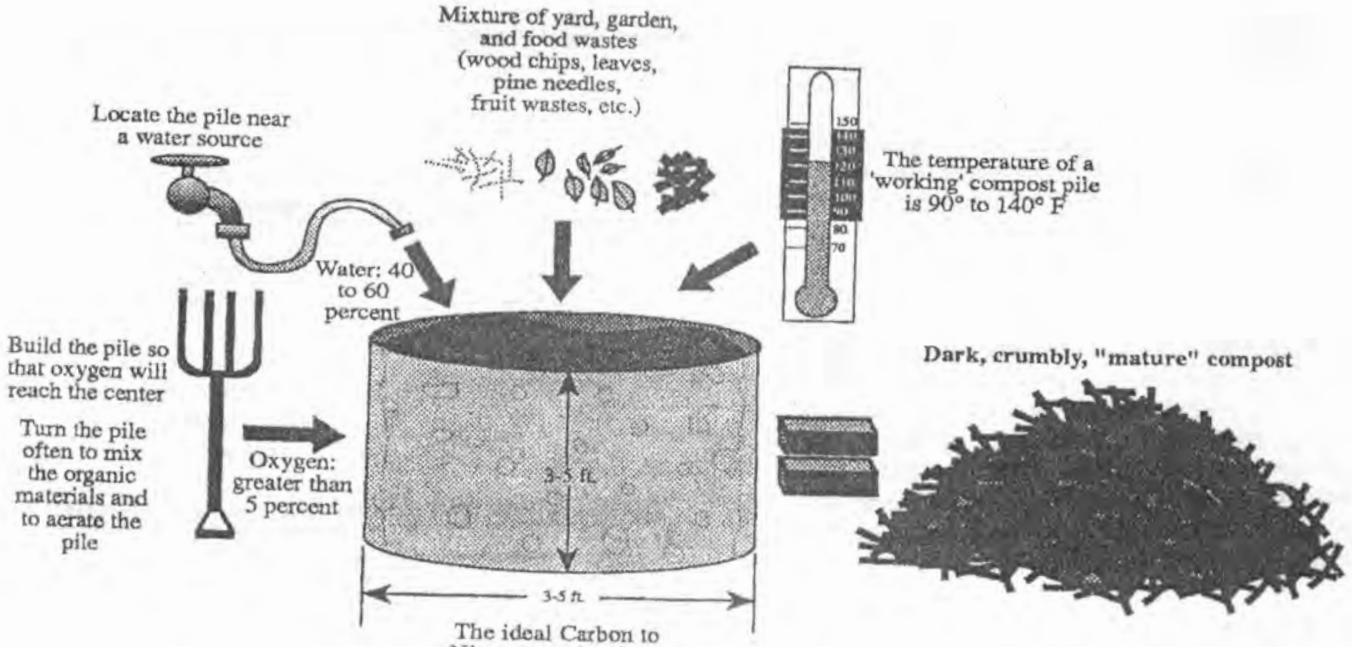

Figure 2. The composting process.

pile becomes slightly anaerobic (without oxygen). Aeration is recommended to help return the acid level in a slightly anaerobic compost pile to normal. In rare cases, when frequent turning does not correct the problem, ground agricultural limestone may be added to neutralize acids.

Carbon and Nitrogen

Organic wastes furnish the microorganisms with carbon and nitrogen. The concentration of carbon and nitrogen varies among the different waste materials added to the compost pile. The ratio of carbon to nitrogen (C:N ratio) of a solid waste influences the rate at which microorganisms will decompose it. Wastes with a C:N ratio near 30:1 are considered optimal for decomposition. The rate of composting slows when the C:N ratio of wastes is much greater than 30:1. Conversely, large populations of microorganisms may rapidly consume high nitrogen materials (materials with a C:N ratio much less than 30:1), resulting in a stagnant, anaerobic compost pile. Organic materials classified as greens (low C:N ratio) or browns (high C:N ratio) may be mixed to maintain a C:N ratio near 30:1 (Table 1). For example, high carbon materials such as leaves, wood chips and bark are mixed with low carbon materials including grass clippings and food wastes. Humus, the relatively stable organic fraction of soil remaining after the added plant and animal residues have decomposed, has a C:N ratio of approximately 10:1.

Water

Living organisms (decomposers) require water as they decompose organic materials in the compost pile. The compost pile should contain 40 to 60 percent water by weight. The activity of decomposers may slow dramatically at a moisture level below 40 percent. However, nutrients may be leached, air volume may be restricted and the rate of decomposition may be limited when the moisture content of the compost pile is greater than 60 percent. The compost pile should feel damp, not saturated. A handful of compost should yield one or two drops of liquid when tightly squeezed.

Table 1. The Approximate Carbon to Nitrogen (C:N) Ratio of Several Organic Materials.

ORGANIC MATERIAL		APPROXIMATE C:N RATIO
Greens		
	Coffee grounds	18:1
	Cow manure	20:1
	Egg shells	35:1
	Fruit wastes	35:1
	Grass clippings	12-25:1
	Horse manure	25:1
	Horse manure with litter	30-60:1
	Pig manure	5-7:1
	Poultry manure	10:1
	Poultry manure with litter	13-18:1
	Sewage sludge (digested)	16:1
	Vegetable wastes	12-20:1
Browns		
	Bark	100-130:1
	Paper	170:1
	Leaves	100:1
	Peanut hulls	50:1
	Pine needles	90:1
	Sawdust[1]	100-500:1
	Straw	80:1
	Wood chips[1]	700:1

[1]Do not compost black walnut sawdust or black walnut wood chips. Some substances released during the decomposition of black walnut may interfere with the composting process and may be toxic to plants.

Temperature

Temperatures in the compost pile ranging from 90 F to 140 F indicate a rapid rate of organic matter decomposition. Easily decomposed materials are broken down during the first of three composting phases, the mesophilic phase. During this phase of composting, which lasts about two to three days, the temperature of the compost pile rises to about 104 F. Most decomposition takes place during the second, or thermophilic phase. The activity of a group of microorganisms tolerant of high temperatures results in an increase in the temperature of the compost pile to about 160 F. Most aerobic microorganisms die at temperatures in excess of 140 F. As temperatures continue to rise and as energy supplies become depleted, the population of thermophilic microorganisms declines. The temperature drops, and the compost pile now contains several compounds resistant to decay. During the third composting phase (stabilization), the temperature stabilizes and the compost pile is, once again, inhabited by microorganisms.

Surface Area

Shredding or chipping large pieces of organic matter will expose more surface area to microoranisms and speed the composting process (Figure 3). However, finely shredded organic materials must be turned frequently to avoid the problems associated with anaerobic conditions and to meet the microorganisms' demand for oxygen. For information regarding chippers and shredders, please refer to Extension SP268-N, The Inside Facts on Chippers and Shredders.

Organic Materials To Be Composted

Although they will almost always decompose, food and yard wastes vary regarding their suitability for home composting (Tables 3 and 4). Some wastes may contain harmful pathogens. Fatty wastes generally attract animals and other pests. Seeds and vegetative pieces of troublesome perennial weeds (i.e. dallisgrass, nimblewill, johnsongrass, bermudagrass, ...) may survive the composting process. Large branches may take several years to decompose unless they are chipped or shredded.

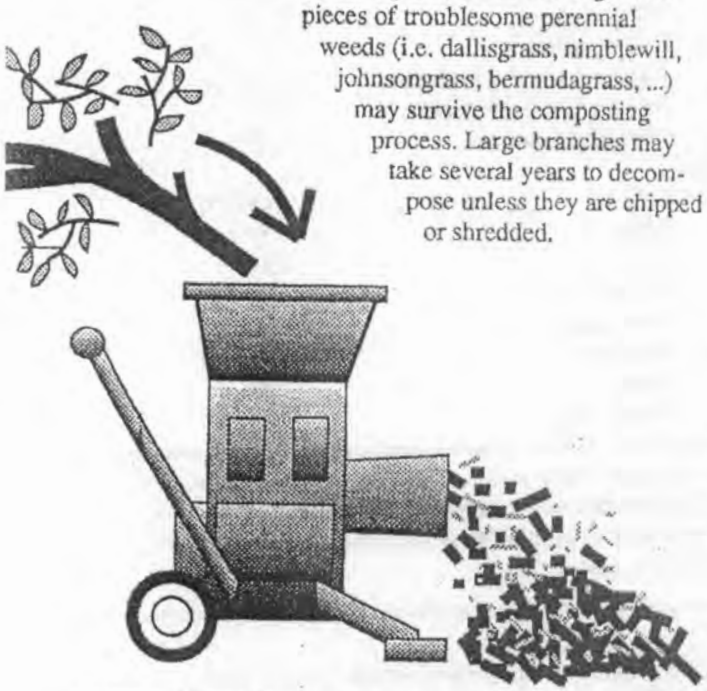

Figure 3. Shredders or chippers are used to process yard and garden wastes.

Table 2. Ideal Conditions for Composting.

Carbon:Nitrogen ratio	30:1
Moisture (% by weight)	40 - 60
Temperature (F)	90 - 140

Table 3. Some Organic Materials That Should Not Be Composted

Butter	Lard
Bones	Magazines
Cat manure	Mayonnaise
Cheese	Meat
Chicken	Milk
Dog manure	Peanut butter
Fish scraps	Salad dressing
	Vegetable oil

Table 4. Frequently-Composted Organic Materials[2]

Material	Comments
Cardboard	Do not mix more than 10 percent by weight with compost.
Coffee grounds	Coffee grounds are acidic.
Cornstalks, cobs	Chip or shred to speed decomposition.
Eggshells	Crush. Egg shells provide calcium.
Fruit wastes	Fruit wastes may attract animals and insect pests. Bury in compost.
Grass clippings	If the lawn has been treated with pesticides, return short clippings to the lawn (please refer to Extension PB1455, Lawn Care to Reduce Landscape Wastes).
Leaves	Oak leaves are acidic.
Manures (chicken, cow, goat, horse, pig and sheep)	Weed seeds can be a potential problem. Compost thoroughly.
Newspaper (shredded)	Do not use more than 10 percent by weight with compost. Avoid composting colored, glossy pages (some questions regarding inks used).
Peanut hulls	Can carry Southern Blight and nematodes.
Pine needles	Pine needles are acidic.
Sawdust	Use judiciously. Mix one pound of nitrogen per 100 pounds of sawdust. Black walnut sawdust is unacceptable.
Straw	Straw is an excellent bulking agent when mixed with low carbon materials.
Vegetable wastes	Vegetable wastes may attract animals and insect pests. Bury in compost.
Wood chips, bark	Add nitrogen to speed the decomposition of wood chips and bark. Please refer to sawdust comments. Black walnut is unacceptable.

[2]Adapted from: Lee, G. S., S. S. Hirrel and T. Riley. 1991. Composting, University of Arkansas, Cooperative Extension Service, Little Rock, AR. S205

Building the Compost Pile

The compost pile should be large enough to retain warmth and small enough so that fresh air can reach its center. As a rule of thumb, the pile should be a minimum of 3 ft. by 3 ft. by 3 ft. (width by height by length) and a maximum of 5 ft. by 5 ft. by any length.

Locate the compost pile on a well-drained site in direct sunlight near a water source. It should be sheltered from high winds and should not interfere with ordinary lawn care and gardening activities.

A compost pile may be created by placing individual organic materials in a pile as they become available or by mixing batches of materials previously collected (Tables 6 and 7).

Table 6. Recipe for Composting Yard, Garden and Food Wastes As They Become Available. (Slow Method)[3]

Time Required: ~ 12 to 18 months
Compost Structure: Bin or pen
Ingredients: Green and brown organic materials from the landscape, garden and kitchen.
Do not add meat or certain food scraps. These often attract animals and produce unwanted odors.
Directions:

1. Locate the compost pile on a gently sloping soil, in an area receiving full sun and rainfall.
2. Add organic materials as you collect them, chipping or shredding the larger pieces.

The organic material in the bottom of the compost pile near its center should be ready to use in 12 to 18 months.

[3]Adapted from: McLaurin, W. J. and G. L. Wade (1991) Composting, Feed Your Landscape... Not the Landfill, The University of Georgia, Cooperative Extension Service, Athens, GA MP426.

Table 7. Recipe for Composting Batches of Yard, Garden and Food Wastes. (Speedy Method)[4]

Time Required: ~ four to six weeks under ideal composting conditions. May require ~ three or more months.
Compost Structure: Bin or pen
Ingredients: Green and brown organic materials from the landscape, garden and kitchen.
Directions:

1. Locate the compost pile in an area receiving full sunlight and rainfall on a gently sloping soil.
2. (Optional). Drive several (three to six) poles into the soil base of the bin or pen. These will be removed after the organic materials are added, to provide aeration channels into the compost pile.
3. Shred or chip large organic materials into small pieces.
4. Layer the compost ingredients as follows:
   A. Six inches of browns from the landscape or garden (i.e. sawdust, wood chips, pine needles, leaves, ...).[5]
   B. Four inches of greens from the landscape, garden or kitchen (i.e. grass clippings, vegetable wastes, coffee grounds, ...).
   C. Increase the nitrogen level by adding 2 inches of chicken, cow, goat, horse, pig or sheep manure. Manure can be mixed with soil (i.e. 75 percent manure + 25 percent soil). If manure is unavailable add 1/2 to 1 inch of soil.
   D. Three to 6 inches of browns from the landscape or garden (i.e. sawdust, wood chips, pine needles, leaves, ...).[5]
   E. Repeat the layering process (steps B thru D) until the compost bin is full. The compost pile should be a minimum of 3 ft. by 3 ft. by 3 ft.
5. Remove the poles installed in step 2.
6. Turn the compost pile every two to five days, thoroughly mixing all the ingredients.
7. Water the compost pile as needed to maintain a 40 to 60 percent moisture level.

The composting process may be complete in as few as four to six weeks under optimum composting conditions. Under less-than-optimum composting conditions, compost may be finished in three to six months, depending on the level of management provided.

[4]Adapted from: Lee, G. S., S. S. Hirrel and T. Riley (1991) Composting, University of Arkansas, Cooperative Extension Service, Little Rock, AR, S305.

[5]If manure is not added in Step 4C, nitrogen can be mixed with sawdust or wood chips at a rate of one pound per 100 pounds sawdust or wood chips. For example, thoroughly mix three pounds of ammonium nitrate (34 percent nitrogen) with 100 pounds of wood chips to supply one pound of nitrogen per 100 pounds of wood chips.

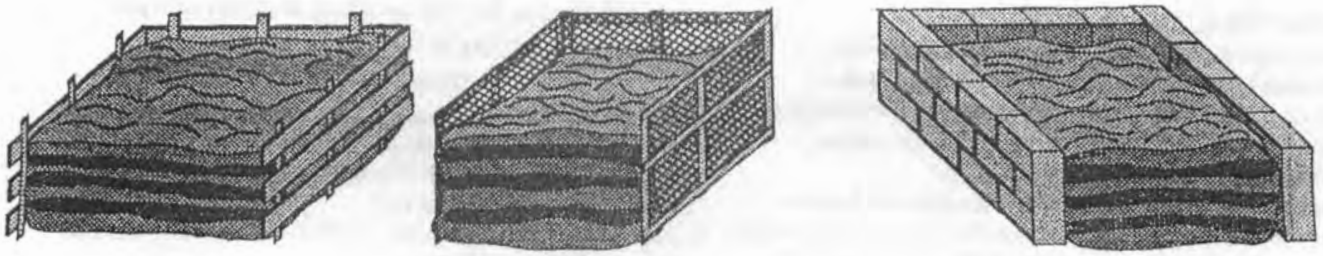

Figure 4. Compost bins constructed from wood, wood and wire fencing and concrete blocks.

Compost Structures

An enclosed compost pile with vertical sides exposed to atmospheric conditions will usually admit more air than a mounded pile. Compost holding units include bins, pens, barrels and tumblers (Figures 4, 5 and 6). They may be stationary or portable, and are constructed from a variety of materials. Considerations before building or purchasing a compost structure include:

- amount(s) and type(s) of organic matter to be composted;
- composting recipe;
- cost of the completed compost structure; and
- durability, aesthetics and space required.

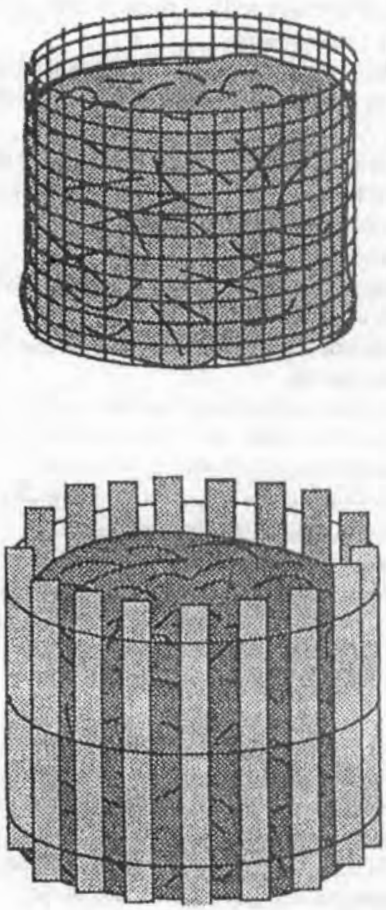

Figure 5. Compost pens constructed from wire fencing and snow fence.

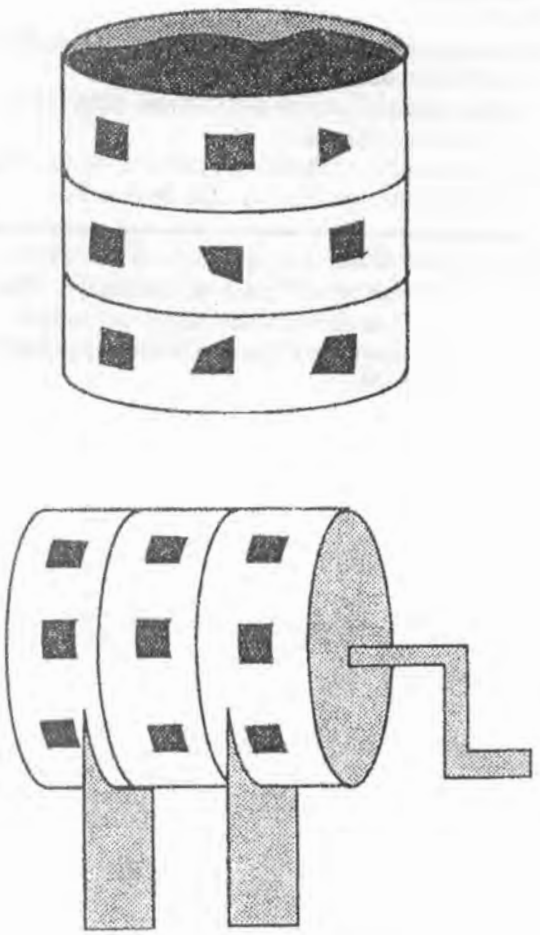

Figure 6. A composting barrel and tumbler.

Troubleshooting

If you want to control the speed of the composting process, keep a watchful eye on the compost pile. Possible solutions to some ordinary composting problems are presented in Table 8. Your time and effort will be rewarded with dark, crumbly, "mature" compost.

Table 8. Solving Composting Problems

Problem	Possible Cause(s)	Solution(s)
Ammonia odor	• Too much nitrogen	• Add high carbon materials (browns) such as sawdust, wood chips or straw.
High temperature (> 140 F)	• Pile may be too large	• Decrease the pile size.
	• Limited oxygen	• Turn the pile more frequently.
Low temperature (< 90 F)	• Pile may be too small	• Insulate the sides of the pile or increase the pile size.
	• Limited oxygen	• Turn the pile more frequently.
	• Low moisture level	• Add water while turning the pile.
	• Lack of nitrogen	• Mix in high nitrogen wastes.
	• Cold weather	• Insulate the pile (i.e. with an extra layer of straw) or increase the size of the pile.
Animals including rodents, raccoons and insect pests	• Food, fruit or vegetable wastes are attracting the pests	• Remove food, fruit, or vegetable wastes or bury them in the pile beneath a layer of soil or sawdust. Construct an animal-proof bin.
Pile dry in the center	• Low moisture level	• Sprinkle the organic wastes with water while turning the pile.
Pile warm and damp in the center; cool and dry near the outer edges	• Pile may be too small	• Increase pile size by collecting and mixing fresh material with the original compost.

*This publication printed on recycled paper.

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