UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1
BOSTON, MASSACHUSETTS 02203

INFORMATION PACKET ON LEAF COMPOSTING FOR INDIVIDUALS
by the Research Library for RCRA
(617) 573-9687

Autumn, 1993

The following compilation of documents on the subject of leaf composting has been assembled to assist residents in Massachusetts, Connecticut, and New Hampshire in complying with new laws banning the disposal by landfilling of leaves and other yard wastes. In some instances your request to a state agency has been referred to the Research Library for RCRA at the US EPA and this Information Packet is the result.

Materials on other subjects related to composting: how to set up a municipal composting program, information about the problems and successes experienced by large scale composting operations, and the marketing of compost products are included in another Information Packet that is available to municipalities on the request of municipal officials. However, if you have a specific question not covered in this Information Packet, call the Research Library for RCRA or your State solid waste agency.

DISCLAIMER:

Contents:

United States Environmental Protection Agency | Solid Waste and Emergency Response (OS-305) | EPA/530-SW-91-009 January 1991

Office of Solid Waste

EPA

Environmental Fact Sheet

YARD WASTE COMPOSTING

Across the nation, composting is gaining increased attention as an environmentally sound way to manage yard wastes. Yard wastes are such materials as leaves, grass clippings, brush, and tree prunings. Many communities and 12 states have banned yard wastes from landfills. Composting diverts yard wastes from landfills and combustors. The U.S. Environmental Protection Agency (EPA) recommends composting yard wastes. Not only is composting sensible from an environmental perspective, it also effectively converts yard wastes into a useful soil additive or mulch.,

'hat Are the Facts bout Yard Wastes?

Yard wastes account for nearly a fifth (over 31 million tons) of all garbage generated in the U. S. each year, making yard wastes the second largest component (by weight) of the municipal solid waste stream. The amount of yard waste generated varies considerably from region to region, during different seasons, and from one year to the next. In fact, during peak months (primarily summer and fall), yard wastes can represent as much as 25 to 50 percent of municipal solid waste.

Why Not Put Yard Wastes In Landfills?

Since these materials are relatively clean and biodegradable, disposal in landfills may be unnecessary and wastes space. In addition, as yard wastes decompose in landfills, they generate methane gas and acidic leachate. Methane is a colorless, explosive gas that is released as bacteria decompose organic materials in landfills. If methane is not controlled at a landfill, it can seep underground and into nearby buildings, where it has the potential to explode. Yard wastes also contribute acidity that can make other waste constituents more mobile and therefore more toxic.

Yard wastes also are generally unsuitable for combustion in incinerators due to their high moisture content, which can inhibit complete burning. When burned, yard wastes emit certain gases which contribute to the formation of smog-causing nitrogen oxides.

Why Not Burn Leaves And Other Yard Wastes?

Burning leaves and other yard wastes pollutes the air and can lead to uncontrolled fires. Leaf smoke can make breathing difficult for people who suffer from asthma, emphysema, chronic bronchitis, or allergies. A number of states currently ban leaf burning, and some communities either ban leaf burning or restrict when it can take place.

What Is Composting?

Composting is the controlled decomposition of organic matter by microorganisms (mainly bacteria and fungi) into a humus-like product. Many home gardeners have created compost piles in their backyards. Towns and cities have set up community-wide composting facilities that furnish the finished compost to a variety of users.

How Can Compost Be Used?

Compost can be used for a variety of gardening projects. It can enrich gardens, improve the soil around trees and shrubs, and be used as a soil additive for houseplants and planter boxes. Compost can enhance soil texture, increase the ability of the soil to absorb air and water, suppress weed growth, decrease erosion, and reduce the need to apply chemical fertilizers and peat moss. Following are some other successful uses of compost:

- Farmers use compost for enhancing crops and for sod farms.
- Landscapers use compost as a soil amendment and for decorative purposes at parks, golf courses, and athletic fields. Landscapers also use compost to cover landfills and carry out reclamation projects.
- Nurseries use compost for enhancing plant and forest seedling crops in reforestation projects.
- Public agencies use compost for landscaping high way median strips, parks, recreational areas, and other public property.

What Materials Can Be Composted?

Yard wastes such as leaves, grass, prunings, weeds, and remains of garden plants all make excellent compost. To speed the composting process, woody yard wastes should be clipped and sawed down, or run through a shredder. Vacuum cleaner lint, wool and cotton rags, sawdust, shredded newspaper, and fireplace ashes also can be composted. Although many foods can be composted, you should check with your local Board of Health to see if any sanitary code restrictions apply to food composting in your area. Do not compost meats, dairy foods, fats, oil, or grease.

How Can I Set Up A Compost Pile?

Composting is easy. You can set up a compost pile in a corner of your yard with few supplies. Choose a level spot about three-feet square near a water source and preferably out of direct sunlight. Clear the area of sod and grass. If you build a composting bin, be sure to leave enough space for air to reach the pile. Materials such as chicken wire, scrap wood, or cinder blocks can be used to build the bin. One removable side makes it easier to tend to the pile.

Place coarse brush at the bottom of the pile to allow air to circulate. Then add leaves, grass, weeds, etc. You may layer the yard wastes with soil, if you want. Keeping the pile moist and turning it every few weeks will help speed up the natural decomposition process. In dry weather, sprinkle water on the pile, but don't let it get too soggy. Don't be surprised by the heat of the pile or if you see worms, both of which are just part of the process. In most climates, the compost is done in three to six months, or when it becomes a dark crumbly material that is uniform in texture.

Can Christmas Trees Be Used?

Many communities have begun programs to reuse the more than 30 million trees discarded each year after the holiday season. The trees are picked up at

he curb or collected at dropoff centers through the second week of January. Then they are ground into small pieces by chippers, and used as mulch in landscaping. To prepare your tree for reuse, carefully remove the ornaments, especially strands of tinsel, and any plastic wrapping or other materials used to transport the tree. You can also chip the tree yourself and use the mulch in your own yard.

How Can I Learn More About Composting?

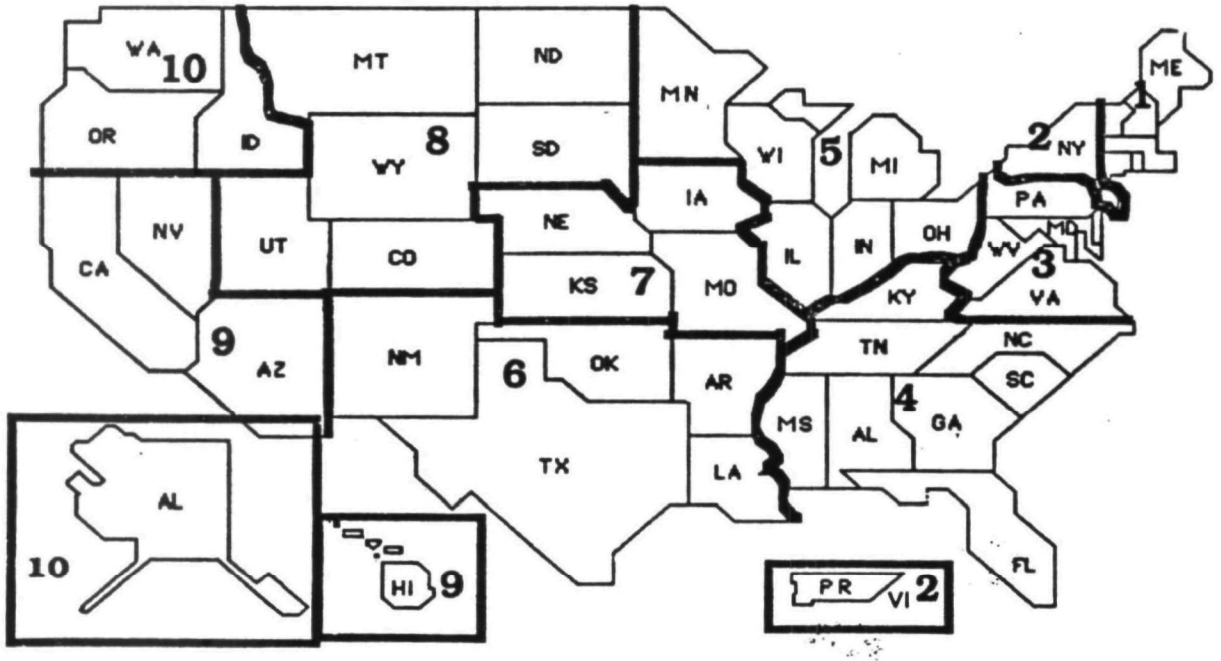
EPA has developed several publications related to composting. EPA recently issued a booklet entitled The *Environmental Consumer's Handbook* that describes how to set up a backyard compost pile. The *Handbook* also contains over 75 practical tips for reducing and recycling solid waste. Another publication, the *Decision-Maker's Guide to Solid Waste Management*, devotes an entire chapter to compost. This *Guide* is targeted at local government decision-makers, and contains solutions to many solid waste management problems. Both of these publications are available at no cost.

Contact the RCRA Hotline. Call Monday through Friday, 8:30 a.m. to 7:30 p.m. EST. The national toll-free number is (800) 424-9346. For the hearing impaired, the number is TDD (800) 553-7672. Copies of these publications can also be obtained by writing: RCRA Information Center (RIC), U.S. Environmental Protection Agency, Office of Solid Waste (OS-305), 401 M Street SW., Washington, DC 20460.

Another report for decision-makers, *Yard Waste Composting: A Study of Eight Programs*, is available for a fee from the National Technical Information Services (NTIS). Call (703) 487-4650 and ask for publication number PB90-163 114. EPA is also developing a *Guide to Composting* that will assist policy-makers in determining what type of composting they should promote in their community and in planning and operating compost facilities.

In addition, EPA has drafted a report entitled *Markets for Compost*, which provides information on markets and uses for compost. These two documents should be available in early 1991 from the Hotline.

EPA Regions



EPA Regional Offices

Region 1
U.S. EPA—Region 1
J.F.K. Federal Building
Boston, MA 02203
(617) 565-3715

Region 2
U.S. EPA—Region 2
26 Federal Plaza
New York, NY 10278
(212) 264-2657

Region 3
U.S. EPA—Region 3
841 Chestnut Street
Philadelphia, PA 19107
(215) 597-9800

Region 4
U.S. EPA—Region 4
345 Courtland Street, NE
Atlanta, GA 30365
(404) 347-4727

Region 5
U.S. EPA—Region 5
230 South Dearborn Street
Chicago, IL 60604
(312) 353-2000

Region 6
U.S. EPA—Region 6
First Interstate Bank Tower
1445 Ross Avenue
Dallas, TX 75270-2733
(214) 655-6444

Region 7
U.S. EPA—Region 7
726 Minnesota Avenue
Kansas City, KS 66101
(913) 551-7000

Region 8
U.S. EPA—Region 8
Denver Place (811WM-RI)
999 18th Street, Suite 500
Denver, CO 80202-2405
(303) 293-1603

Region 9
U.S. EPA—Region 9
1235 Mission Street
San Francisco, CA 94103
(415) 556-6322

Region 10
U.S. EPA—Region 10
1200 Sixth Avenue
Seattle, WA 98101
(206) 442-1200

OS-305

U.S. Environmental Protection Agency
(OS-305)
401 M Street SW
Washington, DC 20460

Official Business
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FOR MORE INFORMATION, CONTACT:

DEM/
OSCAR
(401) 277-3434 or
1 (800) CLEANRI

University of Rhode Island Cooperative Extension
1 (800) 448-1011

R.I. Solid Waste Management Corporation
(401) 831-4440

URTHER READING

he Complete Book of Composting, by the staff of rganic Gardening, Rodale Press, Emmaus, PA, 978.

et It Rot, The Home Gardeners' Guide to Com-sting by Stu Campbell, Garden Way Publishing, harlotte, VT, 1975.

ow to Grow More Vegetables, by John Jeavons, n Speed Press, Berkeley, 1979.

unset Guide to Organic Gardening, by the editors Sunset Books, Menlo Park, 1974.

rganic Gardening, published monthly by Rodale ess, Emmaus, PA.

ot me Rot My Garbage, by Mary Appelhof, wer Press, Kalamazoo, MI, 1982.

me Composting, Bulletin #88-13, by the nnecticut Cooperative Extension Service, 1988.

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WHAT ABOUT BINS ?

Bins are not necessary, but can help large piles stay neat. Use a single bin to hold the compost, or use two or three and turn the compost from one bin into the next as it ages. All bins should allow access for turning and should have holes in the sides so air can circulate into the pile. Bins can be made from:

- stakes and chicken wire
- a garbage can with holes in the sides, and no bottom
- cinder blocks (allow space between blocks)
- old pallets or scrap wood

Troubleshooting Common Problems

Symptom	Problem	Solution
Pile has a bad odor.	Not enough air or too wet.	Turn it.
Center of the pile is dry.	Not enough water.	Moisten while turning the pile.
Compost is warm & damp in middle, but nowhere else.	Too small.	Mix in more materials.
Compost froze in winter.	Too small.	Mix in more material in spring.
Pile sweet-smelling, but won't heat up.	Lack of nitrogen.	Mix in grass, urea, blood meal , etc.

OSCAR
Ocean State Cleanup and Recycling
Department of Environmental Management
83 Park Street
Providence, RI 02903-1037

How do I start

BACKYARD COMPOSTING?

WHAT IS COMPOSTING?

Composting is the biological breakdown of organic wastes like leaves, brush, grass clippings and even food scraps into a soil-like product called humus. Composting is a form of recycling, returning organic waste to the earth.

WHY SHOULD I COMPOST ?

Composting at home:

- preserves landfill space
- saves waste collection costs
- reduces disposal costs

Adding compost to your soil:

- improves soil structure
- helps retain moisture
- adds organic matter
- reduces the need for fertilizers
- helps regulate soil pH
- improves plant health

WHAT CAN I COMPOST?

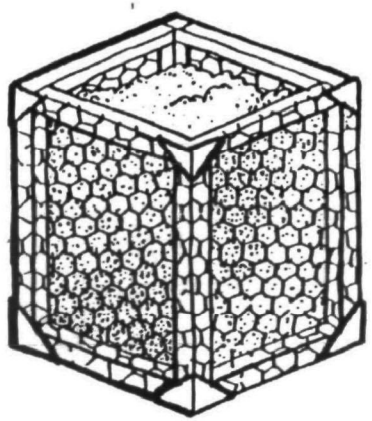
Any organic material will breakdown, but not everything belongs in your compost pile.

Do Use:

- leaves, grass clippings
- garden wastes, weeds
- hedge trimmings
- manures from plant eating animals
- kitchen vegetable and fruit scraps
- tea leaves, coffee grounds
- egg shells, hair, saw dust

Do NOT Use:

- diseased plants
- plants which are toxic to other plants (Ivy, English laurel, rhododendron)
- meats, fish or dairy products
- oily foods, fats or grease
- manures from meat-eating animals



HOW DO I COMPOST ?

Your compost pile will be a little"farm", teeming with "decomposers"-- bacteria, fungi and worms. You must provide them with food, water and air as they work to break down your wastes into compost.

1. Choose a level spot in your yard that is near a water source and that receives about equal amounts of sunlight and shade during the day.

2. Your wastes are the decomposers' food. Place the materials in 2-6 inches thick layers. Try to alternate "greens" (food scraps, grass clippings, manure) and "browns" (leaves, straw, woody material) to help balance the proportion of carbon and nitrogen. The ideal pile size is 4 to 5 feet wide and high. An occasional sprinkle of fertilizer, blood meal or urea will speed the break down by adding nitrogen, but it is not necessary. Cutting or shredding the ingredients helps speed the composting.

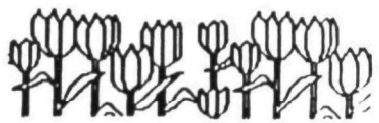
3. Now add water. The pile should be kept moist but not soggy -- like a wrung-out sponge. Slowly dripping water onto the pile is the most effective watering method.

4. Keep air in the pile by turning and "fluffing" the pile periodically --once a week if possible, or whenever you can. Frequent turning speeds the composting.

5. As you have more materials, mix them in or start a new pile.

THE RESULTS

As the materials break down, heat is generated. You may see steam rising from the pile, especially when it is turned. If your compost pile is properly prepared, contains no animal fats and is turned periodically, it will not attract pests or create odors. Decomposition will be complete when the compost is a rich dark brown color and has broken down into small particles. Compost is ready to use after it has cooled. You may screen the compost and return unfinished material to the pile.



HOW CAN I USE THE COMPOST?

- mix several inches of it into soil before planting
- top dress lawns with a one-quarter inch thick layer of compost
- work into top layers of soil around established plants and shrubs
- use up to 25% compost in potting soil

COMMUNITY COMPOSTING

Community composting is beneficial because:

- Leaves take up too much space in landfills—many communities now ban leaves from landfills.
- Many householders do not have the time or space to compost large quantities of organic waste, such as fallen leaves.
- Composting is environmentally safer—leaves in landfills generate dangerous gases; burning leaves creates smoke pollution and is unlawful in many communities.
- Some communities will accept leaves and other yard wastes for community compost heaps. Finished compost is usually available free to residents. Find out what's happening in your area. If no program exists, urge your community leaders to put one in place.

New York State Recycles Printed on Recycled Paper

WHY SHOULD I MAKE COMPOST?

Composting benefits you and your community.

For you...

- Composting is an easy, practical way to recycle your organic yard and kitchen wastes.
- Compost is an excellent soil conditioner for even the smallest yard and garden—it's safe to use and it costs practically nothing to make.
- Compost grows healthy plants and healthy plants improve the air by removing carbon dioxide and making fresh oxygen.
- For serious gardeners, compost is an inexpensive alternative to peat and other soil improvers.

For your community...

- Composting could remove more than 15 percent from the solid waste stream, if everyone participated.
- Many communities now ban leaves from landfills forcing residents to find other alternatives. Some communities have started composting programs.
- Composting eliminates air pollution caused by burning leaves and other yard wastes.
- Composting recycles nutrients by returning them to the soil.

NYSDEC
Division of Solid Waste Bureau of
Waste Reduction and Recycling
50 Wolf Road
Albany, NY 12233-4015
(518)457-7337

TROUBLESHOOTING YOUR COMPOST PILE

SYMPTOM	PROBLEM	SOLUTION
The compost has a bad odor.	Not enough air.	Turn the mixture.
The center of the pile is dry.	No enough water.	Moisten materials while turning the pile.
The compost is damp and warm in the middle, but nowhere else.	Too small.	Collect more material and mix the old ingredients into a new, larger pile.
The pile is damp and sweet-smelling but still will not heat up.	Lack of nitrogen.	Mix in a nitrogen source like fresh grass clippings, fresh manure or bloodmeal.
Steam is rising from the compost pile.	Too hot—pile is too dry.	Add water.

Department of Environmental Conservation

Easy Backyard Composting

New York State
Department of Environmental Conservation
MARIO M. [illegible]ernor
THOMAS C. JC[illegible]missioner

WHAT IS COMPOST?

Compost is a dark, crumbly, earthy-smelling mixture that consists mostly of decayed organic matter. Composting is a simple, natural process, Nature's way of recycling nutrients and returning them to the soil so that they can be used again. *By taking advantage of this natural recycling process, you can help lighten the load of waste that would otherwise go to a landfill.*

Compost is used for fertilizing and conditioning soil. It can be made from materials that most households throw out.

WHAT CAN I COMPOST?

- Yard wastes, such as fallen leaves, grass clippings, weeds and the remains of garden plants.
- Kitchen scraps EXCEPT FOR meat, fish, bones and fatty foods (such as cheese, salad dressing and leftover cooking oil).
- Woody yard wastes, chipped or shredded, can be used as a mulch or for paths where they will eventually decompose and become compost.

HOW DO I MAKE A COMPOST PILE?

It's easy! Follow these simple steps and in just a few hours, you'll be in business.

To build a simple compost bin, you'll need:

- Small-mesh wire fencing or snow fencing
- Seven or more rough boards or stakes, depending on the shape of bin you choose—see the illustration for suggestions

Build a square, rectangular or circular structure—your choice. For a typical home garden, a bin 3-to-4 feet in height and 5-to-8 feet square will do. Locate it away from buildings and combustible materials.

To start your compost pile:

(1) Spread a layer of plant wastes 6-to-8 inches deep in the bottom of your bin. Moisten the layer thoroughly.

(2) Make a second layer of high nitrogen fertilizer, such as 10-10-10. This will be a very thin layer—use ONLY about ½ pound or 1 cup to each 30-to-35 square feet. Moisten thoroughly.

(3) Make a third layer with a few shovelsful of garden soil, about 1-to-2 inches deep. This will ensure that plenty of decay organisms are present in your compost pile. Again, moisten thoroughly.

That's all there is to it!

Repeat steps 1, 2 and 3 until you have used up your waste material. To start, your pile should have at least 4 or 5 layers of waste.

Kitchen scraps (minus meat, fish, bones and fatty foods) should be added to the center of the waste layers where heat will be the greatest.

Pile waste material loosely in the bin. Too much compaction inhibits the flow of air through the pile.

It helps to make the top layer slant toward the center where it will catch rainfall. *Water is the key to successful composting.* A compost pile should be kept damp—but not soggy—especially during dry spells.

Be patient! It will take six months to a year before the compost is ready for use.

COMPOSTING DO'S AND DON'TS

DO add lime, small amounts of wood ashes or crushed eggshells to the compost pile to neutralize acids which may form and cause an odor problem.

DO mix grass clippings with other wastes to loosen them up. They have a tendency to compact.

DO keep compost pile damp, especially during dry spells.

DON'T use unfinished compost. It will rob your plants of nitrogen instead of acting as a fertilizer.

DON'T compost weeds that are heavily laden with seeds. Some seeds will not be killed during the heating process.

DON'T add meat, fish, bones or fatty food scraps to the compost mixture. They will attract animals (dogs, cats, rats, etc.) and they do not decompose readily.

DON'T add diseased vegetable plants to the pile if the compost will be used on a vegetable garden.

FOR MORE INFORMATION

If you want to know more about composting and about other, more elaborate, ways to make good compost, consult books or gardening magazines at your local library—or call your county Cooperative Extension office, listed in the telephone directory.

Cornell Cooperative Extension

Suffolk County

Education Center
246 Griffing Avenue
Riverhead NY 11901-3088
516 727 7850
FAX 516-727 7130

Compost for the Home Garden

L. H. MacDaniels, Professor Emeritus
and R. E. Kozlowski
Dept. of Floriculture and
Ornamental Horticulture
Cornell University

Value of Compost

Compost is a valuable soil amendment for use within garden and landscape plantings Its presence proves soil tilth by binding soil particles together, reases the soil's water-holding capacity, and releases nitrogen and other nutrients for plant use Carbon dioxide from decaying materials combines with water to make a weak acid that promotes more rapid movement of mineral nutrients into solution so that they can be available to plants In this discussion no distinction is made between humus, a relatively stable organic constituent of soils that can be modified only slowly, and crop residues in various stages of decomposition; they, together with humus, form the organic soil ingredients that give the beneficial effects

What Materials to Collect

Practically any plant material can be composted for garden use. Leaves are ideal, but old sod, manure. lawn clippings, find wood chips, straw, old hay, and plant refuse from the vegetable garden or the kitchen can be used. Mature cornstocks and woody prunings should be mechanically shredded and may take more than one year to form compost. Newspapers can be composted provided they are finely shredded and mixed with other material along with a supply of nitrogen.

Diseased plants from the flower or vegetable garden should not be used for composting if the compost is to be returned to the garden later. Although some diseases are killed by heating during compost formation, unless the compost is turned frequently and thoroughly and allowed to remain unused for several years, some of these disease organisms may be returned to the garden with the compost. If diseases have not been a problem, this precaution may not be necessary

Avoid composting weeds heavily laden with seeds. Even though some weeds are killed during composting, many may be returned to the garden with the compost, an unnecessary weed problem being created

Although most garbage can also be used in the compost heap, grease, fat, bones, fish, and meat scraps should be avoided. These attract dogs or other animals and may develop an odor during decomposition. Fats are slow to break down and greatly increase the length of time required before the compost can be used. Pet wastes and kitty litter should not be used.

Building a Compost Pile

Basically, composting is a disintegration process. The structure of miscellaneous organic roughage is broken down by the action of bacteria, fungi, and a host of other soil-infesting organisms to a more or less uniformly fine textured material valuable as a soil amendment and fertilizer. In the process much of the energy in the roughage is lost in the form of heat. The volume is greatly reduced, and some nutrients are lost by leaching or by escaping as ammonia gas. See table 1 for the changes that occur in the nutrient content of composted material of different ages.

To provide conditions for bacteria and fungi to work, the composting material should be kept moist, have access to oxygen, and be supplied with fertilizer high in nitrogen. The fertilizer furnishes the nutrients the soil organisms require for rapid growth If the material used is largely leaves, straw, or other substances low in nitrogen, additional nitrogen will be

authors acknowledge the assistance of Robert Beytuss. Cooperative Extension, Greene County, in gathering information for this fact sheet.

Table 1. Nutrient content of compost piles of different ages

Age of compost	Nitrates	Phosphorus	Potassium	pH	Soluble salts
3 years	20	15	40	7.1	39
2 years	38	18	50	6.9	53
1 year	137	20	250	7.6	130

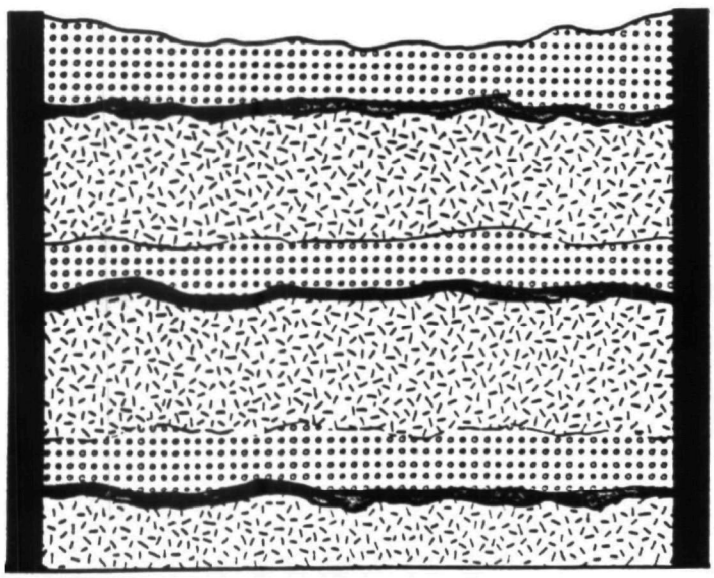
Note: Content determined by Spurway test, parts per million in extract solution.

needed to prevent excessive loss of bulk; bulk is in part determined by the nitrogen level present.

What goes on in the compost pile is a very complicated chemical and biological process, and various systems have been devised to shorten the time to produce compost and increase its value. These are mostly related to increasing the oxygen supply and supplying nitrogen. For practical purposes, building a compost pile is not an exact process. The usual practice is to accumulate the organic material in some out-of-the-way corner of the garden or other inconspicuous place. Fall is a convenient time to make a compost pile because leaves and refuse from the garden cleanup are available. The pile can be built on open ground or in a bin made of rough boards or stakes and small-mesh wire fencing. The sides of the bin should not be tight, because oxygen is essential for decay. To start a pile, part of the plant refuse is spread out in a layer 6 to 8 inches deep. The pile should be large enough for at least four or five layers to be made from the material available. A high nitrogen fertilizer of some readily available formula (10-10-10, for example) should be spread on each layer at the rate of about 1/2 pound or 1 cupful to each 30-35 square feet. If an organic source of nitrogen is desired, commercially available fertilizers such as dried blood (13% nitrogen), cottonseed meal (6% nitrogen), alfalfa hay (2.5% nitrogen), or poultry manure (1% nitrogen) can be used. If alkaline compost is desired, ground limestone can be spread on the pile at the same rate, although this is usually not necessary. Sprinkling a few shovelfuls of garden soil over each layer will ensure the presence of decay organisms.

The material in each layer should be moistened thoroughly. Successive layers are built in this way until all the plant refuse is used. Building the pile with a flat top that slants toward the center to catch rainfall is advantageous. Rapid decay does not usually occur until the following spring and summer. Undesirable heating may occur in a large pile not well moistened. This is indicated by the pile's giving off steam. Applying water stops the heating process. Decay can be hastened by forking over the pile in midsummer and supplying water to parts that have remained dry. The compost will be ready for use at the end of the first summer season. It is an advantage to get it onto the land before it loses all its structure. If uniformly fine textured material is wanted, a longer

Cross section of layering in compost pile

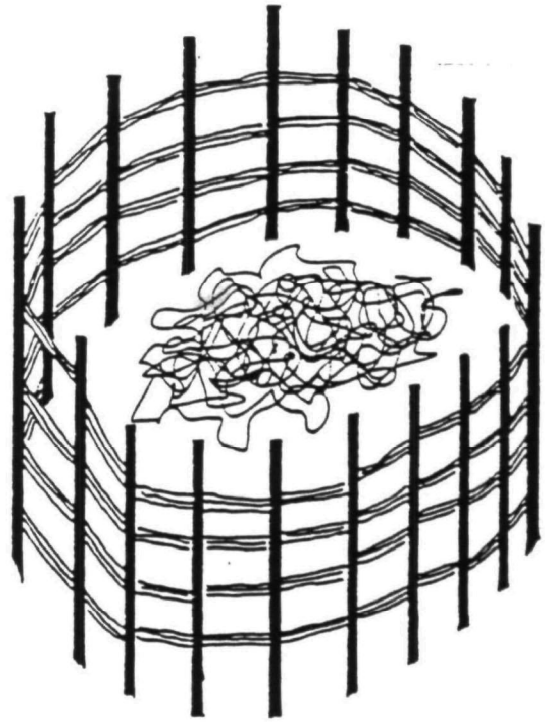


.me may be necessary. Compost should not be allowed o accumulate in the same place year after year.

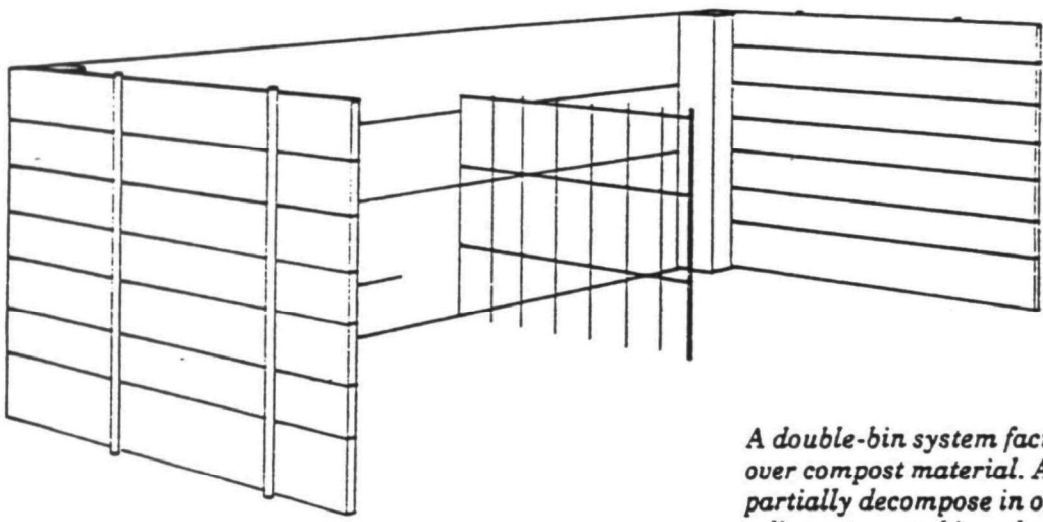
Whether or not pests and diseases persist in the compost depends on the organisms present and the heat generated in the decay process. As a practical matter compost is spread on the garden without disinfestation. Soil sterilization is not feasible for the amateur under present legal restrictions on the use of effective materials. For sowing seeds indoors, a practical solution to the disease problem is to buy sterilized potting soil or sterile materials such as the peat, perlite, and vermiculite mixes from the florist or garden store. (See *Flowers from Seed*, Cornell Information Bulletin 20.)

Organic matter can be used as a mulch without composting, although uncomposted material is harder to handle and may be unsightly. Lawn clippings, leaves, and other fine material can be placed directly around shrubbery or on garden plots where appearance is not important. A discussion of the materials and method of mulching is found in *Growing Vegetables Organically* (Cornell Information Bulletin 39). Organic gardening emphasizes the need for organic matter in soils and encourages soil conservation and the recycling of organic waste.

Various aspects of composting are discussed in *The Biochemistry and Methodology of Composting* (Conn. gr. Exp. Sta. Bul. 727), *Ecology and Compost* (N.Y.S. ollege of Forestry, Syracuse), and *Natural Gardening andbook* (Brooklyn Botanic Garden Rec. 31 (1)).



Heavy mesh wire or snow fencing can be used to construct a freestanding cylinder-shaped compost bin. When it's time for the compost to be turned, the fencing can easily be rolled away from the pile and set up in a nearby location. The freed pile of partially decomposed material can then be placed back into the empty bin.



A double-bin system facilitates the procedure of forking over compost material. After the compost is allowed to partially decompose in one bin, it can be moved to the adjacent empty bin, a lower center wall in the bin making the transfer of compost easier. Bins can be constructed of material such as scrap lumber, snow fence, railroad ties, or cinder block. Bins constructed of pressure-treated lumber are relatively expensive, but will last for many years. The exact dimensions of the bin are not critical. For a typical home garden a bin 3-4 feet in height and 5-8 feet square will suffice.

Compost *A report on how to get your pile of kitchen and yard wastes out of the sick bed, and back to producing rich, loamy compost.*

BY ROBERT KOURIK

ILLUSTRATION BY ALAN E. COBER

BECAUSE I'M SOMETIMES RECOGNIZED AS "THAT GARBAGE guy," more than a few folks have asked me to take a look at their backyard compost piles. They think their ailing piles are in need of a little Rx. Seems plenty of folks are composting kitchen and yard waste, but they don't get that brown, rich stuff seen spilling out of bins pictured in glossy magazine ads. Don't blame the pile. Often, a novice expects too much from a random batch of organic discards. Any heap of dead plants will rot ... eventually. But only a rapidly composting pile, also called hot or active composting, will *quickly* reduce organic waste and possibly conserve a few nutrients.

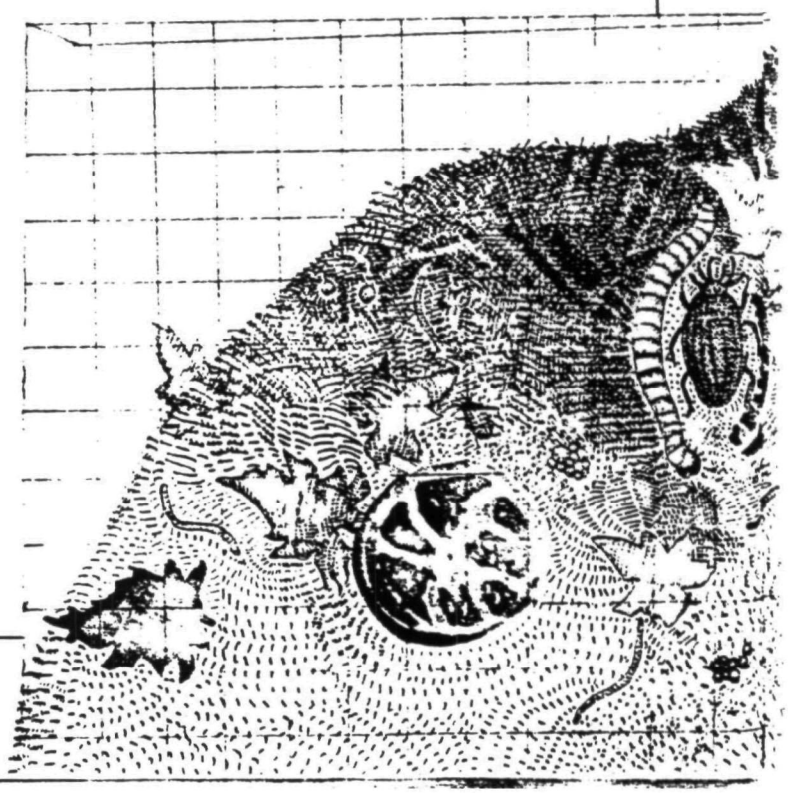
A healthy compost pile produces a valuable amendment that improves the soil's capacity to drain, hold moisture, retain certain nutrients, and remain loose and friable. Composting is a dynamic process — sometimes slow, sometimes fast. Though we may have great expectations, even "fast" composting won't occur overnight.

With active or fast composting, the gardener carefully builds a pile of kitchen and yard waste and regularly turns it, producing a hot interior temperature and a finished material that's a good soil amendment (and a very weak fertilizer). Active compost piles can *sustain* temperatures of 140 degrees F. or more — thus the designation "hot composting." Depending on the type of ingredients you put into the pile and the number of times you turn it, the fast track generally takes two to six weeks to transform yard and kitchen waste into compost.

Slow piles are also known as "passive" composting (because the gardener doesn't have to do much) or "cool" composting. The reason? When the pile is first thrown together, its internal temperature can hit 160 to 180 degrees F. — stoked by heat-generating bacteria feasting on organic matter. As the bacteria are killed by high temperatures, the pile quickly cools. But composting continues (at a slower pace) thanks to bacteria, microbes, and fungi which take over when the pile's internal temperature approximates cooler outside air temperatures.

To be a good compost doctor, you'll need to understand how a pile transforms bulky garden wastes into a material resembling the dark, loamy layer of a forest's floor (look under the leaf layer). Composting is not the same as rotting, decomposing, decaying, or moldering. But it does embrace a bit of all of these processes. Here are a few crucial definitions and their relationship to active and passive (hot and cold) composting:

■ **Decay** - Usually, this refers to a cool process, where internal temperatures roughly equal outside air temperatures. When a pile decays, it loses some nutrients (nitrogen). This slow pro-



cess allows nitrogen to be vented as gassy ammonia (volatilized) or washed away (leached) by rain (especially when the pile is uncovered). The end product may have fewer nutrients than compost from a hot pile, and proportionately more minerals.

■ **Decompose** - All forms of composting decompose the Irish stew of raw garden wastes into basic nutrients such as nitrogen, phosphorus, and potash. Humus, an important end product, is in some ways a more complex substance than the ingredients that go into the bin. Humus is *produced* by the microbial digestion of organic matter. It's *composed* of starch-like molecules that possess a tremendous capacity for retaining moisture and slowly releasing nutrients to a plant's root hairs. A soil's humus content is, in great part, a measure of its fertility, friability, and drought resistance. Passive composting eventually produces some humus. Active composting quickly produces more.

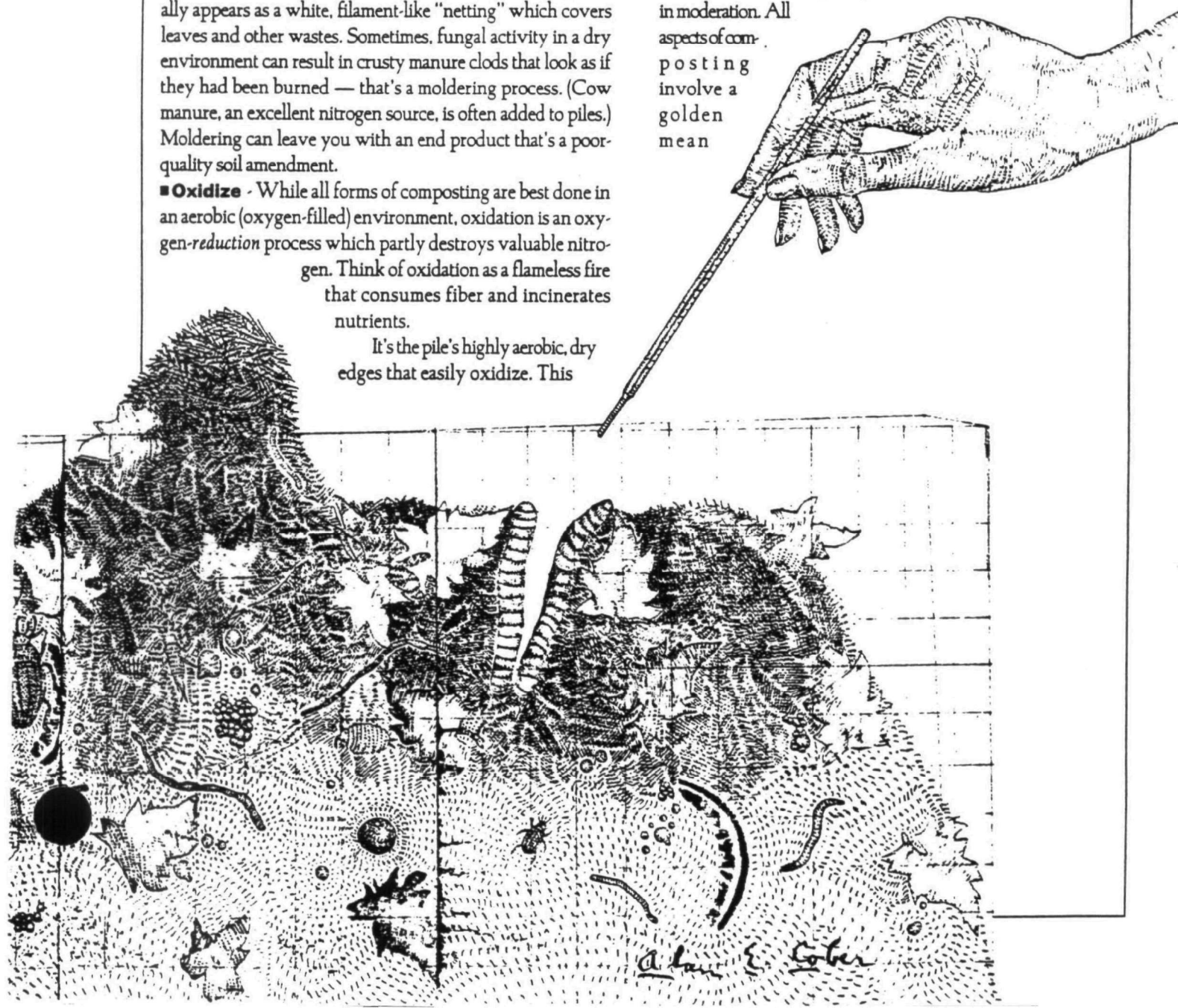
■ **Molder** - While bacteria often get the credit for devouring a pile's organic ingredients, fungi also play an important role in decomposition, particularly of manure. Caution: Fungi consume nitrogen, a key element of fertility. Fungal activity usually appears as a white, filament-like "netting" which covers leaves and other wastes. Sometimes, fungal activity in a dry environment can result in crusty manure clods that look as if they had been burned — that's a moldering process. (Cow manure, an excellent nitrogen source, is often added to piles.) Moldering can leave you with an end product that's a poor-quality soil amendment.

■ **Oxidize** - While all forms of composting are best done in an aerobic (oxygen-filled) environment, oxidation is an oxygen-*reduction* process which partly destroys valuable nitrogen. Think of oxidation as a flameless fire that consumes fiber and incinerates nutrients.

It's the pile's highly aerobic, dry edges that easily oxidize. This reduces the amount of organic matter and humus and volatilizes the ammonia (nitrogen), leaving you with more minerals (mostly ash). While minerals are important soil nutrients, they're the third thing you should try to conserve — after nitrogen and organic matter. (Contrary to popular opinion, "anaerobic" or oxygenless digestion conserves the greatest amount of nitrogen and is a slow, heat-consuming process. Unfortunately, the resulting stench can be overwhelming.)

■ **Rot** - The key difference between composting and rotting is time. Just about everything rots. If you have plenty of space to store bulky garden wastes, then a cool, passive pile (or set of piles) may be your most practical form of composting. Even though a rotting pile will produce a finished material with fewer nutrients, it involves much less work.

An active compost pile is a three-legged chair, dependent on the proper nitrogen content, moisture, and oxygen. If any one of these ingredients is missing, the chair topples. Two other important composting axioms: Always use a variety of raw materials, and use everything in moderation. All aspects of composting involve a golden mean



— too little of, say, carbon-heavy leaves and woody debris will bring about failure, while too much of the same will also lead to ruin. There is no magic formula. Composting is a craft, best perfected by casual practice.

Nitrogen and Carbon

GARDEN WASTES FALL INTO TWO MAIN CATEGORIES: FRESH GREEN stuff and manure, with generous amounts of nitrogen; and woody things with a high carbon but low nitrogen content. A hot, active pile needs a certain amount of nitrogen to reach a high temperature. The heat comes from jillions of bacteria, microbes, and soil fauna furiously munching on organic matter. The protein for their microscopic bodies comes from nitrogen. Without fresh leafy greens, manure, kitchen scraps, or some other nitrogen source, the micro-critter population can't increase enough to quickly digest the tough, chewy carbon found in woody material.

There are lots of confounding formulas for a good compost mix — such as the infamous advice of a carbon-to-nitrogen ratio of 30:1. Don't worry about these fancy "rules." In the real world, you just mix up a pile with lots of what's available ... and watch. The pile will moderate itself. If there's too much nitrogen, the pile will exhale the surplus nitrogen as a gas (it smells like ammonia). If there's too little nitrogen, the pile will heat just a little and will take longer to fully decompose. So you change the mixing formula for the next batch of ingredients. With time, you'll figure how much of each ingredient to include.

Moisture

IF THE MICROBES ARE GOING TO CHEW ON YOUR WASTES, THEY'LL need plenty of water. This doesn't mean the perfect pile is soggy. With a properly moist pile, you can't wring water out of the organic matter.

In areas like the East Coast and Pacific Northwest, rain may provide all the moisture your compost pile needs. Often, high-carbon materials like straw, chipped limbs, and fallen leaves are pretty dry. If rains haven't already moistened these materials, you'll need to add some water while you're building the pile. Use an automatic shut-off hose sprayer or a fine mister. Once the pile is built, cover it with a tarp to trap moisture.

If you get the pile too wet, the soggy, anaerobic mess will emit a slightly sulfurous odor. If the pile is too dry, the material will be slow to rot and you may get a proliferation of a white, filamentous mass due to fungi. In arid regions with little humidity, insufficient moisture is the most frequent missing "leg" of a stable compost "chair."

Oxygen

THE CRITTERS THAT INHABIT A HOT PILE ARE ENERGETIC, AEROBIC little beasts. And they need plenty of oxygen to do their aerobics.

A healthy compost pile requires generous amounts of kitchen scraps and other green materials.

There are bacteria and microbes that work in airless (anaerobic) environments, but they tend to be slower, smellier, and messier. An anaerobic pile often has a noticeably foul odor and is visibly mucky in the pile's middle. To miss out on this mess, build your pile with a wide variety of ingredients. A pile of nothing but grass clippings will certainly be reduced to muck as it settles. A few wood chips, some straw, a few vegetable clippings, and a bit of leaves all mixed together is more likely to remain aerobic. If not, turning the pile will probably correct the problem.

Remember, too much oxygen can be just as bad as not enough. If the woody material seems fluffy and desiccated, or the carbonaceous material hasn't browned, the pile's sides and top should be covered to cut incoming air.

If you're considering buying an insulated bin for cold weather composting, keep this in mind: Composting is due to an *internal* process. A hot pile's high temperatures come from the heat generated by hard-working, heat-loving (thermophilic) bacteria and microbes. Even with a so-called insulated bin, a compost pile will lose heat to cold winter temperatures. With the help of cold-tolerant (cryophilic) bacteria and fungi, cold piles do decay. They just take their time.

You were born with all the diagnostic tools you need to analyze an ailing compost pile — your eyes to gauge the ingredients' quality, your nose to smell odors, and your hands to sample the relative temperature inside the pile. (A compost thermometer, which looks like a poultry thermometer with a long stem, can help track the heating and cooling process.) A compost pile can turn sour on even the most practiced gardener. The question is, "Will I swallow my pride, admit defeat, and rebuild the unproductive pile?"

Reconstructing a pile that's gone bad allows you to diagnose the problem, consider possible remedies, administer the cure, and see how the patient responds. So in the words of W. C. Fields, "Grab the bull by the tail and face the situation!" The effort will accelerate your learning curve, and you'll be better versed in the craft of composting.

The following chart was compiled by consulting a number of composting experts throughout the country. A sick pile's symptoms are followed by a number of possible causes, each with a corresponding corrective measure.

ROBERT KOURIK

CHARTING A HEALTHY COMPOST PILE

SYMPTOM	POSSIBLE CAUSES	PRESCRIPTION
Rotten or sulfurous odor.	• Too many food scraps; or "lumping" food wastes. • Too wet. • Too many grass clippings in a mass. • Material shredded into particles which are too small. • Anaerobic conditions.	• Eliminate food scraps (put them in a worm bin). Or, mix food wastes evenly throughout the pile. Add coarser material to keep moist food scraps more aerobic. • Turn pile while adding some dry, high-carbon material such as leaves or chipped wood. Will eventually correct itself as the pile drives off excess nitrogen. Cover bin during rainy spells. • Mix grass clippings with coarser and drier, high-carbon material. • Turn pile while adding material of different sizes and coarseness. Layer pile with plenty of loose, bulky material. • Tear pile apart, diagnose problems, and rebuild a loose pile with many types of materials. Sometimes, an anaerobic condition is due to a pile which is too big — the weight of the upper portion compresses the lower layers. Make piles smaller.
Ammonia smell, mostly when turning pile.	• Too many grass clippings in one mass, or layered too thickly. • Too much manure; too many kitchen scraps. • Anaerobic.	• All symptoms of too much nitrogen. If the pile is left alone it sometimes self-corrects by volatilizing nitrogen. Leave alone. Or, turn the pile while tearing apart any matted lumps of high-nitrogen material (adding coarser, high-carbon compostables) and rebuild into loose, aerobic layers. • Often due to one of the following: material is the same size; material is overly shredded (bits are too small); pile is too large; pile is overly moist. Either leave alone until the smell ceases; or rebuild using the guidelines mentioned for 2A/2B.
Pile has low temperature.	• Pile has finished composting. Not a problem, time to use the material. • Pile too small. • Too much high-carbon material. • Too dry or too wet. • Material too coarse or too fine. • Not enough nitrogen.	• Congratulations, you're now a certified Captain of Compost. • The classic formula for hot compost recommends a pile built with at least 27 cubic feet (3' X 3' X 3' — a cubic yard) of material. Save up raw materials until you have enough to build a pile of one cubic yard. • Rebuild pile, adding nitrogen — manure, grass clippings, kitchen scraps, or fresh garden wastes. • If too moist, you'll smell something awful. Rebuild and add dry, carbonaceous material. Cover when raining. A dry pile has no odor — rebuild pile while misting the raw material. In arid regions, a cover may help contain moisture. • Overly coarse material can make a dry pile; overly fine can make an anaerobic pile. Use many different-sized materials. Rebuild pile with a heterogeneous mix.

A compost thermometer helps track a pile's heating and cooling process.

Turning the pile helps circulate oxygen.

SYMPTOM	POSSIBLE CAUSES	PRESCRIPTION
Pile too hot.	• Temperatures above 160 degrees F. can kill beneficial microbes. Temperatures above 180 degrees F. will sterilize the pile's core. • Pile too big. • Too much nitrogen.	• The hot pile will kill off a lot of the bacteria and the temperature will drop, then a few remaining microbes will re-inoculate the pile. Turning the pile will help cool it. • Shred the large pile into smaller piles of one cubic yard or less. • Turn pile while incorporating more carbonaceous material.
Pile bursts into flames.	• Pile way too big. • Enormous pile is too dry.	• The pile must be very large. It rarely bursts into flames, but can smolder. • Don't build big piles. While lots of nitrogen is needed to generate heat, the pile's upper layers must be very dry to combust.
White moldy/fungal growth.	• Not really an illness; most likely the filament of beneficial fungi as they help digest compostables. While there are fungi which thrive at all temperature levels, fungal growth is usually noticed when the pile is in a mesophyllic condition (cooler than hot compost, but not a cold process). • Too wet or too dry.	• If you want a thermophilic pile, adjust the carbon-to-nitrogen ratio, check the moisture level, and turn the pile. • A dry condition often favors fungi. Either slowly adjust moisture by rebuilding the pile while either adding moist or dry material (depending on the condition).
Nothing rots.	• Not enough moisture. • Material too woody or not enough nitrogen. • Not enough available carbon. • Pile too small.	• Rebuild the pile while misting material. • Shred any woody material which is too chunky, or mix in more nitrogen-filled material (such as fresh lawn clippings). • Shredding "waxy," hard leaves helps aerobic microbes. • Save up raw materials until you can build a pile measuring 22 to 27 cubic feet.
Flies and insects in and around pile.	• Too much food waste.	• Reserve the kitchen scraps for your worm bin, or add them only to the pile's middle. If this doesn't solve the problem, stop mixing vegetable wastes with fruits and edible parts.
Mice and rats in pile.	• Food wastes.	• First try adding the kitchen scraps to the middle of a hot pile. If that doesn't work, try eliminating all meat, dairy and fish scraps and all salad and cooking oils. Or, eliminate all kitchen wastes and use them in a worm bin. Some bins are sold with tight fitting, plastic bottoms and lids to help exclude rodents.

Old wooden pallets are a good material for building bins.

Sources: Hanna Hasan, Master Composter Program, Seattle; Dr. Robert Rodale, University of California at Berkeley; Gary Briner and Joy Stinson, Alachua County Cooperative Extension Service, Gainesville, Fla.; Paul Conrad, The Gardener's Supply Catalog, Burlington, Vt.; Chip Tynan, the Missouri Botanical Garden, St. Louis.

25TH STORY of Level 1 printed in FULL format.

St. Louis Post-Dispatch

May 20, 1993, THURSDAY, FIVE STAR Edition

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HEADLINE: EXPERT ADVICE SOUGHT ON ELIMINATING ODOR FROM ROTTING LEAVES

BYLINE: Neal Learner Post-Dispatch Special Correspondent

BODY:

The foul smell coming from Ladue's leaf mulching facility continues to create foul tempers among nearby residents.

Ladue's Superintendent of Public Works, Dennis Bible, presented the Ladue City Council with several proposals to stop the vile smell caused by decaying vegetation at the leaf composting site, 9810 South Outer 40 Road. But Bible recommended seeking advice from several experts before going ahead with plans that would cost the city nearly $ 200,000.

A number of residents from the adjacent neighborhoods of Twin Springs and Tall Timbers expressed anger at a situation they felt had already gone on too long. They demanded the board take immediate action or close down the facility.

Resident Alicia Tierney said, "It's unbearable. We're regularly prevented from using our yards and opening our windows. We don't want to sacrifice another summer." Others complained of headaches caused by the smell.

Council Member Joyce Merrill, 3rd Ward, said of her visit to the neighborhood last Thursday, "I had trouble breathing. I thought I was going to be sick to my stomach."

Bible said the smell comes from the huge stockpile of leaves at the site. "When you dig into it, it really hits you. It's doubly bad because we've had so much rain." He noted that the leaves were being sprayed with chemicals to knock out the smell, but that the rain would "drive out the stuff we treated."

The runoff from the persistent rain has created a standing swill of decomposing, rotten vegetation.

Mayor Edith Spink said, "The only way to get rid of the problem is to get rid of the swill."

This is one of Bible's proposals. He explained that the stockpile lies on a grade of only 2 percent, which does not allow water to drain quickly. The proposal calls for placing the stockpile on a steeper 7 percent grade, creating a more efficient drainage system for the swill.

Another possibility is to create more rows of leaves where the decomposition takes place. According to Bible, these rows create no smell. With the facility using less than 5 acres on a 14-acre plot, Bible said the area could accommodate enough rows of leaves to eliminate any need for a stockpile.

St. Louis Post-Dispatch, May 20, 1993

Councilman Robert Mudd, 3rd Ward, said, "I don't mind spending $ 200,000 for the existing site if there is a 95 percent chance of success." Mudd agreed with Bible that further opinions should be sought before funds could be allocated.

"I want to have two other opinions about the source of the smell by the next meeting," he said.

Resident Burdick Burtch said he appreciated the board's intentions to fix the problem, but that if the city's efforts were unsuccessful, the city should remove the facility from a residential neighborhood.

Bible has already looked into the possibility of hauling the leaves to a landfill. The cost to do this would be more than $ 656,000. Other immediate, less expensive options call for covering the stockpile with a plastic tarp or shelter to keep off rain water.

The smell is not the only problem at the site. Noise from the facility's hammer-mill, used for making wood chips, can be heard throughout the area. The council is considering installing an innovative "living-wall" built of recycled plastic segments that are filled with dirt. Harry Sanders, president of the company that builds these earth-based walls, presented his product to the board.

He said this type of wall, which has been used in several European countries, has never been built in America. The dirt in the wall absorbs the sound rather than bouncing it back like traditional metal or plastic barriers. The barriers can also be planted with vegetation to greatly improve its appearance.

The walls can be adjusted to a height of 21 feet, depending on the recommendation of sound engineers.

Spink noted that this type of wall was less expensive than the traditional barriers.

LANGUAGE: English

A Glossary of Compost Terms

by the

Solid Waste Composting Council

COMPOSTING GLOSSARY*

AERATED STATIC PILE: composting system using controlled aeration from a series of perforated pipes running underneath each pile and connected to a pump that draws or blows air through piles.

AERATION: the bringing about of contact with air of composting solid organic matter, by means of turning or ventilating to allow microbial aerobic metabolism (biooxidation).

AEROBIC: composting environment characterized by bacteria in the presence of oxygen (aerobes); generates more heat and is a faster process than anaerobic composting.

AEROBIC RESPIRATION: the energy yielding chemical reaction in which the final electron acceptor is oxygen.

ANAEROBIC DIGESTION: the energy yielding chemical reaction in which the final electron acceptor is an inorganic molecule.

ARTIFICIAL SOIL: growth medium for plants obtained by mixing soil, or inert soil substitutes, with stabilized organic matter.

BACTERIA: unicellular or multicellular microscopic organisms.

BATCH COMPOSTING: all material is processed at the same time, without introducing new feedstock once composting has begun; windrow systems are batch systems.

BIOASSAY: a laboratory assay using a biological test organism.

BIOAVAILABLE: available for biological uptake.

BIODEGRADABILITY: the potential which an organic component has for being converted into simpler structures by enzymatic activity.

BIOOXIDATION: aerobic microbial metabolism which involves the oxidation of organic or inorganic compounds, for the purpose of supplying energy and precursors for the biosynthesis of cell material.

BIOCHEMICAL OXYGEN DEMAND (BOD): the amount of oxygen used in the biochemical oxidation of matter.

CARBON TO NITROGEN RATION (C:N RATIO): ratio of organic-carbon to organic-nitrogen in compost or in the organic matter of origin.

COMPOST (synonym of mature compost): the stabilized and sanitized product of composting which is beneficial to plant growth; it has undergone an initial stage of decomposition and is in the process of humification (stabilization).

COMPOST CLASSIFICATION: division into fresh, mature and cured compost, according to the degree of stabilization.

COMPOST GRADE: division into very fine, medium and coarse compost according to its physical and chemical characteristics.

COMPOSTING: controlled biooxidative process that 1) involves an heterogeneous organic substrate in the solid state, 2) evolves by passing through a thermophilic stage and a temporary release of phytotoxins, and 3) leads to the production of carbon dioxide, water, minerals and stabilized organic compost matter (compost).

CONDENSATE: moisture in the air that is pulled through the compost pile.

CONTAMINANT: foreign metal lending impurity to a primary material; physical contaminants of compost can include glass and plastic; chemical contaminants can include heavy metals and toxic organic compounds.

CONTINUOUS FLOW: a system of composting in which material is continuously added to the composting process and in which the end product is continuously removed; often used for large operations.

* compiled from a variety of sources including Zucconi, Franco & Marco de Bertoldi· *Compost Specifications for the Production and Characterization of Compost From Municipal Solid Waste* and many critiques of earlier drafts of this document

CONTROLLED COMPOSTING: a process in which most important operating factors are controlled for the purpose of achieving maximum efficiency, reducing process time and sanitizing the organic mass.
CONTROLLED DYNAMIC SYSTEM: compost piles receive forced aeration and periodic turning.
CURBSIDE PICKUP: the curbside collection of household solid waste material for removal by a waste hauler to a centralized waste handling facility (municipal or private) such as a transfer station, a materials recovery facility (MRF), an incinerator or landfill. Waste at curbside may be mixed together in common containers or source separated by the householder into separate waste fractions such as all newspapers together, all glass together or any variation of waste mix and separation.
CURING: last stage of composting, after much of the readily metabolized material has been decomposed, which provides additional stabilization and allows further decomposition of cellulose and lignin.
DECOMPOSITION: the initial stage in the degradation of an organic substrate; characterized by processes of destabilization of the preexisting structure; in properly controlled composting, decomposition is conducive to a subsequent stage of stabilization (humification and mineralization).
DENITRIFICATION: the biological reduction of nitrogen to ammonia, molecular nitrogen or oxides of nitrogen resulting in the loss of nitrogen into the atmosphere.
DEWATERED SEWAGE SLUDGE: municipal sewage sludge with a total solids content of 6% or greater that can be transported and handled as a solid material; usually done by belt press, screw press, vacuum filtration or centrifuge.
DRUM COMPOSTING SYSTEM: enclosed cylindrical vessel which slowly rotates for a set period of time to break up and decompose material.
DYNAMIC PILE SYSTEM: compost piles receiving forced aeration that are *not* turned.
FERMENTATION: the energy yielding chemical reaction in which the final electron receptor is an organic compound.
FINISHING: post-processing, screening, air flotation, air classification, grinding or a combination of similar processes to remove plastics, glass, bones, leather and metals remaining after composting.
FOOD WASTE/SCRAPS: residual food from residences, institutions or commercial facilities; unused portions of fruit, animal or vegetable material resulting from food production.
FOREIGN MATTER: non-biodegradable products contained in wastes such as glass, plastic, metals, etc.; permitted only at low levels in market compost.
FRESH COMPOST: organic matter that has gone through the thermophilic stage of composting and achieved sanitization; it has undergone a partial decomposition but it has not yet stabilized.
FRESH ORGANIC MATTER: raw organic substrate for composting before undergoing decomposition (or at the beginning of it).
GREEN MATTER: portion of the municipal solid waste stream consisting of grass clippings, tree trimmings and other vegetative matter.
HAMMERMILL: powered machine using rotating or flailing hammers to grind material as it falls through the machine or rests on a stationary metal surface.
HAZARDOUS COMPOUNDS: any organic or inorganic compound that may endanger life or health; poisons, heavy metals, pesticides etc. which may be found in waste belong to this group.
HEAVY METALS: trace elements regulated because of their potential for human, animal or plant toxicity, including copper, nickel, cadmium, lead, mercury and zinc.
HOT-BED: cultivation or rooting bed in which a layer of decomposing (heat producing) organic matter underlies a layer of cultivated soil or artificial substrate.

HUMIC ACID: the main constituent of humus, composed of proteins and lignins, dark brown to black in color.
HUMIFICATION: the microbial synthesis of three dimensional polymers of saccharides and phenols resembling gums and lignin; a process of storing organic energy as compounds of high molecular weight which are slowly biodegradable.
HUMUS: a complex aggregate of amorphous substances, formed during the microbial decomposition or alteration of plant and animal residues and products synthesized by soil organisms; principal constituents are derivatives of lignins, proteins and cellulose; humus has a high capacity for base exchange (cation exchange capacity), combining with inorganic soil constituents and for water absorption; finished compost may be designated by the general term humus.
INERTS: non-biodegradable products contained in waste (glass, plastic, metals, etc); permitted only at low levels in market compost.
INOCULA: preconditioned microorganisms or compost product added to a raw material to provide the appropriate microorganisms for decomposition.
INORGANIC: substance in which carbon-to-carbon bonds are absent; mineral matter.
LATENT METABOLISM: metabolic processes that remain to be completed before achieving stabilization; latent metabolism may be measured by the evolution of respiration, heat production, toxicity, etc. in appropriately set conditions.
LEACHATE: liquid which has percolated through solid wastes and extracted dissolved and suspended materials; liquid that drains from the mix of fresh organic matter.
LIGNIN: the component of wood responsible for its rigidity.
MATURE COMPOST: (synonym of *compost*) the stabilized and sanitized product of composting which is beneficial to plant growth; has undergone an initial stage of decomposition and is in the process of humification (stabilization); is characterized as rich in readily available forms of plant nutrients, poor in phytotoxic acids and phenols and low in readily available carbon compounds.
MESOPHILIC PHASE: phase of composting during which the temperature of the organic mass is between 30 and 45 degrees Centigrade.
METABOLISM: sum of the chemical reactions within a cell or a whole organism, including the energy-releasing breakdown of molecules (catabolism) and the synthesis of complex molecules and new protoplasm (anabolism).
MUNICIPAL SOLID WASTE (MSW): residential and commercial solid waste generated within a community.
MUSHROOM COMPOST: Cellulose-rich organic matter that has undergone the initial (decomposition) stage of a controlled composting process. The fungi bring about cellulolysis and humification of the substrate (stabilization stage).
ORGANIC: substance which includes carbon-to-carbon bonds.
ORGANIC CONTAMINANTS: synthetic trace organics including pesticides and polychlorinated biphenyls (PCBS).
ORGANIC MATTER: includes synthetic organic matter and matter having a biological origin; biodegradability is mostly confined to the second group.
ORGANIC SOIL CONDITIONER: stabilized organic matter marketed for conditioning soil structure; also improves other (chemical and biological) properties of the soil.
PATHOGEN: any disease-producing microorganism.
PERSISTENCE: refers to a slowly decomposing substance which remains active in the natural cycle for a long period of time.
PHYTOTOXIC: detrimental to plant growth and viability; caused by the presence of a contaminant or by a nutrient deficiency.

RESPIRATION: the metabolic function of consuming oxygen.
ANITIZATION: the reduction of disease-producing organisms below the level of health risk.
SCREENING: the sifting of compost through a screen to remove large particles and improve consistency and the quality of the end product.
SEPTAGE: liquid and solid material pumped from a septic tank or cesspool during cleaning.
SHREDDER: powered mechanical device used to break waste materials into smaller pieces.
SIZE REDUCTION: generic term for separation of the waste aggregate or of breaking up solid waste or other materials into smaller pieces through tearing, screening, tumbling, rolling, crushing, chipping, shredding, grinding, shearing, etc.; the process makes waste easier to separate and can increase surface area for composting.
SLUDGE: waste material deriving from the treatment of sewage.
SOIL AMENDMENT/CONDITIONER: soil additive which stabilizes the soil, improves resistance to erosion, increases permeability to air and water, improves texture and resistance of the surface to crusting, eases cultivation or otherwise improves soil quality.
SOLID WASTE: garbage, refuse and other discarded solid materials, including materials resulting from industrial, commercial and agricultural operation and community activities.
SOURCE SEPARATION: the separation, by residents, of wastes generated within the household into separate fractions such as newspapers, glass, etc. and the placement in separate containers at the curbside for pickup by the waste hauler; the extent of source separation desired of residents varies with local markets for recycled products and by municipal policy regarding waste disposal.
STABILITY: state or condition in which the composted material can be stored without giving rise to nuisances or in which it can be applied to soil without causing problems; the desired degree of stability for finished compost is one in which the readily decomposed compounds are broken down - only the decomposition of the more resistant biologically decomposable compounds remains to be accomplished.
TABILIZATION: second stage of composting (following decomposition); characterized by slow metabolic processes, lower heat production and the formation of humus.
STATIC PILE SYSTEM: an aerated static pile with or without a controlled air source.
THERMOPHILIC PHASE: phase of composting during which the temperature of the mass exceeds 45 degrees Centigrade.
TOXICITY: reversible adverse biological effect due to toxins and other compounds.
TOXINS: unstable poison-like compounds of biological origin which may cause a reduction of viability or functionality in living organisms.
VOLATILIZATION: gaseous loss of a substance to atmosphere.
WINDROW SYSTEM: waste/bulking agent mixture is placed in elongated piles or windrows and aerated by mechanically turning the piles with a machine such as a front-end loader or specially designed equipment.
YARD WASTE: grass clippings, leaves and weeds, and prunings from residences or businesses – six inches or less in diameter.

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NH Municipalities That Compost

Reg = Quantity included in community listed under market

	Community	Pop.	Market	Quantity
* 1	Alton	3286	Local Use	0
2	Andover	1883	Local Use	1
3	Antrim	2360	Town Use	0
4	Barnstead	3100	Pittsfield	Reg
5	Barrington	6164	Local Use	0
6	Bennington	1236		0
7	Bridgewater	796	Town Use	0
8	Canaan	3045	Lebanon	Reg
9	Candia	3557	Local Use	0
10	Center Harbor	996	Meredith	Reg
11	Chester	2691		0
12	Chichester	1942	Pittsfield	Reg
13	Claremont	13902	Town Use	90
14	Derry	29603	Town Use	0
15	Dover	25042	Town Use	90
16	Dunbarton	1759	Town Use	10
17	Epping	5162	Local Use	0
18	Epsom	3591	Pittsfield	Reg
19	Exeter	12481	Town Use	261
20	Farmington	5739		0
21	Francestown	1217		0
22	Gilsum	745		0
23	Goffstown	14621	Local Use	0
24	Gorham	3173		0
25	Greenfield	1519	Wilton	Reg
26	Greenville	2231	Wilton	Reg
27	Hampstead	6732	Local Use	0
28	Hancock	1604	Town Use	0
29	Hanover	9212	Lebanon	Reg
30	Hebron	386		0
31	Jaffrey	5361	Town Use	0
32	Keene	22430	Local	473
33	Lebanon	12183	Town Use	0
34	Lee	3729	Town Use	50
35	Litchfield	5516	Town Use	0
36	Littleton	5827	Town Use	80
37	Londonderry	19781	RCS	0
38	Lyndeborough	1294	Wilton	Reg
39	Marlborough	1927		0
40	Mason	1212	Wilton	Reg
41	Meredith	4837	Town Use	0
42	Milford	11795	Town Use	0
43	Milton	3691		0
44	Mont Vernon	1812		0
45	Moultonborough	2956	Local Use	0
* 46	Nashua	79662	Town Use	50
47	Nelson	535	Keene	Reg
48	New Boston	3214	Local Use	50
49	Northfield	4263	Town Use	0

NH Municipalities That Compost

Reg = Quantity included in community listed under market

	Community	Pop.	Market	Quantity
50	Northwood	3124		0
51	Nottingham	2939		0
52	Orange	237	Lebanon	Reg
53	Peterborough	5239	Local Use	228
54	Pittsfield	3701	Local	0
55	Sanbornton	2136	Town Use	0
56	Sharon	299	Peterborough	Reg
57	Shelburne	437	Local Use	6
58	Sullivan	706	Keene	Reg
59	Surry	667	Keene	Reg
60	Swanzey	6236		0
61	Temple	1194	Wilton	Reg
62	Tilton	3240		0
63	Walpole	3210		0
64	Westmoreland	1596		0
65	Wilton	3122	Local Use	192
*** Total ***		399883		1581

Towns & Quantity ... of ...

	Town	Quantity
1	Ansonia	2,304 cy
2	Ashford	100 cy
3	Avon	8,000 cy
4	Barkhampstead RRDD#1	5,760 cy
5	Beacon Falls*	500 cy
6	Branford	4,000 cy
7	Bridgeport	8,000 cy
8	Bridgewater	200 cy
9	Bristol	25,000 cy
10	Brookfield	500 cy
11	Canaan	100 cy
12	Cheshire*	5,340 cy
13	Coventry*	1,000 cy
14	Cromwell	3,000 cy
15	Danbury	10,000 cy
16	Darien**	6,000 cy
17	Derby	5,000 cy
18	East Haddam	800 cy
19	East Hartford	3,500 cy
20	Enfield	5,000 cy
21	Farmington	3,500 cy
22	Granby***	4,000 cy
23	Groton	1,000 cy
24	Guilford*	250 cy
25	Hamden*	5,000 cy
26	Hartford	7,820 cy
27	Harwinton	100 cy
28	Hebron*	500 cy
29	Lebanon****	20,000 cy
30	Lyme***	1,200 cy
31	Madison	2,000 cy
32	Manchester	18,000 cy
33	Mansfield	700 cy
34	Middletown	10,000 cy
35	Milford*	10,000 cy
36	Morris*	?
37	New Britain*	15,000 cy
38	New Fairfield	3,000 cy
39	New Milford****	10,000 cy
40	Newington	10,000 cy
41	North Canaan	3,200
42	North Haven	20,000 cy
43	North Stonington	800 cy
44	Orange*	?
45	Plainville***	3,600 cy
46	Prospect*	1,500 cy
47	Rocky Hill	5,000 cy
48	Shelton	3,000 cy
49	Simsbury	300 cy
50	South Windsor	12,000 cy
51	Southbury**	2,500 cy
52	Southington	12,140 cy
53	Southington	18,840 cy
54	Stamford	9,000 cy
55	Stamford	20,000 cy
56	Stonington*	1,000 cy
57	Stratford	9,000 cy

	Town	Quantity
58	Thomaston	400 cy
59	Trumbull	10,000 cy
60	Union	60 cy
	Vernon	12,000 cy
	Wallingford	3,500 cy
63	Waterbury*****	12,000 cy
64	Waterford**	4,500 cy
65	West Hartford	10,000 cy
66	West Hartford	30,000 cy
67	West Haven*	30,000 cy
68	Wethersfield	10,000 cy
69	Windham	4,000 cy
70	Windsor Locks	3,000 cy
71	Windsor/Bloomfield	8,000 cy
72	Wolcott	2,000 cy
73	Wolcott****	-
74	Woodbury	800 cy

Total: 2,017,305 478,314 total cy CT has ≈ 3,000,000 people

* registration incomplete, more info required

** leachate plan will be incorporated into landfill closure plan

*** registration under review

**** Private facility

***** site no longer in use.

Massachusetts Registered Leaf Composting Operations as of 11/1/90

1. Acton
2. (Acushnet)*
3. (Adams)*
4. Amherst
5. Andover
6. Attleboro
7. Auburn
8. Avon
9. Barnstable (Cape Resources Co.)
10. Barnstable (municipality)
11. Belchertown
12. Bellingham
13. Beverly
14. Blackstone
15. Boston
16. Bourne
17. Braintree
18. Bridgewater
19. Brockton
20. Chatham
21. Chelmsford
22. Chicopee
23. Cohasset
24. Concord
25. Danvers
26. Dartmouth
27. Dighton
28. Duxbury
29. (E. Bridgewater)*
30. E. Longmeadow
31. Easthampton
32. Easton
33. Erving
34. Fairhaven
35. Fall River (BFI)
36. Falmouth
37. Fitchburg
38. Framingham
39. Franklin
40. Ft. Devens (U.S. Army Base)
41. Gardner/Templeton
42. Granby
43. Greenfield
44. Harwich
45. (Hatfield)*
46. Hingham
47. Holden
48. Holliston
49. Holyoke
50. Hopkinton (Weston Nurseries)
51. Ipswich (Appleton Farms)
52. Kingston (O'Donnell Sand and Gravel)
53. Kingston (municipality)
54. Lawrence
55. Littleton (Cataldo Nursery)
56. Longmeadow (leaves disked into farmland)
57. Lowell
58. Ludlow
59. MDC - Randolph
60. Marion
61. Mashpee
62. Maynard
63. Melrose
64. Methuen
65. Millis
66. Milton
67. Montague
68. Nahant
69. (Nantucket)*
70. Natick
71. Needham
72. New Bedford
73. Newburyport
74. Newton
75. N. Andover
76. N. Attleboro
77. Northampton
78. Northbridge
79. N. Reading
80. Norwood
81. Orleans
82. Oxford
83. (Peabody)*
84. (Pepperell)*
85. Pittsfield (VICON)
86. Plainville - Laidlaw
87. Quincy
88. Randolph (BFI)
89. Reading
90. Rehoboth (Fine Tree Farm)
91. Sandwich
92. Saugus
93. Seekonk
94. Sharon
95. Shirley
96. (Shrewsbury)*
97. Southampton
98. Spencer
99. Springfield
100. Sturbridge
101. Sudbury
102. Swampscott Landscapers
103. Taunton
104. Templeton (with Gardner)
105. Tewksbury
106. Uxbridge
107. Wakefield
108. Walpole
109. Wayland

110. Webster
111. Wellesley
112. Westboro
113. Westfield
114. Westford (Laughton's Nursery)
115. Weston
116. Westwood
117. Weymouth
118. Wilbraham
119. (Williamstown)*
120. (Woburn)*
121. Worcester
122. Wrentham
123. Yarmouth

*Note: communities in parentheses are not yet composting