

A Green Guide to Yard Care

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Your yard is the environment over which you have the most control. YardWise is a simple four-step program to help you maintain a healthy yard with less cost, less work, and less waste.

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Why YardWise?

Many common yard care practices are out of balance with nature:

- Every year more than five million tons of yard trimmings and other organic materials end up in Texas landfills instead of building up the soil.
- Millions of gallons of city-treated water are used to irrigate landscapes where native vegetation once grew in naturally mulched soil, sustained by rainfall.
- Much of that water runs off the land, eroding depleted and unprotected soils that are unable to absorb it. The excess sediment from your lawn and many other yards can smother aquatic life in the receiving bodies of water. Excess sediment can also increase the cost of operating water supply reservoirs.
- Costly synthetic fertilizers and pesticides are applied to compensate for the loss of nutrients and protection once provided by organic debris and rich soil life. Surprising as it may seem, residential users apply more pounds per acre of these chemicals than farmers do—often to the point of disrupting beneficial soil life.
- As your soil loses its organic matter, it allows more of these chemicals to run off and wash through it—contributing to the pollution of lakes, streams, and underground water. In excess, these pollutants can harm aquatic life or contaminate the food chain.

These practices cost Texans millions of dollars every year:

- Disposing of organic materials in Texas landfills costs more than \$150 million a year and consumes more than 15 million cubic yards of space.
- The extra water and chemicals used to sustain gardens and landscapes in depleted soil costs many more millions.
- It is difficult to put a price on the loss of water quality in Texas rivers, lakes, and aquifers. However, it is almost always less expensive to prevent pollution than to clean it up.

As our population increases and home landscapes become a larger part of the Texas environment, it is more important than ever to manage them responsibly.

Glossary

- aerobic*—having sufficient free oxygen to support respiration
- anaerobic*—not having sufficient free oxygen to support respiration
- annual*—a plant with a natural life span of one year or less
- botanical*—derived from plant matter without chemical alteration
- “brown” materials*—organic materials with a high carbon-to-nitrogen ratio such as dead leaves, dry hay, dry wood chips, and paper
- dripline*—the ground directly below the farthest reach of a tree’s branches
- essential plant nutrients*—elements that are necessary for the normal growth of plants
- “green” materials*—organic materials with a low carbon-to-nitrogen ratio such as green grass clippings, vegetable trimmings, and fresh manure
- humus*—the complex mixture of materials resulting from extensive decomposition of living things
- macronutrients*—essential plant nutrients that are used in relatively large quantities: nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur
- micronutrients*—essential plant nutrients that are used in very small amounts: iron, manganese, copper, zinc, boron, molybdenum, chlorine, and cobalt
- microorganism*—a living thing that is only visible through a microscope
- organic*—consisting of residues from living things, including dead leaves and branches, grass clippings, manure, and the products of the natural decomposition of these residues
- organism*—living thing
- peat moss*—a moss harvested from peat bogs and used as a soil amendment and as a component of potting soils
- perennial*—a plant with a natural life span of more than two years
- pH*—a measurement of the acidity or alkalinity of a material, on a scale from 0 (maximum acidity) to 14 (maximum alkalinity), with 7 representing neutral.
- synthetic fertilizer*—a material containing manufactured essential plant nutrients
- synthetic pesticide*—a material containing manufactured chemicals designed to kill pests
- toxicity*—the ability of a substance to cause adverse effects (that is, to be *toxic*) in living organisms; a high toxicity means that very small amounts of the substance cause adverse effects

Grasscycling: “Don’t Bag It!”*

Basics

Grasscycling means leaving grass clippings on the lawn to decompose into soil.

- **Mow** grass at the proper height and disperse the grass clippings down to the soil.
- **Water** grass only as needed—about 1 inch of water once a week.
- **Fertilize** grass with slow-release fertilizers as needed to correct deficiencies.

Grasscycling Benefits

- makes turf greener and tougher
- prevents common turf diseases
- reduces lawn fertilizer requirements
- does not cause thatch—in fact, helps prevent it
- reduces total time spent mowing and maintaining your lawn
- cuts down on watering needs and costs
- eliminates disposal of grass clippings (and sometimes leaves too)

Grasscycling Guidelines: Mowing

The key to grasscycling is to mow at the proper height (see Figure 1) and disperse the small grass clippings evenly so they fall down to the soil. Mowing grass too short causes stress, discourages deep root growth, and results in rapid loss of soil moisture. Letting grass grow too tall between mowings causes excess grass clippings that smother the turf and take a long time to break down.

You do not need a special mulching mower. However, grasscycling results may be improved by using a mulching mower, by replacing a standard mower blade with a mulching blade, or by covering a mower’s outlet spout.

- Raise the mowing height during the hot and dry season. A higher setting reduces moisture loss and encourages deep root growth.
- Mow often enough that each mowing removes no more than one-third of the grass blade; for example, if you set your cutting height at 2 inches, then cut before the grass is more than 3 inches tall.
- Keep mower blades sharp and clean, and mow when the grass is dry.
- Mow over leaves so they will decompose along with grass clippings.

- Collect leaves and grass clippings for mulching or composting when they are too heavy or too wet for grasscycling.

Grasscycling Guidelines: Watering

Grasscycling reduces the amount and frequency of watering. Watering too heavily or too often weakens the turf and causes erosion and runoff pollution.

- Water when footprints across the lawn remain visible or when it is difficult to push a screwdriver into the turf.
- Water deeply (6-inch penetration or deeper). Apply approximately 1 inch of water once a week. Water slowly enough to avoid runoff.
- To measure your sprinkler application, place an empty 6-ounce tuna can on your lawn. Stop watering when it is full.

Grasscycling Guidelines: Fertilizing

Excess fertilization weakens roots, increases watering needs, causes thatch and excessive growth, and pollutes waterways. Your county extension office can help you analyze your soil and recommend fertilizers and application schedules.

- Grasscycling provides about 2 pounds of nitrogen per 1,000 square feet of lawn per year. Some people find that grasscycling completely eliminates the need for synthetic lawn fertilizers.
- Slow-release nitrogen sources such as compost, blood meal, sulfur-coated urea, and urea formaldehyde help lawns grow at a moderate, even pace. Avoid using quick-release fertilizers.
- Gently water your lawn after applying fertilizers. Never wait for a rainstorm to water in your fertilizer—in most cases, the rain will fall too rapidly for the fertilizer to be absorbed, and much of it will wash into the nearest stream.

Figure 1. Recommended Mowing Heights

Type of grass	Cut when height reaches ...	Set cutting height at ...
Centipede	1-1/2 to 2 inches	1 to 1-1/2 inches
Common Bermuda	1-1/2 to 3 inches	1 to 2 inches
Hybrid Bermuda	3/4 to 2-1/4 inches	1/2 to 1-1/2 inches
Tall Fescue	3 to 4-1/2 inches	2 to 3 inches
St. Augustine	3 to 4-1/2 inches	2 to 3 inches
Zoysia	3/4 to 2-1/4 inches	1/2 to 1-1/2 inches

* Don't Bag It is a program created by the Texas Agricultural Extension Service. Used with permission.

Mulching

Basics

Mulch is a material spread on top of the ground to benefit soil and plant health, and make landscape maintenance easier. Wood chips, leaves, grass clippings, wood shavings, and compost all make good mulches.

Mulching Benefits

- prevents soil compaction and erosion
- suppresses weeds
- captures and retains soil moisture
- protects plant roots and crowns from extreme heat and cold
- protects and stimulates microbial activity in the soil
- adds nutrients to the soil as they break down

Mulching Guidelines: Make the Best Use of Mulch Covers

- Mulch all areas that are not in grass or thick ground cover.
- Trees and shrubs benefit from mulch spread at least as far as their outermost branches (the “dripline”). To prevent

diseases and pest infestation, avoid piling mulch against tree trunks.

- Use a layer of coarse mulch 3 or more inches in depth for weed control.
- When converting grassy areas to mulch, smother the grass with a thick layer of cardboard or newspapers rather than kill it with chemicals. Some hardy grasses must be rooted out for successful removal.
- Blanket perennials with several inches of shredded leaves or whole pine needles to protect them from winter cold.
- Use long-lasting mulches (wood chips, shavings, evergreen needles) for trees and shrubs.
- Spread mulches under annuals after they are well established (4 to 6 inches tall).
- Water the ground thoroughly before and after applying a mulch cover.
- Never rely on a rainstorm to water in your mulches. In many cases, the rain will fall too heavily and quickly, and a fair amount of your mulch may run off into the storm drain and local creeks.
- Never mulch with diseased or insect-infested yard trimmings.

Table 1 gives further details about using mulch.

Table 1. Mulch Application Guide

Mulch Use	Material	Thickness	Notes
Top Dressing for Lawns	Compost	1/4 to 1/2 inch	Sifted through 1/2-inch mesh or finer screen; apply especially after aerating or reseeding, then water in.
For Annuals and Perennials	Grass clippings	1/2 to 1 inch	Do not mulch with herbicide-treated clippings or hay that has been treated with the persistent herbicide picloram. Can use unshredded leaves on perennial beds in autumn.
	Shredded leaves and stalks	1 to 1-1/2 inches	
	Compost	1 to 2 inches	
	Old straw	1 to 2 inches	
For Shrubs and Trees	Wood or bark chips	2 to 6 inches	2 to 3 inches for fine chips; up to 6 inches for large chips (more than 1 inch in length). Coarse shavings only. Sawdust can bind up soil nitrogen. Coarse compost is best.
	Wood shavings	1 to 2 inches	
	Compost	1 to 3 inches	
For Erosion Control	Wood chips or coarse compost	2 to 4 inches	2 to 4 inches over any area without cover; 3 to 4 inches on slopes.

Composting

Basics

- “Composting” means the controlled decomposition (decay) of organic material such as yard trimmings, kitchen scraps, wood shavings, cardboard, and paper.
- “Compost” is the humus-rich material that results from composting.
- Compost contributes nutrients and beneficial life to the soil, improves soil structure, and helps prevent runoff that can pollute rivers and lakes.
- Compost helps the soil absorb and retain nutrients and moisture, and protects plants from diseases and pests. Better moisture retention means less watering, allowing you to conserve water and reduce runoff pollution.

Compost Benefits

Compost makes good mulch. It can also be mixed into garden and potting soils.

Nutrients. Compost contains the full spectrum of essential plant nutrients. However, testing the nutrient levels in your soil can be helpful in determining what supplements your landscape requires. Ask your county extension agent for more information.

- Compost contains micronutrients such as iron and manganese that are often absent in synthetic fertilizers.
- Compost releases its nutrients slowly, over several months or years.
- Soil enriched with compost retains fertilizers better than lifeless soil does. Less fertilizer runs off to pollute waterways.
- Compost balances both acid and alkaline soils, bringing pH levels into the optimum range for nutrient availability.

Soil Structure. Compost helps bind clusters of soil particles (aggregates). Soil rich in aggregates is full of tiny air channels and pores that hold air, moisture, and nutrients like a sponge.

- Compost helps sandy soil retain water and nutrients that would normally wash right through the sand.
- Compost breaks up tightly bound particles in clay or silt soil, allowing roots to spread, water to drain, and air to penetrate.
- Compost alters the texture and structure of all soils, increasing their resistance to erosion.
- Compost particles attract and hold nutrients strongly enough to prevent them from washing out, but loosely enough so that plant roots can take them up as needed.
- Compost makes any soil easier to work and cultivate.

Beneficial Soil Life. Compost introduces and feeds diverse life in the soil, including bacteria, insects, worms, and more, which support vigorous plant growth.

- Compost bacteria break down mulch and plant debris into plant-available nutrients. Some soil bacteria also convert nitrogen from the air into a plant-available nutrient.
- Beneficial insects, worms, and other organisms are plentiful in compost-enriched soil; they burrow through the soil keeping it loose and well aerated.
- Compost suppresses diseases and harmful pests that overrun poor, lifeless soil.
Water Quality. In the summer, as much as half of urban water usage goes for the irrigation of lawns and landscaped areas. Compost increases soil’s ability to retain water and decreases runoff. Runoff pollutes water by carrying soil, fertilizers, and pesticides to nearby streams.
- Compost promotes healthy root growth, which decreases runoff.
- Compost can reduce or eliminate your use of synthetic fertilizers.
- Compost reduces the need for chemical pesticides because it contains beneficial microorganisms that protect your plants from diseases and pests.

Two Compost Recipes

There are two approaches to composting:

- Cool and Easy Composting is adding materials gradually to a bin or pile and allowing them to compost slowly with little maintenance.
- Hot and Fast Composting is building and actively mixing a pile to produce disease-killing temperatures and can yield finished compost in three to four months.

The following are sample “recipes.” There is no need to follow them exactly. There are many different “right” ways to compost.

Cool and Easy Compost

With this low-maintenance, “continuous feed” approach, compost is ready in six months to two years. This practice does not destroy weed seeds, runners, or plant diseases.

Ingredients:

- mixed yard trimmings as available, including grass clippings, flowers and stalks, leaves, weeds without seeds or spreading roots, twigs, and small branches
- vegetable and fruit scraps, and coffee grounds
- rainwater and additional water as needed

Tools:

- pitchfork
- square-point shovel or machete
- water hose with spray head
- chipper-shredder (optional - for composting thick woody materials)
- compost bin (optional)
- tarp, burlap, or black plastic cover (optional)

Directions:

1. Set compost bin or pile where water does not puddle when it rains, preferably a shaded spot near a water source.
2. Put yard trimmings in bin or pile as they are collected.
3. Chop or shred woody trimmings.
4. When adding grass clippings and green garden wastes to the pile, mix them into the leaves and other yard materials already in the pile.
5. Bury kitchen scraps under 10 inches of yard trimmings or finished compost.
6. Moisten dry materials as they are added.
7. Optional: Cover top of compost with tarp or sheet plastic to keep it moist.
8. When material at the bottom looks like dark, rich soil, you have compost. When convenient, move the undecomposed materials into a new pile or bin, and harvest and use the compost.

Hot and Fast Compost

This approach requires more maintenance but produces compost in batches that are ready in one to four months. (A minimum “batch” is enough to fill a plastic bin or to build a pile at least 3 feet high and 3 feet in diameter.) This practice destroys most plant diseases, weeds, and weed seeds.

Ingredients:

- three to four or more wheelbarrows of “green” yard materials—such as grass clippings and garden debris
- three to four or more wheelbarrows of “brown” materials—such as leaves, dry weeds, brush, and woody prunings
- vegetable and fruit scraps, and coffee grounds (as available)
- water

Tools:

- pitchfork
- square-point shovel or machete (optional)
- rotary lawnmower or chipper-shredder (when composting woody material or dry leaves)
- water hose with spray head
- compost bin (optional)
- tarp, burlap, or black plastic for covering the pile and/or mixing materials (optional)
- compost thermometer (optional)

Directions:

1. Pick a 4-foot by 8-foot area where water does not puddle when it rains, preferably a shaded spot near a water source.

2. Chop up the gathered stalks and garden plants with shovel or machete. Chip or shred woody trimmings.
3. Cover half of the 4-foot by 8-foot area with a 6-inch layer of “brown” materials.
4. Add a 3-inch layer of fresh “green” materials, and add a dash of soil or finished compost.
5. Mix this layer lightly into the layer below it with a hoe or hand cultivator.
6. Top with a 3-inch layer of “brown” materials; add water until moist.
7. Repeat steps four through six until the pile is at least 3 feet high. Note: The pile should be completely covered with 4 inches or more of brown materials. Food materials should be mixed in and buried deep in the pile.
8. Turn the pile over every one to two weeks with a pitchfork or shovel until the pile does not reheat much after turning. With each turning, move dry materials from the edges into the middle of the new pile, and add water as needed. If the pile is not heating, consult Table 2 at the end of the “Science of Composting” section for troubleshooting tips.
9. Let the pile cure for two weeks before using. If materials are not composted (do not look and smell like dark, rich soil), consult Table 2 for troubleshooting tips.

The Science of Composting

Composting involves a complex “food chain” of bacteria, fungi, mites, worms, beetles, and other beneficial organisms that consume organic materials and produce humus. The composting process is mostly accomplished by bacteria, especially when it is proceeding rapidly at a high temperature. Bacteria quickly populate any good composting environment. Other organisms become active as conditions become favorable to them. All you have to do is maintain the conditions that allow these organisms to thrive in your pile or bin until the job is done. The proper environment for them is a mass of organic materials that contains a balanced diet of carbon and nitrogen, and adequate moisture and oxygen. For rapid composting, the materials should also have the right particle size and heat up to 120 to 150 degrees Fahrenheit.

Basics

Composting means creating an environment where things can decay without creating nuisance odors or attracting pests. There are two main causes of nuisance odors in composting: too much nitrogen or not enough oxygen.

- Ammonia odors are caused by too much nitrogen from fresh or “green” materials like food scraps and green grass clippings. Use “brown” materials like dry grass or dead leaves for more than half of the material in your pile. Mix your “green” materials into the “brown” materials so there are no big pockets of “green” material left.
- “Rotten” odors are caused by low oxygen levels where your material is water-soaked and compacted. Keep your

pile full of air by mixing in lots of coarse materials or by remixing and turning the pile often. Your compost should stay lightly moist like a wrung-out sponge so that no water drips out when you squeeze it.

Pests are attracted to composting piles by “green” materials that are close to the surface. You can keep pests away from your pile by mixing “green” materials deep inside the pile and by keeping the top of the pile covered by a bin or a thick layer of “brown” materials. If you use “cool and easy composting,” play it safe and limit the nitrogen and moisture in your pile. If you use “hot and fast composting,” be sure that you keep your pile well-mixed and balanced between carbon and nitrogen.

A Balanced Diet of Carbon and Nitrogen (C:N)

Like human beings, compost organisms require a balanced diet of nutrients. You don’t need to worry about proteins, vitamins, and minerals. Just balance the carbon and nitrogen in the composting materials by mixing high-nitrogen “green” materials—food scraps, green grass clippings, and manure—and high-carbon “brown” materials—dry grass, dead leaves, and wood chips and shavings. (Table 3 on page 9 gives carbon-nitrogen characteristics of common compost ingredients.)

- A compost pile made up only of “brown” materials breaks down slowly because it does not contain enough nitrogen to support a large population of compost organisms.
- A compost pile with too much “green” material begins to harbor pests and to lose its nitrogen in an ammonia form, which creates odor problems.
- A good rule of thumb is to mix equal amounts by weight of “green” and “brown” materials, or a larger volume of “brown” materials than “green” materials.
- Add green and brown materials in thin layers; then mix them.
- Where it is critical to prevent odor and pest problems, use more brown material.

Understanding C:N:

Living things are largely made up of nitrogen (in proteins) and carbon (in sugars, starches, and fiber). While alive, living things have a high nitrogen content—they are “green.” When they die and start decomposing and drying out in the open, airborne bacteria and other decomposers consume the protein-rich tissues first and disperse the nitrogen in the form of dead bacteria, bug droppings, ammonia, and other by-products. The carbon-rich plant fibers stay intact much longer. This is the process that turns “green” materials like green grass clippings that are left in the open into “brown” materials like dry grass. Manure is considered a “green” material because it stays rich in nitrogen for a long time.

Importance of C:N:

Part of the purpose of composting materials in piles and bins is to keep their nitrogen from dispersing. Dead bacteria

and the nitrogen-rich materials that living bacteria excrete, including ammonia, diffuse and cascade slowly through the pile. New generations of bacteria and other composting organisms recycle this nitrogen as they consume the high-carbon plant fibers for energy.

Adequate Moisture and Oxygen

Just as carbon and nitrogen must be balanced, so does moisture and oxygen. Too much moisture leaves no air spaces, but too much ventilation dries out the materials.

Early in the composting process, the main difficulty is to keep all the materials in a well-mixed pile moist. Later, as they break down into a more crumbly, absorbent, compact mass, the main challenge may be to keep the material “aerated” with fresh air. Rapid composting at high temperatures can deplete oxygen in the pile quickly, even early in the composting process.

Thoroughly moisten your materials, preferably with a fine spray, as you build your pile or add to it. A pile of dry organic material can shed water like a duck. If your pile is too dry, you can

- turn it (pull it apart and restack it), wetting the materials as you restack them;
- mix in damp materials such as food scraps; or
- mix in fine-particle, absorbent materials like manure.

If your pile is too wet, turn it and mix coarse materials like dry leaves or straw into it as you restack it. If your pile keeps drying out, help it retain its moisture and nutrients by building it larger (a minimum 3-foot diameter and height), by putting it in a covered bin, or by covering it with a tarp, a plastic sheet, burlap, straw, or other mulch.

Importance of Moisture and Oxygen

Where moisture is lacking, decay is very slow. Where oxygen is lacking (that is, in “anaerobic” conditions), materials are decomposed slowly by “anaerobic organisms” that can produce foul smells and noxious by-products. The best level of moisture for a compost pile is as much moisture as the materials can contain without filling the air space between the particles—like a completely damp, wrung-out sponge. When you squeeze the material, no water should drip out.

Most “brown” materials, including leaves and wood chips, are coarse, stiff, and “angular,” creating air spaces in the pile and thus helping it stay “aerated” (oxygen-rich). “Brown” materials also tend to dry out quickly and to absorb moisture slowly. It can be difficult to keep them moist. On the other hand, “green” materials, such as fresh grass clippings and food scraps, tend to be pliable and moist and to mat together into an “anaerobic” mass.

Mixing green and brown materials together, then, also improves the balance between moisture and oxygen in a pile in most cases. Paper is an exception—it is very “brown,” but it is easy to wet and tends to mat together, so it can help absorb excess moisture but does not help much with aeration.

The Right Particle Size

Composting happens where moist organic materials are exposed to air. When materials are broken into small particles, there is more exposed surface area for composting organisms to attack. Microscopic organisms penetrate solid objects slowly.

Break down large objects before adding them to the pile.

- Twigs and leaves can be run over with a lawn mower or run through a leaf shredder.
- Whole branches can be run through a chipper.
- Garden plants and fleshy prunings can be chopped with a machete or pruning shears.
- Food scraps can be cut up in the kitchen or chopped up in a bucket with a square-point shovel.

Importance of Particle Size:

Rapid, aerobic composting occurs when green and brown materials are reduced to small pieces and thoroughly mixed

together. That way, every part of the pile gives decomposing organisms access to needed carbon, nitrogen, oxygen, and water. Chunks of wood and other lumps of brown material are “nitrogen-poor zones.” Whole apples or other large pieces of green material are “anaerobic zones.” A pile full of large chunks of material will have too much air space, and the surfaces will dry out rapidly. A pile of very fine materials such as manure and sawdust may have too little oxygen and require frequent turning.

A Healthy Temperature

The best way to know whether your compost pile is “healthy” is to take its temperature. Composting occurs most efficiently when the pile’s temperature rises to between 120 and 160 degrees Fahrenheit and stays there until most of the material has decomposed. Composting can be successful at much lower temperatures—it just takes longer.

Table 2. Compost Pile Troubleshooting

Symptom	Possible Causes	Possible Solutions
Damp and warm only in middle of pile	Pile too small, built too gradually, or cold weather	Form pile at least 3 feet high and wide. Cover with tarp. Put in covered bin. Or allow to compost “cold.”
Pile not heating up at all	<ol style="list-style-type: none"> 1. Not enough nitrogen 2. Not enough oxygen 3. Not moist enough 4. Pile too small , built too gradually, or cold weather 5. Compost finished 	<ol style="list-style-type: none"> 1. Mix in fresh grass clippings, manure, or food scraps. 2. Turn or fluff the pile, especially where it is smelly or matted. 3. Turn the pile, wetting as you turn to consistency of damp sponge. 4. Form pile at least 3 feet high and wide. Cover with tarp. Put in covered bin. Or allow to compost “cold” and slow. 5. If dark and crumbly, smells earthy (not moldy or foul)—use it!
Matted, undecomposed leaves or grass clippings	Compaction, poor aeration, or lack of moisture	Avoid thick layers of leaves, grass, or paper. Break up layers with garden fork, then wet and remix the pile. Shred materials.
Odor like rancid butter, egar, or rotten eggs	Not enough oxygen, too wet or compacted	Turn pile, fluffing materials to aerate them. Add vin-coarse dry materials like leaves as needed to soak up excess moisture. If odor is intense, possibly cover with a layer of newspapers and/or coarse dry materials and allow pile to mellow before turning.
Odor like ammonia	Not enough carbon	Add “brown” materials and aerate. If odor is intense, possibly cover and allow pile to mellow before turning (see preceding row).
Attracting rats, raccoons, flies, or other pests	Inappropriate materials (meat, oil, bones) or food too close to surface	Dispose of meat and oil. Use a rodent-resistant dogs, bin. Bury kitchen scraps 8 to 12 inches deep in the pile. For more details on acceptable materials, see Table 3 for a list of compost pile ingredients.
Attracting various insects, pedes, slugs	Normal composting	If garden pests are identified in pile, use traps or centi-barriers between pile and garden.
Infested with fire ants	Too dry, not hot enough, or food too close to surface	Drench ant mounds with compost tea sweetened with feed-grade molasses (see “How to Use Compost” on page 14). Broadcast low-toxicity fire ant bait for major infestations. Carefully rebuild pile to proper conditions, wetting thoroughly.

Table 3. Compost Pile Ingredients: Yes, No, or Use with Caution

Material	Use?	C:N*	Comments
Algae, seaweed, and lake weed	Yes	N	Good nutrient source.
Ash from coal or charcoal	No	O	May contain materials that harm plants. Best to exclude.
Ashes from clean wood (not treated or painted)	Caution	O	Small amounts are acceptable. Large quantities can elevate pH and suppress composting.
Beverages, kitchen rinse water	Yes	N	Use in place of water to moisten the inner pile. May also presoak kitchen scraps. Avoid pouring on surface or over-wetting the pile.
Bird droppings	Caution	N	May contain disease organisms and viable weed seeds.
Cardboard	Yes	C	Use it if it cannot be recycled. Best if shredded into small pieces. Glue is usually organic.
Cat droppings or litter	Caution	N	May contain disease organisms. Best to bury 5 inches deep in noncrop soils at least 100 feet from nearest lake, stream, or well.
Coffee grounds/filters	Yes	N	Worms love them.
Compost activators/ starters	OK; not required.	N	Millions of people make compost successfully without them.
Cornstalks, cobs	Yes	C	Best if chopped and mixed well with green materials.
Diseased plants	Caution	N	Piles often do not heat up enough to destroy all diseases. Compost that might contain diseased plants should be hot-composted, allowed to cure several months, and not be used around plants subject to the disease.
Dog droppings	Caution	N	See "cat droppings" above. Also, may be flushed down a toilet.
Dryer lint	Caution	C	Natural fiber materials only. Scatter thinly into the pile, not in clumps.
Eggshells	Yes	O	Crush them before adding. They break down slowly.
Fish scraps	Caution	N	Potent odor source. Magnet for rodents and other pests unless buried well in the middle of a hot compost pile.
Hair	Yes	N	Scatter thinly into the pile, not in clumps.
Lime	No	O	Add it to finished compost or soil as needed. Can kill composting organisms and can cause release of ammonia gas from compost pile.
Manure (horse, cow, pig, sheep, goat, chicken, rabbit)	Yes	N	Excellent source of nitrogen. If fresh or damp, mix with coarse brown materials.
Meat, fat, grease, oil, bones	Caution	N	Potent odor source. Health hazard to pets. Magnet for rodents and other pests unless buried well in the middle of a hot compost pile.
Milk, cheese, yogurt	Caution	N	Only in small amounts. Mix thoroughly with other materials and bury 8 inches or more deep in a hot compost pile.
Newspapers	Yes	C	Use it if it cannot be recycled. Best if shredded into small pieces. Most inks today are safe for garden use.
Oak leaves	Yes	C	Recommend shredding. Decompose slowly. Acidic.
Pine needles and cones (also cedar, other conifers)	Yes	C	Recommend shredding and using as less than half of pile mix. Decompose slowly. Acidic.
Sawdust and wood shavings	Yes	C	Very high C:N ratio. Recommend using as less than half of pile mix. May need extra nitrogen source. Avoid sawdust and shavings from pressure-treated wood. Use sawdust sparingly.
Sod	Caution	N	Avoid Bermuda sod and other hardy spreading-root sods. Compost separately, grass side down. Cover with black plastic to inhibit sod growth.
Weeds	Caution	N	Avoid roots of Bermuda and weeds that have gone to seed unless they are mixed well inside a hot compost pile. Same for morning glory, ivy, and other plants that spread by runners. It may help to dry them thoroughly on hot pavement.

* C = high carbon, N = high nitrogen, O = doesn't affect C:N balance

- If your pile does not reach 120 degrees Fahrenheit, check to be sure that the particle size is right (see preceding section); that the pile is big enough (a minimum 3-foot diameter and height); and that it has the right balance of green and brown materials, moisture, and oxygen. Building the pile larger, covering it with a tarp or burlap, or putting it in an enclosed bin helps it build up and retain heat.
- If your pile gets too hot (hotter than 160 degrees Fahrenheit), turn it to release excess heat and restore depleted oxygen. Adding water to dry materials as you turn them will reduce overheating and restore needed moisture.
- Heat dissipates at the edges of the pile. There may be 8 inches or more at the outer edges and top of the pile that never reach 120 degrees Fahrenheit, especially in open piles or wire bins. When turning a pile, scrape off this outer layer and mix it into the middle of the new pile to heat the materials.
- Composting thermometers with long probes are available through garden centers.

Importance of Temperature:

The “body heat” of teeming bacteria in a compost pile can build up temperatures of 160 degrees Fahrenheit or more when the materials are still fresh. As the material decomposes, it cannot support as many bacteria. As the number of bacteria decreases, the temperature gradually drops. Temperatures above 130 degrees Fahrenheit kill off most disease organisms within hours, and temperatures above 140 degrees Fahrenheit kill most weed seeds. However, rapid, hot composting depletes oxygen and necessitates frequent turning of the pile. Temperatures rising above 140 degrees Fahrenheit kill off organisms that help with the later stages of composting, thus delaying the curing of the pile.

Typical Composting Systems

Desirable compost bin features are summarized in Figure 2. Remember that successful composting does not require a bin.

Whichever system you adopt, place the pile in an area where it is unlikely to be washed out by rainfall runoff.

Piles: Open or Covered

Approximate Cost:

\$0–\$10 (for optional tarp, black plastic, burlap, or other covering).

Basic Design:

Arrange your materials in a compact mound with a minimum 3-foot height and diameter. Use a covering if desired to help contain moisture and heat.

Homemade Bins:

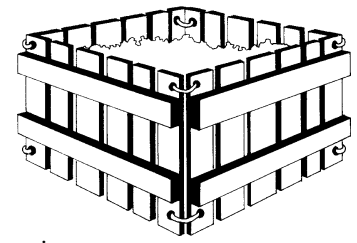
Pallet Bin

Approximate Cost:

\$0–\$10.

Basic Design:

Arrange four used pallets of uniform size and shape to form an open-top box. Usually it works best to set them with the short ends up. Avoid pallets with wide gaps between the boards. Use spare wire or coat hangers, nylon or poly rope, or strapping to lash them together near the top and bottom of each corner. Be sure that the lashing on at least one corner of the bin can easily be undone (if you use rope or strap, use a slip-loop knot, top and bottom) so you can open the bin readily by unfastening one corner and swinging one of the pallets out like a door.



Perforated Garbage Can or 55-Gallon Drum with Lid

Approximate Cost:

\$0–\$30.

Basic Design:

A metal or plastic trash container or drum that has not contained harmful substances, if well aerated with evenly-spaced holes in its side.

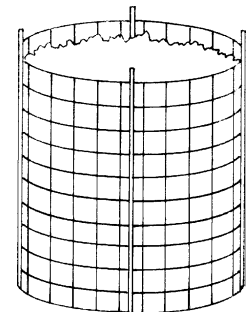
Circle Bins of Wire Fence or Hardware Cloth

Approximate Cost:

\$0–\$50.

Basic Design:

A 12-foot length of wire fence or hardware cloth (at least 3 feet high or higher), available at building materials and hardware stores, can be looped around with its ends overlapped about 1 foot, making a ring (cylinder) between 3 and 4 feet in diameter. Fasten ends with metal clips or wire ties. For safety and ease of opening, roll back and flatten the sharp cut ends of the fencing or hardware cloth before fastening together. Bins made with poultry wire will bulge and collapse unless supported by a sturdy frame.



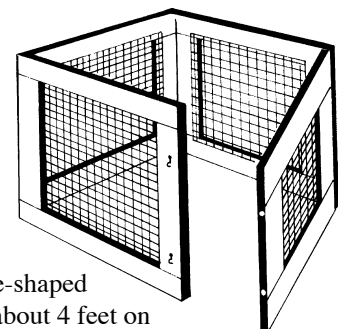
Wooden or Wood-Frame with Wire Mesh

Approximate Cost:

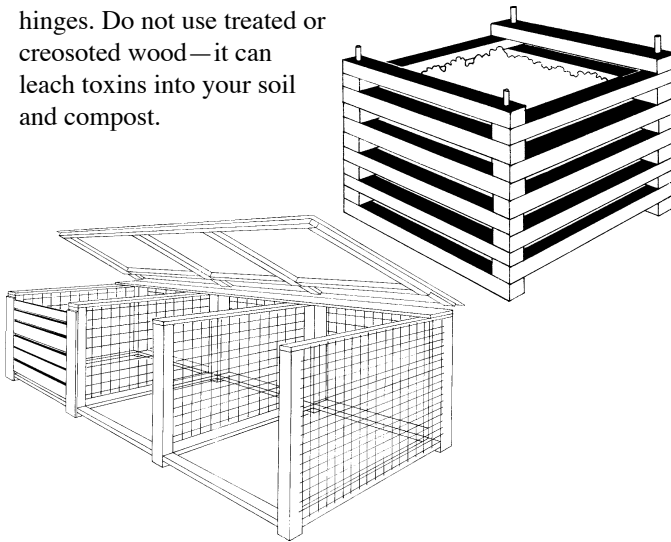
\$0–\$100.

Basic Design:

Any number of designs are possible. Several designs use wood-framed panels of wire mesh for the sides. Another design is a cube-shaped frame of two-by-fours, about 4 feet on each side, with three fixed plywood or board sides, one side a hinged door, and possibly a lid on



hinges. Do not use treated or creosoted wood—it can leach toxins into your soil and compost.



Cinder Block or Brick

Approximate Cost:

\$0–\$100.

Basic Design:

Construct a three-sided square enclosure (at least 3 feet to a side) by laying cinder blocks or bricks in a staggered pattern without mortar. Leave gaps between the blocks for as much aeration as desired. The corners can be braced, if necessary, with fenceposts inserted through the blocks if they are lined up properly. When compost begins spilling out of the open side, it can be contained by propping up boards or laying extra blocks or bricks across that side, one row at a time as the bin fills. When it is time to harvest the compost, that wall can be taken down again.

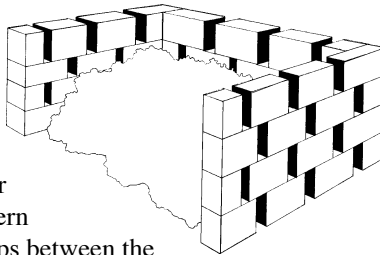


Figure 2. Desirable Compost Bin Features

Capacity. The best composting temperature is reached in a pile or bin of at least 1 cubic yard (3-ft. length, width, and height).

Access. Select a bin design that allows easy access for adding material, for watering, and for turning.

Ease of assembly and relocation. These features allow turning by moving the bin and refilling.

Security. A well-managed compost pile should not attract harmful bugs, but pet and varmit access should be restricted.

Moisture and heat retention. Enclosed bins work better for smaller amounts of material.

Flexible size and adjustable shape. These features will accommodate changes in compost volume.

Aesthetics. This is a very personal consideration for both you and your neighbors.

Manufactured Bins

Approximate Cost:

\$10–\$150.

Basic Design:

Manufactured bins come in a wide variety of designs, including

- hook-together panels of heavy-duty plastic-coated wire fencing or wood-framed wire mesh,
- wooden slats stacked “Lincoln-Log” fashion on metal corner rods,
- flexible sheet-plastic rectangles that loop around to form cylinder-shaped bins, and
- molded plastic units with latching lids and harvesting doors.

Harvesting and Using Compost

When Is Compost Ready?

Using compost before it is ready can damage plants. Undecayed “brown” materials in the soil can temporarily reduce plant-available nitrogen. Undecayed “green” materials can harbor pests and diseases. Immature compost can also introduce weed seeds and root-damaging organic acids. Compost is ready when

- it smells earthy—not, sour, putrid, or like ammonia
- it no longer heats up after it is turned or wetted; and
- it has a crumbly texture and it looks like dark soil.

How to Harvest Compost

Compost can be shoveled out of a pile or bin and used just as it is, especially for mulch. Remove undecayed objects by sifting them through a screen. If you are using compost in preparing soil for planting or sodding, sift it through a 1-inch mesh screen. Compost used in potting mixes or as top-dressing on lawns is commonly sifted through a 3/8-inch or 1/2-inch mesh screen. Make a simple screen by mounting hardware cloth or other durable wire mesh in a sturdy wooden frame that will fit neatly onto the wheelbarrow or other container into which you will screen the compost. Spread compost onto the screen in a thin layer and shake it. You can work the finer material through the screen with a paddle if it is clumpy. Add the “oversized” material that remains on top of the screen to a new pile to help it start composting faster.

How to Use Compost

Information on using compost as a topdressing or mulch can be found in Table 1, “Mulch Application Guide”, on page 4.

The following are rules of thumb. Obtain procedures for using commercial compost from the store where you purchased it or from the manufacturer.

Soil Builder:

Plants benefit most from compost when it is mixed thoroughly with the soil 6 to 12 inches deep. Plants growing in a layer of pure compost have difficulty sending roots down below the compost into the soil. Compost used as a soil preparation should be sifted through a 1/2-inch or finer mesh screen.

■ Flower and vegetable beds and ground covers.

- New areas: dig or till soil to an 8- to 10-inch depth, add a 1- to 4-inch layer of compost, and mix it thoroughly into the tilled soil.
- Established areas: mix 1 to 3 inches of compost into the top 6 to 10 inches of soil before each planting. (It takes one-half cubic yard or 6 bushels to cover 100 square feet to a 1-inch depth.)

■ **Lawns.** Till soil 6 to 12 inches deep and then thoroughly mix in a 1- to 2-inch layer of fine compost (sifted through a 1/2-inch or finer mesh screen) before sodding or seeding.

■ **Trees and shrubs.** Before planting, dig or till 8 to 12 inches deep over the entire planting area—or at least 2 to 5 times the area covered by the root ball. Add and thoroughly mix in a 1- to 4-inch layer of compost.

Potting Mix:

Mix compost into potting soil; compost can be one-fourth to one-third of a potting soil mix in planters or seed-starting flats or pots. Unlike sand, bark, peat, vermiculite, or pumice, compost supplies nutrients and suppresses harmful fungi. Use only mature compost. Sift it through a 1/2-inch or finer mesh screen.

This simple potting soil recipe is acceptable for general use;

- 1/3 compost
- 1/3 sand
- 1/3 healthy top soil

Potting soil recipes for specific types of plants are available from local nurseries and natural gardening manuals.

Compost Tea:

Soak finished compost in water to produce a nutrient-rich liquid for foliar feeding (spraying on plants) or for watering gardens, landscapes, or potted plants. The following are two methods of making compost tea. The “dregs” can be returned to your compost pile.

- Fill an old cloth bag or pillow case with mature compost and tie it off. Soak it in a tub or barrel for one day. Remove and squeeze out the bag. Dilute the compost solution to the color of iced tea.
- Fill a clean 5- to 15-gallon bucket at least half full of manure-based compost, and finish filling with water. Let the mix sit for 3 to 14 days, then strain and dilute to color of iced tea. Compost tea (especially from manure-based compost) is effective against many insect and fungal pests when applied as a foliar spray. Compost tea made with feed-grade molasses is an effective drench for fire ant mounds.

Worm Composting

Worm composting means decomposing materials in a controlled environment where earthworms rather than bacteria do most of the work. Table 4 compares its advantages and drawbacks.

Kinds of Worms

Large soil-burrowing worms such as “night crawlers” can thrive in open outdoor beds, but they do not do well in enclosed containers. Instead, select “red worms,” “red wigglers,” “manure worms,” or “brown-nose worms.” The most widely used species is *Eisenia foetida*. For a list of mail-order sources of composting worms and related supplies, call the Small Business and Environmental Assistance division of the Texas Commission on Environmental Quality (TCEQ) at 512/239-3100.

Materials for Worm Composting

Bedding:

Torn-up paper, including newspapers, junk mail, and cardboard, is an excellent bedding material for worms to live in. Other “brown” materials can serve as bedding, particularly if they are partially decomposed, such as leaf mold. Worms eventually consume their bedding.

Food Scraps:

Almost any material derived from grain, fruit, or vegetable—other than oil—is suitable for worm composting. Egg shells, coffee grounds and filters, and tea bags are also

Table 4. Comparison of Worm Composting with Composting in Large Piles

Advantages of Worm Composting	Drawbacks to Worm Composting
<ul style="list-style-type: none"> ■ It does a faster and more thorough job of composting paper than large compost piles. ■ It takes less work, particularly if paper and food are the main materials to be composted. No heavy lifting or shoveling is involved. ■ It can be done in small containers, even indoors. ■ It creates a product richer in plant-available nutrients than other composts. 	<ul style="list-style-type: none"> ■ It does not destroy diseases and weed seeds, and it does not drive off pests because it does not get hot enough. ■ It requires a larger area to handle large volumes of materials than typical composting piles do.

fine. Worms can eat food scraps more quickly when they have been mashed or cut up or presoaked in leftover beverages. However, avoid saturating the bedding with excess liquid. Worm compost should not be damper than a wrung-out sponge.

Other Materials:

A little soil or fine sand may be needed to provide grit. Livestock manure is excellent food for worms in outdoor containers. Grass clippings can be added in small amounts.

Materials to Avoid or Use with Caution:

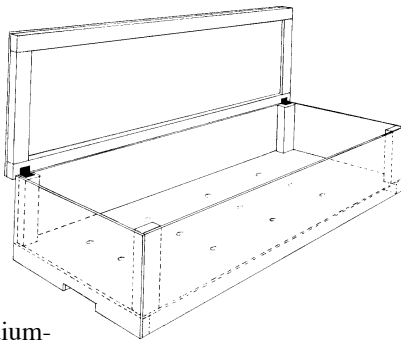
The same as those noted in Table 3 on page 9, a list of compost-pile ingredients.

Containers for Worm Composting

You need enough capacity to contain your food scraps and an equal amount of bedding until some of the compost is ready to harvest (about four months). A wooden box approximately 1 ft. by 2 ft. by 3-1/2 ft., or four 10-gallon plastic containers, may be about right for a medium-sized family. Because materials will be added in thin layers and worked in from above, it helps to use broad, shallow containers.

A 3- to 4-inch “mulch” layer of clean bedding on top is usually effective in keeping small pests out of the food.

A tight-fitting lid that fastens may be needed for outdoor containers visited by large pests like raccoons. However, worm composting containers need to be ventilated to allow oxygen in and excess moisture out. Several 1/8-inch holes drilled in the sides of a wooden box provide enough ventilation. Plastic containers with sealed lids need more ventilation than wooden boxes. Cut two holes 2 inches wide by 4 inches



Steps to Establish a Worm Composting Bin

1. Soak bedding in water and let it drain.
2. Add drained bedding to a bin until it is one-third full.
3. Mix in a little soil or fine sand.
4. Add a pound of worms for each pound of food scraps you compost each week.
5. Add a 1/2 inch or thinner layer of food scraps on top, mix it lightly into the top 3 inches of bedding, and cover everything with 2 inches or more of clean bedding (at least 3 inches if the bin has no lid).
6. Wait two days or longer, and then repeat step 5 as food scraps become available.

Always maintain at least 1 inch of clean bedding covering all food materials.

long in the lid or upper part of the sides of a plastic bin. Cover these holes with fine-mesh screen such as “tree wrap” or stocking fabric, using a hot glue gun or duct tape to attach it. Do not put holes in the lid if the bin will be exposed to rain.

Use soil-burrowing worms for composting in shallow beds in the ground, but fire ant infestations are likely in soil beds unless food scraps are well buried in moist bedding.

Harvesting Worm Compost

When a worm bin is full, scoop out undigested food scraps and the material that contains the most worms—usually the top 6 to 8 inches of the material. Put this worm-rich material in another bin and mix it with an equal amount of fresh bedding; cover the mixture with 2 to 3 inches of clean bedding. Use what is left in the first bin as compost. If you are not sure it is fully composted, let it sit for a few weeks without adding any more food before using it.

There are several ways to recover worms from finished compost.

- Sift the compost over a 3/8-inch or finer mesh screen; save the worms that don't go through.
- Set the compost out in mounds and scrape off the top layer as it dries; the worms will mass at the bottom of each mound.
- In the compost, bury an onion sack or other mesh bag containing a favorite worm food such as rotten apple or banana for a day or two as a “worm trap,” and pull it out before harvesting the compost.
- In a large bin, move older material to one side and add fresh material to the other side; most of the worms will migrate out of the older material before it must be harvested.
- Lay compost on an old window screen above an empty garden space and wash the compost through with a spray nozzle, leaving clean worms on top.

Composting worms that are not removed from compost can thrive in the moist bottom layer of a mulch cover in your yard or garden.

Preventing Problems

- Worms can double in population every 90 days. You should never need to add more worms unless you suddenly increase the amount of food you compost.
- Immediately store food scraps that are awaiting composting in a sealed container or refrigerate them to keep them free of pests.
- Add food scraps to the bin in small amounts, especially at first. Otherwise your bin may get smelly or moldy, or it may start hot composting and drive out your worms.
- Keep your bin in a shaded or sheltered location where the bedding can stay below 90 degrees Fahrenheit. If the compost must be in an area that gets hot, a large wooden box with a good amount of compost and bedding in it will resist heating better than a small plastic bin.

- Don't let the bedding become soaking wet. Add dry paper as needed to soak up excess water in the bin.
- Keep the bedding damp like a wrung-out sponge. Old, dry bedding harbors roaches and other pests, and is difficult to re-wet.
- Handle the worms and their bedding gently—with gloved hands or a weeding fork, not a shovel.
- Wash your hands after you handle worm compost.

Composting in the Ground

Putting materials on or into the ground without composting them saves you time and effort, and burying the materials stops odor problems fast.

Walkway Composting

Spread a thick layer of leaves, chipped branches, and grass clippings into shallow ditches or rows between garden beds to form walkways. Add more material later as it compacts. In a few months, most of this material will decompose enough to incorporate it into the garden soil when it is reworked for planting.

Sheet Composting

A few inches of leaves can be tilled into fallow garden space in the fall to enrich the soil for spring planting. Avoid sheet composting just before planting. Much of the soil's plant-available nitrogen will become temporarily unavailable as composting microbes consume it along with the brown leaves. A few months after sheet composting, there will be more plant-available nitrogen in the soil than before.

Burying Food Scraps

This practice is a useful way to compost food or other high-nitrogen materials that have become smelly. The material should compost within a year without releasing odors or harboring pests. Material buried too deep, however, decomposes more slowly and benefits plants less. There are several variations; here are two:

- In "trench composting," put food scraps in trenches 12 to 18 inches deep, mix into the soil, then bury under 8 inches of soil (see Figure 3). After one year, planting rows or beds are created above these trenches. Some gardeners lay out garden rows or beds in groups of three, so that each row or bed spends one year as a trench for food scraps, the next as a planted row or bed, and the next as a mulched walkway.
- In "compostholing," place kitchen scraps mixed with soil in postholes or other narrow holes 12 to 18 inches deep and bury under 8 inches of soil (see Figure 4). These "compostholes" can be placed in any fallow landscaping or garden space. Some people prefer to place them around the driplines of trees and shrubs.

Burying Pet Droppings

Most manures (horse, cow, pig, sheep, goat, poultry, rabbit) are safe to compost in piles or worm bins. Cat, dog, and bird droppings, however, can contain disease organisms that infect humans. Bury them at a depth of 5 to 8 inches. Avoid burying them where food crops grow or where they are likely to be washed out by rain water.

Figure 3. Trench Composting

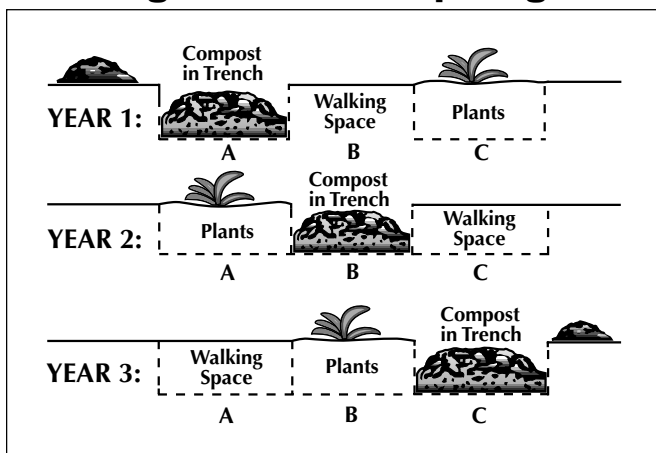
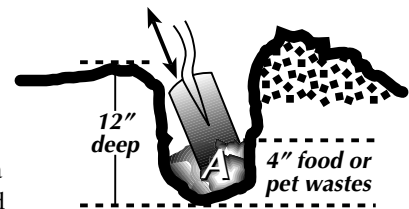
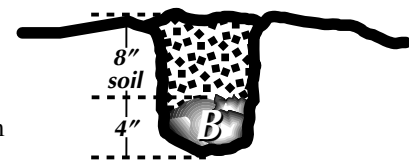


Figure 4. Burying Food or Pet Wastes

To bury food or pet wastes, first dig a hole about 1 foot deep. Put 3 – 4" of the material at the bottom of the hole, and use a shovel to chop and mix the wastes into the soil (A):



Then cover the material to keep rodents and pets from digging them up (B):



Green Landscape Design and Yard Care

(For additional information on the care of lawns, gardens, and landscapes, consult your county extension office, city environmental office, local garden center, and various gardening publications. These sources can help you select and perfect “green” yard care practices that are appropriate to your climate, soil, and other local features.)

Basics

Now you’re ready to build on your foundation of healthy soil restored by grasscycling, mulching, and composting. The following strategies will boost the health of your yard and garden, and they will minimize pests, water and chemical usage, soil erosion, runoff, and pollution.

- Put the right plants in the right places—using native and adapted plants and grasses.
- Be water wise—avoid watering wastefully, too rapidly, or too often.
- Use “integrated pest management” to control pests with a minimum of chemical pesticides.

The Right Plants in the Right Places

Start with a Plan

Begin with a well-planned design. Sketch your yard showing the location of existing structures, trees, shrubs, and grass. As you plan, consider budget, appearance, function, maintenance, and water requirements.

Grow Native Landscape Plants

Native plants are the best choice for trouble-free gardening. They need less water and fertilizer, and have fewer pest problems than plants imported from other areas.

Select Appropriate Grasses

Carefully select grasses according to their intended uses, planting location, and maintenance requirements (see the sidebar “Selected Lawn Grasses”). Grasses require more frequent watering and maintenance than most other landscape plants.

Reduce Thirsty Turf Grass Area

In most landscaped areas, turf grasses have the highest water demand and the highest maintenance requirements of all plants. Alternative plant areas and other forms of ground cover can reduce your ongoing expenditures of time, energy, and money. Group plants that have similar watering needs to prevent overwatering and excessive plant growth.

Practice Garden Diversity

Incorporate a variety of plants. Diverse plantings provide food and cover for a variety of living things. Diversity minimizes damage from pests because many attack only one plant species.

Install Low-Maintenance Design Features

Lawn edging and hard surfaces between turf and other landscape features reduce weeds, trimming, and use of herbicides. Dense plantings provide shade that keeps out invading weeds. Avoid narrow strips or odd shapes of turf grass that will be difficult to irrigate without wasting water.

Minimize Soil Disturbance

Avoid frequent, deep cultivation, which can damage plant roots, dry out the soil, disturb healthy soil organisms, and bring weed seeds to the surface where they will germinate.

Design Your Landscape to Minimize Runoff Pollution

Take note of slopes, and consider including buffer zones of turf grass or other thick vegetation to absorb runoff from buildings and patios, and to reduce runoff into driveways and streets.

WaterWise

Much of the water applied to lawns and gardens is never absorbed by plants. The greatest waste of water results from applying it too rapidly or too often. Water applied too rapidly

Selected Lawn Grasses

- Buffalo Grass. This is the only native Texas lawn grass and is the best choice for full sun. It requires little water and fertilizer. Left to grow uncut, this prairie grass reaches a maximum height of 6 to 12 inches. Buffalo grass needs at least six hours of sun per day. It takes one to two years to establish it from seed.
- Bermuda Grass. This popular grass is easy to maintain and inexpensive to install. It only grows in full sun. It can be a problem because it spreads into planting beds. Common Bermuda grass is less susceptible to diseases and insects than other Bermuda varieties.
- Zoysia Grass. A slow-growing grass for full sun to partial shade, zoysia grass is exotic looking with dark green, thick, and succulent foliage. Zoysia grasses are less drought tolerant than buffalo and Bermuda grasses.
- St. Augustine Grass. A wider blade than Bermuda grass, it can tolerate more shade, but it will not do well in heavy shade. St. Augustine requires more water and care than other grasses and is susceptible to freeze and disease.

is lost as runoff, which may carry polluting fertilizers and pesticides to streams and lakes. Some water evaporates when applied to bare, unmulched soil, or in the hot afternoon.

Basics

- Water thoroughly, but only as needed—monthly for trees, shrubs, and ground covers, every week or so for lawns.
- Water early in the morning to prevent diseases and to minimize evaporation.
- Use drip irrigation where possible to minimize evaporation.
- Avoid wasting water on sidewalks and other paved areas. Also, try to keep water from running off your yard.
- Set sprinkler head to spray large droplets, not fine mist.

Watering Lawns

The key to watering lawns is to apply the water infrequently, yet thoroughly. This creates a deep, well-rooted lawn that efficiently uses water stored in the soil. See the “Grasscycling” section on page 1 for more details.

Watering Trees, Shrubs, and Ground Covers

As with lawns, apply water infrequently yet thoroughly. In the absence of rain, most trees, shrubs, and ground covers benefit from a thorough monthly watering during the growing season. Move a slow-running hose from point to point along the dripline of each plant until each area becomes saturated to a depth of 8 to 10 inches.

Drip Irrigation

Drip irrigation is more efficient than using a sprinkler. Drip irrigation slowly applies water to the soil. The water flows under low pressure through emitters, bubblers, or spray heads placed at each plant. Water applied by drip irrigation has little chance of waste through evaporation or runoff.

Sprinkler Irrigation

Make sure that sprinkler heads are properly adjusted to avoid watering sidewalks and driveways. A sprinkler head should spray large droplets of water instead of a fog of fine mist, which wastes water by evaporation and wind drift. Water early in the morning when possible. Avoid watering from mid-morning to late afternoon—you can lose one-third of your water to evaporation. Avoid watering in the evening because lawns and plants left wet overnight are more prone to disease.

Integrated Pest Management (IPM)

Practicing “green landscaping,” including efficient watering, planting, soil building, will significantly reduce your pest problems. When, despite your best efforts, unwanted pests sometimes take hold, the steps outlined in this section provide a strategy to control pests with a minimum of harm to your health, your pocketbook, and the environment.

Basics

- Identify the problem before taking action. Pests are often a symptom of plant stress caused by conditions such as poor soils, too much or too little moisture, or the wrong plant for the location. If so, the first step is to address the cause of plant stress.
- There are landscaping features that attract and support natural predators to keep pests under control, particularly a water source and a variety of perennial plants.
- Use the least-disruptive and least-polluting protections against a pest before resorting to more polluting methods. In general, try the following methods as applicable: first, physical removal, barriers, and traps; next, biological controls; then, appropriate botanical and mineral pesticides; and finally, the least toxic chemical pesticides.
- Carefully follow safe use and disposal instructions for all pesticides. Always store pesticides in original containers away from food and out of reach of children.

Identify the Problem

Before considering what control measure to use, identify what is harming your plants. Keep in mind that insect infestations and diseases are often not the main problem, but rather a symptom of stress caused by poor growing conditions such as sterile or compacted soils, nutrient deficiencies, too much or too little moisture, or a poorly adapted plant for the climate or the particular landscape conditions. Simply correcting the stressful condition may control the pest and prevent further infestations. Your county extension office, local nurseries, and gardening books can help you diagnose your landscape problems.

Know a Friend from a Foe

Nature has a system of checks and balances that limits pest activity. Of the millions of kinds of insects in the world, less than 2 percent are harmful. Beneficial insects such as ground beetles, ladybugs, fireflies, green lacewings, praying mantids, spiders, and wasps keep harmful insects from devouring your plants. They also pollinate your plants and decompose organic matter. Chemicals may harm beneficial insects more than unwanted pests. Organic gardening books identify beneficial insects and provide tips on how to avoid interfering with them.

Use Appropriate Controls

The control depends on the problem. Options include removal by hand, barriers, repellants, traps, biological controls, and least-polluting chemical controls.

Removal

The only 100-percent effective, species-specific pesticide is removal by hand. Watch plants carefully for signs of damage. You can catch invading pests before they do much harm. Don't run for a can of pesticide when you could pick off and mash a few harmful insects. A blast of water can strip

Creating a Haven for Beneficial Insects

Beneficial insects will come to the landscape if they are provided the following.

Water. This could be as small as a bowl or bird bath or as large as a pond, just as long as it is available and filled with fresh water all year. Be sure to keep the water fresh; stagnant water attracts mosquitoes and other insect pests.

Shelter. Every animal needs shelter to protect it from enemies and raise its young. To build “houses” for beneficial insects, grow a variety of plants, including annual flowers, perennial flowers, bulbs, grasses, small shrubs, large shrubs, and deciduous and evergreen trees. The beneficial insects will find their niches.

Food. Pollen and nectar sustain some insect predators when insects are not available to eat. Vertebrates, such as birds and squirrels, enjoy fruits, grain, and seeds, especially during the winter. Once beneficial insects, birds, and animals get to know a particular landscape as a place to find food all year, they will come back.

aphids from your plants. Use pruning shears to remove tent caterpillars. Pruning and removing diseased leaves, branches, or whole plants can stop the spread of diseases. Uproot weeds that have spreading roots; chop the others with a hoe or pop them with a mechanical weed-puller.

Barriers

Barriers, like a screen door on a kitchen, don’t kill pests but keep them out.

■ **Floating row covers.** These are thin, lightweight pieces of fabric or plastic that are placed over growing plants. They allow light, air, and water to reach plants, but keep insects off. Drape them over plants, and secure the covers on the sides with stones or soil. As plants grow, they push the fabric up.

■ **Netting.** Netting is good for keeping birds off plants, especially as they come into fruit.

■ **Copper slug barrier.** Slugs cannot cross a 3-inch wide sheet of copper. Cut sheet copper to size and attach to raised beds or planters. This method also keeps slugs in, so be sure to remove any slugs first. Apply banding vertically (like a fence) rather than horizontally (like a floor). The copper remains effective after it turns green. The up-front investment is repaid in long-term, effective slug control.

■ **Protective collars.** Protect individual seedlings from cutworms with a 3-inch collar made from stiff paper or plastic pressed 1 inch into the ground. (Toilet paper tubes work well.)

Repellants

Herbal pest repellants include garlic and hot-pepper sprays, which can be made by processing these herbs with

water in a blender and straining out the pulp. You can add a few drops of soap, which is toxic to soft-bodied insects.

Traps

Traps work by attracting a target pest into a container from which it cannot escape. Place traps away from your garden so that pests don’t eat your plants before they get to the trap. Electric “bug zappers” destroy many more beneficial insects than harmful ones. Use traps that attract only the insects that are causing you problems.

■ **Sticky traps.** These use a sticky surface with one or more attractants such as color, smell, or shape to bring the target pests in and keep them there.

■ **Japanese beetle trap.** Japanese beetles are attracted to a fermenting mush of mashed fruit and sugar water or wine, with some yeast to spur fermentation. Cut the necks off 1-gallon plastic jugs and fill one-third full with the fermenting mixture. Strain out the beetles regularly and reuse the mixture.

■ **Slug and snail trap.** Set out a bait of stale beer, spoiled yogurt, or a mixture of yeast and water in saucers or tuna cans. Bury with the lip of the container level with the soil surface, so the pests fall in and drown. Put a raised cover over the trap to keep rain from diluting the beer and to keep large animals from drinking it.

Biological Controls

Using living organisms (for example, beneficial insects and animals, parasitic nematodes, and microorganisms) to control pests is called biological control. It is the essence of a balanced ecosystem, whether in the forest or in the backyard. A good integrated pest management (IPM) plan takes the fullest advantage of the beneficial species that are naturally present.

Table 5 shows some of the biological control agents that you can buy. Their effectiveness depends on the time, location, and manner in which they are released. Obtain detailed instructions before releasing these agents.

Least-Polluting Chemical Controls

Using IPM practices can eliminate the need for pesticides. But you may at times choose to use them as a last resort. All

Table 5. Selected Biological Control Agents

Control Agent	Target Pests
Ladybird Beetles (Ladybugs)	Aphids, small worms, and other soft-bodied insects
Lacewings	Aphids, scales, spider mites, and other soft-bodied insects and eggs
Predatory Mites	Spider mites and other pest mites
Trichogramma Wasps	Moth and butterfly eggs
Bacillus thuringiensis (Bt)	Larvae of moths, butterflies, mosquitos, and other pests

Table 6. Selected Botanical Pesticides: Targets and Toxicity

Botanical	Targets	Human Toxicity
Insecticidal Soaps	Soft-bodied insects like aphids, scales, and mites	Very low
Pyrethrum/Pyrethroids	Most insects	Moderate
Rotenone	Most insects; best used against leaf-eating caterpillars and beetles	Low; very toxic to fish
Ryania	Most insects; best used in hot weather	Low; moderately toxic to some animals
Sabadilla Dust	Most insects; works for adult insects not controlled by other botanicals	Very low; but lethal to honey bees
Nicotine Sulfate	Most insects	Extremely toxic; use only as last resort

pesticides are toxic to some living things and often indirectly affect other living things.

■ Botanical pesticides (see Table 6), almost all of which are insecticides, are derived directly from plants. Some are more toxic than others, and a few are even more toxic than some synthetics. However, many synthetic pesticides are persistent in the environment—that is, they take a long time to break down into harmless substances—but all botanicals break down rapidly, usually in a matter of hours or days. Also, some synthetic pesticides accumulate in the food chain—that is, they concentrate in the tissues of predators that eat the poisoned pests—but botanicals are not known to do so.

■ Mineral pesticides. Dormant and horticultural oils are low-toxicity mineral products used to suffocate insects and their eggs on plants. Powdered diatomaceous earth is a highly abrasive material used to damage the skin and body joints of insects and to create slug barriers.

■ Synthetic pesticides are chemical compounds invented in a laboratory. Some are more toxic than others, some are longer-lasting than others, and some release compounds that are more toxic than the original pesticides when they break down in the environment. Some accumulate in the environment and cause harm far removed from the original site or purpose of application. Others, called persistent materials, do not break down for long periods of time and remain in the soil or water.

When Using Pesticides

- 1.** Read and follow all label directions. Never use more than is recommended.
- 2.** Protect yourself. Wear a long-sleeved shirt, long pants, boots, rubber gloves, goggles, a hat, and a respirator when mixing and applying pesticides.
- 3.** Never apply on a windy day or when rain is forecast.
- 4.** Only mix as much as you will use in one day.
- 5.** Dispose of unwanted pesticides safely. If possible use up all of the pesticides, or give them to someone who can use them. If you still cannot get rid of the pesticides, take them to a household hazardous waste collection facility or event. Never pour pesticides down the drain, into a storm drain, or directly on the ground. For more information about household hazardous waste

collection and disposal, contact the TCEQ’s Small Business and Environmental Assistance division at 512/239-3100.

- 6.** Dispose of empty containers properly. When a product label says to “triple rinse the container,” rinse it three times, pour the rinse water into the sprayer, and apply it to the target area according to the label instructions. Do not pour the rinse water down the drain or onto paved surfaces. Wrap empty and rinsed containers in newspaper and dispose of them in your trash can. Home-use pesticide containers are not acceptable in most community recycling programs. For information on recycling programs for empty pesticide containers, call the TCEQ’s Agricultural Waste program at 512/239-3100, or your county extension agent.

Your Yard and Clean Air

Small Engines—Big Problems

Most people do not associate air pollution with mowing the lawn. Yet emissions from lawn mowers, chain saws, leaf blowers, and similar outdoor power equipment can be a significant source of pollution. Today's small engines emit high levels of carbon monoxide—a colorless, odorless and poisonous gas that results from incomplete fuel combustion. Infants and people with heart disease or respiratory problems are especially sensitive to carbon monoxide poisoning.

Small engines also emit hydrocarbons and nitrogen oxides, which are pollutants that contribute to the formation of ozone and acid rain. While ozone occurs naturally in the upper atmosphere and shields the earth from harmful radiation, ozone at ground level is a noxious pollutant. Ground-level ozone impairs lung function, inhibits plant growth, and is a key ingredient of smog.

New Regulations—Part of the Solution

The U.S. Environmental Protection Agency (EPA) and the power equipment industry are working to implement new provisions of the federal Clean Air Act that place increasingly strict emission requirements on small nonroad engines. Before a regulated engine can be sold in the U.S., the manufacturer must provide test data and other information demonstrating that the engine model meets the applicable emission standards, and must receive a certificate of conformity from the EPA.

The EPA requires that the engine manufacturer label each certified engine to indicate compliance with the rule for small spark-ignition engines. Emission labels on the engine or elsewhere may read “This engine conforms to Phase 1 (or Phase 2) U.S. EPA regulations for small nonroad engines.” Some engine labels will indicate compliance with both EPA and California (stricter) regulations.

Pollution Prevention in Your Own Back Yard

Many people who use power equipment unintentionally contribute to air pollution by carelessly handling fuel and by improperly maintaining their equipment. By adopting simple, common-sense practices, consumers can help protect the environment now and in the future.

Avoid Spilling Gasoline

Preventing spills and overfills is an easy and effective way for power equipment owners to prevent pollution. Even small gasoline spills evaporate and pollute the air. Here are some tips:

- Use a gasoline container you can handle easily and hold securely. Pour slowly and smoothly.
- Use a funnel, or a spout with an automatic stop device to prevent overfilling the gas tank. Keep the cap or spout and the vent hole on gasoline containers closed tightly.
- Transport and store gasoline and power equipment out of direct sunlight in a cool, dry place.
- Use caution when pumping gasoline into a container at the gas station.

Maintain Your Equipment

Follow the manufacturer's guidelines for maintenance, including the following practices:

- Change oil and clean or replace air filters regularly. Be sure to recycle your used oil at a collection center. To locate a used-oil recycling center near you, call 1-800-CLEANUP, or go to www.cleanup.org.
- Use the proper fuel/oil mixture in equipment with two-stroke engines.
- Get periodic tune-ups, maintain sharp mower blades, and keep the underside of the deck clean.
- Make sure your equipment is protected from the elements when not in use.

Consider Cleaner Options

Ask your dealer about the new, cleaner-operating gasoline equipment entering the marketplace. Electric equipment is cleaner than equipment powered by gasoline engines. Electrically powered lawn and garden tools produce essentially no pollution from exhaust emissions or through fuel evaporation. However, generating the power to run electric equipment does produce pollution.

Use Manual Tools

Tools without electric or gasoline engines are especially handy for small yards or small jobs. Hand tools—like shears, edgers, and reel push mowers—are lightweight, quiet, easy to use, and generate no emissions.

Reduce Mowing Time

- Use low-maintenance turf grasses or grass-and-flower seed mixtures that grow slowly and require less mowing. See the “Selected Lawn Grasses” section of this guide, or check with your local Texas Cooperative Extension office or lawn and garden center about what is appropriate for your region.
- Replace turf grass areas with native and adapted trees, shrubs, and flowers. Doing so reduces the energy needed to heat and cool your house, and it provides landscaping for wildlife. Native wildflowers and plants require little or no maintenance after planting.

For more information on small gasoline equipment for lawns and gardens, go to this EPA Web site:

www.epa.gov/otaq/equip-ld.htm

For More Information

General

Texas Commission on Environmental Quality
www.tceq.state.tx.us

Texas Cooperative Extension
<http://texasextension.tamu.edu>

Composting

General Composting

Environmental Protection Agency
<http://www.epa.gov/epaoswer/non-hw/compost/index.htm>

Cornell Composting

Cornell University's Waste Management Institute
www.cfe.cornell.edu/compost/Composting_Homepage.html

Don't Bag It™ Program

Texas A&M University
Slides on leaf management: <http://aggie-horticulture.tamu.edu/earthknd/compost/compost.html>

Composting guide index: <http://aggie-horticulture.tamu.edu/extension/compost/compost.html>

Backyard Composting

www.MasterComposter.com™
Mary Tynes
3941 Legacy Drive,
Suite 204, #197-B
Plano, TX 75023-8320

Worm Composting (Vermicular)

Worm Digest
P.O. Box 544
Eugene, Oregon 97440-0544
Phone and Fax: 541/485-0456
E-mail: mail@wormdigest.org
www.wormdigest.org

Mary Appelhof's Site for Worm Composting Resources

10332 Shaver Road
Kalamazoo, MI 49024
Phone: 269/327-0108
Fax: 269/327-7009
www.wormwoman.com

Xeriscaping

Aggie Horticulture
<http://aggie-horticulture.tamu.edu/plantanswers>

EPA's Green Landscaping with Native Plants
www.epa.gov/greenacres

Integrated Pest Management

Integrated Pest Management Practitioners' Association
Phone: 541/345-2272
E-mail: ipmpa@efn.org
www.efn.org/~ipmpa

Small Gasoline Equipment for Lawns and Gardens

Environmental Protection Agency
Lawn and Garden (Small Gasoline) Equipment
Phone: 734/214-4636
E-mail: asinfo@epa.gov
www.epa.gov/otaq/equip-ld.htm

Sources

- U.S. Environmental Protection Agency, Office of Transportation and Air Quality
- Composting Council
- Texas Agricultural Extension Service
- Integrated Pest Management Practitioners Association
- *The Secret Life of Compost*
by Malcolm Beck
- *The Rodale Guide to Composting*
by Jerry Minnich et al.
- *Don't Waste Your Wastes—Compost 'Em*
by Bert Whitehead
- *The Dirt Doctor's Guide to Organic Gardening*
by Howard Garrett
- *Worms Eat My Garbage*
by Mary Appelhof
- *A Guide to Alternatives to Pesticides*
by Environmental Services, City of Portland, Oregon
- *Rodale's Encyclopedia of Organic Gardening*
- *The Nature and Properties of Soils, 8th Edition*
by Nyle C. Brady

For more information, contact:

Small Business and Environmental Assistance Division, MC 113
Texas Commission on Environmental Quality
PO Box 13087
Austin TX 78711-3087
512/239-3100
www.tceq.state.tx.us

The TCEQ is a partner with the private sector, the U.S. Environmental Protection Agency, and other states to provide citizens with environmental information about their communities. An automated system provides a single source of environmental and recycling information over the Internet and through a state-of-the-art, computerized, interactive phone system. People can call 1-800-CLEAN-UP then enter their five-digit ZIP code to get information on topics such as these:

- local recycling information
- environmental events
- household hazardous waste collections

This information is available 24 hours a day using the interactive phone system or the Internet. If a community or county is not listed, citizens can add it to the system. For more information on the system, contact:

1-800-CLEAN-UP
www.1800cleanup.org

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