



Growing Healthy Soil



A lush garden scene with a gravel path, yellow and red flowers, and green foliage. The path is made of grey gravel and leads through a variety of plants, including yellow daisies, red flowers, and green foliage. The background is filled with dense greenery and trees.

Healthy Soil

An Investment In Your Garden

Did you know that by simply improving your soil, you can beautify your garden, cut your water bill, improve water quality in our streams, and even reduce your work? Growing healthy soil — and a healthy garden — is as easy as adding compost and other organic amendments to your soil. In fact, this is the single most important thing you can do for your garden.

Compost is the dark, earthy material naturally produced by decaying plants and animal wastes. This mix of living and dead organic matter supports an intricate web of soil life, which in turn keeps your soil loose, moisture-holding, fertile and well-drained.

The following three steps for growing healthy soil are explained in this guide:

- Before planting, amend the soil throughout the entire planting area with compost.
- Mulch existing plantings with compost, leaves, grass clippings and woody mulches.
- When you need to feed plants, use natural organic and slow-release fertilizers.

Understand Your Soil

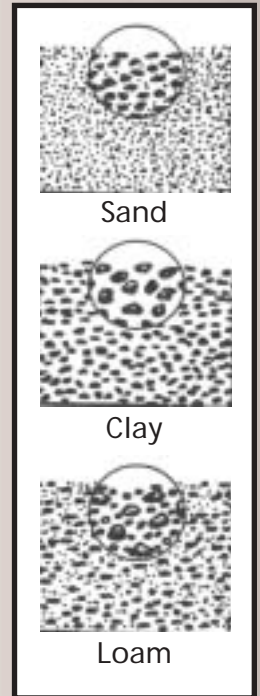
“Dirt” is the mineral portion of the soil that supports plants, supplies nutrients and stores water. There are three general types of soil determined by the size of the soil particles. This affects how the soil functions. You may have more than one kind of soil in different areas of your garden. **Sandy soils** contain large particles that are visible to the naked eye. They feel gritty and will not form a ball when squeezed in your hand. Sandy soils are loose and drain easily, but do not store water or nutrients for plants. **Clay soils** are made of tiny particles that feel sticky when wet and dry into dense chunks or fine powder. They hold nutrients and water well, but drain poorly. **Loamy soils** are a mix of sand, clay and organic matter. When squeezed in your hand, moist loam forms a ball which crumbles when poked with a finger. Loamy soils are generally loose, well-drained and able to store moisture and nutrients.

Air and water are essential elements that transport nutrients to plants and carry away waste. Together, they make up half the volume of healthy soil. Compacted or heavy clay soils may not have adequate space for air and water to move freely to plant roots.

Organic matter and soil life make up just a small part of the soil volume, but are the glue that holds healthy soil together. Decomposing plant materials, like compost, support a great variety of beneficial organisms ranging from microscopic bacteria to earthworms.

Organic matter and soil life keep plants healthy by:

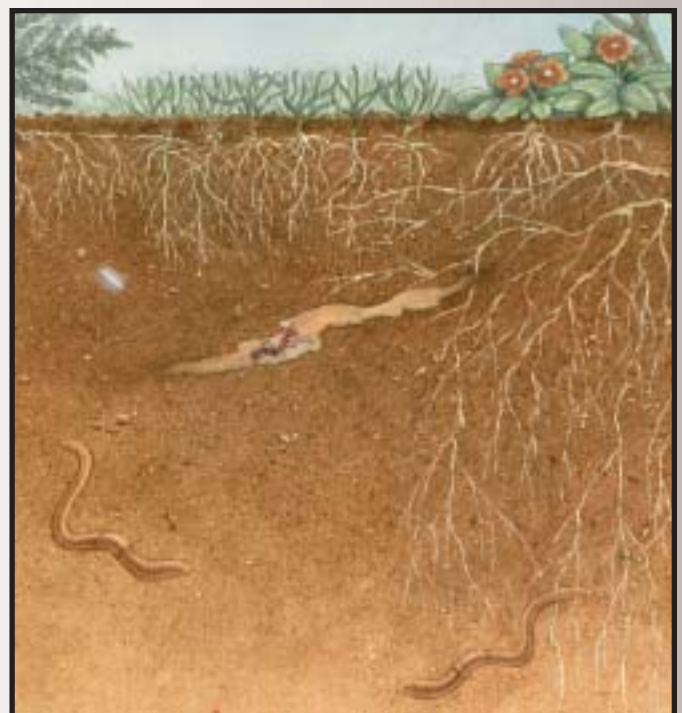
- Supplying balanced nutrients to growing plants;
- Fighting plant diseases and pests;
- Storing fertilizers and natural nutrients for gradual release, while preventing them from washing into water bodies;
- Storing water, which reduces runoff and your garden’s irrigation needs;
- Making clay soils better drained and easier to work; and
- Trapping and breaking down pesticide residues and polluted runoff.



Protect your soil’s health!

Excessive use of chemicals, overwatering and soil compaction can harm beneficial soil organisms and reduce their ability to keep soil healthy.

- Think twice before using pesticides that may damage soil life.
- Don’t overfertilize. More is not better.
- Avoid overwatering. Too much moisture can promote plant disease and exclude air from roots.
- Prevent soil compaction by walking on garden beds as little as possible, keeping heavy equipment and cars off lawns, and minimizing the use of rototillers.



Enrich Your Soil Before Planting

The best way to improve the soil is to add plenty of compost or other organic matter throughout the entire planting area before planting. Thoroughly mixing these materials deep into the soil helps provide water, air and nutrients to plant roots.

When?

Mix in organic material before:

- planting lawns, perennials, trees and shrubs;
- replanting annual beds;
- dividing perennials; and
- repotting container plants.

How?

Use a shovel or digging fork to mix amendments into the top six to 12 inches of soil. **It is important to amend the entire planting bed — not just small holes for each plant.** When planting individual trees and shrubs in lawns or existing beds, amend an area at least three feet wide, or at least four to five times as wide as root balls more than 12 inches in diameter. Rototill large areas where digging is impractical.

What?

Different types of organic amendments may provide special benefits for certain plants or soil types, as the chart below describes. But any clean composted or aged organic amendment will improve the soil. The best advice is to use what is reasonably priced, plentiful and readily available.

Recommended amount of compost to mix into each 100 SQUARE FEET of planting area
Lawns: mix compost down to six-inch depth Clay soils: 8 cubic feet (.3 cubic yard) = one inch layer of compost Sandy soils: 13 cubic feet (.5 cubic yard) = 1.5 inch layer of compost
Gardens: mix compost to 10- to 12-inch depth Clay soils: 16 cubic feet (.6 cubic yard) = two inch layer of compost for new gardens. Use one inch per year in established gardens. Sandy soils: 24 cubic feet (.9 cubic yard) = three inch layer of compost for new gardens. Use one - two inches per year in established gardens.

How Do I Know Good Compost?

Poor quality compost can introduce weeds to a planting bed and make nutrients unavailable to plants while it finishes decomposing. Signs of good compost are:

- sweet, earthy smell;
- dark brown or black color;
- fibrous texture (like peat); and
- no weed sprouts, mushrooms or other growths.

Which Soil Amendment to Use?

AMENDMENT CHOICE.....PROS AND CONS

Best All-Purpose Materials

Compost made from yard debris, biosolids or barnyard manureRecycled and readily available. Balanced nutrients. Yard trimmings can be composted at home. Properly composted materials are free of weeds, pests and diseases.

Leaves (composted or fresh)Free. Rich in nutrients. Usually contain a few weed seeds.

Other Materials

Aged bark or sawdustImproves drainage in clay soils. Good for trees and shrubs. Fresh materials must be composted until dark brown in color, or they can tie up nutrients and inhibit plant growth.

Peat mossImproves moisture and nutrient storage in sandy soils, but does not support soil life.

Coconut coirImproves moisture and nutrient storage in sandy soils, but does not support soil life. Renewable product from coconut palms.

Topsoil mixesGood for raised beds on top of compacted or poorly drained soil. May contain poor fill soil or weeds. Best to use mixes containing only compost and clean sand.



Mulch Your Plantings

Mulch refers to a material placed on the soil surface. Although usually organic, mulches also can be products such as landscape fabric. Mulches reduce evaporation, limit weed growth and limit soil erosion that can choke streams and fish. Most mulch products provide these benefits, but organic mulches — such as compost or bark — can be especially beneficial because earthworms and other soil life gradually break them down, mixing them into the soil to nourish plants.

When?

- Apply annually or as needed.
- Mulch in early summer to conserve moisture, feed plants and prevent weed seeds from sprouting.
- Mulch in fall to protect soil from erosion, smother weeds and retain warmth.

How?

- Remove weeds and grass before spreading mulches.
- Use porous weed barriers such as woven landscape fabric or cardboard to smother aggressive perennial weeds before mulching.

Where?

- Mulch annual and perennial planting beds, as well as the surface of container plantings.
- Cover entire tree and shrub planting beds, or make mulch rings at least three feet wide around each plant in lawns.

How Much?

- Grass clippings: 1/2 to one inch deep.
- Compost, leaves, sawdust or medium- or fine-ground bark: one to two inches deep.
- Coarsely shredded bark, wood chips or tree trimmings: two to four inches deep.

Note: One cubic foot of mulch covers 12 square feet one inch deep. One cubic yard will cover 324 square feet one inch deep, or 108 square feet three inches deep.

Mulch Choice	Pros and Cons
Annuals, Perennials, Berries and Roses	
<i>Annuals and perennials benefit from mulches like compost, aged manure or grass clippings which feed plants quickly, and can be mixed into the soil without tying up nutrients.</i>	
Composted yard debris, bark, barnyard manure or biosolids	Neat appearance. Important to use aged manure or quality compost that is free of weed seeds.
Leaves and grass clippings	Free and readily available. May spread weed seeds or disease. For a finer texture, leaves can be composted or run over with a lawn mower before being applied. May be considered unattractive.
Other Shrubs and Trees	
<i>The best mulches for shrubs and trees are coarse, woody materials that protect the soil for a year or longer, slowly releasing nutrients for steady plant growth.</i>	
Fresh bark	Tidy appearance and readily available. May inhibit growth of some plants.
Sawdust/wood shavings	Usually free. Best if aged. Cannot be from chemically treated lumber. May be considered unattractive.
Wood chip/shredded prunings	Natural look. Free and readily available. May spread weed seeds or disease.
Cardboard or newspapers layered under other mulch materials	Decompose to feed soil. Aggressive weeds may grow through.
Woven fabric weed barrier	Long lasting, but does not break down to feed soil. May get tangled in weeding hoes. Aggressive weeds may grow through fabric over time.



Fertilize Moderately and Responsibly

Fertilize moderately with natural organic and slow-release fertilizers to grow healthy, easy-to-maintain plants. Too much fertilizer can produce excess growth that is easily damaged by pests, wind, frost and drought. Many of the nutrients in quick-release fertilizers may wash off to pollute lakes, streams and groundwater.

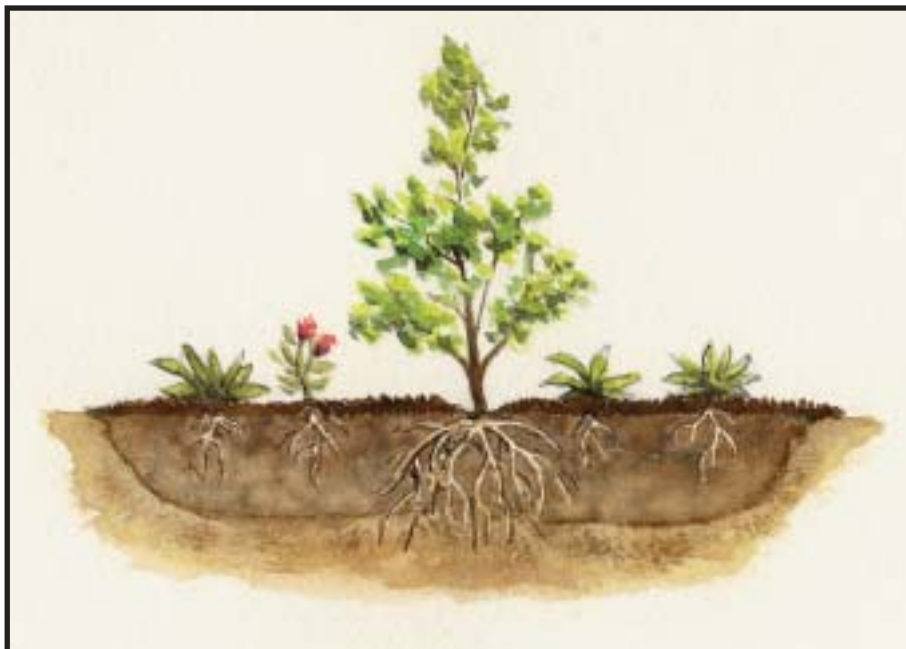
Most established trees and shrubs do not need regular fertilization. Mulching can provide all their nutrient needs in most cases. Even heavy feeders like roses, annuals and flowering perennials take in adequate nutrients through yearly mulch applications.

When choosing a fertilizer, look for the words **natural organic** or **slow-release** on the fertilizer bag. Though these fertilizers may cost more, they offer better value and greater protection of water quality as more of their nutrients actually feed plants, instead of washing into streams or groundwater.

Natural organic fertilizers include rock phosphate and other minerals, plant products such as alfalfa meal and animal by-products like bone or fish meal. Most nutrients in natural fertilizers must be digested by bacteria before they dissolve in water and plants can use them. These nutrients are slowly released when warm soil stimulates the bacteria, which is when they are needed by actively growing plants.

Slow-release fertilizers such as sulfur-coated urea become available as outer coatings are dissolved by moisture and soil bacteria when plants are actively growing.

Quick-release fertilizers like urea and ammonium sulfate quickly dissolve in water. They wash through the soil with rain or irrigation if not immediately used by plants or absorbed by organic matter.



Keep In Mind

- Amend the soil in the entire planting area instead of making individual holes for plants. As in a forest soil, organic matter should be concentrated near the surface.
- Mulch the entire area, keeping mulch away from the crown of trees and shrubs.
- Fertilize established trees and shrubs only if they are stunted or show signs of need.

Basic Fertilizing Schedule

Lawn grass	Pounds of Nitrogen per 1,000 sq. ft. per application*	When to Apply
Bahia grass	1/2	May, July
Bermuda grass	1	May, June, July, August
Centipede grass	1/2	May**, July
St. Augustine grass	1/2	May, June, July, August
Zoysia grass	1/2	April, July, August
Fescue, Bluegrass	1/2 to 1	February, September, November

* Split into at least two or three parts
 ** Use a complete balanced (N-P-K) fertilizer in which some of the nitrogen is slowly available. Fertilize centipede grass using a low phosphorus, high potassium fertilizer.

Reality Check

Fertilizing should ideally be based on observed plant needs or soil tests. If you would like to have your soil tested, call the Clemson University Cooperative Extension Office listed in your telephone book or see their Web site: www.clemson.edu/extension.

By the Numbers

Soil tests recommend actual pounds of nutrients to apply, yet fertilizer labels list nutrient contents by percentages. The three numbers prominently displayed on fertilizer packages are the percentages of nitrogen, phosphorous and potassium. To figure out how many pounds of fertilizer are needed to get one pound of a nutrient, divide 100 by the percentage of the nutrient contained in the fertilizer. For example:

Recommendation:

Apply one pound of nitrogen per 1,000 square feet.

Fertilizer nutrient content:

5:3:2 = 5 percent nitrogen, 3 percent phosphorous and 2 percent potassium. Calculate: $100/5 = 20$ pounds of fertilizer per 1,000 square feet to supply one pound of nitrogen.

If you use soluble fertilizers, you can reduce nutrient runoff by applying half the suggested amount, twice as often as recommended. Avoid using any fertilizer near bodies of water to prevent pollution.



Soil Testing

There are several nutrients that are essential for plant growth. A soil test is used to determine the amount of these nutrients in your soil. In addition to indicating the level of nutrients in your soil, the resulting report will also tell you the pH value or how acidic or basic your soil is, and it will make a recommendation for the amount and type of fertilizer and/or lime you need to add. This allows you to customize your soil fertilizer and lime applications to your plants' needs.

How to Take Soil Samples

- To have a soil analysis done, you need to collect soil from 12 or more places in your yard that will be combined as one composite sample. A garden trowel or shovel can be used to collect the samples. The samples should include soil from the surface to a depth of six inches in all areas of gardens/landscaping, or two to three inches in lawns.
- Follow the sampling procedure above for each area of your yard or garden to be tested. Testing results might be very different for lawns and garden areas. You may want to do one sample in your turf area, one in any foundation or perennial bed and one in your vegetable garden.
- If you have a problem area where plants do not seem to grow well, take a separate soil sample from that location.
- Place the samples in a clean plastic bucket and mix them thoroughly. Use clean sampling tools because pesticide or fertilizer residues will create misleading results. The sample must not be excessively wet before it goes to the lab. It should be crumbly and break apart easily.
- Bring a minimum of two cups of soil per sample to your county (Clemson Extension) office.
- Be sure to keep track of which part of your yard the sample came from. At the Extension office they will ask you to fill out the information on a soil test box, fill out a record sheet and check the appropriate boxes for the analyses desired.
- The cost of a standard soil test is \$5 for each sample. This test provides unbiased, scientific information on the soil pH value, the current soil levels of phosphorus,

potassium calcium, magnesium, zinc and manganese, and fertilizer and lime recommendations, if needed.

The Clemson University Extension Service recommends soil testing each year. Soil samples can be taken at any time, but it is best to sample the soil a couple of months before planting or fertilizing.

Soil Test Results

Within seven to 14 days, a copy of your soil analysis will be mailed directly to you from the Agricultural Service Lab. Your county Extension office will also receive a copy. Your soil analysis will have a bar graph representing the amount of soil nutrients found and the soil pH value. The primary nutrients for healthy plant growth are nitrogen (N), phosphorus (P) and potassium (K). Secondary nutrients calcium (Ca), magnesium (Mg) and sulfur (S) are required in less quantity, but are also essential for good plant growth. Zinc and manganese are micronutrients required in very small amounts, easily corrected by keeping the soil at the optimum pH value.

The report will show how much lime (if needed) to add for each 1,000 square feet. The comments page will tell you what type of fertilizer you need, how much you need and how to apply it. These recommendations are specific to whatever type of plant you want to grow (as indicated on the soil test record sheet).

Questions? Please contact your local county Clemson Extension office or call 1-888-656-9988.

Adapted from information provided by Marjan Kluepfel, HGIC Information Specialist, and Bob Lippert, Extension Soil Fertility Specialist, Clemson University.

