

Organic Matter

Adding organic matter to soil may be the key to unlocking your garden's full potential.

Understanding the importance of organic matter is crucial to success with organic gardening. Organic matter is a term that encompasses a wide variety of living or dead plant and animal material, ranging from kitchen wastes and shredded leaves to well-rotted manure and compost. Here's what adding organic matter to your soil can do:

- Supply nutrients for plants by providing surfaces where nutrients can be held in reserve in the soil
- Facilitate better drainage by loosening soil structure
- Store water in the soil
- Help increase air drainage
- Increase the activity and numbers of soil microorganisms
- Encourage earthworms

You can increase your soil's organic content by mulching with organic materials such as compost or shredded leaves, or by digging or tilling them into the top several inches of the soil. Then, to maintain a healthy, humus-rich soil, make adding organic matter part of your yearly garden activities.

Organic matter does not remain unchanged once you add it to soil because soil microorganisms act to break it down to simpler compounds. That's a good thing, because these compounds are then food for your plants. You can renew soil organic matter by side-dressing crops with compost, mulching during the growing season, and mulching or planting a cover crop during winter.

As a general rule, strive to maintain 5 to 6 percent organic matter in your soil. Don't overdo it! Adding too much fresh organic matter, such as plant stalks, sawdust, and other plant residues and uncomposted manure, can overstimulate soil microorganisms, which then consume so much nitrogen and other plant nutrients that soil fertility temporarily declines.

Keep in mind that in hot, humid climates, organic matter breaks down more quickly than in cool or dry climates. If you want to slow the loss of soil organic matter, cultivate the soil as little as possible, and when you do work the soil, do it gently, by hand, rather than using a rotary tiller.

Compost

Nature creates compost all the time without human intervention. But gardeners can step in and speed up the composting process by creating the optimal conditions for decomposition: *Air + Water + Carbon + Nitrogen = Compost*

Air. Like most living things, the bacteria that decompose organic matter, and the other creatures that make up the compost ecosystem, need air. Compost scientists say compost piles need porosity—the ability for air to move into the pile. I like to think of porosity in terms of fluffiness. A fluffy pile has plenty of spaces—or pores—for air to move about. A flat, matted pile of, say, grass clippings does not. Even fluffy piles compress during the composting process. Occasionally turning your pile re-fluffs the material, moves new material into the center, and helps improve air flow into the pile, says Craig Cogger, PhD., extension soil scientist at Washington State University.

Water. Compost microbes also need the right amount of water. Too much moisture reduces airflow, causes temperatures to fall, and can make the pile smell; too little water slows decomposition and

prevents the pile from heating. Conventional wisdom says that compost should feel like a wrung-out sponge, says Abigail Maynard, Ph.D., agricultural scientist at the Connecticut Agriculture Experiment Station.

Carbon ingredients. The microbes that break down organic matter use carbon as an energy source. Ingredients with a high percentage of carbon are usually dry and brown or yellow in color. The most common high-carbon ingredients are leaves, straw, and corn stalks. Sometimes people call these ingredients *browns*.

Nitrogen ingredients. Microbes need nitrogen for the proteins that build their tiny bodies. Ingredients high in nitrogen are generally green, moist plant matter, such as leaves, or an animal by-product, such as manure. These ingredients are called *greens*, but in reality they can be green, brown, and all colors in between.

C/N ratio. In order for a compost pile to decompose efficiently, you need to create the right ratio of carbon (C) to nitrogen (N) (C/N). Piles with too much nitrogen tend to smell, because the excess nitrogen converts into an ammonia gas. Carbon-rich piles break down slowly because there's not enough nitrogen for the microbe population to expand. An ideal compost pile should have a 30:1 C/N ratio. Grass clippings alone have about a 20:1 C/N ratio. Adding one part grass clippings, or other green, to two parts dead leaves, or other brown, will give you the right mix.

Building a Compost Pile

There are two main ways to make compost: cold compost (minimum effort) and hot compost (maximum effort).

Cold Black Gold

Nearly every expert I talked with admitted (sometimes sheepishly) that they do this type of composting in their own backyards because it's easy. Here's how to make cold compost: Mix together yard wastes, such as grass clippings, leaves, and weeds, place them in a pile, and wait 6 to 24 months for the microorganisms, earthworms, and insects to break down the material. Add new materials to the top of the pile. You can reduce the waiting period by occasionally turning the pile and monitoring and adjusting the pile's moisture level. The compost will be ready when the original ingredients are unrecognizable. Generally, compost on the bottom of the pile "finishes" first. You may not want to include woody material, because it breaks down too slowly.

Pros: Takes little effort to build and maintain; can be built over time.

Cons: Takes up to two years to produce finished compost; doesn't kill pathogens and weed seeds; undecomposed pieces may need to be screened out.

Some Like It Hot

Hot, or fast, composting takes more work and the right combination of ingredients, but you can get high-quality compost in under two months. Here's how: Wait until you have enough material to create compost critical mass (27 cubic feet), which is the minimum volume for a pile to hold heat. Then mix one part green matter with two parts brown matter. Bury any vegetative food scraps in the center to avoid attracting animals. Check to make sure the mixture has the ideal moisture level. Continue adding mixed greens and browns and checking the moisture until you've built a pile that is 3 feet x 3 feet x 3 feet, or 5 feet wide at the base and 3 feet wide at the top. The microorganisms will immediately start decomposing, and their bodies will release heat. The pile will insulate the heat, and the temperature of the pile's interior will reach 120 to 150 degrees F. Turn the pile weekly and regulate moisture levels. After about a month, the hot phase will be done, and the pile will finish decomposing at temperatures between 80 degrees F and 110

degrees F. The compost will be ready to use when it no longer heats and all of the original ingredients are unrecognizable.

Pros: Produces high-quality compost within 2 months (and sometimes as soon as a few weeks); can kill weed seeds and pathogens. (Organic Gardening does not recommend adding weed seeds or manures that contain human pathogens to compost—hot or cold—because uniform heating is difficult to achieve in home compost piles.)

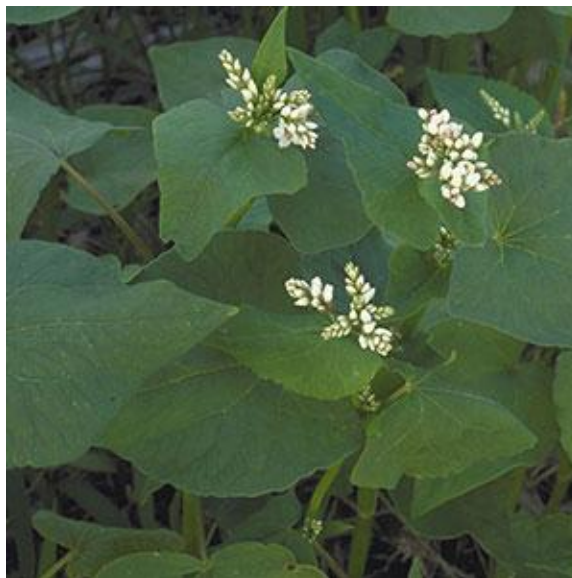
Cons: Time-consuming; requires careful management of moisture, air, and C/N ratio.

Cover Crops

Cover crops just might be the hardest-working plants you'll ever grow. Cover crops (also called green manure) suppress weeds, build productive soil, and help control pests and diseases. Plus, cover crops are easy to plant and require only basic care to thrive. And they grow well in nearly every part of the country.

Get started!

Maybe you already know about the benefits of cover crops but think they're just for farmers and other large-scale growers. Think again. Cover crops are well suited to all gardens, whether they're big or small. Here's a step-by-step guide to reaping the rewards of cover crops in your garden.



Step 1: Planting.

If you've ever reseeded a bare patch in your lawn, rest assured you can plant a cover crop. Work up the soil gently with a garden rake, broadcast seed over the soil, and then rake it in. Raking establishes good soil-to-seed contact and protects the seed from birds. "Birds sometimes eat the seeds if they are too close to the surface," says Nancy Creamer, Ph.D., director of the Center for Environmental Farming Systems at North Carolina State University. If you decide to plant cover crops in the fall, be sure to allow them plenty of time to become established. "This means planting them four weeks before killing frosts. The one exception is cereal rye, which can be planted right up to a frost," says Marianne Sarrantonio, Ph.D., associate professor of sustainable agriculture at the University of Maine.

Step 2: Care.

Cover crops are low-maintenance compared to most crops, but they still need some care. Mowing keeps large cover crops manageable, and sorghum-sudangrass actually increases its root growth if mowed once or twice. White Dutch clover planted in garden pathways needs to be mowed regularly to keep it from competing with vegetables and flowers. Be sure to water cover crops during times of drought.

Step 3: Killing.

You must kill your cover crops before they set seed and the topgrowth gets out of control. That's right, kill them. "The best time to kill them is at flowering or when the seedheads emerge on grains. The annuals can all be killed at this point by cutting at the base of the plant," advises Dr. Sarrantonio.

You can mow cover crops with a lawn mower or a weed trimmer, depending on how tall the plants are. Wait a day or two until the leaves and stems dry down, and then dig them in. Longer pieces of stems and vines may interfere with tilling, but it won't take long before the vegetative growth partially decomposes.

After turning under a cover crop of grasses, wait two to three weeks before planting vegetables or flowers. The decomposition of the green material can tie up soil nitrogen. And cover crops such as rye are *allelopathic*, which means they inhibit seed germination.

Finding space in your garden

When I discuss cover crops in gardening classes, a common concern is the amount of valuable garden space they occupy. However, you can fit cover crops right into your garden plan.

Succession cropping is one of the easiest ways to do this. After spring crops of lettuce, radishes, and other early vegetables have been harvested, plant a fast-growing cover crop, such as buckwheat. In most climates, you can allow this cover crop to flower and still have time to plant a crop of frost-tolerant vegetables. Cover crops can also be planted in the fall after some main season crops, such as cabbage, are finished.

Interplanting cover crops with vegetables is possible, though a bit trickier. "Ample water and nutrients available to both cover crops and vegetable crops, and controlling growth of the cover crop, are key to making this approach work," cautions Dr. Creamer. It's also important to delay your planting of the cover crop. "A good rule of thumb is to sow the cover crop seed into the vegetable bed one-third of the way through the vegetable crop's growing cycle," says Steve Diver of ATTRA—The National Sustainable Agriculture Service. For example, if you've planted a 75-day corn variety, interplant a cover crop about 25 days after seeding the corn. Organic farmers have had good luck with delayed interplantings of yellow blossom sweet clover with lettuce and onions. Dr. Sarrantonio suggests transplanting young tomato and pepper plants into a mowed mulch of hairy vetch and rye. The mulch reduces weeds, maintains moisture, and provides nitrogen.

The Easiest Cover Crops

Which cover crop is right for you? "You have to keep in mind the time of year and the species you are growing," says Diver. Some, such as cereal rye, are very cold-tolerant and work well for late-season plantings. Others, such as buckwheat, are very frost-tender. The cover crops listed here are widely adapted and can be grown in most areas of the United States, either as a summer or winter cover crop, depending on where you live.

Rye. This crop comes in two different types: *annual rye* and *cereal rye*. Both have their advantages. Sow cereal rye during the late summer or early fall, and it will grow until late in fall and resume growing in spring. With annual rye, which winterkills in USDA Plant Hardiness Zones 5 and colder, you'll be able to plant your garden earlier, since you won't have to turn the cover crop into the soil and then wait three weeks as you would with a perennial cover crop.

Field peas/oats. This dynamic duo combines the benefits of a legume (peas) that fixes nitrogen and a grain (oats) that contributes plenty of organic matter. And the plants have complementary growth habit—the peas climb right up the oats. Both crops are cold-tolerant, which makes this a good mixture to plant in late summer or early fall. In colder climates, they will also winterkill, allowing an early spring start.

Sorghum-sudangrass. As its name suggests, this grass is a cross between sorghum and sudangrass. This hybrid generates large amounts of organic matter and needs little encouragement to grow 5 to 12 feet tall. You can keep this frost-tender plant in check by mowing it down to 6 inches when it reaches a height of 3 feet or by planting it just seven weeks before frost.

Buckwheat. It's not wheat, and it's not a *Little Rascals* character! Buckwheat is a broadleaf plant and an excellent smother crop—it's effective even against weeds like quackgrass. "Buckwheat is very fast-growing and can provide a quick canopy to shade weeds. Just be careful to not let it go to seed, or you'll have buckwheat in your next crop," says Dr. Creamer. It matures in just six to eight weeks and can be squeezed in between spring and fall vegetable plantings. Buckwheat's white flowers serve two purposes—they work well as a filler for flower arrangements, and they attract beneficial insects.

Clover. Clover comes in a plethora of different shapes and sizes. White Dutch clover works well as a living mulch, since it tolerates both shade and traffic. Yellow blossom sweet clover is an excellent nutrient scavenger and helps build good soil structure. Crimson clover attracts beneficials and looks great, too. Whatever the color, clover fixes nitrogen and helps to build rich soils. For best results, make sure you inoculate your clover seed with Rhizobium bacteria (available from Peaceful Valley Farm Supply, 888-784-1722, www.groworganic.com).

SOURCES The one drawback of cover-cropping for gardeners is that you may pay premiums for seed in small packages rather than a farmer's bulk seed prices. Check with your local farm supply store for seed—they may be willing to order varieties they don't normally carry. The following are mail order sources for untreated and certified organic cover crop seed: Peaceful Valley Farm & Garden Supply, Grass Valley, California, 888-784-1722 Johnny's Selected Seeds, Winslow, Maine, 877-564-6697 Seven Springs Farm, Check, Virginia, 540-651-3228

Mulch

The best time-saving measure a gardener can take is applying mulch. This goes for every garden site, from vegetable garden to flower bed. Mulched gardens are healthier, more weed free, and more drought-resistant than unmulched gardens, so you'll spend less time watering, weeding, and fighting pest problems.

There are two basic kinds of mulch: organic and inorganic. Organic mulches include formerly living material such as chopped leaves, straw, grass clippings, compost, wood chips, shredded bark, sawdust, pine needles, and even paper. Inorganic mulches include gravel, stones, black plastic, and geotextiles (landscape fabrics).

Both types discourage weeds, but organic mulches also improve the soil as they decompose. Inorganic mulches don't break down and enrich the soil, but under certain circumstances they're the mulch of choice. For example, black plastic warms the soil and radiates heat during the night, keeping heat-loving vegetables such as eggplant and tomatoes cozy and vigorous.



Using Organic Mulches

There are two cardinal rules for using organic mulches to combat weeds. First, be sure to lay the mulch down on soil that is already weeded, and second, lay down a thick enough layer to discourage new weeds from coming up through it. It can take a 4- to 6-inch layer of mulch to completely discourage weeds, although a 2- to 3-inch layer is usually enough in shady spots where weeds aren't as troublesome as they are in full sun.

Wood chips and bark mulch: You can purchase bags of decorative wood chips or shredded bark from a local garden center to mulch your flower garden and shrub borders. A more inexpensive source of wood chips might be your tree-care company or the utility company. They may be willing to sell you a trunkload of chips at a nominal price. Many community yard waste collection sites offer chipped yard debris or composted grass clippings and fall leaves to residents for free (or for a small fee).

Shredded leaves: If you have trees on your property, shredding the fallen leaves creates a nutrient-rich mulch for free. You can use a leaf-shredding machine, but you don't really need a special machine to shred leaves—a lawn mower with a bagger will collect leaves and cut them into the perfect size for mulching.

You can spread a wood chip or shredded leaf mulch anywhere on your property, but it looks especially attractive in flower beds and shrub borders. Of course, it's right at home in a woodland or shade garden. Wood chips aren't a great idea for vegetable and annual flower beds, though, since you'll be digging these beds every year and the chips will get in the way. They do serve well as a mulch for garden pathways, though.

Grass clippings: Grass clippings are another readily available mulch, although it's a good idea to return at least some of your grass clippings directly to the lawn as a natural fertilizer (see the Lawns entry). It's fine to collect grass clippings occasionally to use as mulch, and the nitrogen-rich clippings are an especially good choice for mulching vegetable gardens. Your vegetables will thank you for the nitrogen boost!

Compost: If you have enough compost, it's fine to use it as a mulch. It will definitely enrich your soil and make your plants happy, but keep in mind that when any kind of mulch is dry, it's not a hospitable place for plant roots. So you may want to reserve your compost to spread as a thin layer around plants and top it with another mulch, such as chopped leaves. That way the compost will stay moist and biologically active, which will provide maximum benefit for your plants.

Pine needles: Pine needles are a trim-looking mulch for garden beds. They allow water to pass through easily and they break down slowly. Despite what you may have heard, using pine-needle mulch will not make your soil significantly more acid.

Straw and hay: Another great mulch for the vegetable garden is straw, salt hay, or weed-free hay. It looks good and has most of the benefits of the other mulches: retaining soil moisture, keeping down weeds, and adding organic matter to the soil when it breaks down. But be sure the hay you use is weed and seed free, or you'll just be making trouble for your garden. And don't pull hay or straw up to the stems of vegetables or the trunks of fruit trees or you'll be inviting slug and rodent damage.

Organic Mulching Mechanics

Spreading organic mulch saves labor and nurtures plants by:

- Preventing most weed seeds from germinating; the few weeds that do pop through the mulch will be easy to pull.
- Keeping the soil cool and moist in summer, reducing the need to water.
- Decomposing slowly, releasing nutrients into the soil.
- Encouraging earthworm activity, improving soil tilth and nutrient content.
- Keeping dirt from splashing on flowers and vegetables.
- Preventing alternate freezing and thawing of the soil in winter, which can heave plants from the soil.

Nothing, unfortunately, is perfect. When using organic mulches, keep in mind the following facts:

- As low-nitrogen organic mulches such as wood chips and sawdust decay, nitrogen is temporarily depleted from the soil. Fertilize first with a high-nitrogen product such as blood meal or fish meal to boost soil nitrogen levels.
- An organic mulch retains moisture, which can slow soil warming; in spring, pull mulch away from perennials and bulbs for faster growth.
- A wet mulch piled against the stems of flowers and vegetables can cause them to rot; keep mulch about 1 inch away from crowns and stems.
- Mulch piled up against woody stems of shrubs and trees can cause them to rot and encourages rodents, such as voles and mice, to nest in the mulch. Keep deep mulch pulled back about 6 to 12 inches from trunks.
- In damp climates, organic mulches can harbor slugs and snails, which will munch on nearby plants; don't spread mulch near slug-susceptible plants.
- Organic mulches are usually more or less acidic, depending on their content; mix some lime with the mulch beneath plants that prefer neutral or slightly alkaline soil.

Double mulch stops weeds. If you know that a garden bed is filled with weed seeds or bits of perennial weed roots, use a double-mulching technique to prevent a weed explosion. Set plants in place, water them well, then spread newspaper and top it with organic mulch.

Using Plastic Mulch

Mulching a vegetable garden with sheets of black plastic film can do wonders. When it's spread tightly over a smooth soil surface, black plastic will transmit the sun's heat to the soil beneath, effectively creating a microclimate about 3°F warmer than an unmulched garden. Because the plastic film remains warm and dry, it protects the fruits of vining crops such as strawberries, melons, and cucumbers from rotting and keeps them clean. And of course, the mulch prevents weed growth and retains soil moisture.

Infrared transmitting (IRT) plastics cost more than standard black plastic, but they can result in even higher yields. These plastics warm the soil as well as clear plastic does, but also control weeds as well as black plastic does.

In raised bed gardens, lay down a sheet of plastic over the entire bed. Bury it at the edges or weigh the plastic down with rocks. Then punch holes in it for the plants. A bulb planter makes quick work of hole cutting. Sow seeds or plant transplants in the holes.

Because water can't permeate plastic, the mulch retains soil moisture but it also keeps rainwater from soaking the planting bed. Thus, the ideal watering system for a plastic-covered bed is soaker hoses or drip hoses laid on the soil surface before you put down the plastic.

Don't use plastic as a mulch under shrubs. Although it keeps out weeds and can be camouflaged with decorative mulch, black plastic destroys the shrubs' long-term health. Because water and air cannot penetrate the plastic, roots grow very close to the soil surface—sometimes right beneath the plastic—seeking moisture and oxygen. The shallow roots suffer from lack of oxygen and moisture and from extremes of heat and cold. Eventually the plants decline and die. Stick to organic mulches such as shredded leaves, bark, wood chips, or compost under your trees and shrubs.

Plastic Imperfectio

Although black plastic mulch seems like a great boon to organic gardeners, its use is not problem free. One issue of concern with black plastic is its manufacture (it's a petroleum product) and its disposal—there are very few places it can be recycled. If you carefully lift black plastic at the end of the growing season and store it in a dry place over winter, you should be able to reuse it for several years, but eventually it will become torn and you'll have to throw it away.

An alternative is a biodegradable plastic mulch (cornstarch based). These materials are designed to break down in place by the end of the growing season, and you can dig any remaining bits into the soil. However, one of the breakdown products of biodegradable plastic mulch is carbon dioxide. Black paper mulch made from recycled paper is also available, but these products are usually treated with a synthetic antimicrobial substance to prevent them from breaking down too quickly.

Unlike black plastic, landscape fabrics let air and water through to the soil beneath while keeping weeds from coming up. But landscape fabrics (geotextiles) have some of the same drawbacks as black plastic. To begin with, they are petroleum products. When exposed to light, they degrade over time, so to make them last longer, you have to cover them with a second mulch (they're ugly, so you'd want to, anyway). However, many gardeners have discovered that shrub roots grow up into the landscape fabric, creating real problems when you eventually want to remove it. And weeds that germinate in the surface mulch send roots down into the fabric, too, tearing it when you pull them out.

Soil

The terms alkaline and acid refer to the pH of your soil. So what exactly does that mean? A little science lesson will be helpful (and I promise not too painful) here. Sometimes described as potential hydrogen, pH is a measure of the relative amounts of positively charged hydrogen ions (H⁺) and negatively charged hydroxide ions (OH⁻) in a solution (soil, for example). A solution with a neutral pH has a balanced amount of hydrogen and hydroxide ions. When the concentration of hydrogen ions increases, acidity increases, and when the concentration of hydrogen ions decreases, alkalinity goes up.

Scientists measure pH on a logarithmic scale that ranges from 0.0 (most acid) to 14.0 (most alkaline), with 7.0 being neutral. Don't worry if you can't recall the definition of logarithm; all you need to know is that each unit on the pH scale represents a tenfold difference in acidity or alkalinity. For example, if lemons have a pH of 2.0 and oranges have a pH of 4.0, this means that lemons are 100 times more acid than oranges.



You're probably wondering what all this chemistry has to do with your soil. Plant nutrients must be dissolved in the soil solution in order for plants to absorb them, and the pH of soil affects the solubility of minerals. Most vegetables and landscape plants grow best in soil with a pH of 6.0 to 7.5. When soil pH falls below 6.0, nitrogen, phosphorus, and potassium are less available to plants; and when the pH rises above 7.5, iron, manganese, and phosphorus are less available.

Each individual plant has an ideal pH range. Some plants, such as camellias and blueberries, have an ideal pH range that falls on the acid side, while other plants, such as daylilies and hollyhocks, grow well in soils that range from slightly alkaline to slightly acid. If you have soil with a very high or low pH, you can alter it. But before you ever add an amendment, make sure to get a soil test and follow the lab's amendment recommendations. Liming (adding limestone) increases the alkalinity of soil, and adding elemental sulfur (buy only sulfur products approved by the Organic Materials Review Institute, or OMRI) increases the acidity of soil. Regular applications of compost have been shown to help bring soil pH into balance. And, of course, you can also work with what you've got and grow plants that thrive in the natural pH of your soil.