

## **Using Organic Matter in the Garden**

Health of the garden depends on organic matter. What happens below the soil line makes the garden healthy. In gardening, many products are called organic matter. Animal manures, peat moss from bogs, leaves, straw, newspaper, sludge, yard and garden waste, kitchen scraps, and green manures or cover crops – all are forms of organic matter that can be incorporated directly into the soil. Often such products are composted, rather than used directly, and the compost is used in the garden. Compost can be made at home from the kitchen, garden, and yard wastes, or it can be produced by an industry or local municipality.

Organic matter is used in the garden for many reasons, beginning with its effect on soil structure. Organic matter helps soil particles bind together into aggregates, or clumps, which makes it easy to dig or penetrate. We often call this quality tilth. In this way, adding organic matter helps all poor soils, whether they are too sandy or made of too much clay. A soil with good tilth also has good nutrient-holding and water-holding ability. In addition, organic matter improves soil by stimulating or feeding the life of the soil. It provides nutrients to bacteria, fungi, earthworms, and other organisms in the soil, which in turn recycle the nutrients into forms that are readily available for plants to absorb through their roots. Organic matter also helps to prevent soil and wind erosion by binding sandy soil particles together. Organic matter also prevents caking, cracking, and water run-off that occurs when clay soil dries out.

### **When to Use Organic Matter**

The short answer is “as often as you can.” Amending the soil of planting areas for landscaping – trees, shrubs, lawns, and herbaceous plants – is an important gardening practice for new homeowners or those who are revamping their property. Adding organic matter to a vegetable garden, a fruit orchard, or to an existing lawn is equally important for success. Experienced gardeners often consider soil building or soil replacement (bringing in and incorporating organic matter) nearly half the work of gardening.

Community projects often begin with substandard soil that needs amendment. In the rush to set out plants, gardeners sometimes do not add any or add insufficient amounts of organic matter. In reality, the soil preparation for planting beds is more important than the act of planting.

There is some disagreement about using any organic matter amendments in backfilling planting holes for trees, shrubs, or woody perennials. There is little data about long-term benefits. Some professionals have demonstrated that amending the original soil hole with a backfill mix encourages a teacup effect. That is, the artificial well or teacup of improved soil is so different from the surrounding soil that the roots never leave their comfort zone, becoming entrapped in the teacup over time. Other professionals have shown that there is early root growth and possibly reduced soil-borne pathogens in soil that has been amended with organic matter. Currently, backfilling planting holes with organic matter, when planting

new trees or shrubs, is not recommended for homeowners unless the soil quality is exceptionally poor. Incorporating organic matter over an entire site or planting bed, however, is recommended.

In most situations, gardeners should add organic matter to “poor” soils, whether they are too clayey, too sandy, compacted or poor in nutrients.

## **Compost**

Compost is often called the black gold and many consider it the most important form of organic matter. It is universally recognized for improving soil structure and water-holding capacity. Compost helps the soil stay loose and easy to cultivate. Compost is, in fact, the end-product of the decomposition of organic matter. Making and using compost is also a way to recycle organic matter, especially products which might otherwise have been treated as home or industrial wastes.

In addition to soil improvement and the economic and social benefits of recycling organic matter, composting can provide other benefits. Composts help fight soilborne pathogens that cause plant diseases. However, not all composts are suppressive to all diseases. Compost, along with other organic matter, improves the capacity of soil to hold nutrients through a complex process called cation exchange capacity. In addition, compost indirectly provides nutrients for plant use when earthworms and other organisms digest organic matter, producing nutrient-rich castings, or excrement. These products are significantly richer in nutrients than the surrounding soil, and in a form, which is readily available to plant roots. While compost provides some nutrients and makes other nutrients more available, it is not considered fertilizer. However, in many organic gardening or farming systems, compost is the major amendment to enrich soil.

Not all composts are alike. Composts vary greatly, depending upon what goes into them and how they are processed. Quality also varies depending on maturity, pH, presence of weed seeds, concentration of toxic substances, and the population of soil-dwelling organisms, such as earthworms, insects and microorganisms. High quality compost has good water holding capacity and nutrient availability.

Maturity makes a difference. Use of immature composts can cause problems. Maturity means that the compost has decomposed extensively and has become fairly stable. Immature compost may still contain some plant inhibitors. When immature compost is added to the garden, its bacteria compete with plants for nitrogen in the soil. The result is unhealthy plants with symptoms such as yellow leaves or stunted growth. If compost is still hot, smells like ammonia, or you can still recognize the original form of organic matter, then it is not ready to use. When in doubt, let compost mature longer.

Maturity is not the same as quality. Maturity means the energy and nutrient containing materials have merged into a stable organic mass. Mature compost (also called “finished” compost) is dark colored and has an earthy odor. Quality is the chemical composition of

that mass. For example, a compost could be mature but of poor quality if nutrients had leached away or it contained contaminants.

Source materials affect quality. Soluble salts, nutrients and contaminants vary depending on what the source material of the compost is. Soluble salts are actually chemically charged particles (ions), usually from dissolved fertilizer and irrigation water, but may come from the composted material itself. While not a human health concern, concentrated soluble salts can cause problems in plant growth. Compost made from food (fruits and vegetable scraps, fish residues, coffee grounds, brewery and bakery wastes) is typically richer in nutrients, but may have high salt content. The concentration of soluble salts, as well as the concentration of contaminants like lead and other heavy metals, in composted sewage sludge varies greatly depending upon which industrial waste products are discharged to the sewage treatment plant. Yard waste compost is typically low in nutrients, contaminants and soluble salts. Composted manure is generally high in nutrients and soluble salts, while low in contaminants.

Hot is different from cold. Composts may or may not heat up during decomposition. Particularly in small-scale home composting systems, compost may not get hot. Some tests have shown that finished cold compost may actually have a higher nutrient content than products from a hotter compost. However, weed seed and disease organisms are more likely to be destroyed in hot compost.

Gardeners use compost in many ways. It is used in establishing a planting bed, improving soils, mulching gardens, backfilling during planting of trees, shrubs, or perennials, establishing or topdressing lawns, sidedressing vegetables, or controlling erosion.

The amount of compost to use varies, depending upon soil and site characteristics, plant selection, compost quality, and availability. Most mature composts can be used in most planting situations without serious concern for precise amounts. In estimating how much compost is needed, measure the overall planting area, and calculate how much compost you will need to cover the area with 1 inch (or your preferred amount) of compost in a season. For instance, to apply 1 inch of compost over a 10 X 10 foot area, you'll need about 8 cubic feet, or about 300 pounds of compost. For a home garden, two 4 X 4 X 4 foot piles of compost can provide enough compost to accomplish this. Experienced compost users rarely have enough compost for its many functions and are concerned with dispersing the black gold equitably among the garden and landscape plants.

There are easy ways to apply compost for different horticultural uses. Compost in planting beds for perennials is often applied at a rate of 1 to 2 inches. This could be about 8 to 16 cubic feet of compost per 100 square feet of the planting beds. Incorporate the compost evenly about 6 to 8 inches into the soil. The prepared bed for trees and shrubs, however, should be 30-50% by volume to change structure, as well as to improve drainage, and root penetration into the site. To achieve this, add 4 inches of compost and incorporate it into the top 12 inches of the planting bed. This is about 32 cubic feet of compost per 100 square feet of planting bed. To use it as a landscape mulch, apply compost 1-3 inches deep over the soil surface. This could be 8-24 cubic feet of compost per hundred square feet of

mulched area. A few inches of compost may also be layered under other landscape mulches, such as wood chips, to provide improvement to the soil without working the compost into it. In using sludge composts, apply no more than 2 inches. Limit sludge compost to one inch if you are mulching around salt sensitive plants. In establishing a lawn, mix compost with the planting soil in order to improve drainage, especially in a heavy clay soil. Compost may also suppress specific soil-borne diseases and plant pathogens in lawns. Before seeding a new lawn, evenly apply 1-2 inches of compost over entire area. Incorporate into the top 5-7 inches of soil, resulting in a final volume of 30% compost content. Established lawns may be top-dressed, that is, sprinkled with compost over the top of the grass and watered into the top layer of soil. However, it is important not to apply more than a quarter of an inch at a time, as the compost could smother established lawns if it is applied thickly.

Compost may be added in many ways to vegetable gardens. Prior to planting, compost may be spread 3 inches over the surface and worked into the top 3-6 inches of soil. Other guidelines suggest 2-3 bushels of compost per hundred square feet should suffice. Side-dressing, or digging in compost next to growing plants, is often done a month or two after planting. Compost is also an excellent vegetable garden mulch, which breaks down slowly, encourages soil life and maintains an even soil temperature in the heat of summer.

For erosion control, compost may be added to a sloped area to increase the soil's ability to retain water and discourages run-off. To do this, spread a 3-4 inch layer of compost over the entire area and work into the top 6-8 inches of soil.

## **Manures**

Animal manures have long been a popular form of organic matter as well as fertilizer for farms and gardens. Farm manure is still the most readily available manure, purchased directly or sometimes free from the farm. It is sometimes bagged and sold in garden centers – with a wide range in its quality, nutritional content, age, and weed seeds present. It is not recommended that homeowners use any manure from dogs, cats, or other meat-eating animals, since there is risk of parasites or disease organisms that can be transmitted to humans.

Using manure: Manures differ from each other because of their source, their age, how they were stored (piled, spread, turned over or not), and the animal bedding material, which may be mixed in. For that reason it is difficult to provide precise guidance about how long manure should be aged before use, or how much to use. Composting is the safest way to make the most of manure's nutritional potential – if the logistics of making and hauling compost are viable. For direct use in the garden, first aging manure for 6 months is a good rule of thumb. Many farmers and gardeners spread fresh manure in the fall or winter, and till or turn it in at spring planting time. When manure is spread in the spring, even if aged, it is safest to wait for at least one month before planting crops, since the microbial activity it stimulates may interfere with seed germination or plant growth before that time.

When composted manure is spread directly over the soil, it is helpful to add about 40lbs. per 100 square feet, turned into the top 6 to 9 inches. Aged manure is often used in home vegetable gardens as a side-dressing, or placed directly in holes under the soil where vine crops such as pumpkins are planted.

Manure tea, made by soaking bags of manure in tubs of water, is a nutrient-rich liquid that is full of microbial life. It is another way to use manure as a fertilizer, whether it is poured on the leaves of plants (called foliar feed) or onto the soil.

Problems with manure: While it is one of the most readily available forms of organic matter and fertilization for many gardeners, manure can present some problems.

- The relatively high nitrogen content makes manure extremely valuable in composting, where it activates soil bacteria and contributes to rapid decomposition of organic matter. But, as a direct soil amendment, that same high nitrogen content can be a deficit. Fresh, raw, or hot manure activates and builds up soil microbial activity to the extent that the nutrients volatilize, or burn up, before plants can use them.
- Fresh manure also can damage plant tissue and kill seedlings. An excessive amount of soil nitrogen can produce plants with a high nitrate content. These high nitrate levels are not only potentially harmful to humans, they also are more attractive to pests than crops grown with less nitrogen, and do not store as well either.
- Manure also is notorious for adding undigested weed seeds to the garden, particularly from horses and other animals that eat hay. Composting in a hot system (when the pile reaches over 155 degrees) destroys most weed seeds, but most composting systems are inexact and seeds can come through. For that reason, those who use manure usually plan on weed-control techniques such as mulching, interplanting (growing cover crops between rows), mechanical or hand weeding, or herbicides in some situations.
- Particularly in agriculture, manure use can pose pollution problems when rain or irrigation systems carry nitrogen from the fields before it is used by plants. Nitrogen from manure or synthetic fertilizers has been identified in New York State as a pollutant in groundwater.
- Fresh manure must be used with caution in the garden because it may contain pathogenic bacteria such as E. coli, Listeria, and Salmonella. Although the chance of contamination is slim, severe sickness and even death may occur if contaminated produce is eaten. To be safe, either compost your manure or apply it in the fall after you harvest. Try to leave at least 120 days between application of fresh manure and harvest of a crop.

### **Green Manures of Cover Crops**

Several grasses, grains, and legumes are used in gardening and farming and referred to as cover crops or green manures. The term cover crops describes an important function of these crops: to cover the soil, block weeds, prevent erosion, and maintain soil moisture, among other

benefits. Green manure refers to the other primary function of using these crops: to add organic matter into the soil. Green manure crops are grown during fallow seasons (when a garden or field is not in use), during part of the growing season, or over winter to add biomass to the soil. Biomass is the quantity of organic matter that living crops provide. Some green manure crops are also used between crop rows or plants while they are growing, which is called intercropping or interplanting. Cover crops are sometimes broadcast over existing crops a few weeks before harvest, so that the cover crop is already growing before the area is left bare. There are as many systems for green manuring or covercropping as there are garden layout, and many ways to add organic matter with these plants.

Crops used for green manure: There are many choices of green manure crops, with a variety of benefits for using them. The crops are divided into legumes (beans, peas, alfalfa, clovers, hairy vetch, and soybeans) and non-legumes (annual ryegrass, buckwheat, oats, winter rye, sudan grass, and winter wheat). The legumes provide the benefit of fixing nitrogen, actually taking nitrogen from the air and holding it as nodules on plant roots. As plants are turned under or cut off at the stem this nitrogen becomes available in the soil for future plant use. Other cover crops are biological subsoilers such as alfalfa, with roots that reach down into the subsoil up to 8 feet, bringing valuable hard-to-reach nutrients up to the soil surface as the crops are harvested.

In choosing a green manure crop, many factors have to be considered: the amount of biomass, the nitrogen-fixing factor, time required to grow, and most of all how the crop coordinates with the other plants in the particular garden's system. Even the equipment available, or your individual strength, are factors in choosing. For instance, taller crops such as oats or winter wheat offer the most biomass, but they require serious equipment or massive effort to cut them down or turn them under.

Crops that over-winter, such as winter rye, protect the soil during the winter and provide spring growth, which is later cut down and turned under. However, to incorporate these into the soil late spring requires powerful equipment. Tilling earlier in the spring is possible, but getting into the garden during a wet spring can be a problem. Other crops, such as buckwheat, do an excellent job of blocking weeds and attracting beneficial insects, but offer less biomass. The governing factor in most cases is the timing. Once the summer crops are harvested there are only a few choices that can be established in September (annual ryegrass or oats) or as late as October (winter rye or winter wheat).

## **Peat Moss**

For many years, bales of peat moss have been on our list of garden supplies and we've never given it a thought. Now, gardeners around the world wonder if peat companies are destroying these fragile and unique bog ecosystems by removing the peat. They ask whether these companies are harvesting this abundant resource in a responsible and sustainable manner. Canada, where we get most of our peat moss from in the United States, has 25% of the world's peatlands and only .02% of them is being harvested. The industry is regulated and practices restoration and reclamation to attempt to keep peat a sustainable resource. Environmental assessments are conducted before opening a virgin bog to harvest. Horticulturally, peat is used

in a variety of ways. It is a soil amendment, an ingredient in potting soils and planting mixes, and used as a bulking agent and carbon source in composting.

Use peat conservatively. Use peat in your growing mixes for starting seeds and cuttings. Since peat is sterile, it minimizes disease problems. However, focus on composting to supply the larger quantities of organic matter needed to improve your garden soil. By substituting compost for some of your garden needs, you can help to cut down on the rate of peat moss mining.

A highly decomposed form of peat, dark brown to black in color, is peat humus. It has a much lower water-holding capacity and is more expensive than peat moss. It is, however, an excellent soil conditioner.

Because of its tight, fibrous structure, peat moss should not be used as a soil surface mulch. As it dries, it has the tendency to absorb water, robbing the soil underneath from valuable water from rain or irrigation. Peat should only be mixed into the soil, not laid on top of it.

Since compost is often considered a substitute for peat moss, the following chart may help to delineate the differences and similarities between peat moss and compost.

<b>Peat Moss</b>	<b>Compost</b>
Expensive	Often free
Poor in nutrients	Relatively rich in nutrients (but not a fertilizer)
Low pH	pH usually neutral or slightly alkaline
Doesn't compact	May compact
Excellent at holding water	Good at holding water
Hard to re-wet	Re-wetting capacity varies
Uniform in composition	Variable in composition and contaminants
Might contain pathogens	Full of microorganisms (mostly beneficial)
Contains no weed seeds	May have weed seeds if not composted properly
No disease suppressing qualities	Capable of suppressing some plant disease-causing pathogens
Uses a natural resource, obtained by mining	Recycles organic waste matter
Not a mulch	Excellent as a mulch

### **Other Kinds of Organic Matter**

Paper – sever paper products – especially newspaper and cardboard – are useful in the garden. While it provides no nutrients, paper is organic material, made primarily of wood fibers. It decomposes slowly but provides structure when used in a compost pile. Shredded newspaper or telephone book paper are good paper choices for composting or digging into soil directly; they decompose well when mixed with high nitrogen products such as manure. Shredded newspaper may also be used under other mulches in the landscape, where it is broken down by earthworms. Shredded computer or other office paper may be used although it breaks down slowly. Glossy magazine-style and contains dioxin. There are enough concerns about the dioxin in glossy paper that it would be wise not to use in the garden. Waxed paper almost never breaks down.

There has been concern about using colored paper or ink, which contains heavy metals. Evidence shows such low concentration of heavy metals – if any at all – that colored paper may be used without danger. Many inks currently used are soy-based.

Cardboard and newspaper (several sheets thick) are effective mulches around vegetables or flowers, used to block weeds and retain soil moisture. For similar reasons, in landscape plantings cardboard or paper may be used under other mulches such as wood chips. This method has several other benefits: the paper products may block the light and prevent weeds longer than less solid mulches, and may decrease the amount of wood chips or other surface mulches needed. In addition, there is the benefit of reusing paper products, which reduces costs and the need for their disposal in overcrowded landfills.

### **Direct Incorporation of Organic Matter**

Composting is not always a viable option for the home gardener. However, there are many other ways to add organic matter to the soil and still reap the benefits.

- Sheet method – spreading organic matter such as leaves and grass clippings, straw, rotted hay or raw manure directly over the soil. Some users turn it under whenever it is applied and others let it cover the soil in winter and turn it under in spring. When opaque (black or red) plastic is used, a variation on sheet composting is to spread the organic matter under the plastic, where it decomposes more quickly using the heat created by plastic.
- Trench method – one of the oldest and simplest ways to add organic matter is simply digging a trench or one hole at a time and burying organic matter as it becomes available. The trench can even be made between plants or rows during the growing season. The organic matter is typically kitchen waste, such as food scraps or coffee grounds, but any organic matter can be added this way.
- Hugel method – often called in-place composting, the gardener creates a mound or hill of organic matter in the garden. While there are several variations, all include piling up organic materials in layers, usually with the coarsest on the bottom and letting the materials decompose in place. In most systems, crops are planted in the top layer, while the lower layers are still in the original undecomposed form. Possible materials from bottom to top are: twigs, leaves, manure, straw, grass clippings and compost or soil.

### **Mulch**

Another way that organic matter is used in the garden is to cover the soil. Mulches can be applied in winter or summer. Winter mulches protect young perennials, while summer mulches retain soil moisture and limit weed seed germination. Tree bark, branches and trunks can be chipped and spread as a mulch. Even newspaper is used. Almost any composted material can be used as mulch, while peat moss cannot. Mounding compost mulch (or any mulch) against tree trunks poses serious dangers of disease, rodent or insect damage to the tree.

Source: Cornell Cooperative Extension