MASTER GARDENER
COLORADO STATE UNIVERSITY
EXTENSION

CMG GardenNotes #243

Using Compost in Colorado Gardens

For information on home composting see Colorado State University Extension Fact Sheet #7.212, *Composting Yard Waste.*

Compost Products

The term ***compost*** refers to organic matter that has been biologically degraded. Organic matter, which is essentially anything that is made of carbon, is a critical component in soils for numerous reasons. For one, organic matter is the food source for the soil organisms that form the base of the soil food web. Soil life slowly mineralizes the nutrients in organic matter through decomposition, making the nutrients available for plants to use. Organic matter also promotes the aggregation of soil particles, which can ultimately improve the physical characteristics, like porosity and water infiltration, of the soil over time. Additionally, organic matter has a high water and nutrient holding capacity, which can improve sandy soil's tilth. Having adequate levels of soil organic matter supports a healthy soil ecology and, ultimately, benefits gardeners.

Compost can be made at home using kitchen scraps and garden waste. Making homemade compost is an environmentally sustainable way to convert both kitchen and yard wastes, which would otherwise be taken to a landfill, into valuable soil-building resources. One of the main advantages of homemade compost is that the gardener controls what goes into the compost pile and, therefore, can avoid weed seeds, diseased plants, and salt problems.

There are also many compost-based products available in the retail trade. Compost can be purchased either in bags from a variety of retailers, or in bulk from large compost producers or landscape supply companies. They can be derived from any combination of plant residues, manure, and/or biosolids, and may also have added fertilizers or animal by-products. Many suppliers of compost will have information on what the product is made from and may even have a laboratory analysis of the product available upon request.

While Colorado requires that commercial compost be sufficiently composted to reduce pathogens and vector transfer (C:N ratio must be 18:1 or less), there is no standard regarding the compost's state of decomposition. As a result, it is important to be mindful when purchasing a compost since the quality of compost will vary based on the materials being composted, the process being used, the duration of composting, etc.

Application Rates and Salt Problems

Routine application rates of organic soil amendments depend on the desired results, type of amendment, salt potential of the material, and the depth to which it will be cultivated into the soil. Before applying any amendment, it is best to do a soil test. **Table 1** gives approximate application rates for plant-derived compost.

Table 1. Routine Application Rate for Compost

Site	Incorporation Depth[1]	Depth[2] of Compost[3] Before Incorporation
One-time application for lawns.	6 inches	1-2 inches
First-time application when installing vegetable or flower gardens.	8-12 inches	3-4 inches
Annual application to existing vegetable flower gardens.	8-12 inches, or as deep as possible	0.25-1 inch

1 According to the indicated incorporation depth, cultivate compost into the top of the soil profile using a digging fork, spade, or rototiller if necessary. On compacted/clayey soils, anything less may result in a shallow rooting depth predisposing plant to reduced growth, low vigor, and low stress tolerance. If the actual incorporation depth is different, adjust the rate accordingly.

2 Three cubic yards (=81 cubic feet) covers 1,000 square feet approximately 1 inch deep.

3 These application rates are based on the use of plant-derived compost (compost made solely of plant materials, such as leaves, grass clippings, wood chips and other yard wastes) or compost known, by soil test, to be low in salts. For compost made with manure or biosolids and compost known, by soil test, to be high in salts, application rates will need to be reduced substantially. Excessive salts are common in many commercially available products sold in Colorado.

* When consistently repeating annual applications, application rates can be lowered over time. An annual soil test will be the best measure for the need for compost.

Compost derived from manure or biosolids has the potential to have a high salt content, so application rates will need to be reduced substantially unless a laboratory analysis of the compost shows a low salt level.

An amendment with up to 10 dS/m (10 mmhos/cm) total salt is acceptable when incorporated into a low-salt garden soil (less than 1 dS/m or 1 mmhos/cm). Any amendment with a salt level above 10 dS/m (10 mmhos/cm) is questionable. Note: dS/m or mmhos/cm is the unit used to measure salt content. It measures the electrical conductivity of the soil.

Generally, compost needs to be thoroughly mixed into the upper six to eight inches of the soil profile. Do not leave compost in chunks, as this will interfere with root growth and soil water movement.

As the soil organic content builds in a garden soil, the application rate should be reduced. A soil test is suggested every few years to establish a baseline on soil organic matter content.

Nitrogen Release Is Limited and Slow

The typical macronutrient content of compost is 1.5% to 3.5% nitrogen, 0.5% to 1% phosphate, and 1% to 2% potassium, plus micronutrients. As with other organic soil amendments, the nitrogen release rate from compost is very slow (i.e., over a period of years). Thus, compost is not considered an effective substitute for fertilizer due to the low levels of nutrients present and the slow rate of release. In gardens where compost is routinely added, phosphorus and potassium levels are likely to be adequate to high.

The need for nitrogen fertilizer generally depends on the soil organic matter content of the soil. The more organic matter a soil contains, the greater its nitrogen content and the less nitrogen it requires from a fertilizer.

4-5% Organic Matter – Soils with 4-5% organic matter from compost will mineralize (release to plants) about 0.2 pound of nitrogen per one hundred square feet per year. This should be sufficient for plant nitrogen needs.

2-3% Organic Matter – Soils with 2-3% organic matter from compost will mineralize about 0.1 pound of nitrogen per one hundred square feet per year. Additional nitrogen fertilizer will be needed for high nitrogen crops like broccoli, cauliflower, cabbage, potatoes, and corn.

<2% Organic Matter – In soils with less than 2% organic matter, the release rate for nitrogen will be too low to adequately provide the nitrogen needed for crop growth. A supplemental organic or manufactured nitrogen fertilizer may be needed.

However, soil organic matter content is not the only factor that affects the need for nitrogen fertilizer. The type of crop, level of production, and soil nitrate levels should also be considered when determining the N application rates.

Beware of Unfinished Compost

Using unfinished compost can be problematic for several reasons. For one, the carbon to nitrogen (C:N) ratio of unfinished compost may be too high. Ideally, a finished compost will have a C:N ratio of approximately 20:1. However, depending on the kinds of materials that the compost is derived of, the C:N ratio of compost can be as high as 600:1. When C:N ratios are high, the microbes performing decomposition don't have enough nitrogen to break down the high amount of carbon, so they will scavenge nitrogen from other places. If those other places happen to be your garden soils because you applied unfinished compost with a high C:N, the microbes may immobilize nitrogen in your garden soils from plant uptake. To prevent nitrogen immobilization, compost with a high C:N ratio must be sufficiently composted.

However, C:N ratio does not necessarily indicate the maturity of compost. Compost derived from vegetable wastes, for example, will naturally have a low C:N ratio (approximately 10-20:1). Immature compost with low C:N has a higher proportion of nitrogen which, if not finished properly, may be available in the form of ammonium. At high levels, ammonium can be toxic to plants, burning plant roots (when applied to the soil) or plant leaves (when applied as mulch).

Furthermore, microbes consume oxygen (O2) during decomposition so, if applying unfinished compost near plants, the microbes can potentially consume all of the O2 from the root zone as they continue to decompose the compost and, as a result, can greatly inhibit root growth.

Additionally, unfinished compost may not have fully destroyed any potential pathogens or weed seeds present in the compost.

Finished compost will have an earthy smell and will not resemble its original contents anymore. Compost maturity can be assessed in a laboratory by measuring the carbon dioxide (CO2) production by the microorganisms living in the material. Lower levels of CO2 indicate more mature compost (i.e., microbial activity is low because they have used the available nitrogen to decompose the carbon in the compost). Conversely, if microbes are producing CO2, they are still actively decomposing the material in the compost.

When making compost at home, it is advisable to turn the pile when the compost pile temperatures drop below 120ºF and before the compost pile temperatures exceed 160ºF. To encourage active microorganism processing, moisten the pile so that it feels like a wrung-out sponge. When temperatures do not rise above 120ºF after turning to reheat, compost has entered its curing stage. It should cure for at least forty-five days before being considered finished so that the compost can reach a chemically stable end point.

Weed Seeds and Diseased Plants

It is advisable not to compost diseased plants or weeds loaded with seeds. If the compost pile did not heat adequately or was not turned, the compost could be a source of weed seeds or plant disease pathogens. All parts of the compost should reach 145ºF to kill weed seeds and plant disease pathogens. Because only the inner layers of the pile will reach this temperature, it is important that the outer layers are folded into the inner layers and the pile is allowed to reheat to 145ºF. These temperatures must be maintained for at least 3 days. Temperatures of 130ºF will somewhat minimize weed seeds and pathogens.

Livestock manure (horse, sheep, cow, swine, etc.) can also be a source of weed seeds if the animals were fed hay that contained weed seeds or if seeds blew into a pile of manure.

Pet Manure

Do not add companion animal (cat, dog, etc.) feces to compost as this can increase disease transmission to humans, as well as the incidence of nuisance animals rummaging through the compost pile.

Authors: David Whiting, CSU Extension, retired; Adrian Card, CSU Extension; Carl Wilson, CSU Extension, retired; and Jean Reeder, Ph.D., USDA-ARS, retired. Reviewed December 2015 by Dan Goldhamer, CSU Extension. Revised May 2023 by Hania Oleszak, CSU Extension and Eric Hammond, CSU Extension.

Revised May 2023