



# Colorado MASTER GARDENER

## Soil Amendments

**no. 7.741***by D. Whiting, C. Wilson, and A. Card'*

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### Terms

The term **soil amendment** refers to any material mixed into a soil. A **mulch** refers to a material placed on the soil surface. By legal definition, soil amendments make no legal claims about nutrient content or other helpful (or harmful) effects it will have on the soil and plant growth. In Colorado, the term **compost** is also unregulated, and could refer to any soil amendment regardless of microorganism activity.

By legal definition, the term **fertilizer** refers to a soil amendment that guarantees the minimum percentages of nutrients (at least the minimum percentage of nitrogen, phosphate and potash).

An **organic fertilizer** refers to a soil amendment derived from natural sources that guarantees the minimum percentages of nitrogen, phosphate, and potash. These should not be confused with products approved for use by the USDA National Organic Program. The federal Certified Organic Label, USDA Organic, allows only certain regulated products as listed by the Organic Materials Review Institute (OMRI). For additional information on certified organic soil amendments and fertilizers, visit the Web at [www.omri.org](http://www.omri.org).

Many gardeners apply organic soil amendments, such as compost or manure, which most often do not meet the legal requirements as a fertilizer and generally add small quantities of plant nutrients.

### Managing Soil Texture and Structure

Routine applications of organic matter should be considered an essential component of gardening and soil management. Organic matter improves the water and nutrient holding capacity of coarse-textured sandy soil. On a fine-textured clayey soil, the organic matter over time glues the tiny clay particles into larger chunks or aggregates creating large pore space. This improves water infiltration and drainage, air infiltration (often the most limiting aspect of plant growth), and allows for deeper rooting depths (allowing the plant to tap a larger supply of water and nutrients). For additional discussion, refer to the fact sheet 7.722, *Managing Soil Tilth*.

Using **organic soil amendments** is a great way to turn otherwise useless products, like fall leaves and livestock manure, into compost for improving soil tilth.

When using organic soil amendments, it is important to understand that only a portion of the nutrients in the product are available to plants in any one growing season. Soil microorganisms must process the organic compounds into chemical ions ( $\text{NO}_3^-$ ,  $\text{NH}_4^+$ ,  $\text{HPO}_4^{2-}$ ,  $\text{H}_2\text{PO}_4^-$ ,  $\text{K}^+$ ) before plants can use them.



### *Putting Knowledge to Work*

**Application rate depends on the product.** Excessive salt levels are a common issue on manure, biosolids and compost made with manure or biosolids. On these products do not exceed 1 inch per year (cultivated into the upper 6 to 8 inches of soil) unless the product is known, by soil test, to be low in salts. Many commercially available products in Colorado have high salts!

Cultivate or hand-turn the organic matter thoroughly into the soil. Never leave it in chunks as this will interfere with root growth and water movement.

## Selecting a Soil Amendment

For details on selecting a soil amendment, see fact sheet 7.235, *Choosing a Soil Amendment*.

## Evaluating the Quality of Organic Amendments

Determine the quality of organic amendments by both visual evaluation and lab testing.

### Visual Evaluation

**Color** – dark brown to black.

**Odor** – earthy, no ammonia smell.

**Texture** – less than ½ inch particle size; lawn top dressing less than ¼ inch.

**Foreign materials** – less than 1 percent and smaller than ½ inch size.

**Uniformity** within the batch.

**Consistency** between different batches.

**Raw materials** – concern of heavy metals (biosolids), human pathogens (manure), and salts (manure and biosolids).

**Weed seeds** – test by germinating some material.

### Laboratory Testing

**C:N ratio** – less than 20 to 1; 10-12 to 1 is better.

**Ash content** – This measurement of the mineral portion after the organic matter is burned off will determine if soil was a primary part of the mix.

- 20 to 30 percent common;
- Keep below 50 percent;
- If greater than 50-60 percent it probably contains a lot of soil.

**Bulk density** – less than 1.0 gm/cc.

**pH** – 6.0 to 7.8

- May be higher in manure.
- Near neutral is best.

**Salts** – acceptable levels depend on use.

- Potting grade: < 2.5 mmhos/cm;
- Potting media amendment: < 6 mmhos/cm;
- Top dressing: < 5 mmhos/cm;
- Soil amendment in a low salt soil: <10 mmhos/cm.

**Sodium** – sodium adsorption ratio less than 13 percent.

**Ammonium** – less than 1/3 of total nitrogen. If higher, it may not be finished composting.

**Heavy metals** – A concern with biosolids but regulated by application permits.

**Pesticide residue** – Rarely a problem since they break down in composting. Long-term residues of chlordane have shown up in some samples.

**Pathogens** – *E-coli* and other human pathogens are a potential in manure.

**Nutrient content** – varies greatly from product to product.

**Germination test** – Seeds are started to check potential of toxic chemicals.

**Stability (respiration rate) vs. maturity** – Relative measurement of the completeness of microbial activity. If microorganisms are active it will consume oxygen in the root zone causing root problems.

**Bacterial and fungal diversity** – Some compost has been found to suppress plant diseases. This is a high tech field with commercial applications.

## Examples of Soil Amendments

There are two broad categories of soil amendments: organic and inorganic. Organic amendments come from something that is or was alive. Inorganic amendments, on the other hand, are either mined or manmade. Organic amendments include sphagnum peat, wood chips, grass clippings, straw, compost, manure, biosolids, sawdust and wood ash. Inorganic amendments include vermiculite, perlite, tire chunks, pea gravel and sand.

### Perlite and Vermiculite

Perlite and vermiculite are common inorganic amendments used in potting soils and planter mixes.

**Vermiculite** is made from heat expanded silica (mica). It is used to increase pore space and has a high water holding capacity. **Perlite** is made from heat expanded volcanic rock. It is used to increase pore space and has a low water holding capacity.

### Peat



Figure 1. Left: Perlite, with a low water holding capacity, is used to increase pore space without increasing water-holding capacity. Right: Vermiculite, with a high water holding capacity, is used to increase pore space and water holding capacity.

Sphagnum peat is a good soil amendment, especially for sandy soils, which will retain more water after sphagnum peat application. Sphagnum peat is generally acid (i.e., low pH) and can help gardeners grow plants that require a more acidic soil. Sphagnum peat is harvested from bogs in Canada and the northern United States. The bogs can be revegetated after harvest and grow back relatively quickly in this moist environment. In recent years however, harvest rates have become so high that it is raising questions on renewability.

Colorado mountain peat is not an acceptable soil amendment. It often is too fine in texture and generally has a higher pH. Mountain peat is mined from high-altitude wetlands that will take hundreds of years to rejuvenate, if ever. This mining is extremely disruptive to hydrologic cycles and mountain ecosystems.

### Biosolids

Biosolids are a way to add slow release nutrients and organic matter to soil. They are available from some communities or sewer treatment districts in bulk and from garden stores in bags.

Some biosolids are extremely high in salts. For example, test on MetroGro report a salt content of 38.3 dS/m (38.3 mmhos/cm, which is

considerably above acceptable tolerances for soil amendments. (A soil amendment above 10 mmhos/cm is considered questionable.) For details on salty soil amendments, refer to fact sheet 7.729, *Saline Soils*.

Under state and federal laws, use of biosolids is carefully monitored to prevent toxic levels of heavy metals. Special permits are required by the city (or sewer treatment district) or the farmer applying biosolids. To protect from metals and pathogens, use only the top grade biosolids, Class A (federal standard) or Class 1 (state standard).

Biosolids typically have a 5 to 6 percent nitrogen content. Annual applications should be made only when the biosolids and garden soil are routinely tested for salt content.

### Compost, Cover Crops, Green Manure Crops, Manure, and Organic Fertilizers

For details on these soil amendments, refer to the following fact sheets:

7.743, *Using Compost*;

7.744, *Cover Crops and Green Manure Crops*;

7.742, *Using Manure in the Home Garden*; and

7.733, *Organic Fertilizers*.

### Worm Castings

Versatile worm castings can be used in potted plants, soil mixes, and in garden beds. Worm castings pose no threat of burning potted plants. Worms should have digested the batch of vermicompost for 4 months to ensure that microbial oxygen consumption has diminished sufficiently.

Red worm castings are the feces from compost worms. It has a slow release performance due to a mucus covering which is slowly degraded with microorganism activity. It contains highly available forms of plant nutrients that are water-soluble, has a neutral pH, and contains trace elements, enzymes and beneficial microorganisms. The release time for nutrients is around 4 months. For continual release of nutrients repeat application at 4 month intervals.

Some batches made from livestock manure may have high salts depending if the animals producing the manure had access to a salt lick, and if the vermicompost maker leached them or not.

Castings can be applied as a top dressing, 1/4 inch deep, on potted plants, as 25 percent of a soil mix (1 to 4 mix) or tilled into a garden at 1 gallon per 13 square feet or 7.5 gallons (1 cubic foot) per 100 square feet. Due to the high cost in Colorado, they are generally used in small gardens or potting mixes.

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*<sup>1</sup>D. Whiting, Colorado State University, Cooperative Extension consumer horticulture specialist and Colorado Master Gardener coordinator; C. Wilson, Extension horticulture agent, Denver County; and A. Card, Extension agriculture/4-H agent, Boulder County.*

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