

Choosing a Soil Amendment

by J.G. Davis and C.R. Wilson¹(5/05)

Quick Facts...

- Soil amendments improve the physical properties of soils.
- Amendments are mixed into the soil. Mulches are placed on the soil surface.
- The best soil amendments increase water- and nutrient-holding capacity and improve aeration and water infiltration.
- Wood products can tie up nitrogen in the soil.
- Sphagnum peat is superior to Colorado mountain peat.
- When using biosolids, choose Grade 1 biosolids.

A soil amendment is any material added to a soil to improve its physical properties, such as water retention, permeability, water infiltration, drainage, aeration and structure. The goal is to provide a better environment for roots. To do its work, an amendment must be thoroughly mixed into the soil. If it is merely buried, its effectiveness is reduced, and it will interfere with water and air movement and root growth.

Amending a soil is not the same thing as mulching, although many mulches also are used as amendments. A mulch is left on the soil surface. Its purpose is to reduce evaporation and runoff, inhibit weed growth, and create an attractive appearance. Mulches also moderate soil temperature, helping to warm soils in the spring and cool them in the summer. Mulches may be incorporated into the soil as amendments after they have decomposed to the point that they no longer serve their purpose.

Organic vs. Inorganic 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 man-made. 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.

Not all of the above are recommended by Colorado State University. These are merely examples. Wood ash, an organic amendment, is high in both pH and salt. It can magnify common Colorado soil problems and should not be used as a soil amendment. Don't add sand to clay soil -- this creates a soil structure similar to concrete.

Organic amendments increase soil organic matter content and offer many benefits. Organic matter improves soil aeration, water infiltration, and both water- and nutrient-holding capacity. Many organic amendments contain plant nutrients and act as organic fertilizers. Organic matter also is an important energy source for bacteria, fungi and earthworms that live in the soil.

Application Rates

If your soil has less than 3 percent organic matter, then apply 3 cubic yards of your chosen organic amendment per 1,000 square feet. To avoid salt buildup, do not apply more than this. Retest your soil before deciding whether to add more soil amendment.

Wood Products

Wood products can tie up nitrogen in the soil and cause nitrogen deficiency in plants. Microorganisms in the soil use nitrogen to break down the wood. Within a few months, the nitrogen is released and again becomes available to plants. This hazard is greatest with sawdust, because it has a greater surface area than wood chips. If you plan to apply wood chips or sawdust, you may need to apply nitrogen fe

If you plan to apply wood chips or sawdust, you may need to apply nitrogen fertilizer at the same time to avoid nitrogen deficiency.

Sphagnum Peat vs. Mountain Peat

Sphagnum peat is an excellent 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. Colorado mountain peat is not as good a 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. 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.

Are Biosolids Safe?

Biosolids are byproducts of sewage treatment. They may be found alone or composted with leaves or other organic materials. The primary concerns about biosolids are heavy metal content, pathogen levels and salts. To avoid excessive levels of heavy metals and to ensure that pathogens have been killed, always choose a Grade 1 biosolid. While Grade 1 biosolids are acceptable for food Gardens, do not use them on root Crops because they will come in direct contact with the edible portion of the plant. Do not use biosolids below Grade 1.

Manure vs. Compost

Fresh manure can harm plants due to elevated ammonia levels. To avoid this problem, use only aged manure (at least six months old). Pathogens are another potential problem with fresh manure, especially on vegetable Gardens. Compost manure for at least two heating cycles at 130 to 140 degrees F to kill any pathogens before applying the manure to vegetable Gardens. **Most home composting systems do not sustain temperatures at this level.** Home-composted products containing manure are best used in flower Gardens, shrub borders and other nonfood Gardens. See fact sheets [9.369, Preventing E. coli From Garden to Plate](#), and [7.212, Composting Yard Waste](#).

During composting, ammonia gas is lost from the manure. Therefore, nitrogen levels may be lower in composted manure than in raw manure. On the other hand, the phosphorus and potassium concentrations will be higher in composted manure. Modify fertilizer practices accordingly. Salt levels also will be higher in composted manure than in raw manure. If salt levels are already high in your Garden soil, do not apply manures.

Other composts are available that are made primarily from leaf or wood products alone or in combination with manures or biosolids.

Factors to Consider When Choosing an Amendment

There are at least four factors to consider in selecting a soil amendment:

- how long the amendment will last in the soil,
- soil texture,
- soil salinity and plant sensitivities to salts, and
- salt content and pH of the amendment.

Laboratory tests can determine the salt content, pH and organic matter of organic amendments. The quality of bulk organic amendments for large-scale landscape uses can then be determined.

Longevity of the Amendment

The amendment you choose depends on your goals.

- Are you trying to improve soil physical properties quickly? Choose an amendment that decomposes rapidly.
- Do you want a long-lasting improvement to your soil? Choose an amendment that decomposes slowly.
- Do you want a quick improvement that lasts a long time? Choose a combination of amendments.

Table 1: Decomposition rate of various amendments.	
Amendment	Decomposition rate
Grass clippings, manures	Rapid decomposition (days to weeks)
Composts	Moderate decomposition (about six months)

Wood chips (redwood, cedar), hardwood bark, peat	Slow decomposition (possibly years)
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Soil Texture

Soil texture, or the way a soil feels, reflects the size of the soil particles. Sandy soils have large soil particles and feel gritty. Clay soils have small soil particles and feel sticky. Both sandy soils and clay soils are a challenge for Gardeners. Loam soils have the ideal mixture of different size soil particles.

When amending sandy soils, the goal is to increase the soil's ability to hold moisture and store nutrients. To achieve this, use organic amendments that are well decomposed, like composts or aged manures.

With clay soils, the goal is to improve soil aggregation, increase porosity and permeability, and improve aeration and drainage. Fibrous amendments like peat, wood chips, tree bark or straw are most effective in this situation.

Use Tables 2 and 3 for more specific recommendations. Because sandy soils have low water retention, choose an amendment with high water retention, like peat, compost or vermiculite. Clay soils have low permeability, so choose an amendment with high permeability, like wood chips, hardwood bark or perlite.

Vermiculite is not a good choice for clay soils because of its high water retention.

Soil Texture	Permeability	Water Retention
Sand	high	low
Loam	medium	medium
Silt	low	high
Clay	low	high

Amendment	Permeability	Water Retention
Fibrous		
Peat	low-medium	very high
Wood chips	high	low-medium
Hardwood bark	high	low-medium
Humus		
Compost	low-medium	medium-high

Aged manure	low-medium	medium
Inorganic		
Vermiculite	high	high
Perlite	high	low

Soil Salinity and Plant Sensitivity to Salts

Some forms of compost and manures can be high in salts. Avoid these amendments in soils that are already high in salts (above 3 mmhos/cm) or when growing plants that are sensitive to salts. Raspberry, strawberry, bean, carrot, onion, Kentucky bluegrass, maple, pine, viburnum and many other landscape plants are salt sensitive. In such cases, choose sphagnum peat or ground leaves instead of compost or manures.

Salt Content and pH of the Amendment

Always beware of salts in soil amendments. High salt content and high pH are common problems in Colorado soils. Therefore, avoid amendments that are high in salts or that have a high pH. Amendments high in salts and/or pH include wood ash, Colorado mountain peat and composted manures. An amendment with up to 10 mmhos/cm total salts is acceptable if well mixed into low-salt soils (less than 1 mmhos/cm). Amendments with a salt content greater than 10 mmhos/cm are questionable. Choose a low-salt amendment for soils testing high in salts.

Sphagnum peat and compost made from purely plant sources are low in salts and are good choices for amending Colorado soils. Ask for an analysis of the organic amendments that you are considering, and choose your amendments wisely. If no analysis is available, test a small amount of the amendment before purchasing a large quantity.

¹J.G. Davis, Colorado State University Extension soil specialist and associate professor, soil and crop sciences; and C.R. Wilson, Extension horticulture agent, Denver County. 6/00. Reviewed 5/05.