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Fertilizing the organic garden

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Quick Facts

- Organic materials generally contain all the nutrients essential to plants, but they may not be present in the ratio gardeners would like.
- Continued heavy applications of manures may increase soil salts to harmful levels.
- Some organic materials, such as sawdust or straw, may require special handling in the form of composting before use in the garden.
- Direct application of high nitrogen materials, such as dried blood or poultry manure, in large amounts may "burn" plants.
- Nitrogen and phosphate content are most important to the gardener.

Organic gardening emphasizes the use of organic soil amendments to improve the nutrient content and physical characteristics of the soil. Synthetic fertilizers are not used. The presence of decomposing organic matter in soils has long been recognized as a nutrient source for plants and useful in maintaining and improving structure and tilth in clay soils and in improving the water-holding capacity of sandy soils. Moreover, organic matter contains natural organic complexes that make micro-nutrients such as zinc and iron more available to plants.

A wide variety of plant and animal organic materials are useful. The gardener often is able to productively use materials that would otherwise be discarded, thus eliminating some potential environmental pollutants.

Major Nutrients

Of the three major nutrients, crops in Colorado respond most often to the addition of nitrogen and phosphorus; a response to the addition of potassium is rare. Although organic materials contain all of the major nutrients, they are present in widely varying ratios. Thus few organic materials can be regarded as complete or balanced sources of plant nutrients. For example, even though manures are good nitrogen sources, they are relatively low in phosphate. Therefore, manures probably should be supplemented with steamed bone meal.

Activated* sewage sludge is satisfactory when used alone. Continued heavy applications of manures may increase soil salts to harmful levels, a condition that can be avoided by periodically testing the soil.

A gardener always should have some idea of the content and availability of plant nutrients in the materials that are being added to the soil. Many materials contain nutrient elements in forms plants can't use and these may be very slowly converted to available forms. Table 1 gives some representative values for nutrient content of organic materials and estimates of their availability. (For example, 50 percent to 75 percent of the nitrogen in cow manure may be available in the first growing season.)

Some organic materials may require special handling, most often in the form of composting, before use in the garden. For instance, sawdust, straw or other stemmy plant tissue with low nitrogen content or slowly available nitrogen may actually cause a temporary deficiency of nitrogen in crops if directly incorporated into the soil. This happens because the micro-organisms decompos-

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**Activated and digested designate sludge from two different sewage treatment processes. The gardener should find out from the sludge source which kind of sludge it is.*

Table 1: Approximate nutrient content and availability of some organic materials.*

Material	% Nitrogen	% Phosphate	% Potash	Availability
Steamed bone meal	0.7-4.0	18-34	—	slow-med.
Compost	1.5-3.5	0.5-1.0	1.0-2.0	slow
Dried blood	12	1.5	0.57	med.-fast
Cattle manure	0.25-2.0	0.15-0.9	0.25-1.5	med.
Horse manure	0.3-2.5	0.15-2.5	0.5-3.0	med.
Sheep manure	0.6-4.0	0.3-2.5	0.75-3.0	med.
Swine manure	0.3	0.3	0.3	med.
Poultry manure	1.1-2.8	0.5-2.8	0.5-1.5	med.-fast
Peat	1.5-3.0	0.25-0.5	0.5-1.0	very slow
Sawdust	0.2	0.1	0.2	very slow
Milorganite	0.5	2-5	2	med.
Sewage sludge (activated)	2-6	2-7	0-1	med.
Sewage sludge (digested)	1-3	0.5-4.0	0-0.5	slow
Wood ashes	0	1-2	3-7	rapid

**The nutrient content of most organic materials is quite variable and depends upon the specific source and how the material has been handled and stored.*

ing this material require nitrogen for their own tissues and thus compete with crops for it. Nitrogen deficiency can be avoided by composting the low nitrogen material (with added nitrogen in the form of dried blood or poultry manure) before adding it to the soil. Coarse material, such as corn stalks and other plant residues, decompose slowly and also may present problems in soil preparation and cultivation if added directly to the soil. Shredding alone is not as effective as composting to handle these materials, but it is helpful.

Since direct application of high nitrogen materials, such as dried blood and poultry manure, in large amounts may "burn" plants, they should be used in moderate amounts. Composting with low nitrogen materials may be advisable. High nitrogen and low nitrogen materials should be mixed together when building the compost heap.

Table 2: Approximate nitrogen required for decomposition.

Material	Lbs (kilograms) nitrogen required per ton (907 kg) organic material	Cups (milliliters) dried blood per bushel (0.35 cubic meters)
Ground corn cobs	22 lbs (10 kg)	2/3 cup (160 ml)
Grass hay	8 lbs (3.6 kg)	1/4 cup (60 ml)
Sawdust	26 lbs (11.8 kg)	3/4 cup (180 ml)
Wheat straw	18 lbs (8.2 kg)	1/2 cup (120 ml)
Grass clippings	4 lbs (1.8 kg)	1/8 cup (30 ml)

The simplest method of composting is to build a heap by alternating layers of organic material and soil; the layers of soil may be one-half to 2 inches (1.3 to 5.1 centimeters) thick and the layers of organic material 6 to 12 inches (15 to 30.5 cm) thick. If the organic material is composed of more than one-half manure, no additional nitrogen is required, although one-half cup (120 ml) of bone meal per bushel (.04 cu m) may be useful. If the organic material is primarily vegetation, nitrogen may be added according to Table 2. As the heap is built, the material should be watered until it is moist but not soggy. Two to 4 inches (5.1 to 10.2 cm) of soil should cover the final heap. After a few weeks, the material can be turned for aeration and mixed well to move the outer parts to the center. The whole composting process should be complete in about three months in warm weather. (See Service in Action sheet *7.212, Composting.*)

Nitrogen becomes available to plants in the form of nitrate or ammonium by decomposition of organic matter, the resulting nitrate is either taken up by plants (vegetables typically remove 30 to 100 pounds (14 to 45 kg) of nitrogen per acre or .4 hectares), leached from the soil, or lost to the atmosphere as gaseous nitrogen. In the intense production typical of gardens, it is essential that decomposable organic matter be supplied to replace these losses.

A typical fertilizer recommendation for a Colorado garden soil might call for 100 pounds (45 kg) nitrogen and 120 pounds (54 kg) phosphate per acre. A manure containing .25 percent nitrogen and .15 percent phosphate applied at the rate of 20 tons per acre (18,140 kg per acre) furnishes 100 pounds (45 kg) nitrogen and 60 pounds (27 kg) phosphate. Adding steamed bone meal containing 25 percent phosphate at the rate of 240 pounds per acre (104 kg per acre) will supply the remaining 60 pounds (27 kg) of phosphate. Twenty tons of manure per acre (18,140 kg per acre) is equivalent to about 900 pounds per 1,000 square feet (408 kg per 90 sq m) or about three bushels per 100 square feet (.11 cu m per 9 sq m); 240 pounds (109 kg) of bone meal per acre is equivalent to about 5½ pounds per 1,000 square feet (2.5 kg per 90 sq m), or about 1½ cups per 100 square feet (360 ml per 9 sq m).

Phosphate may be added to soil or compost heaps by using steamed bone meal. Although rock phosphate and colloidal phosphate often are recommended to organic gardeners, they become available slowly, if at all, in alkaline western soils.

Phosphate made available by decomposition of organic matter is generally either removed by plants or fixed in slowly available mineral complexes in the soil. Vegetables typically remove 10 to 50 pounds (4.5 to 22.7 kg) of phosphate per acre per year from the soil. Soil retains excess phosphate, unlike nitrogen, making it available to

future crops. As the phosphate level of the soil is built up, the gardener may decrease or stop supplementing the manure with bone meal.

When organic matter is added to the soil, the gardener may assume the potassium needs are being met. There is no need to add greensand, wood ashes, granite meal or kainite, which are potassium sources.

Micronutrients

Iron and zinc are the only micronutrients verified as deficient in Colorado soils. Vegetables most likely to exhibit these deficiencies are corn, potatoes and beans. Many woody plants are also sensitive to lack of iron and zinc. Iron deficiency commonly appears as yellow areas between greener veins of young leaves. In zinc deficient plants, leaves and stems often fail to grow to normal size. There also may be yellowing between the veins of leaves, but usually on older leaves. Decomposing organic matter supplies these necessary nutrients. In addition, organic complexes (chelates) may be formed. These hold the nutrients in a form available to plants and protect them from fixation in the soil in unavailable forms.

Since the requirements of plants for iron and zinc are very small, they almost certainly will be met by any program adding a variety of organic materials to the soil. Of course, materials slow to decompose, such as peat and sawdust, will be less effective than manures or dried blood.

Table 3: Equivalent weights of fertilizing materials per unit area and equivalent volume measurement for 100 square feet (9 sq m). (Adapted from U.S.D.A. Leaflet No. 307).

	Weight specified per			
Material	Acre (.4 ha)	1,000 sq ft (90 sq m)	100 sq ft (9 sq m)	Approximate volume measure for 100 sq ft (9 sq m)
Bone meal	175 lbs (79.4 kg)	4 lbs (1.8 kg)	6½ oz (184 g)	1 cup (240 ml)
Sewage sludge	300 lbs (136.1 kg)	7 lbs (3.2 kg)	11 oz (311.8 g)	2 cups (480 ml)
Manure	13 tons (11.791 kg)	600 lbs (272.2 kg)	60 lbs (27.2 kg)	2 bushels loose (.07 cu m) 1 bushel packed (.035 cu m)