



Colorado MASTER GARDENER

Understanding Fertilizers

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Outline. . .

Fertilizer or Soil Amendment?
page 1

What's in a Fertilizer, page 1

Analysis or Grade, page 1

Ratio, page 2

Formulation, page 2

Complete Fertilizer, page 3

Nitrogen Applications, page 3

Phosphate and Potash
Applications, page 3

Phosphorus, page 4

Potassium, page 4

Specialty Fertilizers, page 5

Fertility is only part of the soil management process. Colorado soils are naturally low in organic matter. To maximize productivity, our soils also need routine applications of organic matter. For flower and vegetable gardens, it's desirable to raise the soil organic content, over time, to 3 to 5 percent.

Manufactured fertilizers are popular with gardeners since they are readily available, inexpensive, easy to apply, and generally provide a quick release of nutrients for plant growth. Application rates for any fertilizer depends on the content and the amount of nutrient to be applied. **In products containing multiple nutrients, the application rate is always based on the nitrogen content.**

Fertilizer or Soil Amendment?

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 more information on certified organic soil amendments and fertilizers, visit www.omri.org.

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) affects they 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 active microorganism activity.

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

What's in a Fertilizer?

Analysis or Grade

By law, all products sold as fertilizer require uniform labeling guaranteeing the minimum percentage of nutrients. The three-number combination (fertilizer **grade** or **analysis**) on the product identifies percentages of nitrogen (N), phosphate (P₂O₅), and potash (K₂O), respectively. For example,

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a 20-10-5 fertilizer contains 20 percent nitrogen, 10 percent available phosphate and 5 percent water-soluble potash.

The product may also identify other nutrients, such as sulfur, iron, and zinc, if the manufacturer wants to guarantee the amount. This may be done by placing a fourth number on the product label and identifying what nutrient was added in the ingredients.

Phosphorus, P, is a primary nutrient in plant growth. The word **phosphate, P_2O_5 ,** refers to the ionic compound containing two atoms of phosphorus with five atoms of oxygen. The phosphorus content of fertilizers is measured in percent phosphate.

Potassium, K, is a primary nutrient in plant growth. The word **potash, K_2O ,** refers to the ionic compound containing two atoms of potassium with one atom of oxygen. The potassium content of fertilizers is measured in percent potash.

Ratio

Fertilizer **ratio** indicates a comparative proportion of nitrogen, phosphate, and potash. For example, a 15-10-5 fertilizer has a ratio of 3-2-1, and an 8-12-4 fertilizer has a ratio of 2-3-1. **Fertilizer recommendations from a soil test are given in ratios.**

When shopping for a fertilizer, select a product with a ratio somewhat similar to that desired. For example, if a soil test recommended a 2-1-0 ratio, the ideal fertilizer would be something like 8-4-0, 10-5-0 or 20-10-0. However, if you cannot find that exact fertilizer, an 8-4-2 would be similar. If a garden soil test calls for a 1-0-0 ratio a 24-2-2 fertilizer would be similar. Note that in the recommendations, amounts of these fertilizer ratios to apply will be based on the nitrogen content.

Formulation

The formulation tells you what specific kinds of fertilizer are used. The table below gives examples of fertilizers that could be mixed to derive any specific analysis, ratio, or brand name.

Table 1. Examples of manufactured fertilizers.

Product	N percent	P_2O_5 percent	K_2O percent
Ammonium nitrate	34	0	0
Ammonium sulfate	21	0	0
Urea	48	0	0
Ammoniated super-phosphate	3-6	48-53	0
Di-ammonium phosphate	11	48	0
Mono-ammonium phosphate	11	48	0
Super-phosphate	0	18-50	0
Triple super phosphate	0	46	0
Potassium chloride	0	0	60
Potassium nitrate	13	0	44
Potassium sulfate	0	0	50
Potassium-magnesium sulfate	0	0	22

What else is in the fertilizer? In a manufactured fertilizer, the grade does not add up to 100 percent since the fertilizer also contains other elements like carbon, hydrogen, oxygen, sulfur, iron, zinc, etc. For example, ammonium nitrate ($NH_4^+ NO_3^-$) has a grade of 34-0-0 with 34 percent of the content from nitrogen and 66 percent from hydrogen and oxygen. Ammonium sulfate ($NH_4^+ SO_4^{2-}$) has a grade of 21-0-0 with 21 percent from the nitrogen and 79 percent from the hydrogen, sulfur and oxygen.

Time release or **slow release** fertilizers contain coating materials or are otherwise formulated to release the nutrients over a period of time as water, heat, or microorganisms break down the material.

In an organic fertilizer, the base is decomposed or processed plant or animal by-products. For example, fish emulsion is ground and processed non-edible fish or fish scraps. Its nutrient content would be around 8-4-2, with 8 percent from nitrogen, 4 percent from phosphate, and 2 percent from potash.

Some manufactured and organic fertilizers contain fillers used to prevent caking, control dust, derive the desired grade, or to facilitate ease of application

Complete Fertilizer

Complete fertilizer is a term used to identify fertilizers that contain nitrogen, phosphorus and potassium. In the national home garden trade, most fertilizers are complete. However, in Colorado, the majority of gardens don't need phosphorus or potassium. It is advisable to avoid heavy applications of phosphate and potash when unneeded, as they contribute to soil salts.

Nitrogen Applications

Nitrogen is the nutrient needed in largest quantities as a fertilizer. Nitrogen is annually applied by manufactured fertilizer, organic fertilizers and/or organic soil amendments. Application rates are critical, since too much or too little directly impacts crop growth.

The standard annual application rate for a home flower or vegetable garden is 0.2 pound actual nitrogen per 100 square feet (2 lb. per 1000 square feet). When organic matter percentage is significant, adjust the rate accordingly to account for nitrogen released by the organic matter.

Manufactured nitrogen fertilizer can be broadcast and watered in, or broadcast and tilled into the top few inches of soil. It can be banded 3 to 4 inches to the side of the seed row. Do not place the fertilizer in the seed row or root injury will occur. Organic nitrogen fertilizers are typically tilled in or applied in irrigation water.

For additional information on fertilizers refer to the fact sheets 7.733, *Organic Fertilizers* and 7.840, *Vegetable Garden: Soil Management and Fertilization*.

Table 2. Standard nitrogen fertilizer application rates for home gardens.

	Soil Organic Content		
	Typical garden soil low in organic matter (less than 1%)	Moderate level of organic matter (1-2%)	High level of organic matter (3-5%)
Nitrogen needed	0.2 lb. actual N per 100 sq. ft.	0.1 lb actual N per 100 sq. ft.	0
Fertilizer to apply			
Ammonium sulfate 21-0-0	1 lb. fertilizer per 100 sq. ft. (approx. 2 cups)	0.5 lb. fertilizer per 100 sq. ft. (approx. 1 cup)	0
OR			
Ammonium nitrate 34-0-0	0.6 lb. fertilizer per 100 sq. ft. (approx. 1 1/3 cups)	0.3 lb. fertilizer per 100 sq. ft. (approx. 2/3 cup)	0
OR			
Urea, 45-0-0	0.4 lb. fertilizer per 100 sq. ft. (approx. 1 cup)	0.2 lb. fertilizer per 100 sq. ft. (approx. 1/2 cup)	0

Phosphate and Potash Applications

A soil test is the best method to determine the need for phosphate and potash. When a fertilizer contains a combination of nitrogen with phosphate or potash, the application rate is always based on the nitrogen percentage, since nitrogen levels are most critical to plant growth. Phosphate and potash fertilizers are best applied in the spring or fall when they can be tilled into the soil.

Phosphorus

Phosphate levels are adequate in the majority of established Colorado gardens. Deficiencies are most likely to occur in new gardens where the organic matter content is low and in soils with a high pH (7.8 to 8.3). A soil test is the best method to determine the need for phosphorus.

Excessive phosphorus fertilizer can aggravate iron and zinc deficiencies and increase soil salt content.

Where phosphate levels are believed to be low, the standard application rate without a soil test is $\frac{1}{4}$ to 1 pound triple super phosphate (0-46-0) or ammonium phosphate (18-46-0) per 100 square feet.

When a phosphate fertilizer is applied to a soil, the phosphorus is quickly immobilized in the soil profile. It typically moves only about an inch! Therefore, it should be tilled into the rooting zone to be most effective. Being immobile, phosphate fertilizer will not leach and become a water pollutant.

However, phosphorus in some organic forms, like manure, is less prone to being immobilized. With excessively high applications rates, some leaching could lead to water quality problems.

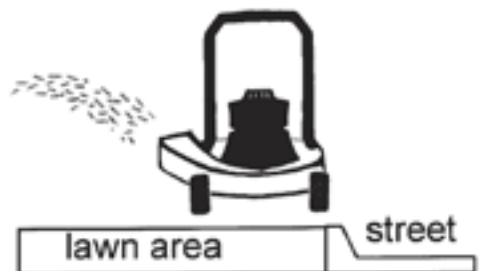
Popular press articles often incorrectly point to phosphorus containing lawn and garden fertilizers as the major source of phosphate water pollution in the urban environment. Remember that the phosphorus in fertilizers is very resistant to leaching through the soil profile. However, fertilizers spread onto hard surfaces (driveways, sidewalks and streets) will wash with surface water into local lakes, streams and ponds. It's not the fertilizer that creates a pollution problem, but rather the applicator. To prevent pollution problems, avoid spreading fertilizers onto hard surfaces, or sweep them back onto the lawn.

Soil erosion is another significant source of phosphate pollution in our lakes, streams and ponds. Water or wind erosion carries soil with its phosphorus into the surface water.

The research base clearly identifies organic matter (i.e., lawn clippings and leaves) as *the major* source of phosphate pollution coming from the landscape.

Figure 1. Grass clippings and leaves mowed or blown into the street are the major source of phosphate pollution from the landscape. Mow in a direction to discharge clippings back onto the lawn and not into the street.

Phosphate in fertilizer is immobilized upon contact with soil and is not a source of phosphate pollution when applied to a lawn (or garden) soil. However, fertilizer over-spread onto the sidewalk, driveway and street move with surface runoff into local lakes, streams and ponds. Exercise caution when fertilizing to keep the phosphate out of the street.



Potassium

Potassium levels are naturally adequate or high in most Colorado soils. Deficiencies occasionally occur in new gardens low in organic matter and in sandy soils low in organic matter. A soil test is the best method to determine the need for potassium.

Excessive potash fertilizer can increase soil salt content.

Where potash levels are believed to be low, the standard application rate without a soil test is $\frac{1}{4}$ to $\frac{1}{2}$ pound potassium chloride (0-0-60) or potassium sulfate (0-0-50) per 100 square feet.

Movement of potassium in soils is dependent on soil texture. As the clay content increases, movement decreases. For most soils, it is important that applied potash be tilled into the root zone. In sandy soils, potassium could leach down past the root zone.

Specialty Fertilizers

For specific uses, specialty fertilizers may be preferred. For example, on lawns slow release fertilizers such as Meister and Once are recommended. **Slow release** or **time release** fertilizers give out small quantities of nutrients over a time period. The release may be controlled by water, temperature, or microbial activity.

In planters and hanging baskets, two popular specialty fertilizers include Osmocote and water solubles (MiracleGro, Peters, etc.).

Osmocote is a time release fertilizer designed for indoor and outdoor potted plants. Each time the soil is watered, a small amount of nutrients is released. Depending on the specific formulation, it would be applied to the soil once every 3 to 9 months. In outdoor pots watered daily, it releases faster, having about half the life span of the product used on indoor plants. Gardeners sometimes see the Osmocote pellets in potted plants and mistake it for insect eggs.

Numerous brands of **water solubles** are popular in the home garden trade, for example, MiracleGro, Peters, Schultz Plant Food, Fertilome Root Stimulator, etc. They are mixed with the irrigation water, typically giving a blue or green color. This can be done in a bucket or hose-on fertilizer applicators. It is important to water the soil with the fertilizer water, not just wet the leaves.

Water solubles are the standard in greenhouse production where the fertilizer is injected into the irrigation water.

Hose-on fertilizer applicators and hose-on pesticide sprayers are not the same thing. Fertilizer applicators apply a heavier volume since the purpose is to water the soil. Pesticides applicators release a lower volume, since wetting the leaf is the objective.

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